AGENDA
LIGNITE RESEARCH COUNCIL MEETING
GRANT ROUND LRC (104)

Thursday, May 9, 2024 - 1:30 p.m. (CT)
Bismarck State College – National Energy Center of Excellence Room #335
1200 Schafer St., Bismarck ND 58501

I. Call to Order – Jason Bohrer

II. **Approval of Minutes**
- LRC Meeting November 9, 2023 – Jason Bohrer

III. Updates
- Project Management and Financial Report – Reice Haase
- R&D Update – Mike Holmes

IV. Projects Submitted:

LRC-104A: Continued Funding for Regional Lignite Public Affairs Program
Submitted by: Lignite Energy Council — Principal Investigator: Kay LaCoe
Request for: $1,800,000 — Total Project Costs: $3,600,000
Project Duration: 3 years
- Technical Peer Reviewers' Ratings
- Technical Peer Reviewers' Comments and Applicant's Response
- Summary and Recommendation

LRC-104B: Phase I Bridge Study for CCS at Coal Creek Station
Submitted by: Rainbow Energy Center — Principal Investigator: Conway Nelson
Request for: $1,094,416 — Total Project Costs: $2,188,833
Project Duration: 10 months
- Technical Peer Reviewers' Ratings
- Technical Peer Reviewers' Comments and Applicant's Response
- Summary and Recommendation

LRC-104C: Lignite Conversion Reactor Optimization for Commercial Carbon Pitch Manufacturing
Submitted by: AmeriCarbon Products, LLC — Principal Investigator: David A. Berry
Request for: $ 743,809 — Total Project Costs: $1,488,809
Project Duration: 18 months
- Technical Peer Reviewers' Ratings
- Technical Peer Reviewers' Comments and Applicant's Response
- Summary and Recommendation

V. **North Dakota Transmission Authority Request for $582,795: IIJA Grid Resilience FY2024** – Claire Vigesaa

VI. Voting Process

VII. Energy Workforce Considerations – Brent Sanford

VIII. 2023/2024 Calendar
- Industrial Commission Meeting – May 28, 2024
- Fall Grant Deadline – October 1, 2024

IX. Other Business
X. Adjourn

Bold and underline indicate action items. Please review the available action items prior to the meeting.

MEETING MINUTES

LIGNITE RESEARCH COUNCIL – GRANT ROUND 103

Thursday, November 9, 2023 - 1:30 p.m. (CT)
Bismarck State College – National Energy Center of Excellence Room #335

LRC VOTING MEMBERS PRESENT:

Jason Bohrer – Lignite Research Council, Chairman
Brenden Brinkman – Coyote Creek Mining Company
Jay Kost – The Falkirk Mining Company
Mike Heger – BNI Energy
Bryan Walther – North American Coal Company
John Bauer- Rainbow Energy Center
Jay Skabo – Montana-Dakota Utilities Co.
Charlie Gorecki – Energy & Environmental Research Center (EERC)
Ed Murphy – North Dakota Geological Survey
Randy Christmann – North Dakota Public Service Commission
Tom Oakland – North Dakota Commerce
Todd Porter – North Dakota House of Representatives
Dale Patten – North Dakota Senate
Bill Sawyer – ALLETE
Al Christianson – Nexus Line LLC
Joseph Heringer – Land Board
Rita Faut – North Dakota Farm Bureau

OTHERS PRESENT:

Reice Haase – North Dakota Industrial Commission
Brenna Jessen – North Dakota Industrial Commission
Mike Holmes – Lignite Research Council
Angie Hegre - Lignite Energy Council Jonathan Fortner – Lignite Energy Council
Kay LaCoe – Lignite Energy Council
Jim Sheldon – Basin Electric Power Cooperative
Brad Zimmerman – Otter Tail Power Company
Randy Bartsch – IBEW 11th District (ND)
Geoff Simon – ND Coal Conversion Counties Assoc.
John Weeda – Quail Hollow Consulting
Rep. Anna Novak – ND House of Representatives
Craig Bleth – Minnkota (presenter)
Claire Vigessa – NDTA (presenter)
Bill Easter – Semplastics EHC LLC (presenter)
Sue Easter - Semplastics EHC LLC (w presenter)

I. CALL TO ORDER

Meeting called to order:
Lignite Research Council (LRC) Chairman, Jason Bohrer, called the LRC meeting to order at 1:35 p.m. (CT) on November 9, 2023.

II. APPROVAL OF MINUTES

Approval of July 19, 2023, LRC Administrative Meeting Minutes:
Bohrer asked for a motion to approve the minutes from the above-listed meeting. Al Christianson so moved; seconded by Charlie Gorecki. Motion carried.

III. UPDATES

Program Management & Financial Report:

Reice Haase shared the financial summary regarding the Lignite Research, Development and Marketing Program. (A copy of the financial summary is available in the Lignite Research Program files, and the meeting packet provided.)

During the committee's meeting, Haase presented a diagram outlining the Industries, Agencies, and Programs under the North Dakota Industrial Commission (NDIC), highlighting the changes made during the 68th Legislative Assembly. Notably, he drew attention to the recent inclusion of the IIJA Grid Resilience grant program. Furthermore, he emphasized the legislative-directed studies undertaken by the State Energy Research Center, alongside the ongoing research activities of the Oil and Gas Research Program and CSEA.

Haase announced that NDIC received legislative approval for two additional FTEs. One of which is Erin Stieg the new grant administrator, with her start date being December 4, 2023.

Haase displayed a high-level dashboard view summary of all the Industrial Commission-managed funds to the committee. Haase shared that the Lignite Research Fund availability as of November 9, 2023, is $1.8 million which is dollars available to commit to new projects. Haase shared that there is one project before the committee today with an ask of $100,000.

Haase brought forth to the committee the Lignite Research fund cash balance of $29 million with $25 million of that being outstanding project commitments. Haase also mentioned a one-time cost for grant management software, technical advisor expenses, and funds being held for litigation purposes.

For the Lignite Research Fund, Haase provided a cumulative view of the fund. Since the program's inception in 1987, 254 cumulative projects have been funded. Each of those projects bring private capital, private match back to the state of North Dakota. That private match has equaled $2.7 Billion project value that has been invested in the state of ND thanks to projects

approved through this program. Currently there are 28 active projects.

In addition, Haase shared the 2023-2025 biennium appropriation and forecasted income. Sharing a graphic showing the Lignite research fund money coming from the Coal Severance Tax, Coal Conversion Tax, Research Tax and formula funding from Oil Production and Extraction Taxes showing a total of $18.5 million through the course of the biennium.

The financial data was emailed before the meeting to the LRC members.

Carbon Capture & Utilization Education and Marketing Special Grant Round Update:
Haase shared that Section 10 of HB 1014 passed by the 68th Legislative Assembly included an appropriation of $300,000 "to contract for carbon capture and utilization education and marketing". The lignite research fund, oil and gas research fund, and renewable energy development fund have been directed to each contribute $100,000 to the effort. The Commission is directed to develop the contract in consultation with each of the fund's respective research councils. A combined special grant round would facilitate a thorough review of applications and would allow the Commission to efficiently consult with all three councils prior to considering a contract that would meet the legislative intent of HB 1014.
Haase suggested that the meeting with all three research councils would take place at the end of January or the beginning of February 2024.

IV. GRANT ROUND 103 APPLICATION

LRC-103A: High-Value Products from Produced Water Mineralization via Reaction with Anthropogenic CO_2
Submitted by: Semplastics EHC LLC
Request for: $100,000
Total Project Costs: $356,494
Principal Investigator: Walter Sherwood
Project Duration: 12 months

Holmes shared Semplastics is teamed with the EERC and requesting funding to perform a project focused on the production of building materials from produced water and CO_2. The objective is to develop and demonstrate a cost-effective method to mineralize sodium, lithium, and other elements in the brine while capturing and storing CO_2. The carbonates would be used to produce samples of building products such as panels, coated mixed carbonates in polypropylene, and sodium carbonate or other commercially useful sodium compounds. The request is for $100,000 from the lignite research program, with the balance from Semplastics for a total project cost of $356,494.

As the Technical Advisor for this project, Holmes recommended funding. He shared that the proposed project focuses on the development and demonstration of value-added products from lignite utilization while storing CO_2. This would be the first step of demonstrating the technology for producing additional building materials. Two of the technical reviewers

recommended funding while the third reviewer recommended funding may be considered. The proposal received an average score of 204 out of 250. The project provides good leveraging state funding by including roughly 72 percent of funding as commercial cost-share.

Holmes stated that funding be subject to the Technical Advisor participating in project reviews, the Technical Advisor reviews the project management plan with the project team.

Holmes stated conflicts of interest include EERC.

Bill Easter, Semplastics presented on behalf of the applicant. (A copy of their PowerPoint presentation is available in the LRP files.)

V. RESULTS

LRC-103A: High-Value Products from Produced Water Mineralization via Reaction with Anthropogenic CO_2
Submitted by: Semplastics EHC LLC

Fund: 15 votes
Do Not Fund: 1 vote
Abstain: 1 vote

Jason Bohrer asked for a motion to bring this recommendation forward to the North Dakota Industrial Commission. Al Christianson so moved, seconded by Jay Kost. Motion passed.

Holmes reminded the committee members that at the July Administrative meeting, he shared a full Research and Development progress report. He shared that he wanted to focus today on the Tundra FEED and Tundra CREST results and introduced Craig Bleth to the committee.

VI. Briefing on completed Tundra FEED and CREST studies

Craig Bleth, Minnkota Power Cooperative shared a PowerPoint presentation showing key outcomes of the FEED Study. Some of these findings were listed for the committee.

- Costs higher than targeted - need to reduce contingency through further study, and evaluation of cost-cutting options
- Ultrafine particulate can be managed effectively with a WESP, included in the FEED design
- Although the design basis was NG boilers, extracting steam was likely cheaper with less risk
- To enable EOR in the Foreman Butte Field a new pipeline and EOR infrastructure is required
    - Costs estimated at $300M and $160M respectively.
- Saline storage site characterization (CarbonSAFE)
    - Detailed characterization, including two seismic surveys and two stratigraphic test wells
    - Enabled two Class VI storage facility permit applications
    - Broom Creek and Deadwood Formations

Bleth continued to the CREST study that was proposed in February 2022. The project had several partners on board, including NDIC, Minnkota, and Fluor Enterprises. The total funding requested for the project was $10.8 million, but only $5.9 million was required to complete it. The NDIC was asked to provide $5.4 million initially, but only $2.9 million was utilized. Bleth shared with the group that the total funding used was significantly less than what was originally requested. Tasks and outcomes were shared with the group.

CREST Key Outcomes

- Task 1 – Project Management and Technology Transfer
- Task 2 – Steam Extraction Studies
    - Both Units - Completed the preliminary evaluations begun in FEED
    - Thermal modeling at various load temperatures, Integration of extraction parameters into Fluor process design
    - Evaluation of STG control systems and instrumentation, ensure safe operation in all operating scenarios
    - Sargent & Lundy – design of the steam delivery piping and condensate return system
    - No fatal flaws
- Task 3 – Aerosol Measurement in Support of Dual Flue Gas Supply - EERC
    - Previous efforts concentrated on characterizing Unit 2 only
    - Generally, reduced plant load tends to reduce fly ash PM, while increasing the content of FGD carryover
    - Cyclic production of aerosols was identified, coinciding with the addition of lime slurry to the FGD absorber modules (cause unidentified).
    - Coal quality and varying cyclones in/out of service did not impact FGD carryover.
- Task 4 – Evaluation of Specific Value Engineering and Cost Reduction Opportunities
    - 70 Items were identified as potential cost reductions with Fluor, 55 were ultimately accepted. Three most impactful:
    - Use of extraction steam instead of capex associated with NG Steam Boilers & NG cost risk
    - Rearrangement and reduction in the size of the plot plan
    - Elimination of redundant pumps
- Task 5 – Analysis of Potential Impacts of Flue Gas Ductwork Pressure Transients
    - Contracted with Trax, LLC., who evaluated 22 separate transient scenarios
    - Predict the behavior of the Units in their future configuration, given existing equipment and equipment added by CCS
    - Condition assessment of existing FRP ductwork was included
    - 33 control recommendations for the Units and the CCS
- Task 6 – Icing Studies
    - Performed by Nels Consulting Services
    - Existing chimneys – full flow to less-than-full flow (no modifications indicated, have extensions)
    - Absorber stack – provide corrosion protection for top 10’
    - Cooling tower (S&L) – will be fogging and rime ice impacts, minimize by optimally locating
- Task 7 – Gaseous Dispersion Modeling
    - AECOM - absorber outlet and the startup/emergency vent stack (plus startup and shutdown scenarios) at various unit load combinations
    - Total concentrations for all pollutants were below the ND requirements and NAAQS

- Task 8 – Construction Project Definition and Documentation
    - Construction-ready EPC Contract template – 140 pages
    - Prepared by MPC legal and technical contract teams
    - Includes list of exhibits

  Bleth ended the presentation by sharing the current status of Tundra. He shared these bullet points with the committee.
    - Working with a joint development partner through FID – TC Energy
    - Completing a FEED study with MHI and Kiewit
        - Ends with a lump-sum turn-key price offer (not an indicative price)
        - Negotiating EPC contract in parallel with the FEED
    - Holder of two storage site permits
    - Completing legal and financial work
    - Applied for Demonstration Funding from DOE-OCED (BIL)
    - Awarded $250M in loans from CSEA
    - Final decision in 2Q24

  - (A copy of the full PowerPoint presentation is available in the LRP files.)

VII. Transmission Authority Update:

During the committee's meeting, Claire Vigessa reported on the recent changes that have occurred within the North Dakota Transmission Authority. Specifically, he mentioned that John Weeda has stepped down as the Director and that he has assumed the role. Vigesaa shared that Weeda is still helping him and working through EPP as well. Vigessa shared that his office is on the 14th floor of the capital.

Vigessa shared the award of a two-year IIJA Federal Grant in the amount of $7.4 million with a state cost share of $1.1 million for a total of $8,623,893. Vigessa shared the tentative NDIC award being December 19, 2023, with an application deadline of November 20, 2023.

Vigessa shared that he attended the Energy Development and Transmission Interim Committee meeting at Coal Creek Station in August and shared some highlights from Isaac Orr's Generation Adequacy studies and MISO and SPP also were there with studies to share. In addition to this meeting, there will also be a meeting at the Capitol in the future. That meeting will share factors that impact grid reliability, areas of congestion, what increased transmission capacity means for North Dakota, and approved transmission projects.

Vigessa shared upcoming studies including the Transmission Capacity Study conducted by Power Systems Engineering and a ND Grid Resilience plan being prepared by EERC to demonstrate the risks faced by the grid in North Dakota. He displayed NERC graphics showing the reduced capacity with increased demand. He went on to discuss transmission projects approved in ND for 2025 to include 345kV Roundup to Kummer Ridge – 35 miles; 345kV Leland Olds to Tioga – 175 miles. In addition to this, he shared upcoming transmission projects.

- (A copy of the full PowerPoint presentation is available in the LRP files.)

VIII. 2023-2024 CALENDAR

Bohrer announced that the next NDIC meeting is scheduled for November 28, 2023. Bohrer reminded the group that the spring grant application deadline is April 1, 2024, and the next LRC meetings are tentatively scheduled for May 9, 2024, and November 14, 2024.

IX. OTHER BUSINESS

None

X. ADJOURNMENT

There being no further business, Jason Bohrer requested a motion for adjournment of the LRC meeting. Charlie Gorecki so moved; seconded by Jay Skabo. Motion carried.

The North Dakota Industrial Commission meeting, when these recommendations will be considered, will be held on November 28, 2023.

Angie Hegre, recording secretary

LIGNITE RESEARCH PROGRAM PROJECT MANAGEMENT REPORT

Reice Haase, Deputy Executive Director, NDIC

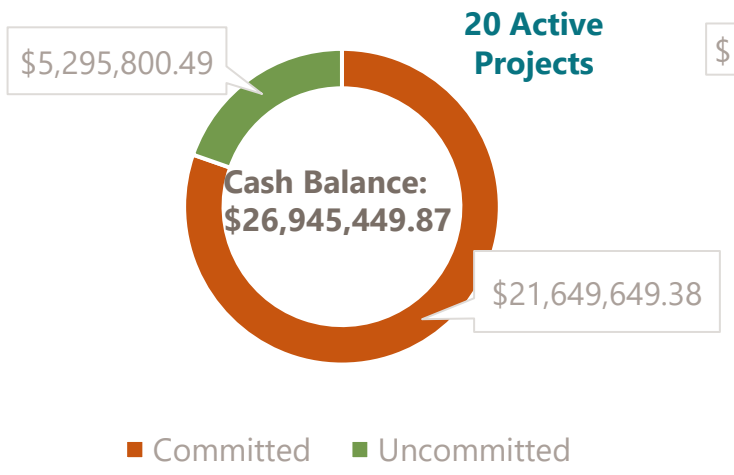
May 9, 2024

NORTH Dakota

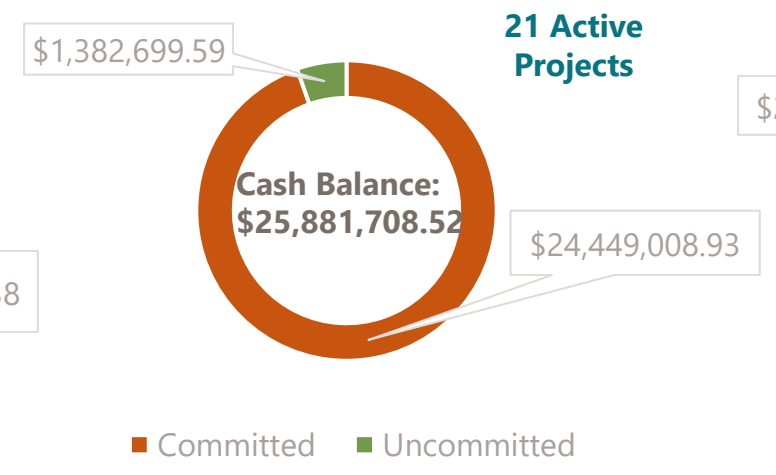
Be Legendary.™

INDUSTRIAL COMMISSION-MANAGED FUNDS

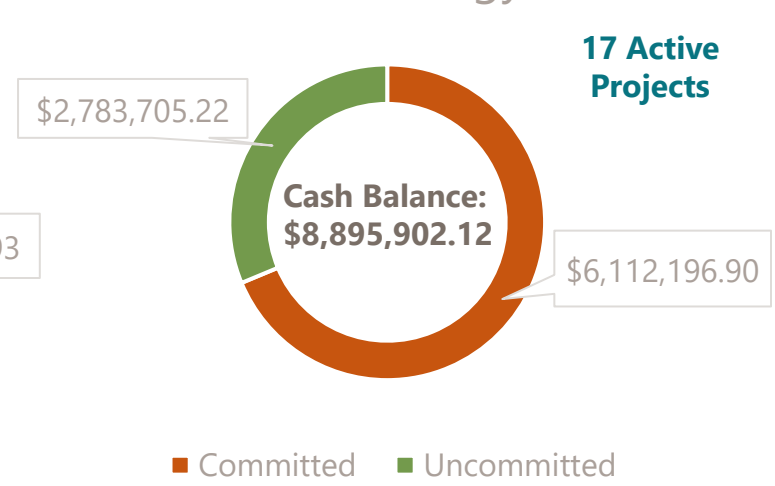
Lignite Research Fund



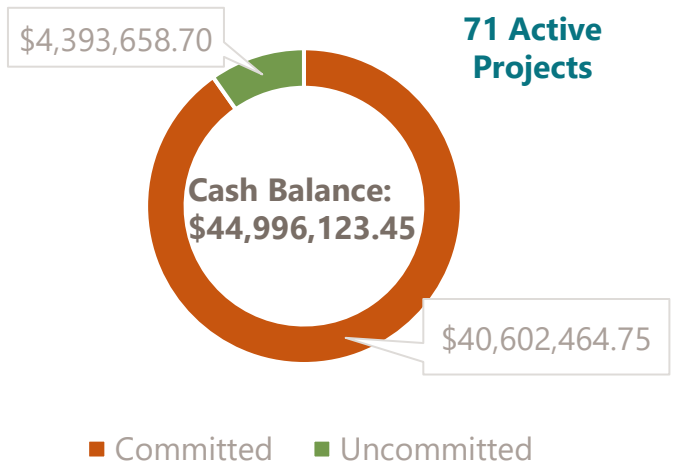
Oil and Gas Research Fund



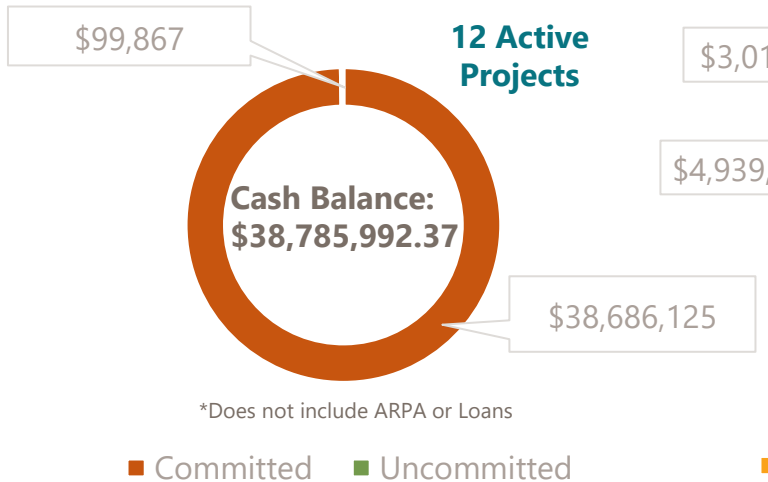
Renewable Energy Fund



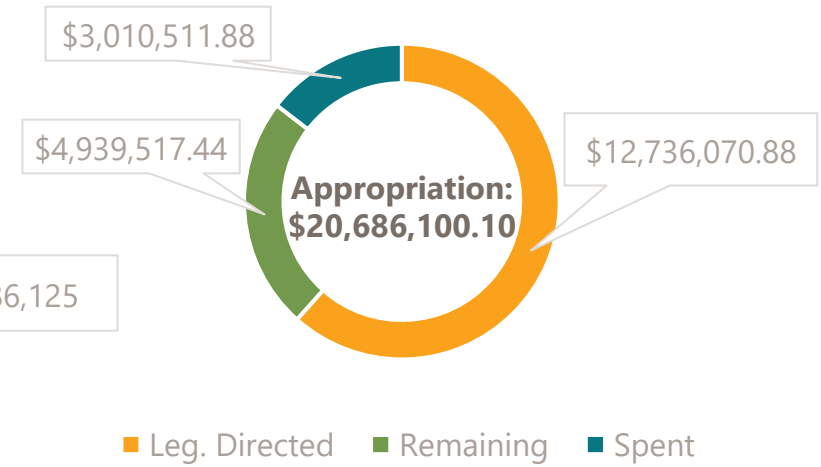
Outdoor Heritage Fund



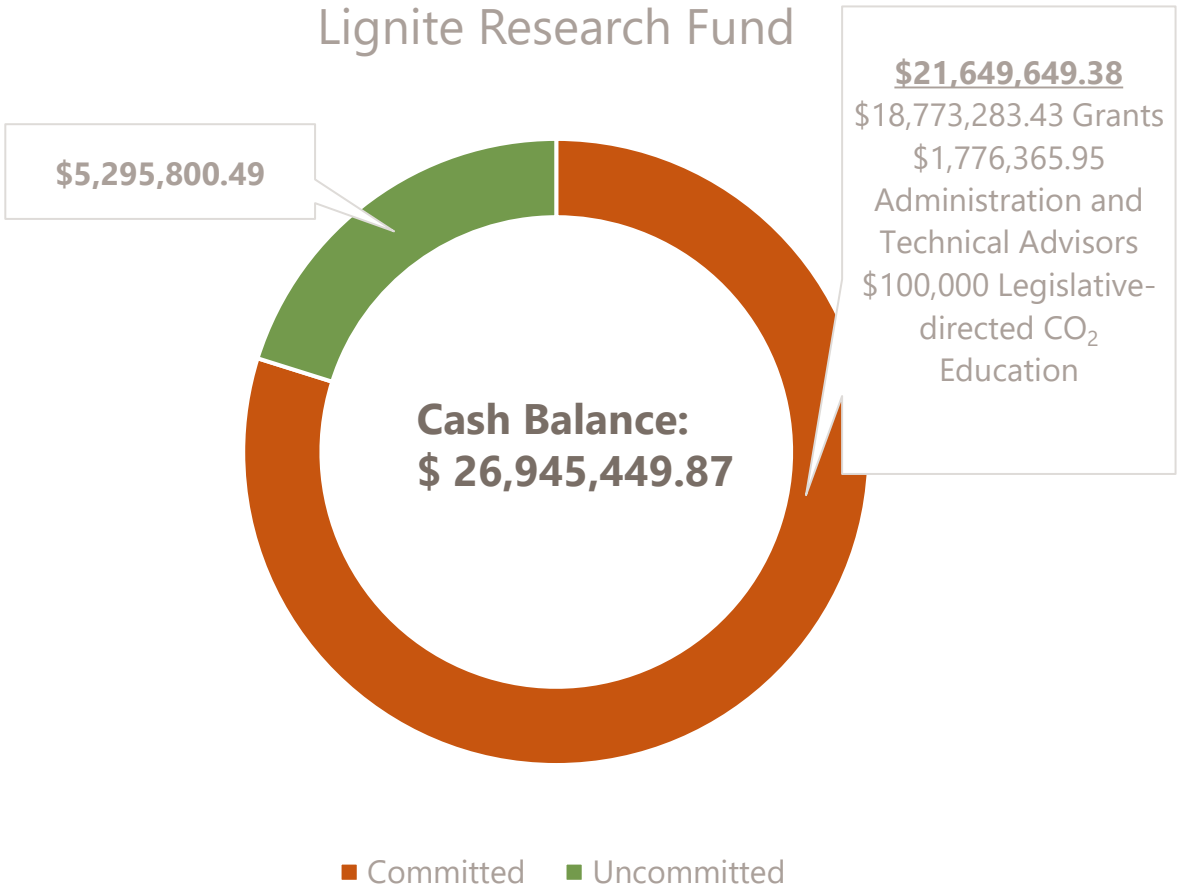
CSEA Fund*



SERC Fund



LIGNITE RESEARCH FUND BALANCE MAY 9TH, 2024



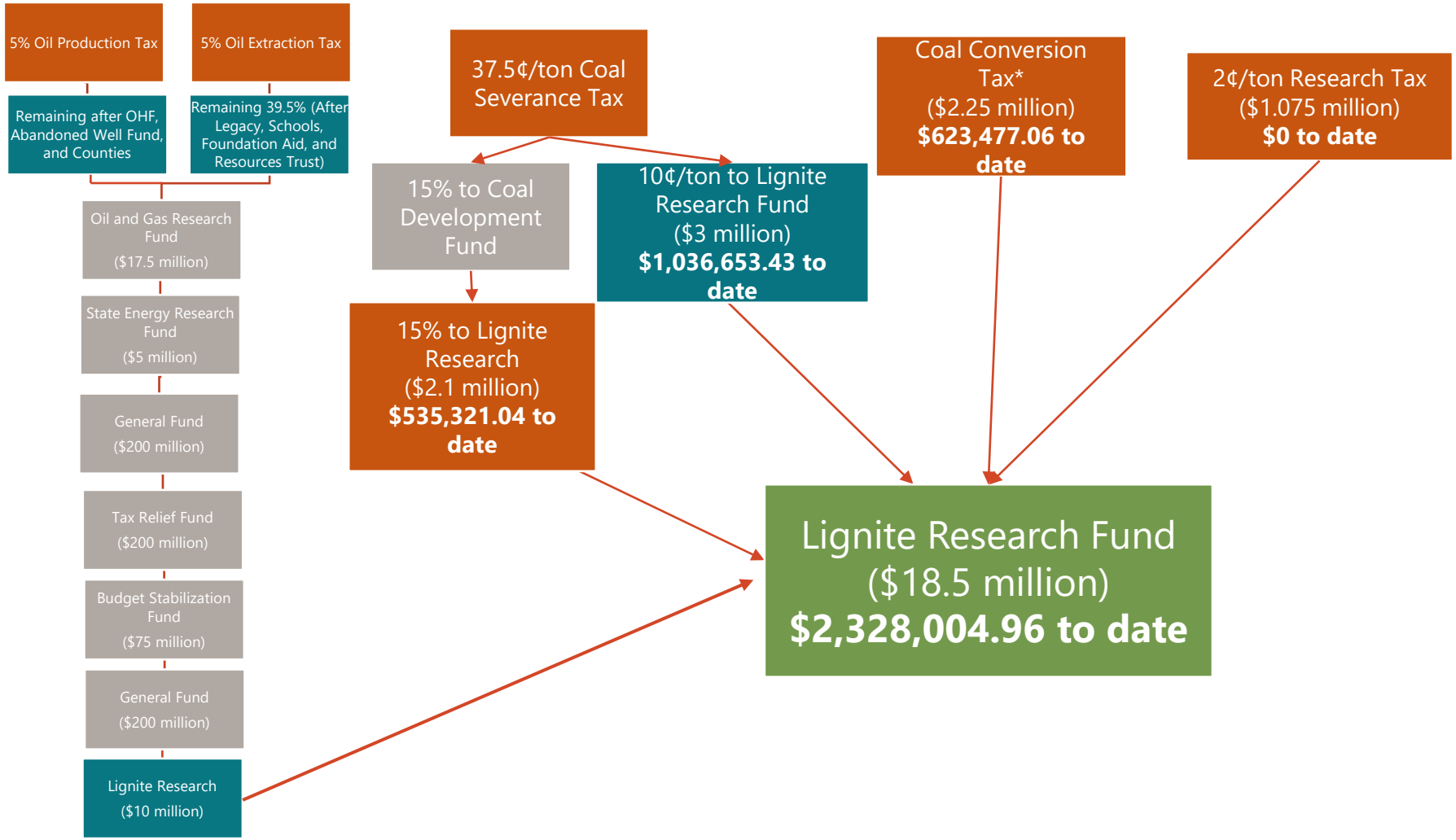
Funding Source:
- **$8.5 million coal severance and conversion taxes**
- **$10 million oil and gas taxes**

255 Cumulative Projects

20 Active Projects

Cumulative Value:
- **$172.5 million granted**
- **$2.8 billion project value**

2023-2025 BIENNIUM APPROPRIATION AND FORECASTED INCOME



TECHNICAL REVIEWER RATINGS SUMMARY

LRC-104A: "Continued Funding for Regional Lignite Public Affairs Program"

Submitted by: Lignite Energy Council
Principal Investigator: Jason Bohrer
Project Duration: 3 years
Request for: $1,800,000
Total Project Costs: $3,600,000

Rating Category	Weighting Factor	Technical Reviewer Rating 104A-01	Technical Reviewer Rating 104A-02	Average Weighted Score
Objective	9	4	4	
Availability	9	4	5	
Methodology	7	4	4	
Contribution	7	5	4	
Awareness	5	3	3	
Background	5	4	4	
Project Management	2	3	4	
Equipment Purchase	2	5	5	
Facilities	2	5	5	
Budget	2	5	4	
Average Weighted Score:		206	208	**207**

Maximum Weighted Score:	250

OVERALL RECOMMENDATION:

FUND		**X**	**X**
FUNDING MAY BE CONSIDERED			
DO NOT FUND			

TECHNICAL REVIEWERS' COMMENTS

1. **OBJECTIVES**

The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Lignite Research Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer 104A-01 (Rating: 4) *The objective of the proposed study is to preserve & enhance development of our State's abundant lignite resources, meeting new challenges from proposed environmental regulations and to sustain/ increase public perception & stakeholder knowledge.*

Reviewer 104A-02 (Rating: 4) *Very clear with list to describe how awareness of the coal industry is and will be promoted using various media, awareness campaigns and educational outreach to help develop emerging markets and how lignite industry goals and objectives will be presented and promoted to maintain the positive image the lignite industry now enjoys.*

Carbon capture is also a large part of the industry that will benefit the coal industry and the state.

2. **ACHIEVABILITY**

With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.

Reviewer 104A-01 (Rating: 4) *The objectives of the proposed study are most likely achievable given the suggested time and budget.*

Reviewer 104A-02 (Rating: 5) *The project has been funded in the past and continues those activities successfully today. The planning for the next grant cycle has been in process since the fall of 2023 and continues today.*

The lignite industry is important to the state because it provides good paying jobs to a large workforce and provides a great deal of energy to the state and the surrounding area.

3. **METHODOLOGY**

The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer 104A-01 (Rating: 4) *The quality of the proposal is above average. The proposal clearly defines how requested funds will be used towards objectives.*

Reviewer 104A-02 (Rating: 4) *The Lignite Energy Council plans to continue with the objective of maintaining a positive public image by assuring reliability and demonstrating the economic benefits of the lignite industry and promotion of the technological advances in the industry.*

4. **CONTRIBUTION**

The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Lignite Research Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer 104A-01 (Rating: 5) *Proposed EPA regulations will negatively impact reliability. Education is necessary so people understand dispatchable versus non-dispatchable resources.*

Reviewer 104A-02 (Rating: 4) *Educational efforts and working with the media to create or improve public awareness of the importance of the lignite industry to North Dakota are some of the efforts that along with letters and endorsements will help sustain the industry. Preserving jobs in North Dakota and ensuring continuation of the lignite industry are important to the State.*

5. **AWARENESS**

The principal investigator's awareness of other current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 104A-01 (Rating: 3) Linking proposed regulations, current generation mix, and how reliability will be impacted would strengthen this application.

Reviewer 104A-02 (Rating: 3) *The principals of this grant request and the Lignite Research Council are well aware of the activities and published material related to the Lignite Councils efforts to promote lignite energy.*

6. **BACKGROUND**

The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 104A-01 (Rating: 4) *The background of the organization appears very knowledgeable.*

Reviewer 104A-02 (Rating: 4) *The Lignite Energy Council has been working successfully for a number of years to promote the industry. Both of the principals have been working in this capacity for a number of years and are very familiar with the need to keep the lignite industry in the forefront of the energy industry.*

7. **PROJECT MANAGEMENT**

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the parties involved in the project, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer 104A-01 (Rating: 3) *There is no milestone chart. The financial plan might have been great to see how these expenses were broken out last year and what is expected this grant application (i.e., print / website / social media / content development)*

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Reviewer 104A-02 (Rating: 4) *This three-year grant request clearly defines activities funding amounts for those efforts and how they will be used to promote the lignite industry.*

8. **EQUIPMENT PURCHASE**

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 104A-01 (Rating: 5) *No equipment- only services*

Reviewer 104A-02 (Rating: 5) *None to be purchased*

9. **FACILITIES**

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 104A-01 (Rating: 5) *N/A*

Reviewer 104A-02 (Rating: 5) *No facilities applicable.*

10. **BUDGET**

The proposed budget value relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value.

Reviewer 104A-01 (Rating: 5) *The financial commitment is of very high value as this is vital messaging.*

Reviewer 104A-02 (Rating: 4) *The budget is well defined and suitable for the proposed activities.*

OVERALL COMMENTS AND RECOMMENDATIONS:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 104A-01 (Rating: FUND)

Further information sought for this proposal include;

- *Tie in previous milestones to projected milestones*
- *Provide data from education/ marketing impact*
- *Provide specific examples of legislative support & action*
- *Tie in EPA regulations impacting industry & reliability*

Reviewer 104A-02 (Rating: FUND) *These efforts are critical to sustaining the lignite industry in North Dakota. The industry will maintain current high paying jobs, create new jobs, provide sustainable energy, and support the North Dakota economy in general. During the last economic downturn, the North Dakota economy was able to sustain itself because of industries such as this along with agriculture and many more.*

Lignite Energy Council
LEADING THROUGH ADVOCACY AND INNOVATION

April 1, 2024

Reice Haas
Deputy Executive Director
North Dakota Industrial Commission
Attn: Lignite Research Program
600 East Boulevard Avenue
Bismarck, ND 58505

Subject: Grant Application Submittal: "Continued Funding for Regional Lignite Public Affairs Program"

Dear Reice:

The Lignite Energy Council, a regional trade association of producer, utility, and business members who produce approximately 28 million tons of lignite and generate electricity from lignite that serves two million people in the Upper Midwest region, is pleased to submit the enclosed proposal to seek continued funding for the Regional Lignite Public Affairs Program.

Members of the Council will provide the matching funds for this project.

Also, enclosed is a $100 check for the grant application fee.

Thank you for the opportunity to submit this proposal.

Sincerely,

LIGNITE ENERGY COUNCIL

Jason W. Bohrer
President and CEO

Enclosures: $100 application check

1016 E. Owens Ave. | PO Box 2277 | Bismarck, ND 58502
701.258.7117 www.lignite.com LEC@lignite.com

Continued Funding for
Regional Lignite Public Affairs Program

Submitted by
Lignite Energy Council

Principal Investigator
Lignite Energy Council

April 1, 2024

Amount Requested: $600,000 Annually for Three Years for a Total of $1.8 million

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Implementation of Regional Lignite Public Affairs Program

ABSTRACT

Due to the continued success of the Regional Public Affairs Program (Program), the Lignite Energy Council is advocating for the continuation of the Program. As a testament to our commitment, we are submitting a comprehensive three-year proposal:

Objective:
To sustain and enhance public perception and stakeholder knowledge regarding the importance of coal-based electricity in the State of North Dakota and the surrounding region, promote its benefits, and drive adoption and investment in emerging markets and value-added initiatives derived from the lignite industry.

Expected Results:

- Development and execution of an integrated marketing and communications plan to educate the public about the North Dakota coal industry.
- Maintain strong favorability ratings of 66% or more in support of coal-based electricity in the State of North Dakota.
- Promote and educate the public and policymakers about emerging markets and value-added products from North Dakota lignite.
- Increase engagement in educational and marketing campaigns about the benefits and impacts of the North Dakota coal and electricity production industries.

Duration:
The Regional Lignite Public Affairs Program is expected to be long-term to achieve the desired objectives. Therefore, this application is for three years and is expected to be Phase X of a long-term plan. This plan began in October 1996 with phase I. Subsequent phases occur every three years. With its proven track record, the Regional Lignite Public Affairs Program is geared to begin Phase X of this critical initiative on January 1, 2025.

Total Project Costs:
The total budget for implementing the Regional Lignite Public Affairs Program is $3.6 million over three years. This request from the Industrial Commission of North Dakota is for $600,000 annually spread over three years, which will be matched by industry. Matching funds are secured via Lignite Energy Council membership dues.

Participants:
The Lignite Energy Council, in collaboration with advisory boards and industry stakeholders, will oversee the implementation and evaluation of the program.

PROJECT SUMMARY

This project, undertaken by the Lignite Energy Council (LEC) and advisory boards, aims to strengthen the reputation, perception, and awareness of coal-based electricity as well as demonstrate its importance to the State of North Dakota and the region over a three-year period. The objectives outlined in this project are grounded in strategic communication, data-driven awareness campaigns, educational outreach, and the development and promotion of emerging lignite-based markets.

The project's first objective is to maintain the public favorability ratings of coal-based electricity over the next three years. This will require consistent efforts to showcase the reliability, economic importance, and technological advancements within the coal industry to continue to maintain and move public opinion in a positive direction.

A key component of the strategy involves continuing our targeted awareness campaigns to reach a significant portion of the state's population and policymakers. This objective will boost the community's and policymakers' understanding of energy challenges, solutions, and the integral role coal-based electricity plays in the regional energy mix.

To guide this public awareness initiative, the project will focus on disseminating carefully crafted message priorities that articulate the lignite industry's goals and merits. Media relations activities include media visits, chamber events, news releases, social media, etc.

An ongoing effort will be made to develop and enhance educational and marketing initiatives that exhibit the advantages and cost-effectiveness of coal-based electricity. This focus ensures that the value of lignite electricity continues to be communicated effectively to consumers, supporting its status as a cornerstone of the regional energy supply.

Fulfilling these objectives, the project aims to maintain and build upon coal-based electricity's vital contribution to the State of North Dakota, advocating for its sustained use and advancement well into the future.

PROJECT DESCRIPTION

The Lignite Energy Council and the Minnesota-focused Coalition for a Secure Energy Future serve as pivotal networks for the numerous individuals, businesses, officials, and groups in North Dakota and Minnesota who champion coal-derived electricity. Our organization offers a platform to unite and align with the State of North Dakota alongside common goals, ensuring effective education for the public and policymakers about the continued use of coal power.

The governance of the public affairs program is rigorously overseen and guided by a committee of representatives from the major member companies of the Lignite Energy Council (LEC) and technical advisement from the Lignite Research Council. The State Public Affairs Committee convenes as required to analyze public opinion polling, strategize, and devise tactics, all of which are executed by the dedicated Lignite Energy Council staff and contractors.

The Lignite Energy Council State Public Affairs Committee is tasked with developing and approving an integrated marketing and communications plan focused on public affairs and

strategic communications efforts. These efforts complement each other to support favorable political and regulatory outcomes regionally and nationally.

The Committee met in late November 2023 to begin developing a strategy for 2024 and 2025. One outcome of that meeting was a Messaging and Audience Priorities survey of the Committee members and members of the Lignite Energy Council Management Committee. The results of the survey were used to identify the following topics designated as the two main issues for the Regional Public Affairs Program to prioritize messaging and campaigns for 2024 and 2025:

- Regulatory "Trainwreck"
- Coal and Carbon Capture

The survey results also helped identify and prioritize topic and issue areas of advocacy and communications support that the State Public Affairs Committee, Lignite Energy Council Management Committee, and other stakeholders continue to value. While these areas and issues may not be the primary focus of public affairs campaigns in 2024, they do represent the major messaging components and educational efforts that support the mission of the Lignite Energy Council and the deliverables outlined in the Grant. These areas should be viewed as day-to-day functions and initiatives for the Council.

- Industry Education: North Dakota's role in the regional energy mix including the grid reliability crisis
- Industry Education: Lignite's value as a baseload power source and how it's used
- Industry Education: Economic importance and impact of the lignite industry in North Dakota
- Additional general education about the fuel source, process, and industry

While this three-year proposal primarily addresses present strategies, the Lignite Energy Council emphasizes the need for adaptability in identifying future strategies, recognizing the dynamic nature of the coal-based electric industry, and the necessity for flexible approaches to meet evolving challenges and opportunities. For instance, while we will continue to promote the successes of the Lignite Research and Development program, we have only recently started a more aggressive promotion of carbon capture technology for the coal industry, such as carbon capture infrastructure and education about the science. It would not have made sense even a few years ago to be out in front of regional utilities in promoting carbon capture for coal before projects were announced, approved, or received funding. Our efforts in this area have served as a springboard and the most substantive building block for the recently approved Carbon Dioxide Education and Marketing grant that was approved by the North Dakota Industrial Commission and funded by the three state research councils.

The program's directives aim to broaden awareness and support of coal-based electricity throughout the region. This involves educating legislators and other elected and appointed officials to increase their understanding of coal's significance to families and businesses. Additionally, it includes meeting with like-minded associations and allies to support policies that keep coal-based electricity as a valuable component of the regional energy mix. It also entails using diverse communication channels to alert interested parties about the Program and

activities, along with proactively messaging about an "all-of-the-above" energy policy that includes and relies on coal-based electricity.

The public affairs committee, working closely with our consultants and staff, ensures seamless alignment of our promotional activities. We are committed to improving our strategies to effectively connect in this ever-changing environment. Despite the ever-changing landscape, certain core activities, such as audio and visual media promotion, earned media placements, and strategic paid media investments, will persist as foundational elements that anchor our commitment to communication. With the historic 10-year mark of the current Program and the 29th year of the State's investment in a regional lignite marketing program, LEC will be conducting thorough evaluations of our contracts with current consultants, ensuring that they are still the best fit for our mission and objectives.

The staff of the Lignite Energy Council and our contractors collaborate closely with fossil fuel advocates, state and national trade groups, global research organizations, the Department of Energy, and academic institutions to deliver timely and accurate messages. We actively partner with the Energy & Environmental Research Center on educational initiatives and engage with both local and statewide chambers of commerce to champion coal-based electricity.

Weekly Lignite Line newsletters and quarterly Coal Suite webinars exemplify our strategy of creating communication tools for our primary audience (members) and repurposing them for secondary audiences. Lignite Line and Coal Suite highlight specific subjects we want our members to share with their friends and family, reinforcing their role as recognized experts in the energy industry. After distributing the information internally, we further amplify the content approved for public consumption by sharing it on social media platforms and with the media.

We will employ a range of media to reach diverse audiences, including policymakers, members, and the general public. Our communication channels include news releases, op-eds, advertising, websites, media relations, social media updates, grassroots outreach, and in-person meetings, all aimed at presenting a cohesive and strong endorsement of lignite-based electricity.

STANDARDS OF SUCCESS

Public affairs strategies and activities are frequently oriented toward the long term, which makes calendar-based goal setting and evaluation difficult. Assessing the effectiveness of many public affairs strategies proves challenging due to their non-transactional nature and often revolves around engaging stakeholders and building alliances. Additionally, objectives may shift during the year, particularly when navigating external entities, regulations, or legislative bodies – what may be an emergent scenario in January could change or be replaced with something else by July. The following metrics serve as key indicators to gauge the effectiveness of our public affairs efforts. These will be continually updated with benchmarks and current figures throughout the year. *Some metrics may be excluded based on the campaign's evolving needs:*

- Social media interaction and engagement
- Comprehensive media coverage
- Media sentiment and tone analysis (positive, negative, neutral)

- Email open rate
- Potential reach across viewership and publication distribution
- Website visitor traffic and analytics
- Advertising impressions and market penetration
- Further engagement metrics: letters of support/editorials, testimonies, and endorsements

BACKGROUND

The Lignite Energy Public Affairs Program was first formed in 1996 to improve the overall public image of coal-based electricity and to promote its use as a low-cost, reliable, and environmentally sustainable energy source for the region. Public opinion polls in North Dakota show that attitudes toward coal-based electricity have improved significantly due to the sustained effort to promote the industry. In a 2023 poll, 72 percent of North Dakotans supported or strongly supported the use of coal to generate electricity.

North Dakota's lignite industry is a cornerstone of the state's economy, ranking as the fifth-largest industry statewide. It generates an impressive 12,000 primary and secondary jobs. The industry's economic impact resonates deeply, contributing a staggering $5.75 billion annually in economic activity and a substantial $104 million in local and state tax revenue each year.

The industry not only offers some of the highest-paying jobs in the state but also boasts an average annual wage of $90,000 - $120,000 for coal miners or power plant operators.

The lignite industry's success during the 2021 Legislative session highlights the effectiveness of the $3.6 million invested over the past three years. This investment has maintained the industry's favorability ranking among the highest in the nation and established a solid foundation of support among North Dakota policymakers. As a result, the state has benefited from $100 million in tax relief and has allocated millions more for research and development projects.

QUALIFICATIONS

The Lignite Energy Council will be responsible for managing the Regional Lignite Energy Public Affairs Program.

Lignite Energy Council: The Lignite Energy Council is a regional trade association with the following mission statement "The Lignite Energy Council shall protect, maintain, and enhance development of our region's abundant lignite resource." LEC conducts programs in four separate areas including: government action; research, development and marketing; education; and public relations. Through these programs, the Council seeks to maintain a viable lignite industry and enhance development of North Dakota's abundant lignite resources in a clean, economical and efficient manner. These programs provide timely, accurate information that enables elected officials, government leaders and the public to make sound, informed decisions on lignite issues.

The principal LEC employees involved in this program include:

- **Jason Bohrer** - president & chief executive officer of the Lignite Energy Council. Jason is a graduate of North Dakota State University and earned his law degree from George Mason University. He was a member of the National Coal Council and serves on the North Dakota Empower Commission. Prior to joining the Lignite Energy Council, Bohrer worked nine years in Washington, D.C. During his career, Jason has worked on energy policy initiatives related to coal mining and energy development, as well as nuclear energy and waste disposal, oil and gas exploration, energy tax credits, hydropower relicensing, and biomass and other renewable energy projects. Jason has drafted legislation to facilitate the expansion of the nation's transmission infrastructure and improve cybersecurity protocols. He was named to his current position in 2013 and has worked to expand its R&D capabilities, public affairs, and legislative programs.

- **Kay LaCoe** has worked for the Lignite Energy Council since 2008 and is currently the vice president - marketing & communications. Kay LaCoe is a graduate of the University of Mary with a bachelor's of science degree in business communications and a master's degree in organizational leadership. Kay's background includes writing, public affairs, website development, graphic design, integrated marketing, and social media management. Prior to joining the Lignite Council in 2008, Kay spent the early part of her career at Basin Electric and Agency MABU working in the communications, marketing, and project management fields.

Public Affairs Company: The Public Affairs Company is based in Minneapolis, MN, and provides an integrated, bipartisan approach to public affairs. It incorporates communications and public relations counsel to help clients successfully execute successful public policy campaigns. The Public Affairs Company coordinates all advertising buys for the Coalition in Minnesota and North Dakota.

- **Luke Hellier** worked in government and politics prior to joining the Public Affairs Company. Luke brings a wide range of expertise in communications, political campaigns, community outreach and news media. Luke earned his degree in political science from St. John's University in Collegeville, Minn.

KAT Marketing, a full-service marketing agency, founded in 1989 by its current owner and CEO, Todd Muggerud. KAT is based in Bismarck, ND, and offers a full spectrum of marketing and advertising services. KAT Marketing assists with Podcasts, a time-lapse photo project at BNI Coal's Center Mine and the NextGen ND program.

D&N Cinematics, a full-service video production house based in Bismarck, North Dakota, creates and produces TV commercials, web-based content, drone-based aerial footage, grip truck rental and video editing. This group produced the 30-minute coal movie and the "I Am Lignite" campaign in 2020.

VALUE TO NORTH DAKOTA

The lignite energy industry is crucial to North Dakota's economic resiliency. Since 1988, lignite production has consistently averaged just less than 30 million tons annually, positioning North Dakota as the nation's top producer of lignite coal and just outside the top five coal-producing states in the nation. While the primary economic activity occurs in the three counties of Mercer, McLean and Oliver, the entire state of North Dakota benefits from the industry through jobs, taxes, and affordable and reliable electricity.

This Regional Public Affairs Program will assist in:

- Preserving and creating jobs involved in the production and utilization of North Dakota lignite;
- Ensuring economic stability, growth and opportunity in the lignite industry; and
- Supporting the lignite industry's significant contribution to North Dakota's tax base, generating substantial tax revenue that promotes prosperity throughout the state.

These efforts contribute to the increasing significance of lignite energy, as outlined in the North Dakota Century Code 54-17.5.01.

MANAGEMENT

The project will be managed on a day-to-day basis by Kay LaCoe, Vice President of Marketing and Communications of the Lignite Energy Council, with oversight from Jason Bohrer, President and CEO of the Lignite Energy Council, with assistance from industry through the State Public Affairs Committee of the Lignite Energy Council (Exhibit 1).

TIMETABLE

The implementation of the Lignite Regional Public Affairs Program is expected to be long-term to achieve the desired objectives. However, this application is for three years and is expected to be Phase X of a long-term plan. Phase X will be implemented starting January 1, 2025, and conclude December 31, 2027.

A thorough evaluation of all objectives will occur during the fourth quarter of each grant year to measure progress and inform the planning for future actions ensuring alignment with current industry goals and political objectives.

BUDGET

The total budget for the implementation of the Regional Lignite Energy Marketing Plan is $3.6 million over three years. Refer to Exhibit 2 for an itemized list of revenue and expenditures for this project. No equipment or additional facilities are needed to implement this budget. If the funding from the Lignite Research Council falls short of the requested amount, the achievement of our objectives will be significantly delayed.

MATCHING FUNDS

The Lignite Energy Council's approximately 250 members pay annual dues, enabling LEC to secure $600,000 in cash match funds annually for three years. This matches the Industrial Commission's funding of $600,000 annually over the same period.

CONFIDENTIAL INFORMATION

The applicant requests confidentiality pursuant to Section 54-17.5-06 of the North Dakota Century Code.

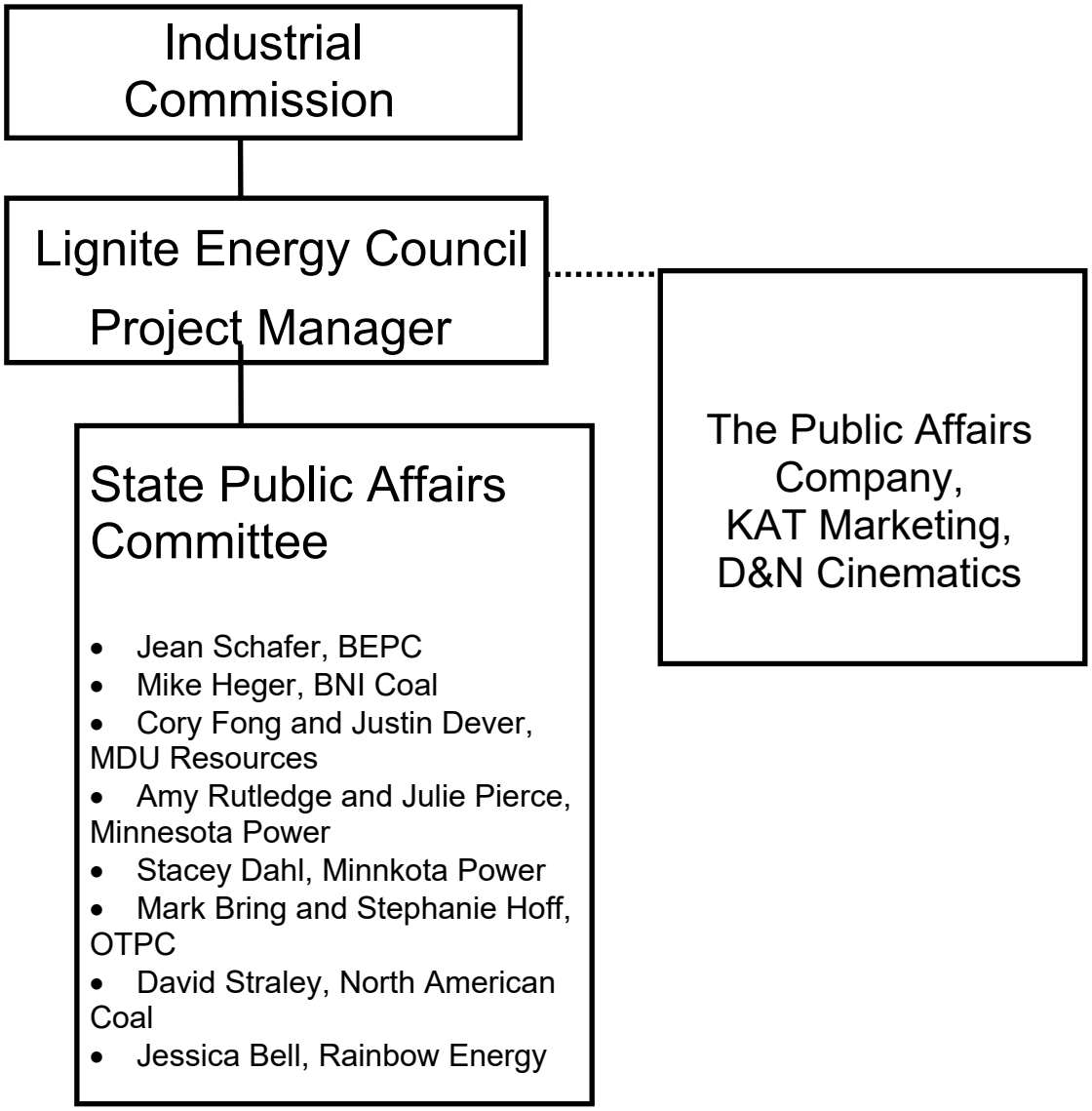
TAX LIABILITY

I, Jason Bohrer, certify that the Lignite Energy Council is not delinquent on any tax liability owed to the State of North Dakota.

Jason Bohrer, President
Lignite Energy Council

Exhibit 1

Management of
North Dakota Lignite Energy Marketing Plan



North Dakota Lignite Energy Marketing Plan Budget

Proposed Annual Revenue	Annual Project Budget		
North Dakota Industrial Commission	$600,000		
Industry Stakeholder Commitments	$600,000		
Total Annual Revenue	**$1,200,000**		
Proposed Annual Expenditures			
Project Costs	**Annual Project Budget**	**NDIC**	**Stakeholders**
Advertising (North Dakota & Minnesota)	304,500	152,250	152,250
Salaries/Benefits/Management Fees	425,504	212,752	212,752
Professional Services	215,000	107,500	107,500
Special Projects	50,000	25,000	25,000
General(office expenses, travel, meetings)	104,996	52,498	52,498
Education/Outreach	100,000	50,000	50,000
Total Annual Expenditures	**$1,200,000**	**$600,000**	**$600,000**

Due to the various budgeting cycles for numerous industry stakeholders and the on-going recruitment of additional funders, it is requested that commitments over and above the $600,000 from the Lignite Energy Council and industry stakeholders be matched by Industrial Commission funding of an increased corresponding amount. Alternatively, matching funds from the State may be smaller than $600,000 annually if the production of lignite is reduced because of early closure of lignite-based facilities.

TECHNICAL REVIEWER RATING SUMMARY

LRC (104B): "Phase I Bridge Study for CCS at Coal Creek Station"

Submitted by: Rainbow Energy Center
Principal Investigator: Conway Nelson
Project Duration: 10 months
Request for: $1,094,416
Total Project Costs: $2,188,833

Rating Category	Weighting Factor	Technical Reviewer Rating 35-04	35-05	35-06	Average Weighted Score
Objective	9	5	5	4	
Achievability	9	4	4	3	
Methodology	7	4	5	4	
Contribution	7	5	5	5	
Awareness	5	5	4	5	
Background	5	5	5	5	
Project Management	2	4	4	4	
Equipment Purchase	2	5	5	5	
Facilities	2	5	5	4	
Budget	2	5	5	4	
Average Weighted Score:		232	234	210	**225**

Maximum Weighted Score:	250

OVERALL RECOMMENDATION:

		35-04	35-05	35-06	
FUND		**X**	**X**	**X**	
FUNDING MAY BE CONSIDERED					
DO NOT FUND					

TECHNICAL REVIEWERS' COMMENTS

1. **OBJECTIVES**

The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Lignite Research Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer 35-04 (Rating: 5) The proposed activity is a bridge study that has as its objective optimizing the CCS design based on additional flue gas characterization and thoroughly reviewing the initial construction cost estimate. This activity builds on the current FEED study and redundancy study to examine opportunities identified to optimize the process design and pursue a more cost-effective design. As carbon management is the key challenge facing the Lignite industry, this objective aligns perfectly with the stated goal of Lignite Research Council/ND Industrial Commission.

Reviewer 35-05 (Rating: 5) The proposed work is in direct alignment with the NDIC/LRC and addresses one of the most important issues facing the lignite industry.

Reviewer 35-06 (Rating: 4) Preserve lignite use and expand jobs.

2. **ACHIEVABILITY**

With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.

Reviewer 35-04 (Rating: 4) This study looks to optimize the product from already funded activities by focusing on identified opportunities for improvement on that work. With that information and the identified team, the goals are most likely achievable with the budget and schedule noted.

Reviewer 35-05 (Rating: 4) The proposed effort, including previous work done and follow-on work proposed represents a huge effort. The work proposed herein should indeed help buy down the future risk of moving forward with the installation of a CCS system. The proposed budget and approach seem appropriate for the phase of work proposed herein.

Reviewer 35-06 (Rating: 3) Tasks will need to be managed actively.

3. **METHODOLOGY**

The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer 35-04 (Rating: 4) The methodology noted and the assembled team in this reviewer's opinion are well-positioned to be successful.

Reviewer 35-05 (Rating: 5) The proposed work specifically focused on obtaining the critical information required for the next phase of the work. It should fill in the identified

gaps in previous work needed to reduce the risks associated with the next phase of the project.

Reviewer 35-06 (Rating: 4) No comment

4. **CONTRIBUTION**

The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Lignite Research Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer 35-04 (Rating: 5) This project looks to help with optimization of the CCS system on ND Lignite fired power plant by focusing on how to address the characteristics of the flue gas steam and minimize both capital and operating cost. This will not only improve the financial viability of Coal Creek Station today but also increase sustainability of energy production and delivery using ND Lignite. This is the goal of the ND Industrial Commission/Lignite Research Council under the Lignite Research Program. The value of the proposed work is extremely high not only for the Lignite industry but for the entire state of North Dakota.

Reviewer 35-05 (Rating: 5) The successful implementation of CCS in North Dakota is critical for the future of the lignite industry. This work specifically addresses this goal of the NDIC/LRC.

Reviewer 35-06 (Rating: 5) Preserve and protect while enhancing.

5. **AWARENESS**

The principal investigator's awareness of other current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 35-04 (Rating: 5) As noted in the proposal, the proposed team includes a number of members who have been successful in completing a number of similar studies on carbon capture systems throughout the world. The awareness of the state of knowledge on this topic demonstrated by the assembled team is exceptional!

Reviewer 35-05 (Rating: 4) While there is little reference to the literature in the proposal, the experience of the team as evidenced by their resumes indicates that the PI and the entire project team has high awareness of the issues and current state-of-the-art as related to CCS.

Reviewer 35-06 (Rating: 5) No comment

6. **BACKGROUND**

The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 35-04 (Rating: 5) The team includes world class experts in the required fields.

Reviewer 35-05 (Rating: 5) All of the companies and the key personnel have excellent backgrounds and are highly qualified to perform the proposed work.

Reviewer 35-06 (Rating: 5) Most qualified and applicable team and technology.

7. **PROJECT MANAGEMENT**

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the parties involved in the project, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer 35-04 (Rating: 4) A detailed milestone chart is included in the proposal. The schedule is aggressive but must be to complete the due diligence to allow for the construction to proceed in a timely fashion and qualify for 45Q tax incentives. The communication plan for the team is sufficient.

Reviewer 35-05 (Rating: 4) The project plan as laid out should be successful in completing this phase of the work. All of the companies/organizations have experience with projects of similar scope.

Reviewer 35-06 (Rating: 4) No comment

8. **EQUIPMENT PURCHASE**

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 35-04 (Rating: 5) No equipment will be purchased during this project.

Reviewer 35-05 (Rating: 5) No equipment will be purchased as a part of this project.

Reviewer 35-06 (Rating: 5) No comment

9. **FACILITIES**

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 35-04 (Rating: 5) The facilities noted are very well suited for the proposed activities.

Reviewer 35-05 (Rating: 5) All organizations have the experience and the required facilities to perform the proposed work.

Reviewer 35-06 (Rating: 4) No comment

10. **BUDGET**

The proposed budget value relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value.

Reviewer 35-04 (Rating: 5) The value of the proposed work is extremely high for the Lignite industry in North Dakota. But the value of the work goes well beyond the industry and extends to the people of the state of North Dakota. Having stable, low cost, low carbon energy available as base load is critical to the well-being of the citizens of the state. One must look at the TOTAL commitment from the proposers including the FEED activity and redundancy studies to understand the commitment of the team to this activity and its value to the State of North Dakota.

Reviewer 35-05 (Rating: 5) This proposal addresses what may be the most important issue currently facing the lignite industry today. Rainbow Energy is committing both cash and in-kind resources as a part of their match.

Reviewer 35-06 (Rating: 4) Cost match could be higher than 50% but understood based on the level of the research.

OVERALL COMMENTS AND RECOMMENDATIONS:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 35-04 (Rating: FUND) I would start my comments on the merits of this activity by saying I strongly recommend funding!
The Governor challenged the industry to be carbon neutral by 2030. At the same time, asking for low cost and readily available supply such that the economy of the state can continue to grow. This project is a critical component of making that challenge a reality.

Reviewer 35-05 (Rating: FUND) I highly recommend funding as successful implementation of CCS technology is critical to the lignite industry. The proposed work is an integral part of the larger effort by Rainbow Energy to add CCS to it Coal Creek Station. Its successful implementation at Coal Creek will produce huge long-term financial returns to the State. Lessons learned should also be translatable to other facilities considering CCS.

Reviewer 35-06 (Rating: FUND) This project is directly in line with what LRC and NDIC is intended to do. The technology and application is vital to the lignite industry.

RAINBOW ENERGY CENTER

2875 Third Street SW
Underwood, North Dakota 58576
701.207.9988

April 4, 2024

Mr. Reice Haase
Deputy Executive Director
ATTN: Lignite Research, Development and Marketing Program
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: REC Proposal Entitled "Phase I Bridge Study for CCS at Coal Creek Station"

Rainbow Energy Center (REC) is pleased to submit this proposal to the Lignite Research, Development and Marketing Program. The $100 application fee is provided through ACH Transaction Number 091310750050064. REC is committed to completing the project as described in the proposal if the Commission makes the requested grant.

If you have any questions, please contact me by telephone at (306) 529-9426 or by email at Conway.Nelson@rainbowenergycenter.com.

Sincerely,

DocuSigned by:
Conway Nelson
1532A5E195574DD...

Conway Nelson, P. Eng., PMP
Director, Carbon Management

CN

c: Erin Stieg, North Dakota Industrial Commission

Lignite Research, Development and Marketing Program

North Dakota Industrial Commission

Application

Project Title: Phase I Bridge Study for CCS at Coal Creek Station

Applicant: Rainbow Energy Center

Principal Investigator: Conway Nelson

Date of Application: April 4, 2024

Amount of Request: $1,094,416

Total Amount of Proposed Project: $2,188,833

Duration of Project: 10 months

Point of Contact (POC): Conway Nelson

POC Telephone: (306) 529-9426

POC Email:

Conway.Nelson@rainbowenergycenter.com

POC Address: 918 East Divide Avenue, Bismarck, ND 58504

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ABSTRACT

Objective: This project will support Rainbow Energy Center's (REC's) Coal Creek Station carbon capture plant front-end engineering and design (FEED) through Phase I of a bridge study focused on creating the most cost-effective plant while ensuring a high level of reliability. Carbon capture from coal-fired power generation is a relatively new technology that brings a higher degree of operational risk and depends on high reliability and low-cost construction and operation for success. The FEED study, commenced on February 1, 2022, and redundancy study, commenced on May 26, 2023, have identified several opportunities to optimize the process design and pursue a more cost-effective design under this bridge study.

Expected Results: Key outcomes from Phase I of this focused study will be a thorough review of the initial construction cost estimate and the development of an optimal design for the proposed REC capture plant. The results of Phase I of the study will provide REC with essential information to execute a second phase of the bridge study that updates the construction and operating cost estimates based on an optimized design to support a final investment decision. This effort also supports the original REC Coal Creek Station carbon capture project's intent to 1) reduce the technological and economic risks associated with investing in a postcombustion capture retrofit project and 2) provide information and learnings that will enable valuation and deployment of similar North Dakota facilities.

Duration: 10 months (February 1, 2024 –November 30, 2024).

Total Project Cost: $2,188,833. REC will contribute $716,897 as cash cost share and $377,520 as in-kind cost share and requests $1,094,416 from the North Dakota Industrial Commission (NDIC) Lignite Research, Development and Marketing Program (LRDMP).

Participants: REC will lead the project in partnership with NDIC through LRDMP. Additional partners include the International CCS Knowledge Centre, Energy & Environmental Research Center, Mitsubishi Heavy Industries America, Sargeant & Lundy, and Burns & McDonnell.

PROJECT SUMMARY

Rainbow Energy Center (REC) proposes a two-phase bridge study to complement the ongoing front-end engineering and design (FEED) and redundancy studies on carbon capture at Coal Creek Station. This project is Phase I of the bridge study and will focus on determining an optimal system design based on additional flue gas characterization and a thorough review of the initial construction cost estimate. Carbon capture from coal-fired power generation is a relatively new technology that introduces a higher degree of operational risk and depends on high reliability and low-cost construction and operation for success.

The project team will thoroughly review the cost estimate from the FEED study; further characterize the Coal Creek Station flue gas; conduct a reliability, availability, maintainability (RAM) study; and finalize the process design. Upon completion of this project, it is anticipated a second phase of the bridge study will be pursued to refine the cost estimate, prepare a project execution plan, and finalize the permitting strategy for construction of the capture system. The carbon capture system (CCS) design and, where appropriate, balance-of-plant (BOP) integration and design will reflect data gathered during the flue gas characterization and RAM study. Specifically, changes may occur to the size and level of redundancy of various systems in the carbon capture plant (CCP), the CCP layout, pretreatment equipment, piping and supports, electrical design (power distribution center), design of the structural/building steel and, possibly, the plant footprint and foundation. These changes will also be reflected (where necessary) in an updated design package that includes general arrangement drawings; process flow diagrams; P&IDs (piping and instrumentation diagrams); electrical diagrams; tie-in list; equipment list; and preliminary structural, civil, and architectural drawings.

PROJECT DESCRIPTION

Objectives: The objective of this project is to support REC's Coal Creek Station CCP FEED through Phase I of a bridge study that will focus on optimizing the CCS design based on additional flue gas

characterization and thoroughly reviewing the initial construction cost estimate. The FEED study, commenced on February 1, 2022, and redundancy study, commenced on May 26, 2023, have identified several opportunities to optimize the process design and pursue a more cost-effective design. To achieve these objectives, the project team proposes completion of a bridge study that will closely examine the following areas to meet the study objectives:

1. Perform an open book review with technology and construction partners to validate the Class 3 project estimate that was produced during the FEED study.
2. Perform testing and analysis to further characterize the Coal Creek Station flue gas to reduce operating risks associated with the CCP.
3. Optimize and finalize the process design based on flue gas testing and a RAM study.

Methodology: The following tasks outline the proposed bridge study as the next phase in the necessary due diligence process in project development. The study is scoped such that the project will be able to begin construction by December 31, 2032, a requirement for 45Q tax incentives. The methods in the proposed Phase I of the bridge study will ensure a thorough understanding of the preliminary capital cost estimate and optimize the technical scope of work in sufficient detail to allow the project cost estimate to be revised in Phase II of the bridge study (to be pursued in the fall of 2024). Four tasks have been identified to execute this work. Additional details can be found in Appendix A, which contains estimates from subcontractors. Some of the subcontractor proposals may contain quotes for Phase I and Phase II. Phase II scopes and pricing will be updated when the team decides to move forward with Phase II.

Task 1 – Cost Estimate Review and Validation

This task will consist of a thorough review of the carbon capture and BOP capital and operating cost estimates to ensure a thorough understanding of these foundational estimates. The review will include a

constructability analysis to consider innovative opportunities for construction cost reductions and a reorganization of the FEED estimate to allow adjustments by process system during subsequent tasks.

Task 2 – Flue Gas Characterization

The FEED study produced a Class 3 cost estimate for a CCP design based on the pilot test completed in 2020 and a level of equipment redundancy that maximizes availability of the CCP. This test was part of a larger study that was cofunded by the North Dakota Industrial Commission (NDIC) and U.S. Department of Energy (DOE). The pilot test was completed to satisfy Subtask 2.7 of this DOE study: WESP (wet electrostatic precipitator) and Aerosol Testing at Coal Creek Station.

The pilot test satisfied the intended goals of reducing aerosol formation in CCSs by utilizing WESP technology and a proprietary Mitsubishi Heavy Industries America (MHIA) amine emission reduction (AER) unit. The test also studied the impact of aerosols on the efficiency and degradation products of carbon capture amines. The purpose of this test was not to study the optimal design parameters for a CCP for Coal Creek Station but rather to give an indication of the feasibility of such an installation.

During the FEED study, it was determined that additional flue gas testing was necessary to supplement the information gathered in the pilot. In February 2024, the project team measured the levels of flue gas constituents that may cause accelerated amine degradation or equipment fouling (constituents such as iron and other metals, NO_X, and particulate matter [fly ash] were measured). The results of this flue gas testing will be used to determine process adjustments that may be necessary to minimize the risk of accelerated amine degradation.

Additional flue gas testing is planned to measure the presence of very small, submicrometer fly ash particles in the Coal Creek flue gas. These micro-fly ash particles were not specifically measured in the latest round of flue gas testing and are expected to have a larger effect on amine degradation than larger fly ash particles. These collected samples may also be used for the laboratory tests discussed below.

In addition to flue gas testing, laboratory tests will be conducted by the Energy & Environmental Research Center (EERC) to examine the potential for Coal Creek fly ash to cause degradation reactions with the proprietary MHIA amine. This is a known problem with a full-scale CCP that is operating on a coal-fired power plant. The level of particulate in the Coal Creek flue gas is lower than the existing unit that exhibits this issue; however, it is critical to understand how the specific Coal Creek fly ash will interact with the specific MHIA amine.

Task 3 – Process Design Finalization

The results of the flue gas characterization work completed in Task 2 will be used to finalize the process design, including the potential need for a WESP for flue gas pretreatment and potential adjustments to the CCP system to effectively control amine degradation.

A high level of redundancy was included in the CCP design (n+1 approach for key equipment) to maximize reliability. A systematic RAM study will be completed in Task 3 to determine an optimal level of redundancy in the process design that will minimize costs while ensuring reliable operation of the CCP.

Prior to finalizing the process design, a hazard and operability (HAZOP) analysis will be completed to ensure that the revised design will not cause operability problems with Coal Creek Station or the new CCP.

Task 4 – Project Management and Reporting

REC, with assistance from the EERC, will manage the cost, scope, and schedule of Tasks 1–3 by holding regular progress meetings with the team and updating progress relative to the project schedule as well as prepare a final report incorporating the results of the FEED and redundancy studies as well as this bridge study.

Anticipated Results: The CCS design packages to be revised may include 1) site plan: civil and architectural, 2) electrical, 3) instrumentation, 4) controls, 5) machinery, 6) piping, 7) structural, 8) tie

points, 9) cost, 10) schedule, and 11) layout. Key outcomes from this bridge study will be an optimized system design and an understanding of the initial construction costs, which will allow REC to move forward with Phase II of the bridge study that will update the cost estimate based on the optimized design and begin project development steps, including permitting and initial procurement.

Facilities: REC maintains offices in Bismarck, North Dakota, and at Coal Creek Station between Underwood and Washburn, North Dakota. The EERC, located in Grand Forks, North Dakota, has over 254,000 square feet of facilities for technology demonstration, process modeling, and project execution. Additional primary subcontractors, International CCS Knowledge Centre, Sargent & Lundy, Burns & McDonnell (BMcD), and MHIA, maintain office and computing facilities in Regina, Saskatchewan; Chicago, Illinois; Kansas City, Kansas; and Houston, Texas, respectively.

Resources: The bridge study primary team of industry experts, BMcD (BOP engineer), Sargent & Lundy (owner's engineer), and MHIA (CCS technology owner), will perform project design activities. International CCS Knowledge Centre, the EERC, and plant owner REC will provide review of designs and advisory services. REC will be the prime applicant, with additional project administrative services provided by the EERC. The project team is committed to providing all necessary personnel and resources to ensure the timely completion of all activities outlined in this proposal.

The EERC's engineering and scientific research staff is equipped with state-of-the-art analytical, modeling, and engineering facilities to address a wide variety of energy, environmental, and mineral resource research topics.

Sargent & Lundy, the International CCS Knowledge Centre, MHIA, and BMcD have been a part of project teams that have executed similar project scopes of work focused on North Dakota utilities. MHIA (with assistance from Kiewit, the designated CCS detailed engineering, procurement, and construction contractor) brings experience gained from design and construction of the 240-MW system at the Petra Nova facility in Texas as well as another dozen commercial projects around the world. The International

CCS Knowledge Centre brings experience from the capture system installed at SaskPower's 115-MW Boundary Dam Power Station.

Techniques to Be Used, Their Availability and Capability: The primary technique for data generation under this project will be to use recognized and generally accepted good engineering practices (RAGAGEP) and costing techniques. The individual partners and subcontractors mentioned within the proposed project represent decades of experience in CO_2 capture and coal plant operations. All project participants have committed the necessary resources to execute this project. These same industry experts have been a part of several pre-FEED and FEED projects on similarly sized systems within North Dakota. In addition to the engineering design work, flue gas testing will be carried out in accordance with standard testing procedures and protocols.

Environmental and Economic Impacts while Project Is Underway: The majority of the proposed work is a paper study and will not have an environmental impact to the FEED study area or partner facilities. A limited amount of flue gas sampling and fly ash collection will take place at Coal Creek Station, and some laboratory analysis will take place at the EERC. Both of these locations are sites where these types of activities occur on a daily basis and are equipped to mitigate any potential environmental impacts.

Ultimate Technological and Economic Impacts: The proposed bridge study is a necessary due diligence process in project development and will provide vital information to secure financing for CO_2 capture at Coal Creek Station. Financing and CCS project business cases continue to be reliant on federal 45Q tax incentive programs that require projects must begin construction by December 31, 2032. Continued investment in this project ensures that this initiative can be economically viable and successfully move along the project development path. Subsequent projects will have a better understanding of challenges with ash constituents, resiliency, and cost and will be better informed and more likely to succeed and make progress toward Governor Burgum's goal of North Dakota carbon neutrality by 2030. The later projects will benefit by being provided with key information relating to considerations for cost and

reliability as well as information on specific carbon capture technologies. By seeking a way to cost-effectively use lignite in a carbon-constrained world, this project supports the core mission of the Lignite Research, Development and Marketing Program (LRDMP) to develop large-scale commercial projects that reduce environmental impacts and increase sustainability of energy production and delivery.

Maintaining and adding jobs will also be a key economic factor for long-term implementation of carbon capture, utilization, and storage (CCUS) in North Dakota. The power industry and a newly created CCUS industry will preserve and gain new careers as a result of the proposed project. If North Dakota can produce a lower-carbon-intensity power product by implementing CCUS at lignite-fired power plants, the state will be able to maintain a reliable baseload power source that can ensure electricity security for North Dakota and complement existing and future renewable generation in the state, adding thousands of direct, long-term careers in the process. If the proposed work moves into construction and deployment phases, Coal Creek Station and the Falkirk Mine will retain the current 700 direct/indirect jobs and add approximately 35–40 direct jobs. Additionally, short-term construction jobs are likely to be over 2000 direct/indirect jobs (Stanislowski and others, 2019).

Why the Project Is Needed: This project is needed to ensure the most cost-effective and reliable capture system is designed for Coal Creek Station, a vital generating asset in our state and region. The 2019 Polar Vortex (which caused severe limitations of wind power generation capacity and natural gas availability) that swept through the Midwest in early 2019 and the 2021 Electric Reliability Council of Texas (ERCOT) challenges are profound reminders of why we need to keep our entire power generation mix secure and reliable; CCUS can serve as a long-term solution to carbon emissions while continuing to provide firm baseload generation to mitigate the impact of increasing intermittent renewable generation on grid reliability. Coal Creek Station can serve as a model and learning opportunity for the rest of the nation's existing coal fleet and provide baseload power with reduced CO_2 emissions. As with the current CCS FEED study, results from this study will support the mission of the LRDMP to

concentrate on near-term, practical research and development projects that provide the opportunity to preserve and enhance development of our state's abundant lignite resources. A final report and update reports as requested will summarize the findings of this study, which will be useful for other North Dakota businesses that wish to pursue carbon capture projects.

STANDARDS OF SUCCESS

This project is a necessary next step on the development path for CO_2 capture at Coal Creek Station. Successful outcomes for the project include development of an optimized CCP design that ensures a high level of reliability and a thorough review of the initial cost estimate, preparing the team for Phase II of the bridge study that will determine a detailed project cost estimate for 95% CO_2 capture at Coal Creek Station.

BACKGROUND/QUALIFICIATIONS

Background: Many of the project participants have been involved in the pre-FEED study, current FEED study, and redundancy study for installing a CCP at Coal Creek Station. As with the pre-FEED, MHIA is the technology provider in the current FEED study, redundancy study, and proposed bridge study. MHIA is a globally recognized expert in amine-based carbon capture and was the technology provider for the Petra Nova project at the W.A. Parish plant in Texas, which is the world's largest postcombustion carbon capture facility installed on an existing 240-MW coal-fueled power plant. The lessons learned from this full-scale experience have provided the best methods and control technologies for use at Coal Creek Station. The involvement of the International CCS Knowledge Centre has also introduced lessons learned from the Boundary Dam Unit 3 CCS project. The pre-FEED and FEED studies for Coal Creek Station included development of design packages, cost and performance estimates, and a process hazard analysis (PHA, commonly called HAZOP) for both the capture facility and for BOP systems, including, among others, the following systems:

- Flue gas extraction, pretreatment, and handling.

- Steam extraction.
- Cooling water supply and heat rejection equipment.
- Electrical distribution systems.
- Fire protection.
- Plant and instrument air.
- Process control systems.
- Demineralized water supply.

Slipstream Capture Testing

Although solvent-based carbon capture is common in gas processing, postcombustion carbon capture from low-rank coal-fired power stations remains a very new technology at the scale proposed in the ongoing work. With any new technology, there is always a risk that full-scale performance will not be as expected. The EERC, REC, and MHIA have previously demonstrated 78 days of solvent performance at Coal Creek Station using a slipstream system installed on Unit 1 of the plant. During this testing, solvent was sampled weekly and analyzed for a wide variety of materials known to be concerns for solvent degradation. Over the course of more than 2 months of continuous operation, accumulation of these materials was examined and reported to the project team. The solvent performance remained steady without indications of major loss of capture capacity. This experience gave preliminary confidence that MHIA's KS1™ and KS-21™ solvent technology is likely to perform well at Coal Creek Station with the unique flue gas from this plant. The next steps proposed in the bridge study are to further test and validate the findings of the slipstream work with additional sampling and laboratory work.

One key factor that has arisen as a concern for postcombustion carbon capture at coal-fired power plants in recent years is solvent loss to aerosol formation. Although this is not a major source of amine loss in traditional CO_2 capture units for natural gas, the very fine fly ash from coal-fired power plants provides surface area where volatile amines can condense to form submicrometer aerosols. This

aerosol mist is difficult to recover using conventional methods. In flue gas from low-rank coals, this aerosol formation can lead to amine losses that are much higher than would be expected from traditional vaporization losses.

During on-site slipstream testing at Coal Creek Station, the EERC worked with MHIA to test MHIA's AER technology for minimizing aerosol losses. During operation with the AER unit, amine was below the 0.1-ppm detection limit at the system outlet, and daily sampling of the solvent over the course of more than 2 months of operation showed that amine content was stable within the expected range. By contrast, during short-term operation with conventional demisting technology, the aerosol and amine contents were significantly higher. Moreover, measurements conducted on the same system using a conventional monoethanolamine (MEA) solution and a traditional water wash section showed large increases in aerosol content through the capture system. These results demonstrate that MHIA's proprietary combination of solvent and AER technologies are likely to be effective at limiting amine losses to aerosols at Coal Creek Station. As noted in the methodology section, the project team will be considering implementing a WESP to further mitigate impacts to the solvent and amine emissions.

FEED/Redundancy

The results from the pre-FEED and slipstream tests provided initial information for the project team to build directly into the current FEED and redundancy study. The proposed bridge study will support efforts to improve cost and manage risk with reliability/availability of the carbon capture facility and will run concurrently with the current FEED/redundancy study.

The FEED study was focused on the addition of a full-scale postcombustion CCS that will capture 95% of CO_2 emissions at the 1100-MWe Coal Creek Station. The capture system design features 1) steam cycle integration with advanced heat recovery to improve energy efficiency, 2) an integrated solution for aerosol emissions to improve environmental and operating costs, 3) design of the world's largest capture facility (9.0 million tonnes/yr, representing 19% of the CO_2 from North Dakota's stationary

sources), 4) engineering for cold-climate performance, and 5) equipment redundancy to improve CCS reliability and availability.

To date, the project team has completed many aspects of the FEED and redundancy projects and is taking a deeper dive into reliability based on additional flue gas characterization and creating the most efficient and cost-effective design that is possible. The bridge study will build off of the work completed to date.

Qualifications: REC is the project lead and the proud owner and operator of Coal Creek Station. The REC team works to maximize efficient energy production and sound energy management to unlock the energy sector's full potential. REC is working diligently to capitalize on innovative technologies so that future generations have sustainable energy solutions. REC is committed to providing reliable, low-carbon, baseload power to North Dakota and the region. Carbon capture is vital to the success and continued operation of Coal Creek Station, and REC is committed to delivering carbon capture that will serve as a showcase for future projects around the world. Mr. Conway Nelson, Director of Carbon Management, will be the overall project manager. Mr. Nelson will focus on ensuring the overall success of the project by providing experienced management and leadership to all activities within the project. Mr. Nelson will ensure that the project is carried out within budget, schedule, and scope. Mr. Nelson will also be responsible for communication with project partners and REC project personnel. Additional key personnel from REC include Stacy Tschider (CEO), Jeff Jonson (President), Chris Faul (VP Operations), Lyndsey Roemmich (VP Finance), Jessica Bell (VP External Affairs), Jon Price (Director, Projects), Dalton Norton (Project Engineer), and John Bauer (Plant Manager). Letters of commitment from each entity can be found in Appendix B, and qualifications of all key personnel can be found in Appendix C. The organizational chart for the bridge study is shown in Figure 1.

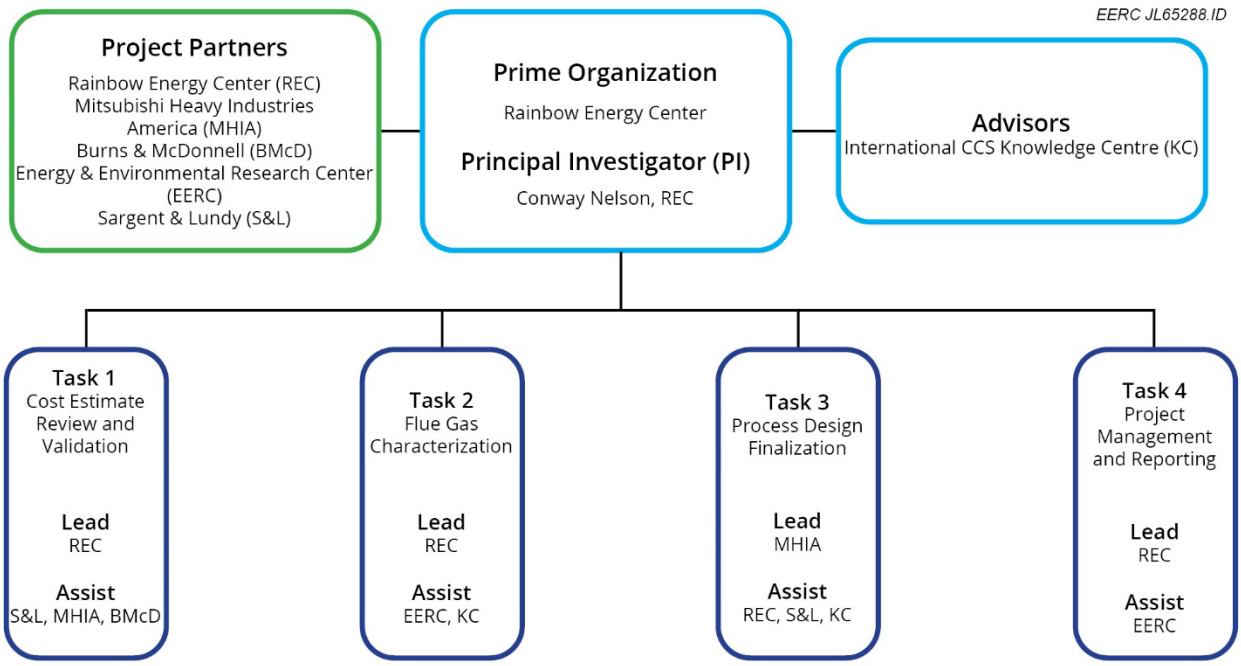


Figure 1. Organization chart.

The EERC is the lead for the current FEED and redundancy projects and will aid with project administration, flue gas analysis, and overall design/costing review. Mr. Jason Laumb, Director of Advanced Energy Systems Initiatives, will be managing the EERC efforts and is the current project manager for the FEED and redundancy studies. Mr. Laumb will also be responsible for communication with EERC project personnel.

Mitsubishi Heavy Industries America, Inc., and Mitsubishi Heavy Industries Engineering, Ltd., are subsidiaries of Mitsubishi Heavy Industries, Ltd., of Japan (together referred to as MHIA). MHIA will be responsible for the CCS scope. Starting in the early 1990s, MHIA jointly developed with Kansai Electric Power Company (KEPCO) the proprietary Kansai Mitsubishi Carbon Dioxide Recovery Process (KM CDR Process™) for carbon dioxide removal from combustion gas exhaust streams. MHIA's KM CDR Process™ is an amine-based CO_2 capture process that uses MHIA proprietary solvents. The CCS is capable of recovering 95% of the CO_2 from the flue gas and compressing the treated CO_2 to adequate pipeline conditions. MHIA has provided 13 commercial CCSs around the world, including the world's largest

postcombustion system capturing 5265 stons/day from a coal-fired power plant in Thompsons, Texas (Petra Nova) for enhanced oil recovery (EOR). Key personnel from MHIA include Mr. Tim Thomas (Senior Vice President and Deputy General Manager), Mr. Takashi Kurioka (Project Manager), and Mr. Hiro Tanaka (Engineering Manager).

BMcD will be responsible for BOP engineering. BMcD is a fully integrated engineering, architecture, construction, environmental, and consulting firm with a multidisciplinary staff of more than 7600 professionals. Founded in 1898, its singular mission has been to make its clients successful. Because BMcD is relationship-focused and dedicated to creating amazing success for its clients, it has a 90% repeat-business rate and client partnerships that span multiple decades. Being 100% employee-owned means that everyone has an ownership stake in the success of the clients and all team members are driven to find great solutions. Key personnel from BMcD include Mr. Aaron Bennett, Project Manager, and Ms. Patricia Scroggin-Walker, Carbon Capture Director. Additional B&McD team members include Doug Randall and Justin Schnegelberger.

Sargent & Lundy will serve as the owner's engineer, with involvement in all aspects of the project, including a focus on permitting strategy development. Sargent & Lundy is a Chicago-based firm that offers the technological know-how for making informed decisions when evaluating and implementing postcombustion CCUS technologies. Sargent & Lundy is an industry leader in CO_2 capture technologies with experience and capabilities for executing pilot- to commercial-scale projects. Sargent & Lundy CCUS services encompass feasibility studies, preliminary conceptual designs, FEED studies, plant integration planning, BOP detailed designs, permitting support, and project and construction management. Sargent & Lundy teams have collaborated with technology suppliers, utilities, investors, and others to support the evaluations and development of new CO_2 capture initiatives and opportunities. Sargent & Lundy key participants are Kevin Lauzze, Project Director, and Donna Eglar, Project Manager.

The International CCS Knowledge Centre will be involved in all technical aspects of the project. The CCS Knowledge Centre provides independent, expert advisory services for CCS/CCUS projects across multiple industries based on its team's unparalleled experience developing the world's first fully integrated postcombustion CCS facility on a coal-fired power plant at SaskPower's 115-MW Boundary Dam Unit 3. Key participants from the International CCS Knowledge Centre activities are Everett Rueve, Project Manager; Colin Campbell, Principal Chemical Specialist; and Yuewu Feng, Senior Engineer.

There are additional project participants not named specifically in the text that will be providing services to the project and paid with REC in-kind contributions. These subcontractors will provide flue gas sampling services, advisory services, and conduct a RAM study.

VALUE TO NORTH DAKOTA

The proposed bridge and the ongoing FEED and redundancy projects' primary value to North Dakota will be maintaining and adding new jobs to the state and local economies in areas where current and new regulations threaten to significantly reduce activity in coal utilization, one of the state's most vital resources. The power industry and a newly created CCUS industry that will result from this project will preserve and gain new careers. If North Dakota can produce a lower-carbon-intensity power product by implementing CCUS at coal-fired generation units, the state will be able to maintain a reliable baseload power source that can be used to complement existing and new renewable generation in the state, adding thousands of direct, long-term careers in the process. If the proposed work moves into construction and deployment, Coal Creek Station and the Falkirk Mine will retain the current 700 direct/indirect jobs and add approximately 35–40 direct jobs. Additionally, short-term construction jobs are likely to be over 2000 direct/indirect jobs (Stanislowski and others, 2019).

Beyond the plant, the lignite-fired power plants in North Dakota present an opportunity to economically demonstrate the large-scale feasibility of CCS for the existing domestic coal fleet that is unique to North Dakota. The North Dakota plants are optimally located near both appropriate geologic

storage and fields amenable to EOR operations, an advantage not found in other parts of the world. The economic health of the central region of North Dakota is tied to energy jobs in the area, and advancing CCUS technologies here can help show the world how projects such as these can be successful. Currently, the lignite industry directly employs 3623 people, with another 9500 indirect employees supported by the industry, accounting for over $5.4 billion in economic impact. Technology advances that continue the responsible use of lignite and bring new industries to the region are critically needed to sustain and grow these jobs. Based on a recent study by the EERC, the economic impact to a state such as North Dakota from development of a new carbon capture and EOR industry would be tremendous if deployed statewide: $2.5 billion – $3.0 billion in annual economic activity, state revenue increase of $160 million per year, and creation of approximately 8000 long-term jobs (Stanislowski and others, 2019). This diversification provides additional stability to a state heavily reliant on a commodity-based economy.

At a project level, the cost and benefits of a redundancy/sparing approach to the ongoing FEED project will benefit the entire lignite fleet. The project will also provide a basis for identifying and evaluating those systems, equipment, and parts essential to maintaining high availability and reliability of the installed CCS. Because space limitations exist at all utility sites, results from this study will identify probable changes to the support structure and overall equipment layout required to implement a capture island at an existing plant. This project will reduce risks: both technological and economic risks associated with investing in a postcombustion capture retrofit project.

The primary deliverable for the project will be a completed Phase I bridge study report. The report will include finalization of an optimized process design, including revised equipment lists, process flow diagrams, P&IDs, electrical load list and single-line diagram, evaluation of possible civil and structural changes required to support the additional equipment recommended within the CCP island, and a summary of the basis for the initial cost estimate. It is expected that the tasks associated with the

proposed study will be completed by November30, 2024, running concurrently with the ongoing FEED and redundancy projects.

MANAGEMENT

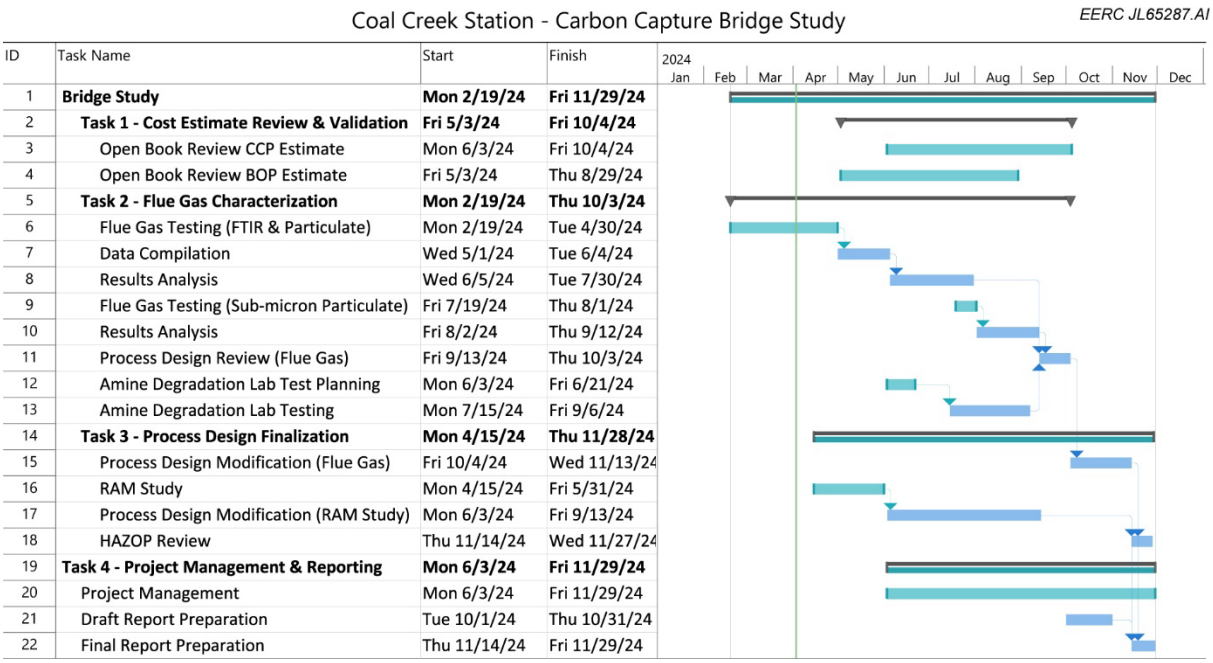
REC is the lead organization for this project and will oversee all associated tasks and management activities. REC will schedule regular internal and external meetings with project staff and advisors to ensure that the project is conducted in accordance with the project plan (budget, schedule, deliverables, and milestones) and meets quality objectives. These meetings will be used to review project status, risks, issues, and potential adjustments to the project plan. REC will keep all partners informed of project progress and 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 team.

TIMETABLE

The overall project timeline can be found in Figure 2. The proposed bridge study is expected to require 10 months, with a projected completion date of November 30, 2024. Some portions of the project are underway, as flue gas testing was completed at Coal Creek Station in February 2024. This initial work was funded by REC and was necessary to keep the project moving. Additional work will start in earnest upon approval from NDIC. This timeline is necessary to maintain a schedule that could allow for construction activities to begin before December 31, 2032.

BUDGET AND MATCHING FUNDS

The proposed budget is $2,188,833, with $1,094,416 from NDIC and $1,094,417 of cash/in-kind support from REC. The budget includes subcontracts for all key subcontractors and those providing services noted in the proposal for Phase I. The detailed breakdown is shown in Table 1. Budget notes can be found in Appendix D. Cash cost share in the amount of $716,897 will be provided by REC.



ID	Task Name	Start	Finish
1	**Bridge Study**	**Mon 2/19/24**	**Fri 11/29/24**
2	**Task 1 - Cost Estimate Review & Validation**	**Fri 5/3/24**	**Fri 10/4/24**
3	Open Book Review CCP Estimate	Mon 6/3/24	Fri 10/4/24
4	Open Book Review BOP Estimate	Fri 5/3/24	Thu 8/29/24
5	**Task 2 - Flue Gas Characterization**	**Mon 2/19/24**	**Thu 10/3/24**
6	Flue Gas Testing (FTIR & Particulate)	Mon 2/19/24	Tue 4/30/24
7	Data Compilation	Wed 5/1/24	Tue 6/4/24
8	Results Analysis	Wed 6/5/24	Tue 7/30/24
9	Flue Gas Testing (Sub-micron Particulate)	Fri 7/19/24	Thu 8/1/24
10	Results Analysis	Fri 8/2/24	Thu 9/12/24
11	Process Design Review (Flue Gas)	Fri 9/13/24	Thu 10/3/24
12	Amine Degradation Lab Test Planning	Mon 6/3/24	Fri 6/21/24
13	Amine Degradation Lab Testing	Mon 7/15/24	Fri 9/6/24
14	**Task 3 - Process Design Finalization**	**Mon 4/15/24**	**Thu 11/28/24**
15	Process Design Modification (Flue Gas)	Fri 10/4/24	Wed 11/13/24
16	RAM Study	Mon 4/15/24	Fri 5/31/24
17	Process Design Modification (RAM Study)	Mon 6/3/24	Fri 9/13/24
18	HAZOP Review	Thu 11/14/24	Wed 11/27/24
19	**Task 4 - Project Management & Reporting**	**Mon 6/3/24**	**Fri 11/29/24**
20	Project Management	Mon 6/3/24	Fri 11/29/24
21	Draft Report Preparation	Tue 10/1/24	Thu 10/31/24
22	Final Report Preparation	Thu 11/14/24	Fri 11/29/24

Figure 2. Project timeline.

Project Associated Expense	NDIC Share (Cash)	REC Share (In Kind)	REC Share (Cash)	Total Project
REC Staff and Subconsultant (in-kind)		$377,520		$377,520
Flue Gas Testing			$200,000	$200,000
International CCS Knowledge Centre			$258,811	$258,811
EERC	$426,302			$426,302
Sargent & Lundy (Owner's Engineer)	$213,114		$191,886	$405,000
MHIA	$455,000			$455,000
B&McD			$66,200	$66,200
Total	**$1,094,416**	**$377,520**	**$716,897**	**$2,188,833**

TAX LIABILITY

REC has no outstanding tax liability.

CONFIDENTIAL INFORMATION

No confidential information is contained in this proposal.

REFERENCES

Stanislowski, J.J.; Folkedahl, B.C.; Jensen, M.D.; Musich, M.A. *Regional Impacts of Carbon Capture and Sequestration in the State of North Dakota*; Final Report for Lignite Energy Council; EERC Publication 2019-EERC-02-07; Energy & Environmental Research Center: Grand Forks, ND, Feb 2019.

APPENDIX A

SUBCONTRACTOR PROPOSALS

EERC
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

April 2, 2024

Mr. Conway Nelson
Director of Carbon Management
Rainbow Energy Center
918 East Divide Avenue
Bismarck, ND 58504

Dear Mr. Nelson:

Subject: EERC Proposal No. 2024-0163 Entitled "Support for Bridge Study Phase I"

Introduction

The Energy & Environmental Research Center (EERC) is pleased to support Rainbow Energy Center (Rainbow) in its Bridge Study Phase I project for the North Dakota Industrial Commission (NDIC) Lignite Research Program (LRP). The EERC has a long history of working with NDIC and has worked with Rainbow through its front-end engineering and design (FEED) and redundancy studies that have led to this proposed effort. The EERC will use this experience to support the proposed project.

The EERC will support the following tasks within Rainbow's scope of work submitted to LRP.

Task 1 – Cost Estimate Review and Validation

The EERC will provide a support role in this task, which will consist of reviewing the carbon capture and balance-of-plant (BOP) capital and operating cost estimates to ensure a common understanding of these foundational estimates. The review will include a constructability analysis to consider innovative opportunities for construction cost reductions and a reorganization of the estimate to allow adjustments by specific process systems during subsequent tasks.

Task 2 – Flue Gas Characterization

The EERC will provide a support role for the flue gas characterization work. During the FEED study, it was determined that additional flue gas testing was necessary to measure the levels of flue gas constituents that may cause accelerated amine degradation or equipment fouling (constituents such as iron and other metals, NO_2, and particulate matter [fly ash] were measured). The results of this flue gas testing will be used to determine process adjustments that may be necessary to minimize the risk of accelerated amine degradation.

The EERC will play a primary role in designing and executing a laboratory study under this task. In addition to the flue gas testing, laboratory tests will be conducted by the EERC to examine the potential for Coal Creek Station fly ash to cause degradation reactions with the proprietary Mitsubishi Heavy Industries, Ltd. (MHI) amine. The EERC will perform experimentation where the MHI amine is exposed to fly ash from Coal Creek Station over long durations. The exposed amine will be periodically sampled and analyzed for products of degradation in EERC laboratories. The specific experimental design will be developed in concert with Rainbow and other project participants.

Task 3 – Process Design Finalization

The results of the flue gas characterization work completed in Task 2 will be used to finalize the process design, including the potential need for a wet electrostatic precipitator (WESP) for flue gas pretreatment and potential adjustments to the carbon capture plant (CCP) system to effectively control amine degradation. The EERC will play a support role in this task by making recommendations based on the results of the flue gas characterization and amine degradation studies.

A high level of redundancy was included in the CCP design (n+1 approach for key equipment) to maximize reliability. A systematic reliability, availability, maintainability (RAM) study will be completed in Task 3 to determine an optimal level of redundancy in the process design that will minimize costs while ensuring reliable operation of the CCP.

Prior to finalizing the process design, the EERC will support a hazard and operability (HAZOP) analysis to ensure that the revised design will not cause operability problems with Coal Creek Station or the new CCP.

Task 4 – Project Management and Reporting

The EERC will play a primary management and reporting role in the project. The EERC will aid in managing the cost, scope, and schedule of Tasks 1–3 by helping with scheduling regular progress meetings with the team and updating progress relative to the project schedule.

The EERC will work closely with Rainbow to prepare a final report incorporating the results of the FEED study as well as this bridge study. The EERC will also support the development of interim status updates as required by NDIC.

The total estimated cost for this proposed scope of work is $426,302 for a project duration of 6 months. Expenses will be invoiced monthly on a cost-reimbursable basis. A detailed project budget is provided as a table in a format requested by the LRP.

Project Associated Expense	NDIC Share (Cash)	Total Project
Labor	$256,238	$256,238
Travel	$557	$557
Supplies	$10,000	$10,000
Laboratory Fees and Services		
Analytical Research Lab	$5,741	$5,741
Shop and Operations	$5,408	$5,408
Engineering Services Fee	$2,887	$2,887
Document Production Services	$1,489	$1,489
Total Direct Costs	$282,320	$282,320
Facilities & Administration	$143,982	$143,982
Total Cash Requested	$426,302	$426,302

We look forward to the opportunity to continue our collaborations with Rainbow on this project. If you have any questions, please contact me by phone at (701) 777-5114 or by email at jlaumb@undeerc.org.

Sincerely,

DocuSigned by:
Jason Laumb
2898A1DC4D60449...

Jason D. Laumb
Director of Advanced Energy Systems Initiatives

Approved by:

DocuSigned by:
Tami Votava
E7468BBB3DE440E...
for

Charles D. Gorecki, CEO
Energy & Environmental Research Center

JDL/rlo

RAINBOW ENERGY CENTER CCUS FEED CONTINUATION BRIDGE STUDY PROPOSAL

SUBMITTED TO:

RAINBOW ENERGY CENTER

MARCH 29, 2024

BURNS McDONNELL

March 29, 2024
Conway Nelson
Director of Carbon Management
Rainbow Energy
918 E Divide Avenue
Bismark, ND 58504

Re: Rainbow Energy Center CCUS FEED Continuation Bridge Study Proposal – Rev 1

Dear Mr. Nelson,

On behalf of the Burns & McDonnell team and our 14,500+ Employees, we are pleased to present our proposal for the Rainbow Energy Center CCUS FEED Continuation Bridge Study. Our team is uniquely positioned and equipped to support Rainbow Energy Center with these items.

The proposed Scope of Work, Schedule, and Terms and Conditions (Confidential) are attached.

We appreciate being considered and look forward to supporting Rainbow Energy Center in this effort. If you have any questions or need any additional information, please contact Aaron Bennett at 816-894-8852 or me at 816-822-3826.

Sincerely,

Chris Ruckman
Decarbonization Vice President
Burns & McDonnell

9400 Ward Parkway \ Kansas City, MO 64114
O 816-333-9400 \ F 816-333-3690 \ burnsmcd.com

Table of Contents

Scope of Work

Commercial (Confidential)

- *Terms*
- *Rate Sheet*

Scope of Work

The Engineering Scope of Work for the Rainbow Energy Center CCUS FEED Bridge Study has been broken into two (2) task items. Task numbering is intended to align with the task numbering in the overall project Funding Application. Scope for both tasks, costs for the proposed services, and schedule for the deliverables are defined within this Proposal.

Task 3 – Develop a Cause and Effect matrix to support the Study HAZOP for BOP controls philosophy. The only deliverable is a Cause and Effect matrix.

Task 7 – General Project Support

a. Project management and engineering support for weekly meetings and associated preparation and follow-up tasks for four (4) months. We have estimated anywhere from 4-8 hours per week total effort during this 4 month time period.
b. Includes a Scope-of-Work kickoff Teams meeting.

Commercial

Pricing

Burns & McDonnell proposes to perform the herein described Scope of Work on a time and materials basis, pursuant to the Schedule of Hourly Professional Services Billing rates included herein. Burns & McDonnell is committed to supporting REC as required throughout the FEED Bridge Period.

Table 1: Summary of Price per Task

	Estimated Hours	Estimated Costs
Task 3 – Cause & Effect Matrix		$31,700
Task 7 – General Project Support		$34,500
Total		$66,200

Schedule

Burn & McDonnell proposes to perform the proposed Scope of Work during a period of four (4) months beginning at award of the FEED Bridge Study Work.

Task 3 – The cause-and-effect matrix will be provided two (2) months after award.

Task 7 – Work will occur through the duration of the Feed Bridge Study.

Terms & Conditions

Burns & McDonnell proposes to provide the proposed services in accordance with the Terms & Conditions for Professional Services included herein (Confidential).

Assumptions & Clarifications

- Burns & McDonnell has assumed a FEED Bridge Study duration of four (4) months.
- 3D Model updates are not included.
- Travel is not anticipated, and no travel costs are included.

BURNS McDONNELL

CREATE AMAZING.

9400 Ward Parkway
Kansas City, MO 64114
burnsmcd.com

MITSUBISHI HEAVY INDUSTRIES

Engineered Systems Division
20 Greenway Plaza Suite 600 Houston, TX 77046 Tel: (713)-351-6400 Fax: (713)-351-6450

April 01, 2024

Mr. Conway Nelson, P.Eng., PMP
Director of Carbon Management
Rainbow Energy Center LLC
2875 Third Street SW
Underwood, ND 58576

By email to: conway.nelson@rainbowenergycenter.com

RE: Proposal for FEED Bridging Work for Rainbow Energy Center Carbon Capture

Dear Mr. Nelson,

Mitsubishi Heavy Industries America, Inc. (MHIA) is pleased to propose to Rainbow Energy Center (REC) "Bridging Work" following the recently completed Front-End Engineering Design (FEED) study for the REC carbon capture project at Coal Creek Station in Underwood, ND. The FEED was based on certain design assumptions and resulted in a ±15% estimate of the engineering, procurement, and construction (EPC) cost for the carbon capture islands. As we understand from our several recent discussions with you, REC would like to revisit certain of the design assumptions for the FEED and estimate potential impacts to the EPC cost.

MHIA supports REC's interest in continuing to advance the carbon capture project. Therefore, for the Bridging Work we propose two primary tasks, as described below.

<u>Task A – Establish Detailed EPC Cost Baseline</u>
In Task A, MHIA and our construction estimating subcontractor will provide to REC a further breakdown of the current EPC cost estimate for the carbon capture islands. Neither the physical scope nor the assumptions behind the current EPC cost estimate will change, but we will develop a breakdown of the current estimate into the following categories:

1. *Bid Tabulation of Major MHI Procurement Items.* This bid tabulation to include:
    a. Shell & Tube Heat Exchangers
    b. Plate & Frame Heat Exchangers
    c. CO2 Compressor (Procurement Estimate Basis)
    d. CO2 Dehydration Unit
    e. Flue Gas Blowers
    f. Larges Motors and Pumps
2. *Construction Cost Estimate Breakdown*. This breakdown will include:
    a. Labor Wage Build-Up
    b. Permanent Materials Bid Tabulations
    c. Small Tools & Suppliers Summary (Manhour ST&S vs Direct Estimated ST&S)
    d. Breakdown of Main Construction Bill of Quantity by Plant Area (Approximate; by MHIA)
    e. Factored Construction Estimate Breakdown by Plant Area BOQ as Above.

MHIA and our construction estimating subcontractor will review the estimate with REC (2 days in Kansas City or Houston; attendance by MHI Japan staff to be remote/virtual).

Task B – Update Project Design Basis

In Task B, MHIA will work with REC to update the design basis for the carbon capture island based on a series of design option impact studies. We anticipate three primary design option impact studies at this time, as described below. Final study scoping and study execution will be performed collaboratively with REC personnel. For clarity, the design deliverables noted in Task B.1 would be produced only once.

1. ***Flue Gas Data Update***. In this study MHIA and REC will evaluate the impact of changes in the current understanding of Coal Creek Station flue gas composition based on the results of recent stack testing and other information, and will evaluate changes to the project design basis as a result of that new flue gas information. In particular, the potential need for a wet electrostatic precipitator and other impurities counter measures, such as solvent filtration and enhanced reclaiming, will be evaluated. As a part of this study the following design deliverables will be developed by MHIA:
    a. Basic Engineering Design Data (BEDD)
    b. Block Flow Diagram
    c. Process Flow Diagram
    d. Utility Flow Diagram
    e. Emissions and Effluents List
    f. Utility Summary
    g. Process Datasheets for related equipment
    h. Engineering Drawings for related equipment
    i. Plot Plan
    j. Single Line Diagrams
    k. Electrical Load List
    l. Technical Analysis Report for new Flue Gas data

    Note that the physical scope of these design deliverables will remain within the carbon capture inside battery limits (ISBL) as defined in the recent FEED study. Design of outside battery limits systems will remain within scope of others.
2. ***Reliability-Availability-Maintainability (RAM) Update***. In this study MHIA will develop and provide technical data on expected carbon capture component reliability to support a revised RAM analysis for the project to be conducted by REC. During REC's revised RAM analysis MHIA will provide rough-order-of-magnitude advice on potential capital and operating cost impacts of several redundancy changes considered by REC.
3. ***Plot Plan Study***. In this study, following conclusion of other relevant studies above, MHIA will support REC evaluation of an alternative layout of the carbon capture project and will develop an alternative plot plan reflecting a preliminary final project design. Although included in our estimated level of effort for the Bridging Work, if MHIA and REC determine that the Plot Plan Study is not required that work can be omitted.

Each design option impact study performed under Task B would include a summary of the key technical implications of the design change, evaluation of the related impacts on the carbon capture system design and performance using MHI design rules-of-thumb and other methods, and estimation of the potential capital and operating cost impacts of the design and performance changes.

MHIA proposes to conduct this work on a time and materials (T&M) basis over a period of six (6) months starting from execution of an appropriate services agreement between MHIA and REC. MHIA would invoice REC monthly for our work, including a breakdown of hours for MHIA and MHI Japan staff, at the hourly rates used during the FEED study (adjusted for inflation). Invoices from our construction estimating subcontractor plus an administrative mark-up of 15% would passed through to REC as-incurred by MHIA. Travel by MHIA our subcontractor for meetings requested by REC would be invoiced at reasonable and customary rates for business travel in the United States.

MHIA estimates the level of effort for this work to be $455,000. We anticipate that an overall not-to-exceed cap would be included in the contract for this work.

Performer	Task A Estimate	Task B Estimate	Total Estimate
MHIA (Time and non-Construction Expenses)	$114,600	$225,400	$340,000
Construction Estimator (Time and Expenses)	$75,000	$25,000	$100,000
Total with Mark-Up	$200,850	$254,150	$455,000

MHIA understands that following the two tasks above, REC may wish to extend the Bridging Work into a second phase that would include revising the FEED study including cost estimating for the selected final project design, as well as development of associated commercial arrangements and firm pricing for project execution. It is difficult to accurately estimate costs for such a second phase at this time, but prior MHIA experience suggests 9 – 12 months would be required for such an effort, and depending on level of redesign required after the current FEED, cost could range from $1 million to $5 million or more for this work.

If you have any questions about this proposal, please do not hesitate to reach out to me at the number below or contact Hirotaka Tanaka at +1 832-206-9323 / hirotaka.tanaka@mhia.com.

Sincerely,

Mike Fowler
Vice President, Business Development
Engineered Systems Division
Mitsubishi Heavy Industries America, Inc.
mike.fowler@mhia.com
+1 832-207-9499

Attachments: MHIA and Construction Estimating Subcontractor Rate Sheets (Confidential)

Kevin Lauzze
Senior Vice President & Project Director
(312) 269-2015
kevin.c.lauzze@sargentlundy.com

April 3, 2024 – Revision 1

Coal Creek Carbon Capture and Storage Project

Bridge Study (Post Feed) Owner's Engineering Services

Mr. Conway Nelson:

Sargent & Lundy (S&L) is pleased to provide this proposal for Bridge Study Services to support Rainbow Energy Center (REC) post combustion carbon capture plant at the Coal Creek Station located near Underwood North Dakota.

S&L has been involved in numerous first-of-a-kind projects and concepts throughout our 133-year history. Our identity is rooted in a culture of innovation and quality. We have been at the forefront of new design throughout this time. Understanding the engineering required for these new applications is necessary for success. S&L is uniquely qualified to support your technology development based on the following:

- **Industry Leader in CCS** – S&L is an industry leader CCUS and have worked on all phases of CCUS projects including feasibility, Pre-FEL, and FEL studies, government funding applications, pilot-skid design, and detailed design/project implementation. S&L has completed 116 projects with an additional 30 active projects currently on-going, for 85 clients involving 30+ technologies since 2007. This includes projects involving DAC technologies across various stages of development.

- **Strong Technology Experience** – While S&L prides itself on being technology agnostic, we believe strong relationships with technology suppliers is essential to our work. However, S&L has a history of supporting technology suppliers in projects that have advanced their overall technology development including developing pilot-scale projects, supporting scale-up efforts, and developing full-scale FEED studies. Over repeated projects and inquiries with technology suppliers, S&L seeks to develop collaborative working relationships with technology suppliers.

- **Team Qualifications** – S&L has a large number of employees who are actively working on CCS projects, including similar projects in North Dakota. These individuals range in discipline and expertise, and include process/environmental, mechanical, structural, civil, electrical, I&C, designers, construction management, cost estimating, and permitting. As a full-service engineering firm S&L has an array of subject matter experts to rely on for expertise across a wide range of topics.

On behalf of S&L's entire organization, I sincerely appreciate the opportunity to provide this proposal and look forward to providing the high-quality services to you that all of S&L's customers have come to expect. If you have any questions or need additional information regarding this submittal, please do not hesitate to call me at 312 269-2105.

Yours very truly,

Kevin Lauzze

Kevin Lauzze
Senior Vice President & Project Director

Electronic Distribution Only

Rainbow Energy Center

Coal Creek Station

Carbon Capture and Storage Project

Owner's Engineer - CCS

Proposal

April 3, 2024

Revision 1

55 East Monroe Street
Chicago, IL 60603-5780 USA
312-269-2000
www.sargentlundy.com

Sargent & Lundy

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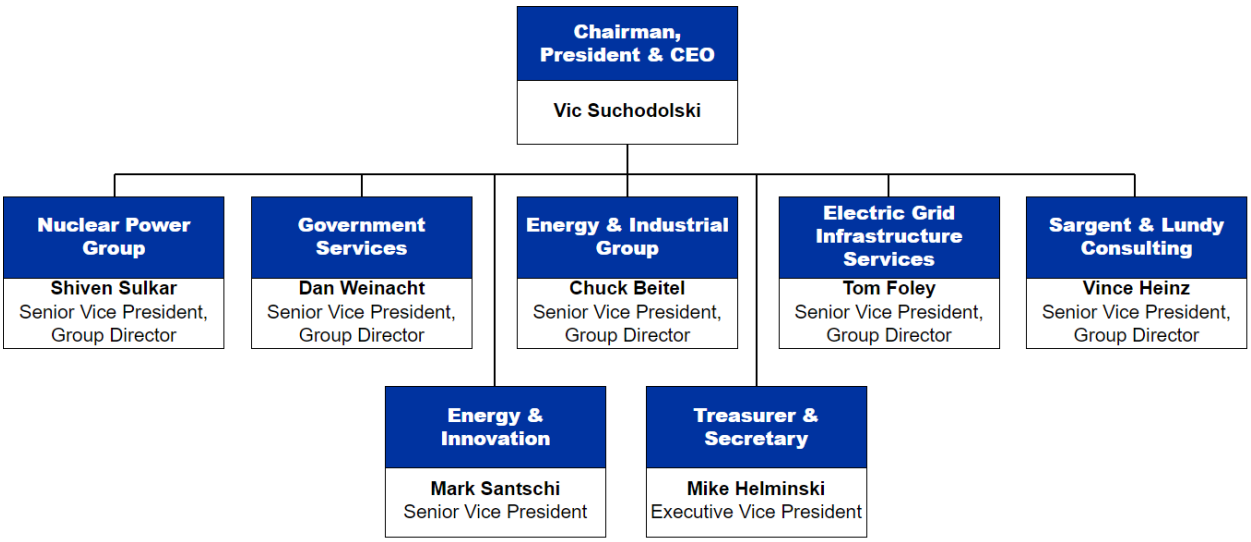
1. S&L COMPANY OVERVIEW

1.1. ORGANIZATION AND STRUCTURE

S&L's overall company business unit organization is structured to systematically promote the exchange of knowledge and experience throughout the firm. Figure 1-1 presents a high-level view of our overall organization. This organizational approach enables our engineers, designers, and technical specialists to keep current in their respective areas of expertise and to provide value-added services and innovative solutions for every assignment undertaken. S&L is 100% owned by the members of the company, and all of the S&L officers are actively and solely engaged in the management and day-to-day operation of the company.

Figure 1-1. S&L Overall Organization



We are not affiliated with any equipment suppliers, constructors, or plant operators. This independence enables S&L to provide our services to our clients free of bias, based solely on sound engineering principles and focused on the good of our customers. Our more than 130 years of continuous experience executing power projects is a testament to our ability to put our clients' interests first, as well as being a firm foundation for our understanding of how plant constructability, equipment and system performance and efficiencies, materials, emissions control technologies, and designs influence long-term operations and maintenance.

Chairman, President and Chief Executive Officer, Vic Suchodolski, provides overall direction to company policy. He is responsible for the long-range planning, administration, and management of our business objectives. This includes guiding and directing marketing and business development efforts to ensure that the firm's current activities support its overall objectives.

Sargent & Lundy's business group leaders and highlights of the respective group's primary areas of focus are briefly described below. Each business group is directed and managed by personnel who have demonstrated leadership, project management, and technical abilities, while consistently satisfying client needs. This dynamic organizational arrangement provides the flexibility to readily allocate and transition key personnel in divisions and groups, as needed.

S&L's business group leaders and highlights of the respective group's primary areas of focus are briefly described below. Each business group is directed and managed by personnel who have demonstrated leadership, project management, and technical abilities, while consistently satisfying client needs. This dynamic organizational arrangement provides the flexibility to readily allocate and transition key personnel in divisions and groups, as needed.

The work proposed here will be completed in our Energy & Industrial Group.

1.1.1. Technical Support Divisions

S&L's business groups are supported by various technical divisions, some organized separately within the business group dedicated to facility development and operating service support. This approach helps to align staff skills to the clients being served by the respective business groups.

Table 1-1. Technical Support

Division/Section	Function
Mechanical Engineering and Design	Mechanical engineering analysis and design for facility mechanical systems.
Electrical and Controls Engineering and Design	Electrical project engineering activities, including electrical design and analysis activities.
Instrumentation & Controls Engineering	Engineering and design of instrumentation control and systems for major steam-electric generating plants.
Structural / Civil / Architectural / Geotechnical Engineering and Design	Structural, civil, architectural, and geotechnical engineering services support for fossil or nuclear operating units or for the development new units.
Piping Analysis and Mechanical Design	Engineering, analysis, and design services associated with piping, piping supports, and related mechanical engineering interface.
Material Handling	Engineering and design for delivery, unloading, storage, reclaiming and conveying of solid fuels and bulk chemicals; and ash handling collection and transport systems.
Plant Performance	Heat and mass balances, cycle optimization, and plant and equipment performance testing.
Plant and Building Services	Engineering and design for fire protection, HVAC, plumbing and architectural services.

Division/Section	Function
Environmental, Permitting, and Regulatory Services	Engineering analysis for air quality control and water quality control technologies, as well as environmental assessments, compliance planning, licensing, and permitting services.
Electrical Analytical	Generation and transmission systems planning studies, plant electrical system design studies, and other analytical work related to the evaluation of electrical system design, performance, and operation.
Materials Engineering	Recommends appropriate materials of construction to suit the service environment and provides quality control surveillance and testing services related to equipment and materials suppliers.
Construction Management	Manages construction activities for new units and retrofit projects, including startup and testing programs.
Transmission and Distribution	Engineering and design services to support the development, maintenance, and upgrading of transmission lines and substations.
O&M Support Services	Prepares operating procedures and training and analyzes overall unit performance improvements.
Procurement	Supports projects with equipment and materials procurement services, including specification preparation, supplier negotiation, expediting and similar services.
Planning and Scheduling	Develops and maintains project plans and schedules.
Cost Information	Prepares cost estimates of equipment, labor, and materials to support projects.

1.2. RESOURCE AVAILABILITY AND LOCATIONS

S&L was formed based on the technical strengths of its founders, with roots dating all the way back to Thomas Edison. Since then, generations of our engineers and technical experts have been leaders in shaping the power and energy industry in the United States and around the world. Our industry leadership continues to this day and includes the following contributions:

- More than 330 members on industry code committees and industry compliance organizations, e.g., ASME, ACI, AISC, ANS, ASTM, IEEE, ISA, and NFPA, among others.
- Leadership as Chair, Vice Chair, or Officer on numerous of the above code committees. For example, a Sargent & Lundy staff member was appointed senior vice president, an officer position, of the ASME Standards and Certification Sector by the ASME Board of Governors. The position of senior vice president of this sector chairs the Council on Standards & Certification. It governs the development and maintenance of all ASME codes, standards, and guides as well as ASME certification activities.
- Continuous investment and leadership participation in global industry conferences and seminars.
- Annual engagements with the Electric Power Research Institute (EPRI) on a paid basis to facilitate the development of market studies, representative costs, and industry trends.
- Industry recognition as a leader in state-of-the-art technical training.

S&L's interdisciplinary professional workforce continually diversifies to evolve in parallel with the changing needs of the global power, energy, and oil & gas industries. Our global office infrastructure and resources

enable us to staff projects quickly and with the appropriate mix of expertise and experience for all assignments.

As noted above, S&L serves the worldwide energy and industrial markets from our headquarters in Chicago, Illinois, from satellite offices across the United States, as well as from our international and joint venture offices in Canada, India, Kingdom of Saudi Arabia, South Korea, and the United Arab Emirates.

2. S&L APPROACH

2.1. PROJECT MANAGEMENT AND CONTROLS

Sargent & Lundy's business philosophy includes a foundation built on strong project management expertise, processes, and tools for effective project controls. Our project teams are led by Project Managers who have extensive experience managing projects of varying degrees of complexity. The technical and management skills of our Project Managers are among the principal reasons that S&L project teams consistently achieve high quality deliverables, budgetary conformance, and schedule adherence. Fundamental to our program is our alignment with the goals and objectives of the Project Management Institute (PMI) and our utilization of their Project Management Body of Knowledge (PMBOK®) which we use as part of our project management training.

S&L manages project schedules and costs using tools and reports tailored to the scope, size, complexity, functional needs and/or other special requirements that have been identified for the project. The project controls program implemented by S&L ensures that the needs of external project stakeholder are considered and set up to support am appropriate progress update and reporting frequency. This reporting cadence ensures that required data is delivered to the appropriate stakeholders when needed.

2.2. QUALITY

Sargent & Lundy has always been committed to providing quality engineering and consulting services. In 1995, we took the proactive step of establishing a quality management system (QMS based on ISO 9001 requirements (the figure below shows our current ISO certificate). The foundation of the QMS is the SL-QAP, Quality Policy, and Program Plan, which includes a set of implementing standard operating procedures or SOPs. Adherence to SL-QAP and SOPs is mandatory for all work companywide.

The Sargent & Lundy QUALITY POLICY, as defined in SL-QAP, is to:
Consistently provide quality work that meets or exceeds customer requirements
Enable our employees to achieve excellence in the industry
Continually improve the effectiveness of the quality management system

For nuclear safety-related work, compliance with our nuclear quality assurance (QA) program, SL-TR-1A, is also required. Sargent & Lundy's Nuclear Quality Assurance Program is maintained as a Topical Report as approved by the U.S. Nuclear Regulatory Commission.

Sargent & Lundy has an established Quality Council that focuses on our quality system and on quality improvement activities. The Quality Council, which has been meeting regularly since 1997, serves as a Board of Directors for quality matters. The Quality Council highlights issues that need top management attention, facilitates knowledge sharing across business groups, monitors selected improvement activities

with companywide impact, and fulfills procedurally/programmatically required roles, such as annual management reviews and trending of our Performance Improvement Process, as described below.

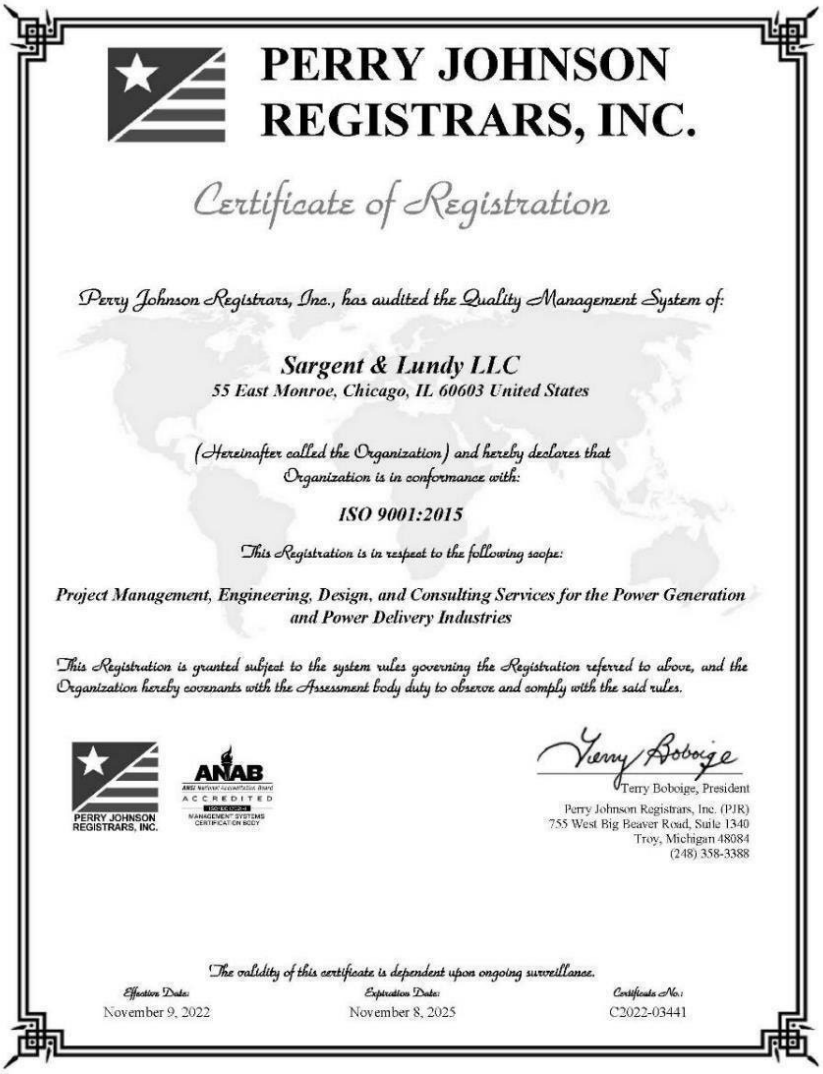
The Quality Council is led by our Chairman and CEO, along with the Director of Quality and senior personnel drawn from all of our functional and business groups.

Our approach toward quality is comprehensive and systematic. Certain elements of Sargent & Lundy's QMS are transparent to our customers, but integral to our approach to their work. These elements address sustained technical excellence through our System of Processes, knowledge sharing via our Communities of Practice (COPs), continual improvement through our Performance Improvement Process, and a defined system of checks and balances, including rigorous oversight through companywide audits.

Additionally, our processes call for independent and interdisciplinary design reviews of critical systems. Unbiased subject-matter specialists, i.e., not an assigned team member, critique the design work of the dedicated project team members. This is done by scrutinizing and challenging assumptions, technical judgment, and conclusions reached during the engineering and design phases. This ensures that our expertise and experience are leveraged on all projects and built into every project schedule. The results are also documented, typically via meeting notes, with recommended action items clearly identified.

All Sargent & Lundy projects and processes are subject to audit by a certified Lead Auditor. Audits typically include technical specialists for a more robust evaluation that goes beyond compliance with procedural requirements.

Our QMS has regularly been certified as meeting the requirements of ISO 9001:2015 by Perry Johnson Registrars, an internationally recognized ISO 9001 registrar. The most recent such audit reconfirmed that the execution of our QMS continues to meet or exceed the requirements of the ISO standard.



PERRY JOHNSON REGISTRARS, INC.

Certificate of Registration

Perry Johnson Registrars, Inc., has audited the Quality Management System of:

Sargent & Lundy LLC
55 East Monroe, Chicago, IL 60603 United States

(Hereinafter called the Organization) and hereby declares that Organization is in conformance with:

ISO 9001:2015

This Registration is in respect to the following scope:

Project Management, Engineering, Design, and Consulting Services for the Power Generation and Power Delivery Industries

This Registration is granted subject to the system rules governing the Registration referred to above, and the Organization hereby covenants with the Assessment body duty to observe and comply with the said rules.

PERRY JOHNSON REGISTRARS, INC.

ANAB ACCREDITED MANAGEMENT SYSTEMS CERTIFICATION BODY

Terry Boboige, President
Perry Johnson Registrars, Inc. (PJR)
755 West Big Beaver Road, Suite 1340
Troy, Michigan 48084
(248) 358-3388

The validity of this certificate is dependent upon ongoing surveillance.

Effective Date:	Expiration Date:	Certificate No.:
November 9, 2022	November 8, 2025	C2022-03441

Sargent & Lundy's QMS promotes a customer focus to our work activities. Our project directors are specifically charged with establishing and maintaining effective working relationships between their respective clients and Sargent & Lundy. To that end, we encourage the active involvement and input of our clients over the life of the project. For example, our procedures emphasize the importance of sharing example deliverables to end-users, including engineering, systems engineering, installers, operations, and maintenance personnel. This proactive approach enables all stakeholders to have clear expectations early on as to the quality of the deliverables provided at the conclusion of a project. Our emphasis on working collaboratively with the client during project planning, execution, and close-out, has proven effective at identifying and resolving problems quickly.

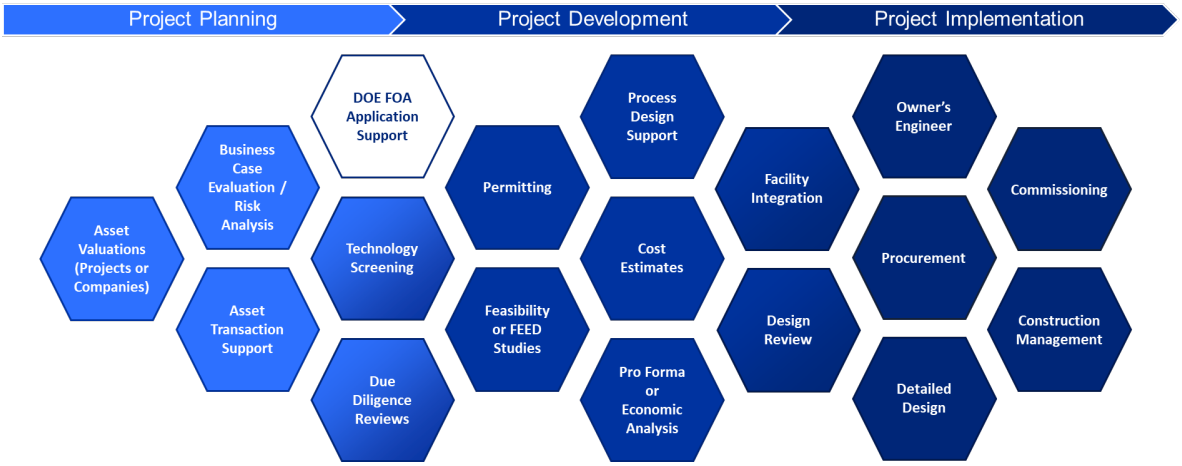
Quality is embedded in S&L's approach to work and is synonymous with the technical excellence we apply to our clients' projects and the high value we place on meeting and exceeding their expectations.

3. RELEVANT EXPERIENCE

Sargent & Lundy is one of the longest-standing and most experienced full-service architect engineering firms in the world. Founded in 1891, the firm is a global leader in power and energy with expertise in grid modernization, renewable energy, energy storage, nuclear power, and fossil-fueled power plants. S&L delivers comprehensive project services—from consulting, planning and design, permitting, and implementation to construction management, commissioning, and operations/maintenance—with an emphasis on quality and safety. The firm serves public- and private-sector clients in power and energy, oil & gas, government, industrial, mining, and other heavy industries.

S&L offers various scopes and services throughout the range of project development, as shown in Figure 3-1, including, but not limited to, technology screenings, due diligence support, business case development, feasibility studies, process oversight, detailed design, and Owner's Engineering reviews.

Figure 3-1. Sargent & Lundy Capabilities



S&L prides itself on being technology agnostic and we approach every project from a standpoint of identifying the best technology or supplier for the specific application. While we remain technology agnostic, we have worked with a wide range of technology suppliers within the CCUS space and maintain on-going discussions and relationships with them to ensure we remain current on the latest industry offerings, experience, costs, and performance.

In addition to S&L's experience with project development phases ranging from feasibility through FEED, S&L has also had significant experience working with technology developers scaling up and designing pilot skids of their technologies. As such, S&L is well aware of the potential scope, schedule, and cost risks associated with these types of projects.

S&L has been an industry leader since our founding and has significant first-of-a-kind experience and is familiar with the potential scope, schedule, cost, and performance risks that may arise in these types of new application projects.

3.1. SIMILAR EXPERIENCE

S&L is currently supporting multiple FEED studies in a multitude of roles including Owner's Engineer, OSBL/integration engineer, and supporting the technology vendors in the ISBL design. Specific example projects are listed below and our full experience list is included as Exhibit 1.

Project Tundra – Owner's Engineer

S&L has been serving as the OE for Project Tundra since 2022. Our role has included being a 'typical' OE in which S&L managed weekly meetings, maintained Action Item lists, coordinated key review meetings with the owner, the technology supplier, and the EPC. We also served as the document review coordinator which entailed managing the drawing review process, including consolidation of all comments (including those from the Owner and other stakeholders). S&L also oversaw multiple on-site testing campaigns, including flue gas testing and WESP testing. S&L has done a number of FEED level design during this time as well, including steam extraction, water treatment, and wastewater disposal. Finally, S&L is currently serving as the FEED study engineer for the CO_2 pipeline and monitoring and controls system.

Gerald Gentleman Station CCS Project – Owner's Engineer

S&L is currently serving as the OE for a carbon capture FEED at Gerald Gentleman Station utilizing Baker Hughes Chilled Ammonia process. The scope is similar to the scope description in Project Tundra with S&L performing more BOP studies such as a steam sourcing study and cooling study. This project kicked off in Q3 2023 and is expected to be completed by Q4 2024.

Heidelberg Materials CCS FEED – FEED Engineer

S&L is currently working with MHI on the Heidelberg Materials Mitchell Cement Plant CCS FEED study. S&L's role is full OSBL and integration engineer and we are serving as the OE for the MHI process deliverables. Kiewit is also working on this project doing constructability reviews and cost estimating.

Prairie State CCS FEED – OSBL Conceptual Design and Owner's Engineer

S&L served as the preliminary FEED engineer and eventually the Owner's Engineer for the full FEED. This FEED was done on the 820 MW Unit 2 and included MHI as the technology provider and Kiewit as the EPC. S&L's scope included the initial design basis document, all of the up front studies (steam and electric sourcing, cooling system design, and water treatment studies). As we transitioned to the OE role, we

participated in weekly model reviews, GA and P&ID reviews, the HAZOP review, and served as the document review management system.

Project Diamond Vault – Owner's Engineer and FEED Study Conceptual Design

S&L has been serving as the Owner's Engineer and FEED Study Conceptual Design Engineer for a 635 MW solid fuel unit since 2021. S&L's support began with a Techno-Economic Assessment of the project before a multi-phase DOE-funded FEED study was initiated in 2022. In the first phase of the FEED study, S&L executed parallel Feasibility Studies with two amine carbon capture technology suppliers and provided the preliminary OSBL design to provide a comparison of capabilities and total estimated project costs. In the second phase, a single technology supplier was selected for the Pre-FEED study. S&L sub-contracted the technology supplier to provide their design and cost information and S&L was responsible for review of all their submittals. S&L completed the OSBL Pre-FEED design including engineering studies for steam supply, electrical supply, cooling water supply, wastewater treatment, emissions estimates, process hazards, and constructability review. S&L also provided a preliminary design package and cost estimate for the CO2 pipeline to the sequestration wells. The Pre-FEED phase was completed with Class 3 cost estimate and a summary report to the DOE. For the final phase, S&L will be serving as the coordinator of the FEED study which will be executed with the technology supplier to refine their design and an EPC contractor that will result in a Class 2 cost estimate and project execution plan.

3.2. CCUS EXPERIENCE

S&L has extensive experience conducting technical evaluations for CO_2 capture projects over the last decade, including feasibility, FEL, Pre-FEED, and FEED studies for clients which included preliminary system engineering, project layout, preliminary design, and cost estimates. Among the most notable FEED studies conducted by S&L was the Petra Nova Carbon Capture Project, which was awarded the Best Project of Merit award from Engineering News Record (ENR). S&L's work on the Petra Nova project included multiple FEED studies, Owner's Engineer services during project implementation, and detailed design of the 240 MW equivalent (MWe) slipstream carbon capture unit onto NRG's W.A. Parish Unit 8.

Figure 3-2. CCUS Experience Overview

Of the 146 projects that S&L has completed or is currently supporting in the CCS space, this includes 66 feasibility studies, 6 Pre-FEED studies, and 26 FEED studies. For all of these projects/studies S&L was the CCS system integrator, providing balance of plant engineering and integration into the existing facilities. For many of these projects, S&L also provided inside the boundary limit (ISBL) scope for the technology vendor. Our remaining 48 projects, have included pilot skid development and design, design of CO_2 pipelines, detailed design support, and miscellaneous project development support including leading FOA applications. Our CCS Experience List is provided in Exhibit 1.

With respect to CCS, S&L has significant experience with the capture technologies and integration of those technologies into new and existing facilities. As a project integrator, S&L works with technology vendors to provide a complete and integrated system design. In recent years our role on those projects has moved beyond balance of plant and integration engineering, and for many of our projects we have worked closely to review and support process engineering and provide design and engineering within the boundary limits of the process or technology island.

S&L also has experience with the compression and transportation portion of the CCS process. Initial compression typically occurs on-site as part of the capture process and has been a part of all of the capture projects that S&L has completed. In addition, S&L has experience with natural gas compressor stations and pipeline design as part of our Oil and Gas work. Building on this experience, S&L just completed detailed design of the Dakota Carbon Pipeline, which began construction in October 2021 and is scheduled to begin operation in the second half of 2023.

4. PROJECT OVERVIEW

Rainbow Energy Center (REC) is planning to install a post combustion carbon capture plant at the Coal Creek Station located near Underwood North Dakota. Once operational, this facility will capture and sequester approximately 95% or 8.5 million tonnes of the CO_2 that is emitted by the 1151 MW coal fired power station.

REC is currently in the FEED study stage of development which is planned to be complete by March 31, 2024. The project is currently divided into ISBL and OSBL areas. The ISBL portion of the FEED is being supported by MHI and Kiewit, and the OSBL portion of the FFED by Burns & McDonnell.

REC has issued an RFP for Owner's Engineering Services to assist with the completion of a Bridge Study, to finalize the scope of work, cost, and schedule.

5. SCOPE OF WORK

5.1. GENERAL

The Bridge Study scope will include reviewing the FEED Study deliverables, including: recent process design decisions made, FEED deliverables (such as P&IDs and general arrangements), and the FEED cost estimate. Additional scope includes identifying optimization opportunities, participating in Bridge HAZOP and RAM, supporting REC in selecting an EPC BOP Contractor, and preparing specifications for long lead items.

At the start of the Bridge study, the S&L project team will meet with REC to review and discuss the available documents and deliverables developed for the project to date. The goal of this review is to algin our understanding of the project status, current design, and REC's goals for the project. P&IDs, General Arrangements, project design criteria, projects lists, and quantities/Bills of Materials are items that are generally developed during FEED and will be useful in reviewing the FEED cost estimate.

REC has provided a list of documents that require detailed structural, civil, electrical and I&C review. Of the 253 capture island and 118 BOP documents listed in the RFP. These documents will be reviewed, taking into account the Project Design criteria including required codes and project specific requirements, in addition to reviewing these against acceptable industry design practice.

5.2. PROCESS DESIGN CHANGES/FINALIZATION

REC expects that there will be process design changes to the Carbon Capture process, resulting from flue gas characterization activities completed last month. One of the possible changes being the addition of a wet electrostatic precipitator to the equipment line-up. S&L has worked on several projects where MHI has been the system designer and is aware of the system changes that have typically been incorporated due to the specific REC flue gas conditions. S&L knows that in an effort to control project costs, it is imperative to review any changes proposed with the system designer to understand the drivers while prioritizing the goal to minimize cost as well as the effect on overall plant arrangement and system pressure drop.

5.3. STUDIES

As Owners Engineer S&L would participate in a RAM study (to be led by others), that will be used to finalize the equipment line-up, including equipment redundancy. We understand that the FEED system design incudes a high level of redundancy (an N+1 design). Based on our experience, this level of redundancy can add significant cost to a project and is not recommended. A high level review of equipment availability can be achieved, with a less conservative level of redundancy, and S&L will use our experience on past FEED studies to drive towards the most cost effective system design that still provides a high degree of availability.

S&L will participate in a Bridge Study HAZOP review to analyze the impact of system changes made during the Bridge Study. It is assumed that like the RAM study, this will be led by others. Please note that S&L does have the capability to facilitate a HAZOP review with a non-project team member. Facilitation would include pre-meeting preparation as well as a post meeting report including recommendations.

5.4. DESIGN REVIEW

S&L will review the FEED design to ensure that it meets the existing project design requirements as well as industry standards. As part of the design review, we will also identify optimization opportunities that may be viable. It is understood that most of the mechanical design has gone through a detailed review and those deliverables will only require a high level review. The remaining deliverables, primarily structural and electrical, listed in Exhibit A of the RFP will require a more detailed review.

5.5. COST ESTIMATE REVIEW

S&L will review the complete (ISBL and OSBL)Class 3 FEED cost estimates, focusing on opportunities to identify potential cost savings by optimizing system design, including items such as additional modularization or other items that may reduce construction or operating costs.

The RFP mentioned that the Cost Review may include a parallel estimate. The cost of a parallel estimate is currently excluded from this proposal as this would depend on REC's desired end goal. This could be a large effort depending on the scope and goal of the parallel estimate.

5.6. CONSTRUCTABILITY REVIEW

S&L will review the existing constructability review and will highlight areas where we believe the layout or execution of the project could be improved.

5.7. PROCUREMENT SUPPORT

For the balance of plant activities, REC intends to go out for competitive bid to select an EPC Partner to engineer, procure, and construct the balance of plant facilities including OSBL scope such as ductwork, dampers, steam supply, closed cooling system, electrical supply, and control integration.

As Owner's Engineer S&L will assist REC in all phases of the OSBL EPC Contractor selection including bid package preparation and bid evaluations. This will be done by reviewing the existing Division of Responsibility and ensuring that the scope split between the ISBL and OSBL is sensible. In addition, S&L has found during many of our recent FEED studies that the scope split should include a third "BOP area" which includes any design work that is done inside the existing plant. This work often comes with a high risk premium from the OSBL EPC entity and is typically work the plant may prefer contractors more familiar with their facility to perform. This can be further discussed with REC after award.

In addition to the EPC procurement support, S&L will review the current long lead equipment study/list. We will work with REC to develop specifications for any items that need to be procured outside of the EPC and based on our recent experience we would expect this list to include major electrical equipment and potentially the CO_2 compressor.

5.8. GENERAL SUPPORT

As Owner's Engineer S&L will support REC with overall project execution and schedule planning. This includes running weekly meetings, maintaining a weekly action item list, and engaging our project execution group (including our project controls and construction personnel) to review the schedules and execution plans put in place by the current FEED study team.

6. PROJECT EXECUTION

6.1. PROJECT MANAGEMENT

6.1.1. Project Management Plan

A project work plan will be prepared to support the Bridge Study execution of the services provided by S&L. The plan will cover project and engineering management, project communications and interface, project organization, project controls management, and document control.

6.1.2. Project Communication

S&L will prepare a project correspondence and communication plan as part of the project management plan. The communication plan will identify the correspondence and distribution protocol between the project organizations. The plan will also establish correspondence numbering procedures, methods for transmitting documents, and documentation requirements for meeting notes and action items.

A decision log will be maintained throughout the project to document key assumptions, decision points, and items requiring follow-up in future project phases.

6.1.3. Document Management and Sharing

S&L can utilize the existing document collaboration site if desired, or we can utilize our internal Egnyte software system for this project if desired at no additional cost to REC.

6.2. BRIDGE STUDY PROJECT SCHEDULE

Based on discussion with REC, it is expected the bridge study will be broken into two phases. Phase 1 will include initial review of the open book cost estimate, flue gas testing and characterization, and process design finalization including and process design modifications required by the flue gas testing. Phase 2 of the bridging study will include updating and reviewing FEED documents, reviewing the updated cost estimates, procurement planning, and creating the EPC specifications. Phase 1 is expected to occur between April and October 2024 and Phase 2 is expected to occur from October 2024 to August 2025.

6.3. PROJECT TEAM

S&L strives to maintain long-term relationships with our clients. To that end, S&L's proven staffing philosophy is to assign personnel to a project team for the life of the project. This commitment ensures both continuity and efficiency because of the team members' in-depth knowledge of the project's progress and of the other team members' activities. All projects S&L undertakes are led by a designated project director

and project manager, with support provided by a core team of lead personnel.. Nearly all team members included on this org chart have been part of the Project Tundra OE team.

Additional staff will be assigned to support this project, as needed. S&L's project team commitment extends to dedicating specific individuals in support areas as well, including subject matter experts. Our multi-disciplined project team staffing approach will ensure that S&L has the appropriate personnel to provide high-quality, timely services.

7. COMMERCIAL INFORMATION

7.1. BRIDGE STUDY PRICING

S&L typically estimates OE work on a level of effort basis. The table below identifies the key positions and the expected workload of each position. The work will be done on a T&M basis, with mutually agreeable rates, so REC will only be charged for the time S&L works on the project. Based on the table below, our total estimate to support this work is $1,090,000. This includes 15 domestic person trips, which may include Coal Creek Station, the EERC, MHI or EPC offices. This cost assumes no trips to Japan are necessary.

Phase 1 is estimated to cost $405,000 while Phase 2 is estimated to cost $685,000

	Phase 1		Phase 2 (thru Aug 15 2025)			
Position	**Q2 2024**	**Q3 2024**	**Q4 2024**	**Q1 2025**	**Q2 2025**	**Q3 2025**
PD	5%	5%	5%	5%	5%	5%
PM	40%	35%	25%	35%	35%	15%
Process/Env Lead	35%	35%	15%	25%	15%	5%
Task Coordinator	30%	30%	15%	30%	30%	15%
Mech Eng	15%	15%	10%	15%	15%	5%
Struct Eng	20%	20%	10%	20%	15%	5%
Elec Eng	20%	20%	10%	20%	15%	5%
I&C Eng	10%	10%	5%	10%	10%	5%
Cost Estimating	10%	15%	5%	10%	15%	5%
Constructability	5%	5%	10%	15%	5%	5%
Misc SMEs	20%	20%	10%	20%	10%	5%

7.2. CONTRACT TERMS

A consulting agreement is currently being negotiated, and this work will be performed under that final agreement.

INTERNATIONAL CCS KNOWLEDGE CENTRE

April 4, 2024

Mr. Conway Nelson
Director of Carbon Management
Rainbow Energy Center
918 East Divide Avenue
Bismarck, ND 58504

Dear Mr. Nelson:

Subject: International CCS Knowledge Centre Proposal for Bridge Study at Coal Creek Station

On behalf of the International CCS Knowledge Centre (the "Knowledge Centre"), we are pleased to continue our support to Rainbow Energy Centre ("REC") in its Bridge Study CCS Project for the North Dakota Industrial Commission (NDIC) Lignite Research Program (LRP). The Knowledge Centre has worked with REC through its front-end engineering design (FEED) study that has led to this proposed effort. The Knowledge Centre will use this experience to continue our support of the proposed project, of which a proposed outline follows.

Bridge Study Phase 1 Tasks

Task 1 – Cost Estimate Review and Validation

Review the carbon capture plant (CCP) and the balance of plant (BOP) capital and operating cost estimates.

Task 2 – Flue Gas Characterization

Review procedures for flue gas stack testing and lab studies. Flue gas constituents (i.e. metals, NO_2, particulate matter) will accelerate amine degradation and/or equipment fouling. It is very important that the testing and studies are performed accurately to ensure correct data is attained.

Task 3 – Process Design Finalization

Expert analysis of the results of the flue gas characterization providing guidance to REC of required process modifications. The Knowledge Centre will also support:

1) the review of CCP and BOP documents
2) optimization of thermal integration from Coal Creek Station

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306.565.5669
198 - 10 Research Drive
Regina, SK S4S 7J7 Canada

3) review of the reliability, availability, maintainability (RAM) study completed by a third party to determine the correct balance of minimizing equipment costs while ensuring reliable operation of the CCP
4) analysis of the benefits and cost impact of a Wet Electrostatic Precipitator (WESP) to reduce flue gas constituents thereby reducing the risk of amine degradation
5) a hazard and operability (HAZOP) analysis of the CCP and BOP to ensure that the overall design will not cause operability problems to Coal Creek Station nor the CCP

Bridge Study Phase 2 Tasks

Task 4 – Cost Estimate Finalization

Review the updated capital and operating cost estimates for both the CCP and BOP.

Task 5 – Project Execution Preparation

Review the engineering, procurement, and supply (EPC) contracts, including separate major supply contracts.

Task 6 – Permitting Strategy Development

Review the necessary permits required to construct and operate the CCP. Examples of these permits include construction, air emissions, waste disposal, and water usage.

Task 7 – Project Management and Reporting

Review the cost, scope, and schedule of Tasks 4-6 (Knowledge Centre tasks only) by scheduling regular meetings and updating REC of both progress and cost.

Bridge Study Estimated Cost

The total estimated cost for both Phase 1 and Phase 2 scopes of work is **$403,014** USD. The table below illustrates the estimated cost of each scope of work and schedule.

	Estimated Cost USD	Completion Date
Bridge Study Phase 1	$258,811	November 30th, 2024
Bridge Study Phase 2	$144,203	October 31st, 2025

We look forward to the opportunity to continue our collaboration with REC on this project. If you have any questions or need any additional information, please do not hesitate to contact me. I may be reached at ranwar@ccsknowledge.com.

Sincerely,

Rafay Anwar
Vice President, Project Development & Technical Services

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Regina, SK S4S 7J7 Canada

APPENDIX B

LETTERS OF COMMITMENT

RAINBOW
ENERGY CENTER

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

April 1, 2024

Mr. Reice Haase
Deputy Executive Director
ATTN: Lignite Research Program
North Dakota Industrial Commission
600 East Boulevard Avenue, State Capitol, 14th Floor
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: Rainbow Energy Center Proposal No. REC001 Entitled "Bridge Study for CCS at Coal Creek Station"

Thank you for the opportunity to present the grant proposal for the Bridge Study for CCS at Coal Creek Station. Your support of this study is critical to the final steps prior to construction for post-combustion capture and storage at Coal Creek Station.

Rainbow Energy Center remains focused on providing baseload energy from Coal Creek Station with carbon capture and incremental generation from renewables to fully utilize the capacity of Nexus Line, our high-voltage direct current (HVDC) transmission system. The execution and implementation of carbon capture and storage is a critical part of our vision to extend the longevity of Coal Creek Station and is an important step toward Governor Doug Burgum's goal for the state to reach carbon neutrality by 2030.

As North Dakota's largest power plant, Coal Creek Station supports over 700 careers at the plant, Falkirk Mine, and other supporting industries. Implementing new technologies preserves existing careers, as well as creates new careers, and serves as an economic backbone for the area communities, county, and state. In support of Coal Creek Station and these communities, Rainbow Energy Center is committing a total of $2,500,000 in cash and in-kind funding to this proposed Bridge Study project. Rainbow Energy Center verifies that this committed funding is not being shown as cost share to any other state programs.

We believe CCS at Coal Creek Station meets the Lignite Research Program's mission to deploy large-scale commercial technologies that produce reliable, dispatchable, low-carbon electricity while also sustaining jobs, tax revenue, and the economic vitality of the state. Rainbow Energy Center is committed to delivering a carbon capture project that serves as a showcase for future projects around the world. Thank you for your consideration of support for this application.

Kind regards,

Jeffrey Jonson
President,
Rainbow Energy Center

EERC
Energy & Environmental Research Center
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www.undeerc.org

March 26, 2024

Mr. Conway Nelson
Rainbow Energy Center
918 East Divide Avenue
Bismark, ND 58501

Dear Mr. Nelson:

Subject: Letter of Commitment for Rainbow Energy Center Proposal Entitled "Bridge Study for CCS at Coal Creek Station"

The Energy & Environmental Research Center (EERC) would like to express our support and commitment for the Bridge Study for CCS at Coal Creek Station project for which a proposal is being submitted to the North Dakota Industrial Commission.

The EERC is recognized as one of the world's leading developers of cleaner, more efficient energy to power the world and environmental technologies to protect and clean our air, water, and soil. We have 65 years of energy research experience, multidisciplinary staff, and state-of-the-art facilities and equipment.

The EERC is committed to making this project a success and our participation in the Coal Creek front-end engineering and design study as well as the redundancy study provides us with project-specific knowledge that we will use to support the proposed bridge study.

We appreciate being considered for this project and look forward to participating with Coal Creek staff and the rest of the project team. If you have any questions or need any additional information, please contact me by phone at (701) 777-5355 or by email cgorecki@undeerc.org.

Sincerely,

Charles D. Gorecki
CEO

CDG/rlo

BURNS McDONNELL

March 29, 2024

Mr. Conway Nelson
Rainbow Energy Center
918 E Divide Avenue
Bismark, ND 58501

Dear Mr. Nelson:

Subject: Letter of Commitment for Rainbow Energy Center Proposal Entitled “Bridge Study for CCS at Coal Creek Station”

On behalf of Burns & McDonnell, this letter expresses our support and commitment for the Bridge Study for CCS at Coal Creek Station project for which a proposal is being submitted to the North Dakota Industrial Commission.

Burns & McDonnell is a fully integrated engineering, architecture, construction, environmental, and consulting firm with a multidisciplinary staff of more than 14,000 professionals. Founded in 1898, our singular mission has been to make our clients successful. Being 100 percent employee-owned means that everyone has an ownership stake in the success of our clients, and all team members are driven to find great solutions.

Burns & McDonnell is committed to making this project a success, and our participation in the Coal Creek front-end engineering and design study as well as the redundancy study provides us with project-specific knowledge that we will use to support the proposed project.

We appreciate being considered for this project and look forward to participating with Coal Creek staff and the rest of the project team. If you have any questions or need any additional information, please contact Aaron Bennett or me.

Sincerely,

Patrisha M. Scroggin-Wicker

Decarbonization Director
Burns & McDonnell

9400 Ward Parkway \ Kansas City, MO 64114
816-333-9400 \ burnsmcd.com

MITSUBISHI HEAVY INDUSTRIES

Engineered Systems Division
•20 Greenway Plaza Suite 600 Houston, TX 77046 Tel: (713)-351-6400 Fax: (713)-351-6450•

March 26th, 2024

Mr. Conway Nelson
Rainbow Energy Center
918 E Divide Avenue
Bismark, ND 58501

Dear Mr. Nelson:

Subject: Letter of Commitment for Rainbow Energy Center Proposal Entitled "Bridge Study for CCS at Coal Creek Station"

Mitsubishi Heavy Industries America, Inc. (MHIA) is pleased to commit its support to the Bridge Study for CCS at Coal Creek Station project for which a proposal is being submitted to the North Dakota Industrial Commission.

MHIA is a wholly owned subsidiary of Mitsubishi Heavy Industries, Ltd. (MHI) and together delivered the Petra Nova Project, the world's largest post combustion CO_2 capture system (4776 tonnes/day of CO_2 captured), including overall engineering, design, and procurement for all major equipment, operator training, and commissioning support.

MHI has delivered 13 commercial plants for coal, natural gas, and oil combustion exhaust gases and holds an outstanding market share in the world in the field of post combustion CO_2 capture, leading the world in commercially proven post combustion CO_2 capture knowledge base. The CO_2 capture system proposed for this project is based on improvements to MHI's proprietary Kansai Mitsubishi Carbon Dioxide Recovery Process (KM CDR Process™), including the use of MHI's proprietary solvent.

MHI is committed to making this project a success, and our participation in the Coal Creek front-end engineering and design study as well as the redundancy study provides us with project-specific knowledge that we will use to support the proposed project.

We appreciate being considered for this project and look forward to participating with Coal Creek staff and the rest of the project team. If you have any questions or need any additional information, please contact me.

Sincerely,

Tim Thomas

Tim Thomas
Senior Vice President
Mitsubishi Heavy Industries America, Inc.
Engineered Systems Division (ESD)
Direct: (512)954-1964/ email: timothy.thomas@mhia.com

Kevin Lauzze
Senior Vice President
(312) 269-2105
kevin.c.lauzze@sargentlundy.com

March 28, 2024

Mr. Conway Nelson
Rainbow Energy Center
918 E Divide Avenue
Bismark, ND 58501

Dear Mr. Nelson:

Subject: Letter of Commitment for Rainbow Energy Center Proposal Entitled "Bridge Study for CCS at Coal Creek Station"

Sargent & Lundy (S&L) is pleased to commit its support to the Bridge Study for CCS at Coal Creek Station project for which a proposal is being submitted to the North Dakota Industrial Commission.

S&L is a global leader in power and energy with expertise in grid modernization, renewable energy, energy storage, nuclear power, and fossil fuels. Our top-ranked design firm delivers comprehensive project services from consulting, design, and implementation to construction management, commissioning, and operations/maintenance.

As an industry leader S&L has remained at the forefront of innovation and technology advancements that support the energy industry, including carbon capture. S&L has been conducting preliminary studies, technical evaluations and detailed balance of plant engineering for multiple carbon capture projects in recent years.

S&L is committed to making this project a success. We appreciate being considered and look forward to participating with Coal Creek staff and the rest of the project team. If you have any questions or need any additional information, please contact me.

Sincerely,

Kevin Lauzze

Kevin Lauzze
Senior Vice President

INTERNATIONAL CCS KNOWLEDGE CENTRE

March 26, 2024

Mr. Conway Nelson
Director of Carbon Management
Rainbow Energy Center
918 E Divide Avenue
Bismark, ND 58501

Dear Mr. Nelson,

RE: Letter of Support for Rainbow Energy Center Proposal Entitled "Bridge Study for CCS at Coal Creek Station"

On behalf of the International CCS Knowledge Centre (the "Knowledge Centre"), we are pleased to submit this letter of support for the Bridge Study for CCS at Coal Creek Station project for which a proposal is being submitted to the North Dakota Industrial Commission.

The Knowledge Centre is dedicated to advancing large-scale CCS projects as a critical means of reducing greenhouse gas emissions and supporting the world's ambitious climate goals. Our mission is to accelerate the deployment of CCS worldwide by allowing the learnings acquired at the Boundary Dam 3 CCS facility (in Saskatchewan) to be shared broadly across industries and around the world. We undertake projects to help inform stakeholders regarding "real world" considerations in the use of CCS to de-risk projects and move them towards a final investment decision. In addition to our deep technical capabilities, the Knowledge Centre team also actively engages financiers and decision makers to ensure high-level information on CCS is conveyed with political, economic, and other strategic considerations in mind. We provide input to policy development and promote broad collaboration between stakeholders to reduce the cost and risk associated with new CCS projects around the world.

The Knowledge Centre is very supportive of this project, and is pleased to be participating in the Coal Creek front-end engineering and design study as well as the redundancy study provides us with project-specific knowledge that we will use to support the proposed project.

We appreciate being considered for this project and look forward to participating with Coal Creek staff and the rest of the project team. If you have any questions or need any additional information, please do not hesitate to contact me. I may be reached at ranwar@ccsknowledge.com.

Sincerely,

Rafay Anwar
Vice President, Project Development & Technical Services

ccsknowledge.com
306.565.5669
198 - 10 Research Drive
Regina, SK S4S 7J7 Canada

APPENDIX C

QUALIFICATIONS OF KEY PERSONNEL

CONWAY NELSON, P. Eng, PMP

43 Arlington St., Regina, Saskatchewan S4S 3H7 · 306 529-9426
conwaylnelson@gmail.com

Engineering and Project Management professional with over 25 years of experience. Highly developed skills in engineering design, project management, people management, team building, leadership, communication, relationship development.

EXPERIENCE

November 2023 – present

Director, Carbon Management

Rainbow Energy Center, Bismarck, ND (remote from Regina, SK)

- Leading the development of an 8.5M tonne per year carbon capture and storage project for a 1200 MW coal fired power station.
- Overseeing execution of a $47M NETL CarbonSafe grant to characterize geologic sequestration in the area local to the power station.
- Overseeing completion of a $16M FEED study to finalize the scope and cost for the retrofit of carbon capture equipment to the power station and a subsequent Bridge Study to work towards a final investment decision.

May 2021 – October 2023

Vice President, Project Development & Technical Services,

International Carbon Capture & Storage Knowledge Centre, Regina, SK

- Led a team of engineers and chemists that provide high level process design and technical advice related to planning and execution of carbon capture projects across various industries (power generation, cement, oil and gas, refineries, etc.).
- Responsible for business development activities and grew the PD&TS team from five to twelve staff in two years.
- Presented at various industry conferences and webinars about Carbon Capture lessons learned and the work of the Knowledge Centre.
- Oversaw technical consulting services executed for carbon capture projects across a variety of industries.

June 2019 – May 2021

Manager, Power Production Project Delivery Office, *SaskPower, Regina, SK*

- Lead a team of 19 project managers and project control specialists to deliver the power production sustainment portfolio of projects ($130m annual budget) as well as new generation projects that are managed by SaskPower (Chinook Power Station, Great Plains Power Station)
- Provide guidance and mentorship to Project Managers across Power Production to ensure effective project delivery.
- Emphasize continuous improvement by defining and optimizing our Project Management processes, developing, measuring and displaying KPI's while continuing to foster strong relationships with our engineering, construction and operations team members

EXPERIENCE (cont.)

May 2018 – June 2019

Lead, Project Lifecycle Optimization Initiative, *SaskPower, Regina, SK*

- Led a corporate optimization initiative to examine how projects are managed across SaskPower and make recommendations to improve performance. Performed internal and external research and worked with the SaskPower executive to achieve alignment regarding the practice of project management.
  SaskPower established a corporate project management office based on my team's recommendations and have been working towards increasing project management maturity

May 2018 – June 2019

Lead, Project Lifecycle Optimization Initiative, *SaskPower, Regina, SK*

- Led a corporate optimization initiative to examine how projects are managed across SaskPower and make recommendations to improve performance. Performed internal and external research and worked with the SaskPower executive to achieve alignment regarding the practice of project management.
  SaskPower established a corporate project management office based on my team's recommendations and have been working towards increasing project management maturity

April 2016 – May 2018

Manager, Power Production Project Delivery Office, *SaskPower, Regina, SK*

- Managed a team of 15 project managers and project control specialists to deliver the power production sustainment portfolio of projects ($130m annual budget) as well as new generation projects that are managed by SaskPower (Chinook Power Station - $680m budget).
- Worked closely with the Transmission business unit PDO to share best practices.

November 2013 – April 2016

Manager, Clean Energy, *SaskPower, Regina, SK*

- Led a team responsible for evaluating the feasibility of clean energy technologies primarily nuclear and solar power.

August 2008 – November 2013

Manager, Mechanical Engineering, *SaskPower, Regina, SK*

- Led a team of engineers and contracted resourced to manage projects and provide mechanical engineering services to execute the power production capital plan.

March 2006 – August 2008

Project Leader, *SaskPower, Regina, SK*

- Managed the refurbishment of a 300 Megawatt boiler and various projects related to emissions reduction technology for coal-fired power plants.

April 2003 – March 2006

Mechanical Engineer II, *SaskPower, Regina, SK*

- Performed engineering design and managed capital sustainment projects of increased complexity and magnitude for power generation plants.

EXPERIENCE (cont.)

March 2000 – April 2003

Mechanical Engineer I, *SaskPower, Regina, SK*

- Performed engineering design and managed capital sustainment projects for power generation plants.

January 1998 – March 2000

Project Engineer, *BAR Engineering, Lloydminster, AB*

- Design and project engineering work for various oil and gas clients.

PROFESSIONAL AFFILIATIONS

Professional Engineer *Association of Professional Engineers & Geoscientists of Saskatchewan*
Permission to Consult *Association of Professional Engineers & Geoscientists of Saskatchewan*
Project Management Professional *Project Management Institute*

EDUCATION

December 1997

B. Sc. in Mechanical Engineering, *University of Saskatchewan*

SKILLS

- Engineering
- Business Development
- Relationship Building
- Project Management
- Corporate Improvement
- Contract Management and Negotiation
- Communication
- Corporate Strategy
- People Management
- Leadership
- Coaching

ACTIVITIES & INTERESTS

- Travelling and spending time with my family
- Cycling, competing in triathlons, running races and adventure races
- Parent volunteer for youth hockey, triathlon, karate and speed skating

REFERENCES

Available upon request

Lyndsey Roemmich

Lyndsey is a Certified Public Accountant with 17 years of experience in a variety of fields including 11 years in the utility industry. Lyndsey joined Rainbow Energy Marketing Corporation in 2018 and has specialized in accounting for monthly electricity transactions, established foreign accounting processes, and played a leading role in coordinating tax compliance and external audit requests. Lyndsey has managed various research and accounting projects as well as implemented numerous process improvements. Prior to her career at Rainbow Energy, Lyndsey worked at a local investor-owned utility. She played an integral role in financial statement preparation and analysis as well as regulatory reporting. Lyndsey also serves on various boards in the community and in the accounting industry.

As Vice President of Finance for both Rainbow Energy Center and Nexus Line, Lyndsey directs all aspects of accounting operations including analyzing financial results, assisting in financial planning and results management, and maintains all necessary accounting policies and systems to ensure that all records are maintained in accordance with generally accepted accounting principles.

John Bauer

jbauer@grenergy.com, Office (701) 442-7000, Cell (701) 897-1853

Summary

As Director of North Dakota Generation for Great River Energy I have oversight of Great River Energy's Coal Creek Station. With over 40 years of experience in the industry, I possess a wealth of power and process knowledge and strive to enhance culture, teamwork, and leadership to maintain a highly engaged work force.

The honor to serve as a member of the Bismarck State College foundation board and as chair of Electric Power Research Institute's operations management technology program provides an opportunity to offer input that creates a well-trained workforce ensuring we improve operations and achieve safe, reliable, cost-effective and environmentally responsible power generation.

This first-hand knowledge and experience allow me to effectively contribute to the overall success of GRE's ND operation regardless of the situation.

EXPERIENCE:

Director, North Dakota Generation
March 2017 – current
Lead, plan and direct the operation and maintenance of North Dakota generating facilities in accordance with Great River Energy's (GRE) values, mission, and strategic imperatives, to achieve safe, reliable, efficient and environmentally sound production of electricity.

Manager, ND Operations Services
April 2015 – March 2017
Provide management oversight for plant operations, fuel operations and utility groups at Great River Energy's Coal Creek, Stanton and Spiritwood facilities. Provide overall site management for Spiritwood Station. Current Alternate Designated Responsible person for ND environmental compliance.

Leader, Plant Operations (day coordination) Great River Energy, Coal Creek Station
Oct 2005 – April 2015
Act as the Operating Authority and provide daily coordination for Coal Creek Station Plant Operations, Facilitate hiring and training for new hires (Operators / Operator Technicians), Mentor the 60 member Operations Team, coordinate new projects affecting the station, system start-up commissioning, work around guidance and emergent response to limit generation loss, Incident Commander for HazMat, fire and unit incidents, Provide leadership to the Operator Technician, Building Maintenance Utility and Temp Labor groups.

Leader, Plant Operations (shift coordination) Great River Energy, Coal Creek Station
Sept 2001 – Sept 2005
Act as the Operating Authority of Coal Creek Station, coordinate shift operation of a 12 member self-directed work team at Coal Creek Station, provide maintenance guidance on short outage and emergent situations to limit generation losses.

Control Room Operator Great River Energy, Coal Creek Station
July 1994 – Aug 2001
Operate Coal Creek Station from the central control room, coordinate maintenance efforts to support maintenance teams with clearances and equipment outage scheduling.

John Bauer

jbauer@grenergy.com, Office (701) 442-7000, Cell (701) 897-1853

Train other levels of plant operations to ensure qualified members for advancing positions.

Additional operations positions, Great River Energy, Coal Creek Station
Mar 1981 – June 1994
Monitor equipment, provide clearances, perform minor maintenance and provide troubleshooting support for Assistant Control Operator, Auxiliary Operator and Equipment Operator plant systems at Coal Creek Station. Provide job leader support for unit outages.

EDUCATION:

Great River Energy Leadership Training, Great River Energy
Foundational Leadership and Leadership in Action
MARC – Managers Guide to Employee Relations Leadership Training

Bismarck State College, Bismarck ND
Power Plant Technology

LEADERSHIP IN OTHER ORGANIZATIONS:

Bismarck State College Foundation board member

Program Chair for Electric Power Research Institute Plant Management Essentials Program

President, Ridgefield Condominium Association, Bismarck

SKILLS AND ABILITIES

Leadership Operations
Project Coordination
Mentoring
Safety
Expertise
Project Commissioning
Teamwork

Stacy L. Tschider

Stacy has strategically built and ran a successful business empire worth half a billion in revenues across the United States, Canada and Mexico. His portfolio of companies in the North American markets have over a quarter century of prominent success leading the wholesale electricity and natural gas, retail natural gas, propane, oil, and real estate industries.

His leadership and business savviness places him at the forefront in all companies he leads as President at: *Rainbow Energy Marketing Corporation, Peak Energy, Rainbow Energy Ventures, Rainbow Energy Center, and Nexus Line.* Entrepreneurial expertise in directing all aspects of operations and development in the highly complex and volatile energy trading commodities specializing in physical and financial products (spot prices, forwards, futures, options and derivatives), demonstrates his professional aptitude for risk management and profit generating strategies.

Stacy a founder of Rainbow Energy Center and Nexus Line, the newest additions to the REMC group of companies. Making strong progress toward diversifying vertically with ownership in two investments: a 1,151 MW power plant and 436 mile high voltage direct current (HVDC) transmission line in the upper Midwest. These acquisitions will not only pave the way in leading edge carbon capture and storage technology, more importantly save over 600 jobs with an estimated impact of $1.5 billion in local North Dakota communities. These recent developments are near and dear to his heart, as forging progress in his local community bring a heightened level of purpose in his entrepreneurial journey.

Jeff Jonson

Jeff has been pivotal in overseeing organizational efforts in business development, joint venture and acquisitions for a business empire worth half a billion in revenues across the United States, Canada and Mexico. His portfolio of companies in the North American markets have over a quarter century of prominent success leading the wholesale electricity and natural gas, retail natural gas, propane, oil, and real estate industries. He pioneered key international business development initiatives as Chief Executive Officer at *RC Energy*, as well as Executive Vice President at: *Rainbow Energy Marketing Corporation, Rainbow Energy Ventures, Rainbow Energy Center, and Nexus Line*.

With his executive leadership expertise in energy trading and asset management across North America, Jeff spearheaded market penetration of the newly formed Mexico energy markets, as Chief Executive Officer of RC Energy in Mexico. RC is a wholesale and retail energy joint venture positioned as one of the leading power, natural gas traders and asset managers in Mexico. Optimizing his expertise, he expanded his geographical footprint with clients in the Guatemalan power market, trading between Mexico and Guatemala.

His business acumen and leadership experience in the energy sector have been crucial in our progress towards acquisitions in the Coal Creek power plant and HVDC transmission line.

Chris Faul

Chris began working with Rainbow Gas, a regional natural gas marketer, and commercial and industrial supplier. He later joined the Rainbow Energy Marketing Corporation (REMC) in hourly trading and settlements, prior to his promotion to Manager of Energy Markets and Projects for REMC and Rainbow Energy Ventures (REV). He leads the REMC settlements team's vast portfolio of bilateral sales, ISO/RTO markets, and asset management deals. His profitable growth strategies have been proven with his project management skills in leading all REV virtual business agreements throughout North America, including a European client. Chris has been a valuable and trusted executive advisor since the inception of the REMC group of companies, and an important foundation to a fast-growing group of companies.

As Vice President of Operations for both Rainbow Energy Center and Nexus Line, Chris provides overall direction to major business division heads. His direct reports include Rainbow Energy Center power plant and IT division heads.

DALTON NORTON

dalton.norton@rainbowenergycenter.com, Office (701) 207-8835, Cell (580) 370-6080

Summary

As an Engineer II at Rainbow Energy Center, I am responsible for the design, specifications, schedule, budget, and project management of various projects at Coal Creek Station. I have previously managed projects at Coal Creek Station and elsewhere that required innovative approaches and diligent planning. My experience in managing these projects has given me useful insight into how to take a project from concept to turnover and keeping safety, budget, and schedule a priority.

My knowledge and expertise in project management allow me to contribute to the overall success of Coal Creek Station and its multiple projects.

Experience

Engineer II, Coal Creek Station
November 2022-Current
Assist in management of the carbon capture project, as well as various other projects related to fire protection and HVAC. Carbon capture involvement consists of design review, integration with existing plant facilities, acting as a representative of REC, facilitating design discussion, coordination of engineering efforts, reviewing project costs, and developing project schedule. HVAC and fire protection projects consist of producing design drawings, assemble budget and schedule, procurement of material, coordinate contractors for execution, and oversee execution for quality and safety.

Project Manager, US Engineering Innovations
March 2022-November 2022
Managed the mechanical and plumbing construction of a 600,000 square foot hospital. Responsibilities consisted of labor management, material procurement, schedule management, interface with GC, design issue resolution, change order management, and managing startup and commissioning efforts.

Project Engineer, US Engineering Innovations
March 2021- March 2022
Reviewed project specifications and design drawings to submit and procure equipment/material suitable for installation. Collaboration with EOR for cost effective issue resolution. Reviewed design changes for constructability. Conducted pricing exercises for proposed design changes. Managed non-compliance and QA/QC tracking and resolution. Pull planned with GC to develop schedule. Coordinated with adjacent trades to prevent rework.

US Army Engineer Officer, United States Army
May 2017-March 2021
Managed earthwork project schedules, material procurement, logistics, life support, labor, and equipment maintenance. Projects typically consisted of earthwork grubbing/clearing, cut/fill, compaction, and grading.

DALTON NORTON

dalton.norton@rainbowenergycenter.com, Office (701) 207-8835, Cell (580) 370-6080

Education

Oklahoma State University, Stillwater OK
Bachelor of Science Mechanical Engineering

Skills and Abilities

Leadership

Project Management

ASHRAE, NFPA, IBC, ASME Standards

Matlab, VBA, Python, MS Project

AUTOCAD, SolidWorks

Jessica K. Bell

1224 1st Avenue Northeast • Beulah, ND • 701.891.9708 • belljessicak@gmail.com

OBJECTIVE To continue my endeavor to positively impact individuals and promote the energy industry by utilizing my experience in environmental and tax policy, business development and government relations.

EXPERIENCE

Rainbow Energy Center **August 2022-Current**
Director, Government & Public Affairs

- Execute project development opportunities
- Evaluate best practices for carbon capture utilization and storage technologies
- Coordinate research efforts with the Energy & Environmental Research Center (EERC)
- Enhance environmental, social and governance practices
- Monitor and evaluate Federal and State regulations as they pertain to independent power producers
- Interact with regional transmission operators to ensure power deliverability

NACCO Natural Resources **May 2004-Current**
Environmental Manager of Northern Operations (2020-2022)

- Oversee and manage all environmental matters for northern operations
- Evaluate best practices for carbon management, including carbon capture utilization and storage technologies, soil carbon storage and other opportunities
- Evaluate and improve environmental, social and governance compliance
- Monitor and evaluate Federal environmental regulations impacting operations and articulate the position of NACCO Natural Resources for Federal Register Notice filings

Coyote Creek Mining Company
Environmental Manager (2017-2020)

- Primarily responsible for all environmental duties at the mine site including securing all permits for operation at local, state and federal level, air quality, wildlife management, cultural resources management, waste management and short and long-term budgeting and department management
- Active participant in the Lignite Energy Council trade organization
- Completed life of mine Individual Permit from the Department of the Army Corps of Engineers
- Initiated application to mine Federal coal with the Department of the Interior

The Coteau Properties Company Freedom Mine
Environmental Specialist (2007-2017)
Tour Guide (2006-2007)
Environmental Assistant (2004-2005)

- Manage over 15,000 acres of mined and reclaimed farm land alongside local producers
- Repeatedly proved mined and reclaimed farm land is more successful than before mining and released thousands of acres of productive land from company liability and bonds
- Write and update all environmental sections of mining permits
- Supervisory experience of both employees and contractors
- Initiated environmental baseline studies for first new coal mine in 30 years in ND

North Dakota State Senate **Nov 2012-Nov 2022**

District 33 Senator & Citizen Legislator

Sixty-third Legislative Assembly

- Member of Industry, Business & Labor and Natural Resources standing committees and Vice-Chair of the Advisory Commission on Intergovernmental Relations interim committee, the former of which was statutorily eliminated during the subsequent legislative session to reduce government bureaucracy; Member of the Taxation interim committee
- Unanimously elected most outstanding freshman senator

Sixty-fourth Legislative Assembly

- Vice-Chair of Energy & Natural Resources and member of Finance & Taxation standing committees, Chair of the Taxation interim committee to study enhanced oil recovery and carbon dioxide capture technologies and related tax incentives and regulatory policies; and member of the Political Subdivision Taxation and Water Topics Overview interim committees
- Elected by peers to Legislative Management and selected to serve on the State Council for Interstate Adult Offender Supervision and the Commission on Legal Counsel for Indigents

Sixty-fifth Legislative Assembly

- Chair of Energy & Natural Resources and member of Finance & Taxation standing committees, Chair of the Taxation interim committee to study state business tax incentives and property taxes, member of Energy Development and Transmission interim committee and member of State Council for Interstate Adult Offender Supervision

Sixty-sixth Legislative Assembly

- Chair of Energy & Natural Resources, member of Finance & Taxation standing committees, Vice-Chair of the special committee on Ethics and member of the Government Finance, Human Services, Legacy Fund Earnings and Taxation interim committees

Sixty-seventh Legislative Assembly

- Chair of Finance & Taxation and member of Energy & Natural Resources standing committees, Chair of the Energy Development and Transmission interim committee and member of the Legacy Fund Earnings and Tribal and State Relations interim committees
- Elected by peers to Legislative Management

Legislative Accomplishments

- Prime sponsor of extensive property tax and industrial tax reform, creation of the Department of Environmental Quality, pore space use and migration reform and numerous energy-related issues
- Creation of the Pipeline Restoration and Oversight Program for landowners
- Main resource for legislative leaders on energy, ESG, taxation and regulatory issues
- Advocate for the elimination of inefficient government and incorporating business-minded policies to improve government agencies and proponent of investments in statewide infrastructure

Additional Legislative Positions

- Selected for and completed the 24-month Aspen Institute-Rodel Fellowship in Public Leadership, a program which seeks to enhance our democracy by identifying and bringing together the nation's most promising young political leaders to explore the underlying values and principles of western democracy, the relationship between individuals and their community and responsibilities of public leadership
- Executive committee member of The Energy Council, a group of legislators from energy producing states who develop and promote comprehensive, responsible energy policy initiatives at both the state and federal levels
- Executive committee member of the Streamlined Sales Tax Governing Board

belljessicak@gmail.com

EDUCATION **North Dakota State University** **Sept 2002-May 2006**
Bachelor of Science Degree

- Natural Resources Management, Major
  - Social Sciences Emphasis
- Economics, Major

NOTEWORTHY INVOLVEMENT

- Member of MDU's Integrated Resource Plan Public Advisory Group, 2022-present
- Recipient of Prairie Business's Top 25 Women in Business in 2021
- Knife River Care Center Board of Directors, 2021-Current
- Solid fuels representative on Department of Environmental Quality Advisory Board, 2019-Current
- Beulah Wellness Center Foundation member, 2015-Current
- Mercer County Economic Development Board member, 2017-2020
- Elected to the Mercer County Soil Conservation District Board, 2010-2017
- Beulah Little People Pre-School president, 2012-2013
- Youth minister for St. Joseph's Catholic Church in Beulah, ND, 2006-2007
- Local, State and Regional Greater North Dakota Chamber involvement
- Special program advisor for North Dakota State University School of Natural Resources
- Certified Army Corps of Engineers wetland delineator
- Mine Foreman certification
- Mine Safety and Health Administration Surface Instructor certification
- Multiple national and local speaking engagements on behalf of North Dakota

belljessicak@gmail.com

JON PRICE

2481 Helen Dr. N, Mandan, ND 58554 ♦ 701-337-6096 ♦ jonprice_5@hotmail.com

PROFESSIONAL SUMMARY

Well-versed in building positive relationships with customers, coworkers, and other stakeholders. Hardworking, forward-thinking, and adaptable to dynamic company needs. Experience in marketing and relationship management as well as finance, accounting, and project management procedures while positively impacting overall productivity.

SKILLS

- Strategic planning
- Attention to detail
- Procurement
- Data analysis and modeling
- Management training courses
- Marketing strategy
- Contract Negotiation
- Statistical and financial analysis
- Stakeholder relations and networking
- Operations management
- Strategy development
- Cost analysis and savings
- Logistics and project management
- Financial management and budgeting
- Project scheduling and planning
- Data mining and analysis

WORK HISTORY

Director of Projects, 03/2023 to Current

Rainbow Energy Corporation – Bismarck, ND

- Oversee all extrinsic projects ongoing at Coal Creek Station to maximize the asset and create financially and environmentally beneficial uses for the site
- Identify business development opportunities to create economic opportunity for the site while ensuring financial benefit and permits are fulfilled to pilot multiple opportunities
- Manage contracts for ongoing and growth projects that have direct impact on the success of the site
- Identify value in operational plant success through energy market evaluation and modeling for market dynamics

Marketing Manager, 03/2020 to 03/2023

Marathon Petroleum Corporation – Mandan, ND

- Work independently to optimize the portfolio of business by actively managing accounts, focusing on the optimal price/volume relationship for all products while executing strategic direction of the territory
- Maintain a broad understanding of industry issues, government regulation, economic conditions, business outlooks, commercial and consumer needs, and MPC competitive strengths and weaknesses by market

Project Manager and Data Analyst, 03/2018 to 03/2020

Great River Energy – Underwood, ND

- Operate as Outage Coordinator for all scheduled Spiritwood Station outages
- Perform detailed assessments of project risks to determine constraints and develop mitigation strategies
- Gather requirements, define scopes, allocate resources, establish schedule and critical path that meet project demand
- Assume ownership of budgeting, forecasting, and strategic supply planning for revenue sources and fuel supply

Finance and Generation Specialist, 09/2015 to 03/2018

Great River Energy – Stanton, ND

- Perform general accounting functions including preparation of journal entries, account reconciliation and local balance sheet data to monitor and analyze general accounting functions as well as performance data analysis

EDUCATION

Master of Business Administration: 2022

University of Arizona, Eller College of Management

- Concentrations in Marketing and Management of Organizations
- Graduated with 3.9/4.0 GPA

Bachelor of Arts: Business Administration, 2017

University of Mary - Bismarck, ND

- Graduated with 3.7/4.0 GPA

Bachelor of Science: Mathematics, 2015

University of Mary - Bismarck, ND

- Graduated cum laude
- Graduated with 3.7/4.0 GPA

PROFICIENT COMPUTER SKILLS

- Microsoft: Word, PowerPoint, Excel, Access, and Project
- Ascend, Lawson, Cognos, Primavera P6, Salesforce, Tableau, SPSS and R Studio

RELEVANT INFORMATION

Collegiate Accomplishments

- Academic All-NSIC Cross Country and Track Selection 3 times
- University of Mary Dean's List 5 semesters
- University of Arizona O-MBA 2022 Top Entrepreneurship and Innovation recipient

Professional Involvement and Accomplishments

- Member of Great River Energy's North Dakota Cultural Enhancement Team - 2 terms
- Expanded portfolio by over 6.5M GPM of product, netting the company nearly $9M incremental growth in 2021 and grading as one of the top 5 Marketing Managers across the country for 'Extraordinary Results' at YE review

Professional Affiliations

- University of Mary Mathematics Degree Advisory Board – 2017 to Current

JASON D. LAUMB
Director of Advanced Energy Systems Initiatives
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, ND 58202-9018 USA
701.777.5114, jlaumb@undeerc.org

Education and Training
M.S., Chemical Engineering, University of North Dakota, 2000.
B.S., Chemistry, University of North Dakota, 1998.

Research and Professional Experience
May 2021–Present: Director of Advanced Energy Systems Initiatives, EERC, UND. Laumb provides leadership on projects related to advanced energy systems and leads a multidisciplinary team of scientists and engineers working on advanced energy technologies from pollution control to new energy platforms. Principal areas of interest and expertise include renewable energy, CO_2 capture, techno-economic modeling, extraction of critical materials, environmental control systems, supercritical CO_2 power cycles, and advanced gasification technologies. Experience includes biomass and fossil fuel conversion for energy production, with an emphasis on ash effects on system performance; trace element emissions and control for fossil fuel combustion systems, with a particular emphasis on air pollution issues related to mercury and fine particulates; and design and fabrication of bench- and pilot-scale combustion and gasification equipment.

September 2019–April 2021: Assistant Director of Advanced Energy Systems, EERC, UND. Laumb assisted the EERC executive team by providing leadership on projects related to advanced energy systems. Laumb led a multidisciplinary team of scientists and engineers working on advanced energy technologies from pollution control to new energy platforms. Specific areas of interest included CO_2 capture, techno-economic modeling, environmental control systems, supercritical CO_2 power cycles, and advanced gasification technologies. Research activities focused on low-carbon-intensity power cycles for fossil fuel-fired systems.

2008–August 2019: Principal Engineer, Advanced Energy Systems Group Lead, EERC, UND. Laumb led a multidisciplinary team of 30 scientists and engineers to develop and conduct projects and programs on power plant performance, environmental control systems, the fate of pollutants, computer modeling, and health issues for clients worldwide. Efforts focused on development of multiclient jointly sponsored centers or consortia funded by government and industry sources. Research activities included computer modeling of combustion/gasification and environmental control systems, performance of SCR technologies for NO_x control, mercury control technologies, hydrogen production from coal, CO_2 capture technologies, particulate matter analysis and source apportionment, the fate of mercury in the environment, toxicology of particulate matter, and in vivo studies of mercury–selenium interactions.

2001–2008: Research Manager, EERC, UND. Laumb led projects involving bench-scale combustion testing of various fuels and wastes as well as a laboratory that performs bench-scale combustion and gasification testing. Laumb served as principal investigator and managed projects related to the inorganic composition of coal, coal ash formation, deposition of ash in conventional and advanced power systems, and mechanisms of trace metal transformations during coal or waste conversion and wrote proposals and reports focused on energy and environmental research.

2000–2001: Research Engineer, EERC, UND. Laumb assisted in the design of pilot-scale combustion equipment and wrote computer programs to aid in the reduction of data, combustion calculations, and prediction of boiler performance. Laumb was also involved in the analysis of combustion control technologies' ability to remove mercury and the suitability of biomass as boiler fuel.

1998–2000: SEM Applications Specialist, Microbeam Technologies, Inc., Grand Forks, North Dakota. Laumb gained experience in power system performance including conventional combustion and gasification systems; knowledge of environmental control systems and energy conversion technologies; interpreting data to predict ash behavior and fuel performance; assisting in proposal writing to clients and government agencies such as the National Science Foundation and the U.S. Department of Energy; preparing and analyzing coal, coal ash, corrosion products, and soil samples using SEM/EDS; and modifying and writing FORTRAN, C+, and Excel computer programs.

Professional Activities
Member, American Chemical Society

Publications
Has coauthored numerous professional publications.

JOHN P. KAY
Principal Engineer, Emissions and Carbon Capture
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.4580, jkay@undeerc.org

Education and Training

B.S., Geological Engineering, University of North Dakota, 1994.
Associate Degree, Engineering Studies, Minot State University, 1989.

Research and Professional Experience

2011–Present: Principal Engineer, Emissions and Carbon Capture, EERC, UND.

- Responsibilities include management of CO_2 separation research related to bench-, pilot-, and demonstration-scale equipment for advancement of technology as well as development of cleanup systems to remove SO_x, NO_x, particulate, and trace elements to render flue gas clean enough for separation.
- Principal areas of interest and expertise include applications of solvents for removing CO_2 from gas streams to advance technology and look toward transformational concepts and techno-economic assessments.
- Experience includes 12 years of field testing site management and sampling techniques for hazardous air pollutants and mercury control in combustion systems along with 10 years of experience utilizing scanning electron microscopy (SEM), x-ray diffraction (XRD), and x-ray fluorescence (XRF) techniques to analyze coal, fly ash, biomass, ceramics, and high-temperature specialty alloys.
- Other interests include computer modeling systems and high-temperature testing systems.

2005–2011: Research Manager, EERC, UND.

- Responsibilities included management and supervision of research involving design and operation of bench-, pilot-, and demonstration-scale equipment for development of clean coal technologies.
- Work also involved testing and development of fuel conversion (combustion and gasification) and gas cleanup systems for removal of sulfur, nitrogen, particulate, and trace elements.

1994–2005: Research Specialist, EERC, UND.

- Responsibilities included conducting SEM, XRD, and XRF analysis and maintenance; creating innovative techniques for analysis and interpretation of coal, fly ash, biomass, ceramics, alloys, high-temperature specialty alloys, and biological tissue; managing day-to-day operations of Natural Materials Analytical Research Laboratory; supervising student workers; developing and performing infrared analysis methods in high-temperature environments; and performing fieldwork related to mercury control in combustion systems.

1993–1994: Research Technician, Agvise Laboratories, Northwood, North Dakota.

- Responsibilities included receiving and processing frozen soil samples for laboratory testing of chemical penetration, maintaining equipment and inventory, and training others in processing techniques utilizing proper laboratory procedures.

1991–1993: Teaching Assistant, Department of Geology and Geological Engineering, UND.
- Responsibilities included teaching Introduction to Geology Recitation, Introduction to Geology Laboratory, and Structural Geology; preparation and grading of assignments; and administering and grading class examinations.

1990–1992: Research Assistant, Natural Materials Analytical Laboratory, EERC, UND.
- Responsibilities included operating x-ray diffractometer and interpreting and manipulating XRD data, performing software manipulation for analysis of XRD data, performing maintenance and repair of XRD machine and sample carbon coating machine, preparing samples for XRD and SEM analysis, and performing point count analysis on SEM.

Professional Activities
Member, ASM International
Member, American Ceramic Society
Member, Microscopy Society of America

Publications
Has authored or coauthored numerous publications.

PATRICIA (TISHA) SCROGGIN-WICKER, PE

Director of Process Technology

Patricia is the Director of Process Technology for our power generation business working with Energy clients at Burns & McDonnell. Her team's responsibilities today include the Hydrogen, Carbon Capture, Liquified Natural Gas (LNG), Flow Battery and other process-oriented technology applications within the power generation industry.

Her career has included from the outset experiences with air quality control, chemical feed, water treatment and other process-oriented technologies. She's had experiences with numerous first of a kind installations including engineering, construction and startup experiences.

EDUCATION

Bachelors, Chemical Engineering, 2002

REGISTRATIONS

Professional Engineer (GA, IL, MO, NH)

19 YEARS WITH BURNS & MCDONNELL

19 YEARS OF EXPERIENCE

Hydrogen and Carbon Capture

Process Technology Director. Assist clients with identifying applicable technology that meets project needs from a scope, schedule and budget perspective. Provide direction to project teams as they are executing technology reviews, scale up evaluations, pilot projects and grid scale projects.

LNG Industry Lead

Multiple Locations | 2019 - Present

Business Manager. Responsible for market understanding, OEM relationships and technical applications around the peak shaving LNG market with respect to the power generation market.

Flow Battery Industry Lead

Multiple Locations | 2019 - Present

Business Manager. Responsible for market understanding, OEM relationships and technical applications for the evolving flow battery industry. Submitted on over 100 MWhr of flow battery project opportunities.

Water Redirection Program | Duke Energy Corp

Multiple Locations | Oct 2015 - Sep 2020

Process consultant. Worked on multiple process wastewater facilities at twelve stations. FGD wastewater treatment system includes clarification, filtration, biological and final polishing.

FGD Physical/Chemical & ZLD Wastewater Treatment | Indianapolis Power & Light Company

Petersburg, Indiana | May 2014 - Jul 2020

Process consultant. IP&L's waste-water treatment plant project, an EPC project, included the addition of a water treatment plant with a zero-discharge facility, thermal evaporation system, and a distillate stream for reuse in the FGD and other systems as permitted in order to discontinue the discharge of bottom ash, fly ash, FGD, and other waste-water materials into their existing ash ponds. The proposal includes as an option the installation of a bottom ash dewatering system allowing for the dewatered ash to be transported to a permitted landfill for disposal. Worked on multiple process wastewater facilities at a

1,760-MW coal-fired facility. FGD wastewater treatment system includes clarification, softening and thermal evaporation using falling film evaporators. Remaining plant wastewater flows are treated within an enhanced heavy metals precipitation process followed by a mercury reduction filtration system.

High Desert Power Project | Tenaska, Inc.

Kansas City, Missouri | Mar 2015 - Feb 2017

Process engineer. Worked on optimization of existing Zero Liquid Discharge system on combined cycle cooling tower blowdown system. Coordination with existing plant operations while optimizing various systems.

Mustang | OGE Energy Corp.

Oklahoma City, Oklahoma | May 2014 - Sep 2016

Process engineer. Worked on FEED study to develop new generation simple cycle and combined cycle site. System design including raw water treatment, demineralization, sampling and cooling tower and cycle chemical feed systems.

Confidential Client | Big Rivers Electric Corporation

Henderson, Kentucky | Jul 2013 - Dec 2014

Project team. Multiple facility review of existing plant water balances for identification and implementation of water reuse and wastewater minimization technologies. Determine potential compliance requirements associated with upcoming proposed National Effluent Limitation Guidelines.

Frank A. Tracy Generating Station | NV Energy, Inc.

Nevada | Feb 2012 - Dec 2013

Process engineer. Worked to review the plant water usage and treatment capabilities to develop a comprehensive water management plan. The plan improved water usage and optimize the use of water treatment equipment to maintain zero liquid discharge operation. This facility is a multi-unit station with oil and gas fired units.

Iatan 2 | Evergy, Inc.

Kansas City, Missouri | Dec 2005 - Jul 2013

Process engineer. Worked on design, procurement and 2.5-year assignment onsite for construction oversight and startup of water related systems at a new 900-MW coal-fired power plant. Systems include wastewater treatment system, condensate polishing, raw water treatment, boiler cycle, sampling and demineralized water. New unit, including scrubber blowdown, is a Zero Liquid Discharge (ZLD) site.

Merrimack Station - Zero Liquid Discharge | Eversource Energy

New Hampshire | Oct 2010 - Apr 2013

Process engineer and Project Manager. Worked on fast track technology selection, design, procurement, and startup of an evaporator/crystallizer Zero Liquid Discharge system for FGD wastewater. System has ability to produce a concentrated stream for landfilling with fly ash, or a fully dry waste product suitable for landfill.

Council Bluffs Unit 3 | MidAmerican Energy

Iowa | Nov 2006 - Dec 2011

Process engineer. MidAmerican Energy's Council Bluffs Unit 3 AQCS project, an EPC project, included the addition of two SDAs, two fabric filters, ID fans and related equipment for the 700 MW unit. Worked on air pollution control upgrade at 690-MW coal-fired power plant. Duties included design review, drawing review, equipment checkout, water balance design and interfacing with other disciplines and contracts. Equipment included dry scrubbers, fabric filters, ductwork, lime slakers and recycle slurry ash systems.

Louisa Scrubber Project | MidAmerican Energy

Iowa | Nov 2005 - Dec 2011

Contract engineer. Worked on air pollution control upgrade at 700-MW coal-fired power plant. Duties included design review, drawing review, equipment checkout, water balance design and interfacing with other disciplines and contracts. Equipment included dry scrubbers, fabric filters, ductwork, lime slakers and recycle slurry ash systems.

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| Oct 2003 - Dec 2007

Process engineer. Worked on design, specification, procurement and submittal reviews for water system equipment upgrades at 500-MW combined cycle power plant. Wrote equipment procurement contracts, performed bid evaluations and reviewed drawing submittals for additional lime slaker, silo, and redundant pressure filter and demineralizer system.

Emery Generating Station | Alliant Energy

| Apr 2002 - Jul 2007

Process engineer. The Power Iowa project included two General Electric 7FA combustion turbine-generators (CT) coupled with two heat recovery steam generators (HRSG) and a single common steam turbine-generator (ST) to operate in combined cycle mode. Worked on design, procurement, and construction of water related systems at 550-MW combined cycle power plant. Systems include cycle chemical feed, circulating water chemical feed, raw water chemical feed, demineralized water, potable water, sampling and analysis, service water, raw water, and well water. Design involved use of reclaimed water and well water for primary cooling water makeup needs. Preparation of fully comprehensive life cycle cost analysis and plant water balance.

Sheboygan Falls Energy Station | Alliant Energy

| Jan 2004 - Sep 2006

Process engineer. Worked on design, procurement, and construction of water related systems at 350-MW simple cycle power plant. Wrote equipment procurement contracts, performed bid evaluations and reviewed drawing submittals for both the service water chemical feed and potable water systems.

Meramec, Rush Island & Sioux Power Plants | Ameren Corporation

| Mar 2003 - Mar 2004

Process engineer. Worked on primary water treatment and potable water system studies. Studies included existing equipment assessment, design basis review in terms of performance, functionality, reliability, and redundancy, identification of required equipment replacements and significant maintenance expected during the next 10 years, assess current and future compliance with EPA and MO-DNR drinking water regulations, propose modifications and upgrades to existing systems,

evaluate alternatives for potable water supply. Preparation of anticipated capital expenditures and operating and maintenance expenses to keep system operating. Life cycle cost analysis for alternative water treatment options.

AARON BENNETT, PE

Project Manager

Aaron serves as a Project Manager in the Burns and McDonnell Energy Global Practice. In recent years, Aaron has been responsible for Project and Engineering Management on projects including two LNG peak shaver projects, wastewater treatment projects at coal fired power plants, and air quality control projects at coal fired power plants. These multi-discipline projects required coordination between multiple engineering disciplines, procurement, and construction professionals to achieve safe and successful projects. In addition to project and engineering management activities, Aaron has been responsible for structural steel, ductwork, and turbine crane design and procurement contracts and the piling construction contract a site with karst geology and significant subsurface challenges. He has also been responsible for layout and design of new structural framing systems, analysis of existing structural framing systems, design and coordination of foundation systems, analysis and design of ductwork, and connection design for Selective Catalytic Reduction reactors.

EDUCATION

Masters, Civil Engineering, 2004;
Bachelors, Civil Engineering, 2002

REGISTRATIONS

Professional Engineer
(MS, OH, WY)

17 YEARS WITH BURNS & MCDONNELL

18 YEARS OF EXPERIENCE

RAINBOW ENERGY CENTER | RAINBOW ENERGY / EERC

Underwood, North Dakota | July 2022 - Present

Project Manager. FEED Study for outside boundary limits systems and equipment for a Carbon Capture Facility at both Units at Rainbow Energy Center. The project includes preliminary design, model development, procurement and construction package development, and cost estimate development for the outside boundary limit systems and equipment for the Project. The systems and equipment include modifications to the river water system; a new cooling water loop, cooling tower, and circulating water pumps; steam lines and condensate return lines between the existing facility and carbon capture island; flue as ductwork and ductwork support structures; warehouses; and connection of multiple plant utility systems.

RHINELANDER GAS COMPRESSOR | WEC ENERGY GROUP

Rhinelander, Wisconsin | Nov 2020 - Aug 2022

Project Manager. Natural gas compressor station for peaking service during peak gas usage periods. The project includes project development, site selection, cost estimate development, and permitting for the compressor station. The station will include a reciprocating natural gas compressor, vent gas recovery system, electrical and control equipment, pre-engineered metal building, and site development. Project manager supporting siting the proposed Gas Compressor Station, development of the Certificate of Authority Application for the Project. Work to date include preliminary engineering for site layout and cost estimate development as well as site surveys to support permitting. These surveys include wetland surveys, sound surveys, and a geotechnical investigation. BMcD is currently developing procurement specifications for long-lead time equipment with the intent of proceeding with the project on an EPOC basis once the project is approved by the Wisconsin Public Service Commission.

AARON BENNETT, PE
(continued)

Wisconsin LNG | WEC ENERGY GROUP
Milwaukee, Wisconsin | Apr 2019 - Apr 2023

Project Manageer. EPC project to install Liquified Natural gas (LNG) peak-shaving facilities at two sites in southeast Wisconsin. Supported client in siting the proposed facilities, performing wetland, cultural, and land surveys as well as permitting with local, county, and state agencies. Performing Owner's Engineer type role for Owner Supplied Equipment (LNG Tank and LNG Process Equipment). Executing the remainder of the scope on an EPC basis including purchasing gas compressors, electrical and control equipment, construction of the facility with the exception of the LNG Tanks, and commissioning and startup of the LNG Facilities.

Multiple Steam Stations | DUKE ENERGY
North Carolina | Oct 2015 - Jul 2019

Project Manageer. The program involved developing the scope, design, schedule, and cost estimates to bring multiple sites into compliance with the EPA effluent limitations guidelines and CCR rule. In general, the scope included closing the ash pond and redirecting flows to a treatment plant. Duties included erosion & sediment control plans, hydrologic & hydraulic calculations, drainage design, site grading, road design, development of contract drawings and specifications. Three sites as part of a program focused on CCR and ELG compliance at 10 operating plants. The scope of work consisted of dry bottom ash conversions, wastewater treatment of FGD blowdown and plant process water and retention basins for treatment of plant process water. The project included preliminary engineering, detailed design, permitting support, equipment procurement and field engineering support. Responsibilities include scope definition with client during initial phase, coordination of engineering design activities, procurement of major engineered equipment, and development of construction contracts.

Four Corners SCR Project | Arizona Public Service
Fruitland, New Mexico | Apr 2014 - Jan 2019

Project Manager and Engineering Manager. Project to support APS as Owners Engineer for the Units 4 & 5 SCR Project. Mr. Bennett led the engineering team in evaluation of the EPC contractor's open-book proposal. This included review of multiple SCR system arrangement options, OEM proposal evaluation, and detailed review the contractor's proposal and cost estimate. After EPC contract award, Mr. Bennett has continued to lead the technical team in evaluation of the EPC contractor's technical submittals, schedule, and installed equipment and material. The project consists of new SCR's, economizer waterside bypass system, air preheaters, urea to ammonia conversion equipment, and dry sorbent injection system for two 770 MW coal fired units.

Ghent Generating Station Units 1, 2, 3, & 4 | LG&E AND KU SERVICES COMPANY
Ghent, Kentucky | Oct 2014 - Dec 2016

Project and engineering manager. Project to capture and transport stormwater that potentially contains CCR material to a designated CCR treatment basin. The project included significant modifications to site grading and underground stormwater piping. New pumps along with corresponding new electrical and control equipment were utilized to convey water from the CCR area to the treatment basin several thousand feet away.

Sibley Generating Station Car Shaker Building | EVERGY METRO INC
Sibley, Missouri | Oct 2014 - Dec 2016

Project and engineering manager. Multiple structural upgrade projects at Sibley Station. Projects include a clarifier enclosure and foundation, electrical building, various monorails, access modifications, and miscellaneous foundations.

AARON BENNETT, PE
(continued)

Allen Steam Station | DUKE ENERGY
Belmont, North Carolina | Oct 2015 - Oct 2016

Project and engineering manager. Project to install a redundant gray water tank. Project includes design of a new field erected tank, new pile supported foundation, and interconnecting piping and control valve. BMcD performed the detailed design and assisted OG&E with procurement of the field erected tank, foundations and earthwork construction contract, and mechanical construction contract.

Muskogee 4,5, 6 Bottom & Waste Ash Stackout Pad | OGE ELECTRIC SERVICES CORPORATION
Fort Gibson, Oklahoma | Jun 2015 - Apr 2016

Project and engineering manager. Project to achieve compliance with CCR regulations prior to the compliance deadline. Mr. Bennett led the team in evaluation of the various compliance options and development of the detailed design packages to support to implement the compliance plan. Mr. Bennett and several design engineers participated in commissioning of the modified systems to facilitate completion prior to the deadline.

SOONER STATION CCR UPGRADES | OGE ELECTRIC SERVICES CORPORATION
Red Rock, Oklahoma | Jun 2015 - Apr 2016

Project and engineering manager. Project to achieve compliance with CCR regulations prior to the compliance deadline. Mr. Bennett led the team in evaluation of the various compliance options and development of the detailed design packages to support to implement the compliance plan. Mr. Bennett and several design engineers participated in commissioning of the modified systems to facilitate completion prior to the deadline.

Ghent Generating Station | LG&E AND KU SERVICES COMPANY
Ghent, Kentucky | Mar 2013 - Apr 2016

Engineering Manager and Lead Structural Engineer. Responsible for design review, schedule review, and project oversight of work performed by the EPC contractor and equipment suppliers. The project consists of new pulse jet fabric filters, ash handling equipment, ID fans, activated carbon injection, interconnecting ductwork, and associated structural steel and foundations at four units on site. In addition, Mr. Bennett performed inspections of existing ductwork and developed contract documents for reinforcing and modification of the existing ductwork to meet increased design pressures.

Ghent CCR Warehouse | LG&E AND KU SERVICES COMPANY
Ghent, Kentucky | Jul 2014 - Mar 2016

Project and engineering manager. Project to improve operability of the CCR material handling area. The project included demolition of existing drag chain conveyors and installation of new bottom ash bunkers in their place. Installation of the bottom ash bunkers required significant modifications and resupport of the existing submerged chain conveyor building as well as relocation of underground duct bank and associated electrical and control cables. The project also included a new elevator, new storage warehouse, and multiple access platforms.

Warren County Power Station | WARREN COUNTY ENERGY PARTNERS
Front Royal, Virginia | Jun 2011 - Oct 2012

Structural engineer. Project was a joint venture with Zachry. Hired by Dominion Virginia Power to perform engineering, procurement and construction Services for a 1,300+ MW Gas Fired power facility. Project consisted of three MHI 501G gas turbines and a MHI TCF4 Steam Turbine. Responsible for various aspects of structural design and contract management on a new 3-on-1 Combined Cycle Power Plant that was constructed on an EPC basis. Mr. Bennett was responsible for the steam

AARON BENNETT, PE
(continued)

turbine crane procurement package and the micropiling construction subcontract. The micropiling construction contract was complicated by karst geology, including sinkholes and highly variable rock depths, and a subsurface endangered species. Mr. Bennett was responsible for concrete foundation and piling design for the Heat Recovery Steam Generator, Pipe Rack, Boiler Feed Pump, and multiple other equipment and structures. He was also responsible for coordination of structural aspects on multiple mechanical and electrical equipment contracts.

Musheireb Downtown Doha | MSHEIREB PROPERTIES
| Oct 2010 - Dec 2011

Structural engineer. Provided Design/Bid/Build services and constructed reinforced concrete buildings. Responsible for design of four story underground reinforced concrete parking structures and interconnecting service tunnels as part of a large development project in Doha, Qatar. The parking structures supported above grade, multistory, multiuse reinforced concrete structures from transfer slabs at ground level and utility rooms located throughout the lower levels. In addition, Mr. Bennett coordinated structure interface and expansion joint details between multiple architectural and engineering entities.

Units 3 and 4 AQCS Retrofit | NRG Energy, Inc.
Delaware | Jun 2009 - Sep 2010

Lead Ductwork and Structural Steel Engineer. Air quality upgrade project on Unit 4 of the Indian River Generation Facility. The project included new flue gas ductwork and corresponding support steel, utility racks, platforms, and evaluation and repair of existing ductwork. Mr. Bennett was responsible for procurement packages and structural design of ductwork, structural steel, and fabric expansion joints.

MSAT II Reformate Stripper Project | Valero Energy Corporation
Multiple Locations | Mar 2009 - Aug 2009

Structural engineer. Provided engineering, procurement, and construction services for new heart-cut reformate splitters at three refineries. Units reduced the benzene content of reformate to comply with Environmental Protection Agency Mobile Source Air Toxics Tier 2 (MSAT2) regulations. Responsible for design of reformate splitter baffle wall for vessels associated with benzene reduction projects at multiple refineries. Mr. Bennett also coordinated and designed radial access platforms for new vertical vessels at the various project sites.

Crystal River SCR and FGD Upgrade | Environmental Partners Crystal River
Florida | Jun 2007 - Apr 2009

Structural engineer. Clean Air EPC project for Progress Energy. Included the addition of two SCRs, two wet scrubbers, ID fans, reagent prep, limestone and gypsum material handling, related equipment and modifications to two ESPs for the two 750 MW units. Included retrofitting two 750MW coal fired power plant units with SCR and wet FGD systems. Responsible for analysis and design of ductwork support and utility support steel as well as coordination of structural issues with Burns and McDonnell's EPC partners. Additionally, Mr. Bennett designed support saddles for large diameter FRP ductwork and assisted in SCR support truss erection planning.

Thomas Hill Environmental Controls Retrofit Project | Associated Electric Coop Inc
Missouri | Feb 2006 - Dec 2007

Structural engineer. Responsible for analysis and design of ductwork; ductwork, SCR, and air preheater support structures; and SCR connections. Mr. Bennett designed drilled shaft and micropile supported foundations. He also served contract engineer for fabrication of the structural support steel and fabric expansion joints

JUSTIN SCHNEGELBERGER, PE

Engineering and Strategy Manager – Decarbonization & Emerging Technology

Mr. Schnegelberger oversees engineering and strategy for decarbonization and emerging technology markets within Burns & McDonnell's Power Division. He focuses on market and opportunity development in this space and is responsible for client and vendor relationship development and management for decarbonization technologies (including but not limited to carbon capture, direct air capture, hydrogen, long duration energy storage, and non-traditional power generation technologies)

EDUCATION

- BS, Mechanical Engineering

REGISTRATIONS

- Professional Engineer (KS)

16 YEARS WITH BURNS & MCDONNELL

17 YEARS OF EXPERIENCE

Mr. Schnegelberger has also served as Proposal Manager for EPC project, Lead Performance Engineer, Project Manager, Development Engineer, Contract Engineer, and Owners Engineer on combined-cycle, simple-cycle, coal-fired, cogeneration, combustion turbine inlet cooling, carbon capture, compressed air energy storage, and renewable energy projects. In these roles, responsibilities include performance testing, thermal performance evaluation, estimation and optimization, equipment specification, contract award and management, conceptual design, technical feasibility, economic analysis, cost estimating, and preliminary scheduling. Below is a sampling of recent experience.

Carbon Capture and Direct Air Capture Technology Manager

2021-Current

Technology and Business Manager for post combustion carbon capture and Direct Air Capture (DAC) technology and projects. Responsible for technical development of carbon capture and DAC opportunities and internal carbon capture and DAC business unit development to support carbon capture and DAC technology and project opportunities. Work with technology suppliers and end-user to develop and implement carbon capture and DAC solutions.

Development Engineering Manager

2018-2023

Responsible for management of proposal managers and development engineering and oversight of project development work ranging from initial conceptual design and evaluation through to thermal performance and acceptance testing. Specialized in project scoping, technology evaluation, new and existing generation assessment, generation planning, project development, generation capital and operating cost estimating and development, conceptual design, feasibility evaluation, and thermal performance for all types of generation projects including fossil and renewable generation, decarbonization technologies, and new and emerging technologies.

EPC Proposal Manager

2015-2018

Proposal Manager and Engineering Manager for gas turbine EPC proposals. Project include simple cycle, combined cycle, and cogeneration/combined heat and power projects. Plant sizes range from small 50 MW aeroderivative and frame combustion turbines to 1000+MW advanced class turbine combined cycle projects, and have included all the major combustion turbine technology suppliers. Responsibilities include preliminary design oversight, schedule development, contract negotiations, management of the engineering team, and overall proposal development management.

JUSTIN SCHNEGELBERGER, PE

(continued)

Sutter Energy Center Carbon Capture Unit (CCU) Feed Study, Calpine Corp.

Sutter County, California | 2023-Present

Lead project development engineer for the Project Management Contractor/Owner's Engineer (PMC/OE) support services for a Carbon Capture Unit (CCUS) at Calpine Corp's existing natural gas combined-cycle power plant. Burns & McDonnell is operating as an extension of CALPINE, providing oversight and review of the front-end engineering design (FEED) contractor.

CO2 Capture and Compression Plant Evaluation Owners Engineer, Basin Electric Power Cooperative

North Dakota | 2010

Lead project development engineer. Owner's engineer for technology provider bid review and FEED evaluation of a 120 MW equivalent slip stream CO2 capture and compression plant at the existing Antelope Valley station. Responsibilities included technical evaluation of CO_2 capture plant technology provider proposals, technology provider design review, performance evaluation, steam turbine integration, and technical submittal review.

Multiple Projects

2013-2016

Lead performance engineer/performance manager in charge of overall thermal performance evaluation, modeling, and optimization for all performance related projects and project activities. Responsibilities include development, oversight, and quality control of thermal performance evaluation, detailed thermal performance modeling and estimation, performance optimization, equipment selection and evaluation, performance test direction and oversight, contract performance review and guarantee parameter development and definition.

Basin Electric Power Cooperative

2014-2015

Project development lead. New generation planning evaluation for combined and simple cycle projects located in North Dakota. Project scope includes technology evaluation and Project Definition Report (PDR) for new combined cycle and simple cycle generation. Responsible for oversight and management of technology assessment considering multiple configurations of combined cycle and simple cycle generation. After completion of the technology assessment, responsible for oversight of the PDR developed a 2x1 combined cycle facility including conceptual plant design and development of engineering deliverables (site general arrangement drawings, electrical one-line diagrams, water balances, project schedule, plant definitions, and thermal performance estimation and evaluation) to support development of project capital and O&M cost estimates, as well of development of major equipment purchase specifications.

New Generation Project Development | Sask Power

2014-2016

Project development lead. New generation planning evaluation for combined and simple cycle projects located in Saskatchewan, Canada. Project scope includes technology evaluation and Project Definition Report (PDR) for new combined cycle and simple cycle generation at greenfield and brownfield sites. Responsible for oversight and management of technology assessment considering multiple configurations of combined cycle and simple cycle generation. After completion of the technology assessment, responsible for oversight and management of the PDR developed for two combined cycle and two simple cycle generation options including conceptual plant design and development of engineering deliverables (site general arrangement drawings, electrical one-line diagrams, water balances, project schedule, plant definitions, and thermal performance estimation and evaluation) to support development of project capital and O&M cost estimates.

JUSTIN SCHNEGELBERGER, PE

(continued)

Capital Power

2013-2015

Performance manager. New combined cycle generation located in Alberta, Canada. Project scope includes development of major equipment (CTG, HRSG, and STG) procurement specifications, and proposal bid, evaluation, negotiation and award. Additional project scoping and definition evaluations performed to determine overall plant configuration and scope.

Queen Elizabeth Power Station | SaskPower

2013-2016

Performance manager. Queen Elizabeth Power Station Repowering project is a 6x1 combined cycle project located in Saskatchewan, Canada. Project scope includes addition of six Hitachi H25 gas turbines, six once through steam generators, and one condensing steam turbine. Responsible for oversight of project thermal performance direction and activities.

Riverton Power Station | Empire District Electric Company

2013-2016

Performance manager & lead performance engineer. Conversion of an existing simple cycle Siemens V84.3 gas turbine to a1x1 combined cycle during EPC proposal phase carrying through to project award and execution. Scope of work included thermal performance optimization, cycle design, project guarantee development, negotiation of EPC contract, equipment specification development, evaluation, negotiation and award.

CAMP Project Evaluation for Lansing Generating Station | Alliant Energy

2011

Lead development & performance engineer. A plant evaluation and upgrade study. The study evaluated various plant efficiency upgrades and replacement and maintenance projects for a nominal 340 MW coal fired power plant. Evaluation included various plant efficiency upgrade projects including boiler, steam turbine generator, and BOP systems impact analysis. Responsibilities included conceptual design, plant performance impact estimation and evaluation, plant and project thermal performance optimization, and project economic analysis. Responsible for development of detailed equipment specification for existing steam turbine steam path and equipment upgrade.

CAMP Project Evaluation for Ottumwa Generating Station | Alliant Energy

2011-13

Lead development & performance engineer. A plant evaluation and upgrade study. The study evaluated various plant efficiency upgrades and replacement and maintenance projects for a nominal 725 MW coal fired power plant. Evaluation included various plant efficiency upgrade projects including steam turbine generator and BOP systems impact analysis. The project included a complete steam turbine upgrade and steam path redesign as well as generator upgrade. Responsibilities included conceptual design, plant performance impact estimation and evaluation, plant and project thermal performance optimization, plant system impact estimation and evaluation, and project economic analysis.

65 MW Steam Turbine Repower Assessment | South Mississippi Electric Power Association

Mississippi | 2008-2012

Lead performance and contract engineer. A 65 MW steam turbine repowering project in Mississippi. Responsibilities included conceptual design, performance estimation and evaluation, performance optimization and modeling using GE's GateCycle software, technical specification development, performance testing, coordination with third party consultants to

JUSTIN SCHNEGELBERGER, PE

(continued)

conduct a steam path evaluation and evaluation of existing equipment for possible upgrades to the existing steam turbine and other equipment, development of plant heat balances, and plant performance testing.

1300 MW Combined Cycle Power Plant EPC Proposal | Saudi Electricity Company

Saudi Arabia |2011-2012

Lead performance engineer. A 1,300 MW combined cycle power plant project in Saudi Arabia. Plant consists of multi-unit "E" gas turbines in combined cycle configuration utilizing air cooled plant heat rejection. Gas turbine evaluation included Siemens and GE "E" class units. Responsibilities included conceptual design, plant thermal performance estimation and evaluation, development of plant heat balances, thermal performance optimization and modeling using GateCycle software, development of equipment technical specifications, and system design.

1700 MW Combined Cycle Power Plant EPC Proposal | Saudi Electricity Company

Saudi Arabia | 2011-2012

Lead performance engineer. A 1,700 MW combined cycle power plant project in Saudi Arabia. Plant consists of multi unit "F" gas turbines in combined cycle configuration utilizing air cooled plant heat rejection. Gas turbine evaluation included Siemens and GE "F" class units. Responsibilities included conceptual design, plant thermal performance estimation and evaluation, development of plant heat balances, thermal performance optimization and modeling, development of equipment technical specifications, and system design.

Saudi Electricity Company

Saudi Arabia | 2010-2011

Lead performance engineer. A 1,200 MW simple cycle to combined cycle conversion project in Saudi Arabia. Existing plant consists of 40 simple cycle gas turbines to be converted to 10 4x1 air cooled combined cycle plants. Responsibilities included conceptual design, performance estimation and evaluation, and performance optimization and modeling using GE's GateCycle software.

CO_2 Capture and Compression Plant Evaluation, Tenaska

Texas | 2010

Lead project development engineer. Owner's engineering support for the nominal 900 MW Trailblazer coal fired power plant. The plant includes CO_2 capture and compression. Responsibilities included technical and performance evaluation for the plant as well as technical review and evaluation of potential CO_2 capture technology providers.

CO_2 Capture and Compression Preliminary Design and Estimating, Powerspan Corporation

2009

Lead project development engineer. Led technical evaluation of CO_2 compression technology and equipment conceptual design for a 140 MW subcritical lignite fired pulverized coal plant. Responsibilities included conceptual design for integration of the CO_2 capture process, technical review of the CO_2 capture process, and technical and economic evaluation of CO_2 compression technology and options.

CO_2 Capture and Compression Preliminary Design and Estimating, Powerspan Corporation

Louisiana | 2009

Lead project development engineer. Feasibility evaluation for the implementation of CO_2 capture and compression at the existing Entergy Nelson Unit 6 600 MW Subcritical Lignite fired pulverized coal plant for the integration and balance of plant design to support addition of the Powerspan Corp. CO_2 capture process. Responsibilities included conceptual design,

project definition, performance modeling and plant performance evaluation, capital cost estimating, and feasibility evaluation.

CO_2 Capture and Compression Preliminary Design and Estimating, Powerspan Corporation
Louisiana | 2009

Lead project development engineer. Feasibility evaluation for the implementation of CO_2 capture and compression at the existing Entergy Nelson Unit 6 600 MW Subcritical Lignite fired pulverized coal plant for the integration and balance of plant design to support addition of the Powerspan Corp. CO_2 capture process. Responsibilities included conceptual design, project definition, performance modeling and plant performance evaluation, capital cost estimating, and feasibility evaluation.

CO_2 Capture and Compression Preliminary Design and Estimating, Powerspan Corporation
Texas | 2008

Lead project development engineer. Feasibility evaluation for the implementation of CO_2 capture and compression at the proposed 800 MW supercritical pulverized coal Tenaska Trailblazer Energy Center. Provided plant integration and balance of plant design support to Powerspan Corp. for the addition of their CO_2 capture and compression facility to the proposed 800 MW unit. Responsibilities included conceptual design, project definition, performance modeling and plant performance evaluation, capital cost estimating, and feasibility evaluation.

CO_2 Capture and Compression Preliminary Design and Estimating, Powerspan Corporation
North Dakota | 2008

Lead project development engineer. Feasibility evaluation for the implementation of CO_2 capture and compression at the existing 450 MW subcritical lignite fired pulverized coal Antelope Valley Station. Provided plant integration and balance of plant design support to Powerspan Corp. for the addition of their CO_2 capture and compression facility to the proposed 800 MW unit. Responsibilities included conceptual design, project definition, performance modeling and plant performance evaluation, capital cost estimating, and feasibility evaluation.

DOUG RANDALL, PE

Lead Process Engineer

Doug works as a Lead process Engineer for Burns & McDonnell. He is involved in projects relating to wastewater treatment, DSI injection and other chemical process aspects of air pollution and water treatment for power stations. Doug supports air and water pollution control projects taking into consideration the relationship between the air pollution control technologies and the subsequent wastewater treatment technologies. Doug has previously supported the preparation of permit applications for new and modified air pollution sources under state and federal New Source Review and PSD permit programs. Doug has assisted on matters requiring regulatory analysis and interpretation. In this capacity, he is involved in preparation of Best Available Control Technology (BACT) and Maximum Achievable Control Technology (MACT) analyses. Doug is familiar with flue gas desulfurization (FGD) process chemistry, with additional experience in permit application and regulatory analysis. Doug's FGD system experience includes work with FGD waste treatment, wastewater treatment and processes and equipment for systems based upon natural oxidation, forced oxidation, and inhibited oxidation. As part of control technology reviews for BACT analyses, Doug has reviewed the development of post combustion NO_x control techniques including selective catalytic reduction (SCR) and various combined SO_2/NO_x control technologies. Doug has performed the evaluation of candidate technologies for specific applications at utility plants considering new or retrofit FGD installations. Doug has also performed the evaluation of candidate technologies for the elimination or treatment of FGD wastewater and miscellaneous other wastewater streams to minimize site discharges, comply with mercury emission limitations, or comply with the Effluent Limitation Guidelines (ELG).

EDUCATION

Bachelors, Chemical Engineering, 2000

23 YEARS OF EXPERIENCE

Carbon Capture | Rainbow Energy Center

Rainbow Energy/EERC Underwood, ND | August 2022-Present

FEED Study for outside boundary limits systems and equipment for a Carbon Capture Facility at both Units at Rainbow Energy Center. The project includes preliminary design, model development, procurement and construction package development, and cost estimate development for the outside boundary limit systems and equipment for the Project. The systems and equipment include modifications to the river water system; a new cooling water loop, cooling tower, and circulating water pumps; steam lines and condensate return lines between the existing facility and carbon capture island; flue as ductwork and ductwork support structures; warehouses; and connection of multiple plant utility systems.

ELG Compliance | Confidential Client

Multiple Confidential sites | 2023-Present

Lead process engineer for multiple sites reviewing how to manage wastewater from multiple ponds that will be shutting down or leachate from landfills that are or soon will be closed down. Evaluations include identifying multiple handling approaches from direct discharge, physical/chemical treatment, biological treatment, and multiple zero liquid discharge options. Discuss the pros/cons of these options and for options deemed worthy of further review, development of Class 5 and 4 cost estimates.

DOUG RANDALL, PE (continued)

Gas Conversion/Co-firing | Multiple Clients

Multiple Sites | 2020-Present

Lead process engineer for multiple sites reviewing the potential impacts on AQCS equipment at a coal fired facility when the unit is firing 100% natural gas or cofiring up to 100% natural gas. Evaluations include identifying what AQCS equipment must remain in operation, benefits/costs of operating existing equipment, identification of necessary modifications, determination of any waste byproducts produced under these future conditions. If byproducts are produced, evaluate how the existing waste treatment systems will operate and discuss the environmental impacts of the waste stream with and without future treatment.

ELG Compliance | Wisconsin Electric Cooperative

Elm Road | 2020-Present

Lead process engineer for now Engineer/Procure/Construct (EPC) project to reuse existing treatment system to achieve ELG limits for FGE wastewater and existing limits for low volume waste through the modification of the existing physical, chemical treatment system, addition of biological treatment for FGD wastewater and additional filtration for low volume wastes. Project began with an ACCE Class 4 cost estimate to evaluate ELG compliance costs to achieve selenium removal, stream concentration, and zero liquid discharge conditions. This evaluation included reviewing options to treat after an existing treatment system and options to the chloride concentration in the scrubber to minimize the overall treatment rate. Options evaluated included biological treatment, zero valent iron, membrane concentration, brine concentration and/or crystallization, and slip stream evaporators.

SCS - PLANT BOWEN WWT 2020 | Georgia Power Co.

Euharlee, Georgia | April 2019 - Sep 2021

Project team. Perform an ACCE Class 3 cost estimate to evaluate compliance costs to achieve metals removal, including selenium, to maintain the anticipated effluent limitation guidelines limits on FGD blowdown. This evaluation included reviewing options to reuse existing treatment equipment to minimize capital cost and increase the chloride concentration in the scrubber to minimize the overall treatment rate. The evaluation reviewed both operating practice changes to increase chlorides as well as a review of the fuels utilized to determine the fuels driving the equipment sizing. Project Resulted in estimating an EPC price for the project for the client to use for budgeting/planning.

Water Redirect and FGD Wastewater Treatment | Duke Energy.

Midwest, South Carolina and Florida | 2015-2019

Lead process engineer for a fleet modification of management and pollution control of wastewater at eight plants and FGD blowdown treatment at five plants. The water reduction portion of the project included the redirection of numerous wastewater streams to new settling ponds and associated chemical treatment to address the closure of existing ponds and the addition of remote submerged flight conveyors (SFC). The FGD blowdown treatment included the specification, bid, award and contract management of three physical chemical and biological treatment system and two ultrafiltration systems at existing biological treatment facilities.

Spurlock CCR/ELG Compliance Project | East Kentucky Power Cooperative

Maysville, Kentucky | 2017 - Present

Project Consultant. Performed original planning study to select FGD wastewater treatment system, including evaluation of options to limit scrubber wastewater. Consulted with lead process engineer on the execution project. The project scope includes treatment of Units 1 and 2 flue gas desulfurization (FGD) process flows, new fly ash handling and storage silo for

DOUG RANDALL, PE (continued)

Units 1 & 2, bottom ash conversion from “wet sluicing system” to “dry” handling system, ash pond closure by removal, and establishment of a new water mass balance (WMB) pond to aid in water quality.

Regional Haze Compliance | Minnkota Power Cooperative, Inc.

Center, North Dakota | May 2018 - Present

Project Lead. Performed a Regional Haze evaluation of steps 1 through 4 for the reduction of NO_x and SO_2 emissions from the two units at Milton R. Young for the purposes of submitting the report to the state and supporting the client responding to comments. Supported the client in coordinating with equipment suppliers to perform boiler testing so that boiler specific performance and costs could be developed for this report. Coordinate with scrubber suppliers to provide site specific scrubber upgrade options and costs. Evaluated the vendor information and included balance of plant cost estimate to provide a 'fully installed' cost estimate and associated dollars-per-ton removal cost for each technology.

Merom Generating Station Industrial Water Treatment Plant | Hoosier Energy Rural Electric Cooperative, Inc.

Merom, Indiana | Sep 2013 - Feb 2017

Lead process engineer. Worked on the specification, bid, award and contract engineering of a physical chemical treatment facility for the all the process waste water discharge of a 2x500-MW facility. Developed technical specifications for final system, evaluated bids and recommend contract award. Coordinate the review and tracking of drawings to ensure that submittals meet the specification. Coordinated with contractor and owner on questions and clarifications during project.

Merom Generating Station U1 ACI SIlo | Hoosier Energy Rural Electric Cooperative, Inc.

Merom, Indiana | Oct 2013 - Apr 2016

Project manager and lead process engineer. Worked on the budgetary cost estimate for standalone or a common activated carbon system for 500-MW units. Coordinate equipment location with the client, and coordinate discipline engineers to estimate site specific quantities for a detailed estimate of an installed cost.

SCR Upgrades, Merom Station | Hoosier Energy Rural Electric Cooperative, Inc.

Indiana | Jan 2012 - Jun 2015

Contract engineer. Worked on the installation of SCR on two 500-MW units. Reviewed and tracked drawings to ensure submittals meet the specifications and are returned in a timely manner. Coordinated with contractor on questions and clarifications during project.

ESP Rebuild Project | Hoosier Energy Rural Electric Cooperative, Inc.

Merom, Indiana | Feb 2010 - Dec 2014

Project manager and lead process engineer. Worked on the replacement of ESP on two 500-MW units. Developed and issued specifications, evaluated bids and recommended contract award. Developed technical specifications for final system, evaluated bids and recommend contract award. Coordinate the review and tracking of drawings to ensure that submittals meet the specification. Coordinated with contractor and owner on questions and clarifications during project.

Dry Sorbent Injection Evaluation and Award | Hoosier Energy Rural Electric Cooperative, Inc.

Indiana | Feb 2010 - Dec 2013

Project manager and lead process engineer. Worked on the addition of a dry sorbent injection system on two 500-MW units. Evaluated potential vendors and participated in on-site sorbent injection testing and data analysis. Developed technical specifications for final system, evaluated bids and recommend contract award. Coordinate the review and tracking of

drawings to ensure that submittals meet the specification. Coordinated with contractor and owner on questions and clarifications during project.

Dendron Site Rail Traffic Impact Study | Old Dominion Electric Cooperative

Virginia | Jun 2007 - Dec 2012

Project team. This rail impact study was related to the proposed construction of a new coal-fired power generating facility near Dendron, Virginia. The purpose of the study was to determine the effects that proposed at-grade rail crossings would have on the local roadway network. Performing BACT and MACT analysis for the preparation of PSD permit application and state permit applications for two 750MW coal fired units. The analyses included determining BACT and MACT emission rates for a PC boiler firing bituminous coal and blending renewable resource fuels.

Confidential Project | Confidential Client

Confidential Location | Feb 2010 - Apr 2012

Project team. Alliant's Edgewater Generating Station AQCS projects included the retrofit of a dry scrubber, fabric filters and flue gas fans for the coal-fired Units 4 & 5, approximately 350 MW each. Performed SO2 BACT analysis for an existing 430 MW Unit for the consideration of the Client regarding future SO2 control plans. Separately, performed an analysis of emission and fuel data of existing semi-dry FGD systems for the Client's submission to the U.S. EPA demonstrating what emission rates and control levels have been maintained in practice.

Cooper Power Station | City of Kansas City, Missouri

Kansas City, Missouri | Jan 2011 - Jan 2012

Project team. Performed computer fluid dynamic modeling of the forced draft fan outlet air flow through a new slip stream duct and to the air heater. Minimize pressure drop between the forced draft fan and the air heater will maintaining sufficient air flow to the slip stream duct. Indian River | Indian River Power, LLC

Compliance Option Study | Northern Indiana Public Service Company, Inc.

Jun 2009 - Oct 2011

Project team. Updated previous multi-pollutant control study requirements on electricity generating units. Developed a program to determine the lowest cost compliance options across multiple units accounting for capital, operating cost estimates and multiple compliance methodologies. Evaluated allowance trading across systems of seven boilers or less.

Overfire Air Retrofit, Laramie River Station Units 1, 2 & 3 | Basin Electric Power Cooperative

May 2008 - Jul 2010

Project team. Performed computer fluid dynamic modeling of the duct work for a new overfire air system. Developing turning vanes to minimize pressure drop and confirm flow distribution.

BACT Analysis, NextGen Project | Basin Electric Power Cooperative

Sep 2006 - May 2010

Project team. Performed BACT analysis for the preparation of PSD permit application and state permit applications for one 700MW coal fired unit. The BACT analysis included determining BACT emission rates for a PC boiler firing PRB coal.

DOUG RANDALL, PE (continued)

Cholla Station Unit 3&4 AQCS Project | Cholla Environmental Partners

Mar 2006 - Jan 2010

Project team. Performed computer fluid dynamic modeling of the duct work from the air heater outlet to the stack. Developed turning vanes to minimize pressure drop and improve flow distribution at the inlet of control equipment.

Thomas Hill Environmental Controls Retrofit Project | Associated Electric Cooperative Inc.

Missouri | May 2005 - Sep 2008

Contract engineer. Worked on the retrofit of an ESP on a 670-MW unit. Wrote specifications and bid documents. Reviewed initial bids for required changes and clarifications. Reviewed and tracked drawings to ensure specifications are met and submittals are returned in a timely manner.

Big Stone II, Otter Tail Power | Otter Tail Power Company

Jun 2004 - Jul 2008

Project team. Evaluated FGD system bid proposals for Big Stone II power plant project.

Multi-Pollutant Control Study | Northern Indiana Public Service Company, Inc.

Sep 2005 - Nov 2007

Project team. Reviewed the impact of pending air quality regulations and proposed multi-pollutant control legislation on electricity generating units. Developed capital and operating cost estimates for various compliance scenarios. Studies evaluated systems consisting of between four and eleven boilers.

Multi-Pollutant Control Study | San Miguel Electric Cooperative, Inc.

Aug 2005 - Sep 2007

Project team. Reviewed the impact of pending air quality regulations and proposed multi-pollutant control legislation on electricity generating units. Developed capital and operating cost estimates for various compliance scenarios. Studies evaluated systems consisting of between four and eleven boilers.

Multi-Pollutant Control Study | Vectren Corporation

May 2004 - Aug 2007

Project team. Reviewed the impact of pending air quality regulations and proposed multi-pollutant control legislation on electricity generating units including A.B. Brown, F.B. Culley and Warrick Generating Station. Developed capital and operating cost estimates for various compliance scenarios. Studies evaluated systems consisting of between four and eleven boilers.

Nelson Dewey Generation Station Unit 3 | WISCONSIN POWER AND LIGHT COMPANY

Oct 2005 - May 2007

Project team. Performed BACT analysis for the preparation of PSD permit application and state permit applications for two 300MW coal fired units. The BACT analysis included determining BACT emission rates for a PC boiler firing PRB coal and renewable resource fuels and a CFB boiler firing bituminous coal, PRB coal, petroleum coke and up to 20% renewable resource fuels.

DOUG RANDALL, PE (continued)

Limestone Electric Generating Station | GENON ENERGY INC

Apr 2002 - Feb 2007

Project team. Study to determine the cause of a recent increase in opacity. Created a report that recommended tests that could be run to determine the source of the opacity increase and possible scenarios to reduce opacity without reducing load.

SCR Installation Project | City of Henderson, Kentucky

May 2001 - Jan 2007

Contract engineer. Worked on the installation of SCR on two 180-MW units. Wrote specifications and bid documents. Reviewed initial bids for required changes and clarifications. Reviewed and tracked drawings to ensure specifications are met and submittals are returned in a timely manner.

Contract Consulting | City of Springfield, Missouri

Apr 2005 - Dec 2006

Project team. Reviewed contract specifications and client/contractor correspondence and documentation. Prepared a report for use in an arbitration regarding an unresolved contract dispute between the client and a third-party contractor.

Confidential Project | Confidential Client

Confidential Location | May 2004 - Jun 2006

Project team. Reviewed the impact of pending air quality regulations and proposed multi-pollutant control legislation on electricity generating units. Developed capital and operating cost estimates for various compliance scenarios. Studies evaluated systems consisting of between four and eleven boilers.

BACT Analysis | The ERORA Group

Feb 2001 - Dec 2005

Project team. Performed BACT analysis for the preparation of PSD permit application and state permit application for two 500MW coal fired units.

Multi-Pollutant Control Study | Hoosier Energy Rural Electric Cooperative, Inc.

Sep 2004 - Aug 2005

Project team. Reviewed the impact of pending air quality regulations and proposed multi-pollutant control legislation on electricity generating units. Developed capital and operating cost estimates for various compliance scenarios. Studies evaluated systems consisting of between four and eleven boilers.

Coronado Generating Station | Salt River Project

Jan 2002 - Sep 2003

Project team. Study of SO2 removal enhancement alternatives for estimated future regulatory legislation compliance.

Feasibility Study | Vectren Corporation

Aug 2001 - Dec 2002

Project team. Feasibility study for conversion of FGD system at A.B. Brown Units 1 and 2 from dual alkali to lime or limestone process. Estimated operation and maintenance costs for new FGD system.

Timothy E Thomas

Senior Vice President & Deputy General Manager
Engineered Systems Division
Mitsubishi Heavy Industries America

Overview

Mr. Thomas is currently Senior Vice President & Deputy General Manager for the Engineered Systems Division of Mitsubishi Heavy Industries America (MHIA) in Houston, TX and oversees MHIA's CO_2 capture business for North America. He is responsible for safety, business development, project development and implementation from initial concepts, feasibility studies, and FEED studies through project completion. Mr. Thomas has over 38 years of related experience including CO_2 capture systems (CCS), flue gas desulfurization (FGD) systems, material handling systems, wastewater treatment systems, and particulate removal systems.

Project Specific Experience

Directs and oversees the preparation of multiple detailed studies for the application of MHIA's CCS including FEED studies for Prairie State and San Juan power plants. Primary focus on the application and feasibility of installing CCS on power and industrial flue gas sources.

· Project Director from 2002 to 2013 for the design, procurement, construction, and commissioning of FGD systems at multiple TVA fossil fuel power plants. These installations completed on schedule and within budget and valued at over $1 billion were provided to TVA through Advatech, a joint venture of URS and MHIA.

· Project Engineering Manager during the $340 million FGD system retrofit for Pennsylvania Electric's Conemaugh Station Units 1 and 2. Managed development of systems design; design criteria; process and instrumentation diagrams; design calculations and equipment optimization; operating procedures and system descriptions.

· On-site Resident Engineer for the construction of JEA/FPL's St. Johns River Power Park, two 600 MW coal-fired generating units. Oversaw the installation of the FGD systems, electrostatic precipitators, and a wastewater treatment facility.

Specialized Training

BS / 1983 / Mechanical Engineering / University of Florida

Chronology

Mitsubishi Industries America, Inc. – Senior Vice President, Vice President, Deputy General Manager, Engineered Systems Division, 2013 to present
URS Corp. and Advatech LLC, Vice President, Project Director, Project Manager, 1996 – 2013
URS - Raytheon Engineers and Constructors – Ebasco Services, Project Engineering Manager, Principal Mechanical Engineer, Senior Mechanical Engineer, Mechanical Engineer, Sr. Associate Engineer, 1983 - 1996

Name : **Hirotaka Tanaka**

Position in this Project : **Engineering Manager**

The Engineering Manager will be responsible for managing all engineering activities required for the scope of work and will report to the Project Manager. The Engineering Manager will review and approve key engineering documents, technical bid summaries and design specification summary sheets. He will work closely with lead discipline engineers to ensure that the engineering work is completed in an integrated team approach to OWNER's satisfaction.

Criteria for Qualification

- Specialty in Process Engineering mainly for Petrochemical Plants and Fertilizer from the Front-end Engineering to the Pre-commissioning and Start-up Supervision
- Project Management Professional (PMP) Certification #2041397 from May 2017 to May 2026 by Project Management Institute Inc., U.S.A.

Summary of Experience

Fifteen (16) years experiences with Mitsubishi Heavy Industries Group which includes Process Design of Petrochemical Projects and Project Management of After Service Projects.

- Process Engineer for seven (7) years
- Assistant Engineering Manager for three (3) years
- Engineering Manager three (3) year
- Project Manager on After Service Projects for three (3) years

Languages

Japanese	:	Native
English	:	Fluent

Education

Education	:	Fukuoka University
Qualification	:	Bachelor of Chemical Engineering
Joined MHI	:	April 1, 2007

Personal Data

Nationality : Japanese

Date of Birth : April 4, 1984

Position in MHI's Organization **: Engineering Manager, Project Department**

Mr. Tanaka's Significant Experience

Engineering Manager (REC-CCS FEED)

- CO2 Capture Plant — North Dakota, USA

  2022 - Present — CLIENT: Energy and Environmental Research Centre・University of North Dakota
  ENDUSER: Rainbow Energy Centre

  Capacity : 26,800 TPD (13,400 TPD/ 2 Trains)

  Scope of work is front end engineering design.

Engineering Manager (Proposal Work)

- Chemical Plan Project — Overseas

  2020 - 2022

  Capacity : NA

Project Manager (After Service Projects)

- After Service Projects on Methanol Plant (Saudi Methanol Company, AR-RAZI) — Al-Jubail, Saudi Arabia
- After Service Project on Methanol Plant (Methanol De Oriente, METOR, S.A.) — Jose, Venezuela

  2018 - Present

  Capacity : NA

  Equipment Replacement Projects on Methanol Plant, including Basic / Detailed Engineering, Procurement, Construction and Commissioning Supervision.

  Process Design Package (PDP) Work on Methanol Plants.

Engineering Manager (NAG-SB)

- After Service Projects on Polyethylene Plant — Mont Belvieu, Texas, USA

  for ExxonMobil Chemical Company

  2018 - Present

  Capacity : NA

  Revamp Project on Polyethylene Plant, including Basic / Detailed Engineering, Procurement.

Assistant Engineering Manager/ Process Engineer (RSAE)

- Acrylic Acid Complex
  - Acrylic Acid (AA)
  - Glacial Acrylic Acid (GAA)
  - Butyl Acrylate (BA)

  Salavat, Russia

  for JSC Gazprom Neftekhim Salavat (GNS)

  2012 – 2017

  Capacity : Acrylic Acid (AA): 80,000 T/Y
  Glacial Acrylic Acid (GAA): 35,000 T/Y
  Butyl Acrylate (BA): 80,000 T/Y

  Lump Sum Turn Key Basis, including Basic / Detailed Engineering, Procurement, Construction and Commissioning Supervision

Turnover Coordinator (SPOX)

- Polyethylene (LDPE)
  (LLDPE / Metallocene LLDPE): Poly & Fin
  Polypropylene (PP)
  (Homo Polymer): Fin only

  Jurong Island, Singapore

  for ExxonMobil Chemical Company

  2009 - 2011

  Capacity : 650,000 T/Y × 2 (PE)
  450,000 T/Y (PP)

  Detailed Engineering, Procurement, Civil Works and Construction Works

Operation Supervisor (OSF)

- Fertilizer Complex
  - Ammonia
  - Urea
  - Utility and Off-site

  Sohar Industrial Area, Oman

  for Sohar International Urea & Chemical Industries S.A.O.C. (SIUCI)

  2009

  Capacity : 2,000 T/D (Ammonia Plant)
  1,750 T/D (Urea Plant) x 2 trains
  Grassroots utility and off-site facilities

  Lump Sum Turn Key Basis, including Engineering, Procurement, Civil Works and Construction Works, with two years warranty period.

Assistant Process Engineer (TAF Early Work)

- Fertilizer Complex
  - Ammonia
  - Urea
  - Methanol
  - Utility & Offsite

  Tatarstan Republic, Russia

  for Ammoni

  2008

  Capacity : 2,050 T/D (Ammonia)
  2,050 T/D (Urea)
  668 T/D (Methanol)

  Process Design Package

Assistant Process Engineer (SPOX)

- Polyethylene (LDPE)
  (LLDPE / Metallocene LLDPE): Poly & Fin
  Polypropylene (PP)
  (Homo Polymer): Fin only

  Jurong Island, Singapore

  for ExxonMobil Chemical Company

  2007 – 2009

  Capacity : 650,000 T/Y × 2 (PE)
  450,000 T/Y (PP)

Detailed Engineering, Procurement, Civil Works and Construction Works

Name : **Takashi Kurioka**

Position in this Project : **Project Manager**

The Project Manager will be assigned to direct and control all project activities through all phases of the Project. Project Manager will be responsible for execution of the contract to highest level of safety and quality, adherence to specified design requirements and compliance with the project schedule and budget. His principal duties include maintaining close liaison with OWNER's Project Management Team and coordinating all task force work to meet the criteria of job quality.

Criteria for Qualification

- Five (5) years Piping Section management experience
- Thirteen (13) years Project management experience for Process Plants
- Nine (9) years Piping Design experience for Process Plants
- Six (6) years system development for Piping Design (including CAD)
- Hazardous Material Officer, Class B, Group 4

  (He can handle Flammable liquids, gasoline, alcohols, kerosene, light oil, heavy oil,
  animal fats and vegetable oils)
- Internal Quality Auditor for ISO 9001
- Pollution Control Manager (Vibration), in Japan
- High Pressure Gas Safety Manager (Class A, Mechanical) in Japan
- Professional Engineer ("PE") in 2003, certified by Oregon State, USA

Summary of Experience

Thirty-three (33) years experience with Mitsubishi Heavy Industries Group, served as Piping Engineer. Specialist for Piping Technical Analysis, System Development, Assistant Project Manager and Spatial Engineering Manager, and Project Manager.

Languages

Japanese	:	Native
English	:	Business-level Score of the Test of English for International Communication (TOEIC) is 700

Personal Data

Education	:	Waseda University
Qualification	:	Bachelor of Mechanical Engineering
Joined MHI	:	April 1, 1990

Personal Data

Nationality	:	Japanese
Date of Birth	:	January 1, 1968

Position in MHI's Organization **: Senior Project Manager,**
Project Department
Engineering Solutions

Mr. Kurioka's Significant Experience

Project Manager (REC-CCS)

- CO2 Capture Unit — North Dakota, USA

  2022 - present — for Energy and Environmental Research Centre・University of North Dakota
  END USER: Rainbow Energy Centre

  Capacity: 26,800 T/D (13,400TPD/ 2 Trains)

  Scope of work is front end engineering design.

Project Manager (TGF)

- Fertilizer Complex — Garabogaz, Turkmenistan
  - Ammonia
  - Urea — for Turkmenhimiya (TH)
  - Urea(Granulated)

  2013 - present

  Capacity: 2,000 T/D
  3,500 T/D
  3,500 T/D

  Scope of work is basic design, detail design, procurement and construction.

Section Manager, Yokohama Plant Layout & Piping Engineering Section

- Responsible for all Plant Layout & Piping Engineering Activities, including authorization of documents, cost estimation for bidding projects, personnel's mobilization, etc. — Management in MHI

  2012 - 2013

Group Manager, Piping Engineering Group

- Responsible for all Piping Engineering Activities, including authorization of documents, cost estimation for bidding projects, personnel's mobilization, etc.

  2009 - 2012

Management in MHI

Spatial Engineering Manager (SPOX)

- Polyethylene

  2007 - 2009
  Capacity : 650,000 T/Y × 2

Jurong Island, Singapore

for ExxonMobil Asia Pacific Pte. Ltd.

Scope of work is basic design, detail design, procurement and construction.

Piping Engineer (Proposal Work)

- Polyethylene

  2006 – 2007

  Capacity : N.A.

Singapore

Assistant Project Manager (MMPE)

- Polyethylene

  2005 – 2006

  Capacity : 300,000 T/Y

Coatzacoalcos, VER Mexico

for Petroquimica Morelos, S.A. de C.V.

Scope of work is basic design, detail design, procurement and construction

Lead Piping Engineer (MMPE)

- Polyethylene

  2003 - 2004

Coatzacoalcos,VER Mexico

for Petroquimica Morelos, S.A. DE C.V.

Capacity : 300,000 T/Y

Scope of work is basic design, detail design, procurement and construction.

Piping Engineer (BAPE)

- Cryogenic Ethylene & Propylene Receiving and Storage Facility

  1996 – 1998

  Batangas, Philippines

  for J.G. Summit Petrochemical Corp.

  Capacity : Ethylene 15,000 Ton
  Propylene 18,000 Ton

  Lump Sum Turn Key Basis, including Basic / Detailed Engineering, Procurement, Construction, Commissioning Assistance and Training

Piping Engineer (BAPE)

- Polyethylene (L-LDPE/HDPE)

  1996 – 1998

  Batangas, Philippines

  for J.G. Summit Petrochemical Corp.

  Capacity : 87,500 T/Y x 2

  Lump Sum Turn Key Basis, including Basic / Detailed Engineering, Procurement, Construction, Commissioning Assistance and Training

Technical Specialist for Piping

- Specialist for Technical Analysis, including Piping Flexibility and Stress Analysis, Piping Steady State Flow Analysis, Discharge Noise Arise from Venting Analysis

  1993 - 1996 , 1998 - 2003

- Specialist for System Development. Including Two / Three Dimensional Computer Aided Design (AutoCAD / Intergraph PDS), Piping Material Control System which covers Material Takeoff, Purchasing and Control (Intergraph Marian)

  1993 - 1996 , 1998 - 2003

Piping Engineer (MJP)

- Polyethylene (L-LDPE/HDPE)

  1992 - 1993

  Pasir Gudang, Johor Bahru, Malaysia

  for Titan Polyethylene (Malaysia) Sdn. Bhd.

  Capacity : 200,000 T/Y

  COC, Fixed Lump Sum Basis, including Basic / Detailed Engineering, Procurement, Construction and Commissioning Assistance

Assistant Piping Engineer (LL1)

- Polyethylene (L-LDPE/HDPE)

  1990 - 1992

  Oita, Japan

  for Showa Denko K.K.

  Capacity : 60,000 T/Y

  Lump Sum Turn Key Basis, including Basic / Detailed Engineering, Procurement, Construction and Commissioning Assistance

Summary

Mr. Lauzze has 18 years of experience in the heavy industrial and power generating industry. He has recent experience managing large engineering and construction projects at both power plants and industrial facilities. He currently serves as the project directory for several active CO_2 capture projects, including FEED studies at coal plants, gas plants, and industrial facilities. He is also currently the project director for the detailed design and installation of multiple CO_2 capture pilot projects. Mr. Lauzze also was the Project Manager for the design and installation of the Wyoming Integrated Test Center and worked on the Petra Nova project from the development phase through the start-up and optimization phase directly supporting NRG and Parish Station.

Education

Illinois Institute of Technology – B.S. Chemical Engineering – 2003
Illinois Institute of Technology – M.S. Chemical Engineering – 2005

Registrations

Professional Engineer – Illinois, Michigan, and Wyoming

Proficiencies

- CO_2 Capture Systems
- FEL and FEED Study Execution
- Transition from FEED and Large Project Execution

Responsibilities

Mr. Lauzze is responsible for S&L's CO_2 capture business development and technical oversight of all of Sargent & Lundy's CO2 Capture, Transport, and Utilization projects. This includes overseeing regular Communities of Practice (COPs) to ensure that company wide knowledge sharing is occurring to improve the overall design effort on all CCUS projects. In addition, as a Project Director Mr. Lauzze is ultimately responsible for the oversight and overall direction of projects that are executed under him.

Sargent & Lundy Experience

Project Tundra

- 2022 – Present | Owner's Engineer for MHI FEED, Project Director
- 2023 - Present | Air Permit Development, Project Director

Heidelberg

- 2022 - Present | Mitchell Cement Kiln CO_2 Capture Pre-FEED Study, Project Director
- 2024 - Present | Mitchell Cement Kiln CO_2 Capture FEED Study, Project Director

LafargeHolcim

- 2023 - Present | Exshaw Cement Kiln CO_2 Capture Pre-FEED Study, Project Director

Membrane Technology and Research (MTR)

- 2021 – Present | Large Scale Pilot Phase 3 Execution, Project Director
- 2019 - 2021 | Large Scale Pilot Phase 2 FEED Study, Project Director
- 2019 - 2023 | Full Scale CO_2 Capture FEED Study at Dry Fork Station, Project Director
- 2020 - 2022 | CO_2 Capture Pre-FEED Study at Balcones Cement Plant, Project Director

ION Clean Energy

- 2021 - Present | Delta Energy Center FEED Study, Project Director
- 2020 - 2023 | Project Enterprise Pilot Integration at Los Medanos, Project Director
- 2019 – 2021 | C3DC2 FEED Study at Gerald Gentleman Station, Project Director
- 2019 - 2020 | C3DC1 Pre-FEED Study at Gerald Gentleman Station, Project Director

Next Carbon Solutions

- 2022 - Present | Elk Hills Power Plant CO_2 Capture FEED Study, Project Director
- 2021 - 2022 | Rio Grande LNG CO_2 Capture FEED Study Validation, Project Director

Global Thermostat

- 2021 – Present | DAC+ FEED Study ISBL Engineer, Project Director
- 2021 - 2022 | CDAC System Evolution Design Support, Project Director
- 2020 – 2022 | Engineering and Construction Support for DAC2K Pilot System, Project Director

Dakota Gasification Company

- 2022 – 2023 | CO_2 Compressor Expansion Study, Project Director
- 2021 - 2024 | Supercritical CO_2 Pipeline FEED Study and Detailed Design, Project Director
- 2021 – 2024 | Supercritical CO_2 Pipeline Construction Oversight, Project Director

Confidential CO_2 Capture Projects

- 2023 – Present | OE for Chilled Ammonia CO_2 Capture Project, Project Director
- 2022 – Present | CO_2 Compression Feasibility Study for Midstream Client, Project Director

- 2022 – Present | Feasibility Study for Coke Making Client, Project Director
- 2022 – Present | Feasibility Study for Cement Client, Project Director
- 2022 – Present | Feasibility Study for Gas Boiler, Project Director
- 2022 – Present | Feasibility Study for Cement Client, Project Director
- 2022 – 2022 | CO_2 Compression Feasibility Study for Midstream Client, Project Director
- 2022 – Present | Feasibility Study for Cement Client, Project Director
- 2022 – Complete | Feasibility Study for Oil Field, Project Director
- 2021 – Complete Feasibility Study for Cement Client, Project Director
- 2021 – Complete | Feasibility Study for Cement Client, Project Director
- 2021 – Complete | Pre-FEED Study for Cement Client, Project Director
- 2021 – Complete | Feasibility Study for LNG Client, Project Director
- 2021 – Complete | Feasibility Study for LNG Client, Project Director
- 2021 – Complete | Pre-FEED for Oil and Gas Processing Facility, Project Director

Jupiter Oxygen

- 2020 - 2021 | Dave Johnson Oxycombustion FEED Study, Project Director
- 2018 - 2019 | Dave Johnson Oxycombustion Feasibility Study, Project Manager

NPPD

- 2023 - Present | New Generation Project Development and Conceptual Engineering
- 2022 - Present | Sheldon Bottom Ash Project, Project Director
- 2020 - 2022 | Gerald Gentleman and Sheldon Station ACE Rule Evaluation, Project Director
- 2020 - 2022 | Gerald Gentleman Regional Haze Evaluation, Project Director

Basin Electric | LRS SCR/SNCR Project

- 2018 - 2019 | Start Up and Commissioning services, Project Manager
- 2017 - 2019 | Construction Management, Project Manager
- 2016 - 2019 | SNCR Detailed Design, Project Manager
- 2015 - 2016 | SNCR Conceptual Design, Project Manager
- 2015 - 2016 | SNCR Permitting, Project Manager
- 2017 - present | SCR Detailed Design, Project Manager

Basin Electric | Other Projects

- 2019 - 2020 | Laramie River Station Four Factor Analysis, Project Director
- 2020 - present | Antelope Valley and Leland Olds ACE Rule Evaluation, Project Director
- 2015 - 2019 | Dry Fork Integrated Test Center Detailed Design, Project Manager

- 2015 - 2015 | Dry Fork Integrated Test Center FEED Study, Project Manager
- 2018 - 2019 | Dry Fork SCR Pluggage Study, Project Manager
- 2018 - 2019 | Antelope Valley Four Factor Analysis, Project Manager
- 2018 - 2019 | Leland Olds Four Factor Analysis, Project Manager
- 2018 - 2019 | Dakota Gasification Four Factor Analysis, Project Manager
- 2019 - 2020 | Laramie River Coal Silo Weld Detail Analysis, Project Manager

Genesis Alkali | 2018 - Present

Granger Optimization Project Detailed Design, Project Manager

Carbon Capture Machine | 2018 - 2020

ITC Small Test Center Pilot Skid Design, Project Manager

NRG

- 2022 – Present | Texas NOx Evaluation, Project Director
- 2020 – Present | Walking Surfaces Inspection – Various Stations, Project Director
- 2019 – Present | Illinois Plants CCR Support, Project Director
- 2013 - 2017 | Petra Nova Carbon Capture Project Ductwork Detailed Design and Owner's Engineer, Project Manager
- 2016 - 2017 | Homer City NOx Reduction Upgrades Study, Project Manager
- 2015 - 2016 | Fleetwide ELG Compliance Study, Project Manager
- 2012 - 2016 | Parish, Limestone, and Big Cajun MATS Compliance Detailed Design, Project Manager
- 2015 - 2016 | Big Cajun II Natural Gas Piping Detailed Design, Project Manager
- 2014 - 2015 | Limestone Station New Fuel Evaluation, Project Manager
- 2014 - 2015 | Limestone WFGD Study, Project Manager
- 2013 - 2014 | Keystone Water Reuse Study and Cost Estimate, Engineering Manager
- 2012 - 2013 | Cheswick Bottom Ash and WWT Upgrade Study, Engineering Manager
- 2012 - 2013 | Parish Unit 8 CO2 Capture FEED Study, Mechanical Lead
- 2011 - 2012 | Parish Unit 7 CO2 Capture FEED Study, Mechanical Lead

RRI Energy | 2011

ICR Data Collection for EPA Data Request, Engineering Lead

PGE | 2008-2009

Boardman Station Multi Pollutant Study, Mechanical Engineer

AEP | 2007-2011

Cardinal Unit 3 WFGD Project Detailed Design, Mechanical Engineer and Piping Lead

Various Environmental Project Support | 2005-2007

- CLECO | Baghouse Study
- Dairyland Power Cooperative | Multi-Pollutant Study and Dry FGD Specification
- LCRA | Computational Fluid Dynamic (CFD) Analysis to improve ductwork flow and optimize SO_2 reduction
- Ameren | CFD Analysis to lower pressure drop in ductwork
- PacifiCorp | Baghouse and FGD Study at Naughton and Dave Johnston
- San Miguel | WFGD Upgrade Study

Academic Experience

- Fuel Cell Research Assistant at Illinois Institute of Technology
- PEM Fuel Cell Research, focusing on computer modeling and control
- Lithium Ion Battery Research assistant at Argonne National Laboratory

Publications

- “Comparison of IGCC & Pulverized Coal Technologies,” K.C. Lauzze and D.G. Rice, Coal Gen, August 2006.
- “Power Control of a Polymer Electrolyte Membrane Fuel Cell,” K.C. Lauzze and D. J. Chmielewski, Industrial & Engineering Chemistry Research, May 2006.
- “Performance of CO preferential oxidation reactor with noble-metal catalyst coated on ceramic monolith for on-board fuel processing applications,” R. K. Ahluwalia, Q. Zhang, D. J. Chmielewski, K. C. Lauzze, and M. A. Inbody, Catalysis Today, January 2005, pp 271-283.
- "ZrO2- and Li2ZrO3-Stabilized Spinel and Layered Electrodes for Lithium Batteries," M. M. Thackeray, C. S. Johnson, J. -S. Kim, K. C. Lauzze, J. T. Vaughey, N. Dietz, D. Abraham, S. A. Hackney, W. Zeltner and M. A. Anderson, Electrochemistry Communications September 2003.

Summary

Donna has more than 35 years of experience in mechanical design and engineering of electric power generating stations. Her overall experience encompasses all major plant systems and equipment, including cooling towers, condensers, boiler auxiliary equipment, water treatment, selective catalytic reduction (SCR), compressed air and gas, particulate control, flue gas desulfurization (FGD) and waste fixation, activated carbon injection (ACI), dry sorbent injection (DSI), ash handling and CO_2 Systems. Broadly, Donna's tasks have involved procurement specifications, equipment sizing and layouts, system design documents, and drawings. She has contributed to preliminary design studies to determine plant layout, established system design criteria, sized and specified equipment, prepared flow diagrams and designed piping systems, evaluated proposals and made procurement recommendations, and supporting licensing activities. Recent experience includes the Laramie River Station SCR retrofit for Basin Electric Corporation.

Education

Illinois Institute of Technology – B.S. Chemical Engineering

Registrations

Professional Engineer – Illinois, Wyoming

Proficiencies

- Mechanical engineering and design
- SCR, FGD, ACI, DSI, and particulate emissions control systems
- CO_2 systems
- Material handling
- Water treatment
- Compressed air and gas systems
- Plant Retrofits
- Vendor Contract Management

Responsibilities

Donna's responsibilities focus on coordination of engineering, design, and other supportive specialists within the mechanical discipline to ensure compliance of mechanical project work with client

requirements; national, state, and local regulations; applicable Sargent & Lundy standards and procedures; standard professional practices; and project schedules.

Sargent & Lundy Experience

Emissions Control and Plant Retrofits

Minnkota Power Cooperative

- *Milton Y. Young Station Unita 1 &2* - Mechanical Project Engineer performing Owner's Engineer oversite for a CO_2 Capture Feed Study. Coordinating review of consortium design and interface with the operating station, participating in HAZOPs, P&ID reviews, Model reviews and RAM Studies. (2023 – Present).

Drax

- *Pellet Plant Carbon Capture System (PPCS) Projects* **--** Mechanical Project Engineer performing independent reviews of Balance of Pant deliverables for a Pre-FEED study evaluating implementation of a large scale, modular carbon capture utilization and storage system at a biomass facility in Bastrop, Louisiana. (2023).

Membrane Technology & Research (MTR)

- Large Pilot Test Facility - *Mechanical* Project Engineer performing independent reviews of Engineering and deliverables on project to construct a demonstration plant to test MTR's membrane-based post-combustion carbon dioxide (CO_2) capture technology at the Wyoming Integrated Test Center (ITC), located at Dry Fork Station (DFS) Unit 1. (2023).

Dakota Gasification Company

- Mechanical Project Engineer overseeing the preliminary design, cost estimates, and bid evaluation for the addition of CO_2 Compressors to an operating gasification facility. (2022 – 2023)

TransAlta

- Sundance Unit 6, Keephills Units 1 & 2 - Mechanical Project Engineer responsible for Owner's Engineer oversight for EPC Projects converting coal units to operation on natural gas. (2019 – 2021)

Cabot Corporation

- Mechanical Project Engineer for Phase 2 Alternatives Analysis of air pollution control and energy center project for a carbon black facility in Louisiana. The project included conceptual engineering of multiple technologies, conceptual process design, major equipment specification development, project schedule development, cost estimate development, and value engineering for cost reduction. (2019 – 2020)

Basin Electric Power Cooperative (BEPC)

- Laramie River Unit 1 - Mechanical Project Engineer. SCR retrofit, including supervision of mechanical team from conceptual design through equipment procurement, detailed design and installation of selective catalytic reduction system, axial induced draft (ID) fan, compressed air system upgrades, DSI system, dampers and expansion joints. (2014 – 2018)

NRG Energy (Formerly GenOn, and RRI Energy)

- Limestone Units 1&2, WA Parish Units 5,6,7,&8: Mechanical Project Engineer. Prepared studies and cost estimates for replacing bottom ash sluice systems with under boiler conveyors. (2022)
- Limestone Unit 1 – FGD Ductwork Rebuild - Mechanical Project Engineer. Responsible for equipment specifications and engineering involved with replacing piping and equipment damaged due to ductwork failure. (2021-2022)
- Shawville Units 1-4 Closed Cycle Cooling - Mechanical Project Engineer. Prepared several studies for converting open cooling system to a closed system. Responsible for supervision of mechanical team including preparation of cost estimates, system layout, cooling tower and supply pump procurement and intake modifications.
- Conemaugh Units 1-2 - Mechanical Project Engineer. Responsible for supervision of mechanical team for SCR retrofit including preparation of project cost estimate, specification preparation and contract supervision for several auxiliary chemical feed systems and installation contracts. (2010 to 2014)

RRI Energy (Formerly Reliant Energy)

- Shawville Units 1-4, Conemaugh Units 1-2, Titus Units 1-3, New Castle Units 3-5, Portland Units 1-2 - Mechanical Project Engineer. BOP design for Alstom ACI systems, including owner engineering review and coordination responsibilities. (2008 to 2009)
- Shawville Units 3 and 4, Baghouse Project, 326 MW total, coal - Mechanical Project Engineer. Baghouse specification preparation. (2008)
- Shawville 3&4 FGD,SCR, and Cooling Tower Study - Mechanical Project Engineer. Coordinate study to determine equipment layout and cost estimate preparation. (2009)
- Avon Lake Unit 9 Steam Supply Study - Mechanical Project Engineer. Coordinate study to optimal alternative to start up Unit 9 steam turbine driver boiler feed pumps for Unit 7 (steam supply) decommissioning. (2007 to 2008)
- Deer Park Cogeneration Expansion Study - Mechanical Project Engineer. Coordinate study and cost estimate for the addition of a combustion turbine and HRSG to the existing two-unit cogeneration facility. (2007-2008)

NRG Energy

- Indian River Units 1-4, 825 MW total, coal - Mechanical Project Engineer. Prepare cooling tower feasibility study and impingement and entrainment evaluation. (2009)

  Mechanical Project Engineer. Pipe routing, design, material specification, owner engineering responsibilities for Unit 3 SO_3 conditioning BOP project. (2009)

  Mechanical Project Engineer. System design, specification preparation, contract coordination for Units 1-4 ACI project. (2007 to 2009)
- Parish Station - Mechanical Project Engineer. Dry FGD retrofit specification preparation. (2007)

Duke-Cinergy

- Cayuga Units 1 and 2 Wet FGD Retrofit, 1060 MW total, coal - Mechanical Project Engineer. Detailed design for addition of wet FGDs, including system design, specification preparation, and mechanical design coordination. (2003 to 2006)

Duke-Cinergy

- Cayuga Units 1 and 2 SCR Retrofit, 1060 MW total, coal - Mechanical Project Engineer. Detailed design for addition of SCR system (installation deferred).

Ameren Services

- Coffeen Units 1 and 2; Sioux Units 1 and 2, coal - Mechanical Project Engineer. Conceptual design, equipment procurement and detailed design for addition of SCR system, ductwork, steel, fans, and electrical system. (1999 to 2000)

Southern Company Services

- State Line Units 3 and 4, fossil - Mechanical Project Engineer. Engineering support for fire restoration. Engineering support to repair fire damage, including supervising modifications and testing of fire protection/detection system and expediting the precipitator and induced draft (ID) fan contracts, which were in progress at the time of fire. (1998 to 1999)

Santee Cooper

- John S. Rainey - Mechanical Project Engineer. Conceptual design and equipment procurement for SCR retrofit in Unit 1A and 1B HRSGs, including supply of the ammonia system. (2003 to 2004)

Illinois Power Company

- Baldwin Units 1 and 2, 600 MW each, coal - Mechanical Project Engineer. Conceptual design, equipment procurement and detailed design for replacement/upgrades of air heater, SCR system, ductwork, steel, fans, precipitator, and electrical system. (1996 to 1998)

TU Electric

- Martin Lake Units 1-3, fossil FGD reconditioning. Lead Mechanical Engineer. Design and procurement of dampers and slurry pumps. Prepared studies for equipment replacement alternatives. (1995 to 1996)
- Monticello Unit 3, fossil, 750 MW - Mechanical Engineer. Design and procurement for FGD and ESP rebuild contracts, including reviewing vendor deliverables and supervising the preparation of Sargent & Lundy mechanical drawings. (1994 to 1995)

Skygen Energy LLC

- Corpus Christi Energy Center - Mechanical Project Engineer. Equipment procurement and design for EPC contract for 425-MW combustion turbine combined cycle cogeneration plant with steam sales to a refinery. Scope included 2x2x1 configuration consisting of two "F" technology combustion turbine generators, two natural circulation, duct fired, heat recovery steam generators one extraction steam turbine, and one water cooled surface condenser. (2000 to 2001)

Skygen Energy LLC

- Androscoggin Energy Center - Mechanical Project Engineer. Equipment procurement and detailed design for the addition of a steam turbine to an existing cogeneration facility. Major equipment procurement included condenser to operate in conjunction with a vertical discharge steam turbine, cooling tower and miscellaneous pumps. Work included administering the steam turbine contract and relocation of existing fire protection and natural gas lines. (2000)

PSI Energy

- Wabash River Unit 1, fossil - Mechanical Engineer. Repowering design and procurement of the water treatment system and the preliminary design of condensate system and piping instrumentation drawings.
- Gibson Unit 4, 668 MW, fossil - Mechanical Engineer. Reroute ash handling system associated with FGD retrofit design. Also responsible for maintenance of FGD dewatering process contract. (1991 to 1992)

Missouri Public Service

- Sibley Units 1-3, 459 MW total, fossil - Prepared specifications for sample panels, chemical feed systems, SO_3 conditioning and nitrogen blanketing. Prepared an evaluation of the plant heat tracing system. (1990 to 1991)

Dairyland Power Cooperative

- Genoa Unit 3, 380 MW, fossil - Mechanical Engineer. Closing of ash pond, including preparing and evaluating equipment procurement and erection specifications/bids for bottom ash handling system. Scope included evaluation of existing waste systems and their method of treatment and disposal upon closing of the ash ponds. (1990 to 1991)

Condition Assessment

Missouri Public Service

- Sibley Units 1-3, 459 MW total, fossil - Heat tracing evaluation.

Decatur Memorial Hospital

- Performed condition assessment of major hospital utility systems, e.g., steam, air, water, power, etc. Developed recommendations for modifications and improvements to existing systems. (1989)

Cincinnati Gas & Electric Company

- Miami Fort 5 - Assessment of sampling and chemical feed system. (1988)

Studies

GDS

- Prepared a report detailing the expected maintenance costs associated with a power plant over a given life span. This study was prepared for an investment firm evaluating the purchase of an existing fossil station. (1990)

Wisconsin Public Service Corporation

- Pulliam 3-5 - Mechanical Engineer. Assisted in evaluation of multiple repowering options. (1990)

Publication

- "Interim Consensus Guidelines on Fossil Plant Cycle Chemistry," (contributing investigator) Electric Power Research Institute, June 1986.

Rafay Anwar P.Eng.

VICE-PRESIDENT PROJECT DEVELOPMENT AND TECHNICAL SERVICES

Rafay guides the engineering and project management teams in project execution and knowledge sharing to support our core value of helping advance the implementation of carbon capture. Rafay has over 16 years of experience in project management and engineering having worked with a variety of stakeholders to successfully execute projects of varying complexity and capital cost. His areas of technical expertise include amine plants, gas compression and dehydration, liquids handling, refrigeration and CO_2 transport.

EXPERIENCE

International CCS Knowledge Centre, Regina, SK *2024-Present*
Vice-President of Project Development and Technical Services

- Developing strategic partnerships with other organizations in the carbon capture space
- Resource management including recruitment, training and compensation philosophy
- Growing the group's technical expertise and supporting the Policy, Regulatory and Stakeholder group

International CCS Knowledge Centre, Regina, SK *2023*
Director of Project Development and Technical Services

- Lead the Knowledge Centre engineering and management teams in project execution
- Develop project scope for existing and prospective clients
- Provide mentorship and support for team members through formal and informal knowledge sharing

Trilogy Projects Ltd., Calgary, AB *2022*
Program Manager

- Develop business for gas processing, liquids recovery and CCS projects
- Project manager for restart of a 50MMSCF/d gas and liquids facility – TAQA North

Gas Liquids Engineering Ltd., Calgary, AB *2007 -2021*
Program Manager – Pembina Gas Services

- Client liaison and manager for all projects with company involvement at Pembina's Duvernay facility
- Project manager for a 150MMSCF/d sour gas facility – FEED to first gas completed in 14 months
- Project manager for a 30MMSCF/d gas lift project including dehydration, compression, and sales riser
- Detailed engineering for a greenfield 30 MMSCF/d, 10,000 bbl./d facility – Pembina Midstream

Project Manager – Various Clients

- Project manager for a 100MMSCF/d facility with gas sweetening and liquids storage – ARC Resources
- Project manager for a CO_2 compression, dehydration, transport & sequestration study – Cenovus
- Project manager for a clean energy generation feasibility study with CCS/EOR – Paramount Resources

Project Engineer – Various Clients

- Brownfield engineering for a 50 MMSCF/d gas dehydration and liquids recovery plant – AltaGas
- Detailed engineering for a 30MMSCF/d CO2 dehydration package – Kinder Morgan
- FEED for a 32,000 bbl./d condensate, NGL, gas compression & storage facility – 7 Generations Energy

EDUCATION

B.Sc., Mechanical Engineering – McGill University 2005

Everett Rueve P.Eng., MBA

Senior Project Manager

Everett has over 25 years in the energy sector, consisting of Oil and Gas refining, Gas to Liquids (GTL) refining, Hydrogenated-Derived Renewable Diesel (HDRD) refining, hydrogen processing (SMR and ATR), crude oil storage terminal operations and pipeline design. Additionally, he has experience with carbon capture utilization and sequestration (CCUS) projects associated with power plants, ammonia facilities, and the cement industry.

EXPERIENCE

Rueve Energy Projects, White City, SK 2021 - Present
Owner & President

- Strategic consultant of creative energy solutions optimizing business development, project development, project management, engineering, and operations
- Project Manager / Mechanical Engineering Specialist for the following CCS Knowledge Centre projects:
  - Rainbow Energy Coal Creek Station CCS Project
    - Owner's technical advisor during Front End Engineering Design (FEED)
  - Nutrien Redwater CCS Project
    - Prefeasibility review of decarbonization options for ammonia production (Blue Hydrogen versus CCS)
  - SaskPower Shand Carbon Capture Test Facility (CCTF) Compression-Dehydration Project
    - Prefeasibility Study, including CAPEX, OPEX, and Levelized Cost of Capture (LCOC) for CO_2 sales
  - Heidelberg Materials Edmonton CCUS Project
    - Optimized Co-Gen heat integration assessing numerous HRSG and OTSG technologies
  - CCUS Client Workshops
    - Present various CCUS technologies and lead the discussion on Blue Hydrogen technologies
- Project Manager for the following Energy Transition projects:
  - Hydrogenated Derived Renewable Diesel
    - Manage the Owner's Engineer during Front End Engineering Design (FEED)
    - Lead RFP development amongst Engineering, Procurement, Fabrication (EPF) firms
  - Hydrogen Power
    - Replace coal fired power production with H_2 fueled gas fired combined cycle technology
    - Aligned the ATR sizing for 300 MW power and engaged GE on H_2 turbine selection
- Project Engineer for the following Energy Transition projects:
  - Blue Hydrogen
    - Prefeasibility Study on a 150 MMSCFD ATR @ >95% CO2 recovery
    - Sized Utilities (Steam, Air Separation Unit, Cooling Water, etc.)
  - Gas to Liquids
    - Fischer-Tropsch process utilizing inexpensive flared fuel gas as feedstock
    - Analyzed H_2 technology to produce the optimum syn gas characteristic for the FT process

Gibson Energy, Moose Jaw, SK 2010 - 2021
Manager, Project Development and Execution / Technical Services / Senior Refinery Engineer

- Lead and mentored a team of Engineers and Technologists optimizing the Moose Jaw Refinery
- Project managed complex "brownfield" debottleneck capital projects

Co-op Refinery Complex, Regina, SK 1998 - 2010
Major Projects Engineer / Unit Operations Engineer / Plant Engineer

- Major Projects Engineer 2008-2010
  - Project Manager $250 MM Industrial Wastewater Re-Use - MBR & HERO Technologies
- Utilities Process Engineer 2003 – 2008
  - Optimized Utility Operations - Demin Water, Wastewater, Steam, Cooling Water, Nitrogen
- Plant Engineer 1998 – 2003
  - Managed capital projects for improved reliability and/or increased capacity

EDUCATION

B.Sc., Mechanical Engineering (1998) - University of Saskatchewan
Executive MBA (2013) - University of Regina (Kenneth Levene Graduate School of Business)

Colin Campbell B.Sc. (Hons), PChem

Principal Chemist

Over twenty-five years of experience as a senior technology consultant specializing in research and development, analytical chemistry, instrumentation and controls systems, electronic design, and software development. Colin has expertise developed as a technical lead on the SaskPower Boundary Dam Unit #3 Carbon Capture project. He serves as a subject matter expert on chemical instrumentation and analysis, CCS technologies, flue gas characterization, data analytics, environment emissions monitoring and management, experimental design, and pilot scale testing.

EXPERIENCE

International CCS Knowledge Centre, Regina, SK 2017-Present
Principal Chemist

Flue Gas Characterization
- Provide flue gas characterization support to numerous clients in multiple industries, including Cement, Steel, Fertilizer, Pulp and Paper, Oil and Gas, and Power production.
- Serve as a subject matter expert on flue gas composition and testing methods.
- Deliver workshops on flue gas characterization as it applies to de-risking carbon capture projects.

Pilot Testing Support
- Support a large international hard-to-abate emitter in implementing two separate CCS pilot plants. Assist in the development of pilot testing goals, testing plans and provide on-site support for gas measurement and laboratory method development.
- Assist in designing a customized pilot plant, in particular, in the design of the instrumentation and measurement systems.

Analytical Chemistry Support for Carbon Capture Systems
- Provide support to customers in designing chemical testing laboratories.
- Develop specialized testing methods to de-risk solvent selection and pretreatment requirements.
- Serve as a subject matter expert to multiple clients in a variety of industries on chemical analysis methods to support environmental monitoring and operations.

Advanced Instrumentation Research
- Performed detailed research into new methods of real time chemical analysis for Carbon Capture systems.
- Responsible for developing working prototypes for these proposed analysis systems, including chemical design, electronics design, embedded software design, remote telemetry, cloud-based analysis and reporting tools.
- Included the design of 3D printed laboratory grade laboratory grade prototypes of various piping and instrumentation components and pressurized reaction cells as well as preliminary designs for all electronic control and sensor components.

Development of New Online Analysis Techniques
- Led a collaborative research project between the International CCS Knowledge Center, the University of Regina, and Scion Instruments to develop new instrumentation systems for the online analysis of carbon capture solvents.

Data Analytics
- Provided advanced analytics to a large international customer related to the monitoring and collection of environmental and operational performance data from their power plants. The goal of this work was to understand discrepancies in multi-year data sets and the possible implications to future maintenance and operations of these power generation units.

Saskpower, Regina, SK 2013 -2017
Manager, Chemical Services / Laboratory Modernization/Expansion for CCS
- Accountable for the operation of several advanced chemical laboratories and a staff of twelve chemistry, materials science, and engineering personnel.
- Responsible for the implementation, maintenance, and support of a complex network of diverse IT systems consisting of many specialized pieces of equipment and wide variety of operating systems of various ages.

Yuewu Feng P.Eng., PMP

Senior Engineer

Yuewu jointed the International CCS Knowledge Centre in 2018. As a senior engineer, Yuewu applies his expertise, gained from the SaskPower Boundary Dam Unit 3 CCS Initiatives (BD3 CCS project), contributing to basis of design development, design review, knowledge share and cost estimation for the feasibility and front-end engineering study of the carbon capture and storage projects development.

Prior to joining the Knowledge Centre, Yuewu worked 7 years at SaskPower BD3 CCS project. His experience includes request for proposal preparation, proposal evaluation, design review, equipment supply and install contracts management, mechanical commissioning leadership, post-commissioning upgrade study, and operation and maintenance support.

Before getting in CCS field, Yuewu has 18 years in mechanical engineering design, upgrade projects development and implement, operation and maintenance training, and overhaul planning and execution for coal power plants.

EXPERIENCE

International CCS Knowledge Centre, Regina, SK *2018-Present*
Senior Engineer

- Basis of design development, technical review, and cost estimation for the feasibility and front-end engineering design study of carbon capture projects developments
- BD3 CCS project knowledge share

BD3 CCS Initiatives, SaskPower, Regina, SK *2011-2018*
Senior Engineer/Mechanical Commissioning Lead Engineer/Mechanical Engineer

- Design review, RFP preparation, proposals evaluation
- Equipment supply and install contracts management
- Hazard and operability study (HAZOP) participation
- Mechanical commissioning team leadership including engineers, consultants, and trades; scope, schedule, and resources management
- Pre-commissioning deficiencies resolution with EPC
- Post-commissioning upgrade study, design review, install contract management
- Operation troubleshooting and maintenance planning support

Poplar River Power Station, SaskPower, Coronach, SK *2008-2011*
Technical Specialist II (EIT), Mechanical

- Turbine and virous mechanical equipment overall plan, implement and shutdown inspection
- Troubleshooting, technical study, and design for plant safety and performance improvement

Thermal Power Institute of Taiyuan Electric Power College, Taiyuan, China *1993-2004*
Taiyuan No.1 Power Station, Taiyuan, China *1986-1990*
Engineering Vice Director, Mechanical Engineering Team Leader, Mechanical Engineer, EIT

- Power plant design, upgrade project development, design and implement
- Training material development for operation and maintenance
- Simulator development support
- Commissioning participation

EDUCATION

M.Sc., Mechanical Engineering –Dalian University of Technology, Dalian, China
B.Sc., Mechanical Engineering - Taiyuan University of Technology, Taiyuan, China

- Advance chemical analysis capabilities required to support the Boundary Dam unit #3 Carbon Capture project. This involved upgrading one existing laboratory and building a new advanced analysis and research laboratory in Regina, SK, and building two smaller field laboratories at Boundary Dam and Shand power stations in Estevan, SK. I was responsible for all aspects of this project from project initiation to final delivery, acquiring executive sponsors, budgeting, procurement of equipment, management of contractors, hiring and training of new staff. A critical factor in this project was the secure management of vendor intellectual property (IP). This involved developing technological solutions, policies, and procedures to protect vendor IP and ensure the top security of all laboratory information and information systems.

TECHNICAL PUBLICATIONS AND COURSES

- Center, I. C. (2021). Continuous Online Analysis of Amine Solvents Using Gas Chromatography. Retrieved from https://ccsknowledge.com/pub/Publications/Gas-Chromatography-Report.pdf
- Idem, R., Supap, T., Shi, H., Gelowitz, D., Ball, M., Campbell, C., & Tontiwachwuthikul, P. (2015). Practical experience in post-combustion CO2 capture using reactive solvents in large pilot and demonstration plants. International Journal of Greenhouse Gas Control, 40, 6-25.
- Nath, D., Campbell, C., Feng, Y., Bruce, C., Philip, F., Henni, A., . . . Janowczyk, D. (2021). A Novel Methodology for Online Analysis of Amine Solution Degradation Caused by Fly Ash. SSRN Electronic Journal.
- Shi, H., Supap, T., Idem, R., Gelowitz, D., Campbell, C., & Ball, M. (2017, July). Nitrosamine Formation in Amine-Based CO(2) Capture in the Absence of NO(2): Molecular Modeling and Experimental Validation. Environmental science & technology, 51(13),
- Supap, T., Idem, R., Gelowitz, D., Campbell, C., & Ball, M. (2016). Optimizing method parameters for ion pair-based high performance liquid chromatographic analysis (IP-HPLC) for complex amine blend formulas used in post combustion carbon dioxide capture. International Journal of Greenhouse Gas Control
- Supap, T., Shi, H., Idem, R., Gelowitz, D., Campbell, C., & Ball, M. (2017). Nitrosamine Formation Mechanism in Amine-Based CO2 Capture: Experimental Validation. Energy Procedia

EDUCATION

B.Sc. (Hons), Chemistry - University of Regina

TECHNICAL REVIEWER RATING SUMMARY

LRC (104C): "Lignite Conversion Reactor Optimization for Commercial Carbon Pitch Manufacturing"

Submitted by: AmeriCarbon Products, LLC
Principal Investigator: David A. Berry
Project Duration: 18 months
Request for: $743,809
Total Project Costs: $1,488,809

Rating Category	Weighting Factor	Technical Reviewer Rating 35-01	35-02	35-03	Average Weighted Score
Objective	9	5	5	5	
Achievability	9	4	3	4	
Methodology	7	4	4	4	
Contribution	7	4	4	5	
Awareness	5	5	5	5	
Background	5	5	5	5	
Project Management	2	4	5	4	
Equipment Purchase	2	3	4	4	
Facilities	2	4	4	4	
Budget	2	3	4	4	
Average Weighted Score:		215	212	226	**218**

Maximum Weighted Score:	250

OVERALL RECOMMENDATION:

FUND		**X**	**X**	**X**	
FUNDING MAY BE CONSIDERED					
DO NOT FUND					

TECHNICAL REVIEWERS' COMMENTS

1. OBJECTIVES

The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Lignite Research Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer 35-01 (Rating: 5) The proposed prototype reactor is in line with adding the beneficial use of lignite. It is also an excellent replacement source for products with current reliance on foreign sources.

Reviewer 35-02 (Rating: 5) AmeriCarbon plans to optimize their Eco-pitch process reactor configuration utilizing ND lignite then, design, fabricate, install, and commission a prototype to generate product for analysis and meet potential customer specifications. This design could then lead to a commercial-scale unit in McLean County.

Reviewer 35-03 (Rating: 5) The proposal lays out a clear path from the current knowledge and results to completion of the prototype reactor and how the process would move to commercial following this work.

2. ACHIEVABILITY

With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.

Reviewer 35-01 (Rating: 4) The only concern would be the design specification first, then the lead time for reactor manufacturing. Prototypes may have delays. The applicant discussed this in the risks area, but it is still a concern.

Reviewer 35-02 (Rating: 3) The $1,488,809 project has a schedule of 18 months. The NDIC is being asked for half or $743,809 to support the project. The schedule calls for 6 months to do procurement, fabrication, installation, and commission; this seems a bit optimistic.

Reviewer 35-03 (Rating: 4) The time and budget seem reasonable for the work scope identified. I was not clear in the budget if the cost of a building to house the process was included. Suggest that this be clarified for the Council consideration.

3. METHODOLOGY

The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer 35-01 (Rating: 4) No comment

Reviewer 35-02 (Rating: 4) All testing and Lab analysis will be in AmeriCarbon's facility in West Virginia. Five specific tasks have been laid out and explained in thorough detail: analyze design, develop new specifications, engineering analysis and Prototype design, fabricate, install, commission then generate lignite-based pitch materials.

Reviewer 35-03 (Rating: 4) The quality of the technical work to be undertaken was clear. The description for the demand for pitch and other carbon products was not as clear relative to what markets will create the demand. That could be made more clear for the Council.

4. **CONTRIBUTION**

The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Lignite Research Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer 35-01 (Rating: 4) This application is a great diversification of the existing use of ND lignite and will likely trigger additional applications when commercialized.

Reviewer 35-02 (Rating: 4) Successful completion and building of commercial scale reactors will utilize ND lignite resources and create technical jobs while creating a saleable product that can be utilized to make carbon products and reduce or eliminate foreign dependence for pitch to do so.

Reviewer 35-03 (Rating: 5) This technology does have the potential to develop an industry that is very compatible with the NDIC/LRC Research goals and that could expand to a sizeable impact.

5. **AWARENESS**

The principal investigator's awareness of other current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 35-01 (Rating: 5) The applicant provided a brief history of coal liquefaction and existing technologies worldwide and a strong background for the research completed in this field.

Reviewer 35-02 (Rating: 5) David A. Perry, has a Master's degree in Chemical Engineering, is CEO/CTO of AmeriCarbon, and before than managed multimillion dollar projects for the NETL from 1986 to 2020. He was Associate Director of the NETL from 2009 to 2020.

Reviewer 35-03 (Rating: 5) The principal investigator seems very aware of the research and the path forward for this technology.

6. **BACKGROUND**

The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 35-01 (Rating: 5) Strong background from applicant and also the partners working on the engineering and design, along with management and the history in financing energy related projects.

Reviewer 35-02 (Rating: 5) The remainder of the team is made up of engineers with either coal to liquid or coal to coal tar pitch experience. Worley Parsons engineers have been retained for final reactor and plant design. AmeriCarbon also has other engineers familiar with the technology and finance managers to take care of those details.

Reviewer 35-03 (Rating: 5) The team that has been identified is very experienced in this work.

7. **PROJECT MANAGEMENT**

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the parties involved in the project, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer 35-01 (Rating: 4) Flat management structure is a positive considering the short timeline with five phases needing to be completed in an 18-month timeframe. Milestones were clearly laid out.

Reviewer 35-02 (Rating: 5) All the above elements listed above are included. Milestones were delineated on the schedule and budgetary tables given for direct, indirect, and equipment costs. Reports will be provided every quarter and more frequently if needed. Communication to the NDIC is planned on a regular basis.

Reviewer 35-03 (Rating: 4) The plan has been thought through and complete as presented.

8. **EQUIPMENT PURCHASE**

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 35-01 (Rating: 3) The one risk to highlight is how accurate the estimate for the prototype reactor can be, considering that the design and engineering are the first phases of this project.

Reviewer 35-02 (Rating: 4): $96,779 for lignite coal dryer, reactor instrumentation, slurry pumps, reactor hot oil heat transfer heating system were listed as equipment. $17,450 for chemical, solvents, lubricants, heat trace, insulation, piping, fittings, etc. supplies were listed.

Reviewer 35-03 (Rating: 4) The equipment list is clear for the pursuit of the project.

9. **FACILITIES**

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 35-01 (Rating: 4) There is a great existing facility in WV. The only downfall is that the prototype will not be in ND.

Reviewer 35-02 (Rating: 4) AmeriCarbon's pilot reactor and various other coal to liquids equipment are located in Morgantown, West Virginia. It is a 12,000 sq-ft facility with multiple highbays. Six commercial flame suppression hoods and wet chemistry lab are also inside the facility.

Reviewer 35-03 (Rating: 4) The discussion of facilities and location was very general. The description does discuss McLean County, but it is not clear if property has been obtained and the building to be used. The equipment as defined should be available to order of fabricate as listed. Supply chain issues are a test of any project schedule and will be a risk here also.

10. **BUDGET**

The proposed budget value relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value.

Reviewer 35-01 (Rating: 3) All in-kind matches for funding. Will there be any additional capability for financing if the proposed design specs exceed the purchase estimate?

Reviewer 35-02 (Rating: 4) Pending successful reactor optimization and generation of lignite-based pitch the potential for this process to create an additional and saleable product from ND Lignite would be quite advantageous to ND. Additional technical jobs will be created, added source of revenue for the lignite economy, reducing carbon footprint, and less or no dependence on foreign pitch for necessary manufacture of EV's, energy storage, infrastructure and national defense. Additional lignite conversion reactors might be built following the initial McLean County add.

Reviewer 35-03 (Rating: 4) The request for support from NDIC/LRC is reasonable and equal to support provided by others to the project.

OVERALL COMMENTS AND RECOMMENDATIONS:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 35-01 (Rating: FUND) The application for coal tar pitch and associated carbon products manufacturing utilizing ND Lignite is in line with NDIC goals to further use cases and increase economy and quality job growth in ND. The additional notes about existing reliance on foreign countries for carbon-based products, along with projected growth of demand, further solidify the need for projects like this. I recommend funding this application. One question to comment on: with 2026 projected McLean Plant construction, are there any specifics to be shared about the financials of such a project, along with investor interest in bringing a project of this magnitude to reality?

Reviewer 35-02 (Rating: FUND) A risk management plan was included in the proposal which mentioned technical complexity/uncertainty, operational challenges, materials selection/compatibility, supply chain/fabrication, and potential feedback/collaboration challenges. If any of these risks outweigh the return on investment it is presumed a prior mutual agreement will return unused funds. Since Worley Parsons and other partners would stand to reap considerable benefits from a successful test and potentially several commercial reactors, it would be good to consider some financial support to that end. I might also suggest the State of North Dakota negotiate a small return on their initial investment in the technology as other systems come online; a collaborative agreement, if you will. Beyond all that, I believe it's a well-written proposal by qualified people and worth the risk at this time to see if ND lignite can play a role in creating valuable carbon-based materials while reducing our foreign dependence for coal tar pitch.

Reviewer 35-03 (Rating: FUND) This proposal is a project that has a path to commercialization in a manner that would diversify mining in North Dakota. There are questions posed that need to be clarified for the Council.

AmeriCarbon

April 1, 2024

State of North Dakota
The Industrial Commission
State Capitol
Bismarck, ND 58505
ATTN: Lignite Research Program

RE: Transmittal Letter

This transmittal letter is to set forth a binding commitment on behalf of AmeriCarbon Products, LLC to complete the project as described in the accompanying application if the North Dakota Industrial Commission makes the grant requested therein.

Sincerely,

Greg Henthorn
Vice President of Corporate Development
AmeriCarbon Products, LLC

(888) 367-1650
www.americarbon.com
3001 City View Drive
Morgantown, WV 26501

THIS DOCUMENT HAS A COLORED BACKGROUND AND MICROPRINTING. THE REVERSE SIDE INCLUDES AN ARTIFICIAL WATERMARK.

AmeriCarbon Products, LLC
3001 Cityview Drive
Morgantown, WV 26501
(888) 367-1650

Clear Mountain Bank
PO Box 205
39 Union Street
Bruceton Mills, WV 26525

No. 1901

69-259/515

Date 4/1/2024

Pay To The Order Of State of North Dakota **$** **100.00

One Hundred and 00/100 **Dollars**

Memo: Application Fee

Gregory G. Hamilton

⑈00000190⑈ ⑆051502599⑆5000254615

1901 **Amount: $100.00** **Date: 4/1/2024**

Pay to: State of North Dakota

1901 **Amount: $100.00** **Date: 4/1/2024**

Pay to: State of North Dakota

AmeriCarbon

Submitted To:	State of North Dakota The Industrial Commission State Capitol Bismarck, ND 58505 ATTN: Lignite Research Program
Project Title:	Lignite Conversion Reactor Optimization for Commercial Carbon Pitch Manufacturing
Applicant:	AmeriCarbon Products, LLC
Principal Investigator:	David A. Berry
Date of Application:	April 1, 2024
Amount of Request:	$743,809

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1. Abstract

The United States is dependent on China for a number of critical materials and supplies that place our nation's economic and defense security at risk. Advanced carbon materials – possessing properties such as possessing high strength-to-weight ratio, flexibility, electrical conductivity, thermal control, chemical resistance, and radar absorption – are playing an increasingly critical role in a number of sectors, including national defense, infrastructure, energy storage, and transportation.

Ironically, the United States is rich in carbon deposits in the form of coal. However, the current industrial process for producing coal tar and coal tar pitch, intermediate forms required to unlock coal's potential for advanced materials applications, is exclusively a ~5% by-product of coking ovens used in steelmaking. Because the United States' steel production capacity has been decimated since the 1980s, our nation's supply chains are unnecessarily dependent on China and other Asian countries for coal tar and coal tar pitch, leaving our national security vulnerable to manipulation and dependence. A major supply shortfall in coal tar pitch has emerged, with market prices increasing approximately 50% in the past year alone; projections suggest these dynamics will only increase for the foreseeable future.

With substantial support from the State of North Dakota and The North American Coal Corporation, AmeriCarbon is at the forefront of efforts to mitigate the carbon materials supply crisis by accelerating the commercial adoption of Eco-Pitch™, an alternative to China-derived coal tar pitch, which will be manufactured in North Dakota using an alternative chemical pathway that does not rely on steel manufacturing. Instead, AmeriCarbon's patented and proprietary non-combustible process uses lignite coal as its primary feedstock, with the flexibility to use different types of coal and the capacity to tailor its operating conditions to produce multiple formulations of its end products to meet specifications for different applications.

AmeriCarbon is entering into its final stage of commercial engineering design & scaleup for its proprietary Liquid Carbon Process to manufacture Eco-Pitch™. Through its numerous internal studies and design efforts, AmeriCarbon has identified an optimized reactor configuration that incorporates specific operational benefits for lignite coals. Prior supported efforts by NDIC, in partnership with North American Coal, have led to valuable insights through the successful conversion of lignite coal into specialty pitches, asphalt, and graphite. These insights will be incorporated into the improved design of an optimized reactor that will be utilized in our planned commercial plant to be located in North Dakota. Within this scope, this innovative reactor will be validated and will generate a variety of lignite-based pitches that will be shared with AmeriCarbon's customer base to generate feedback and expand market base for lignite coal. The proposed $1,488,809 project (including $743,809 requested from NDIC) will span 18 months upon initiation and involves the following primary participants: AmeriCarbon Products, LLC (applicant), Worley

Parsons, and The North American Coal Corporation, which have collectively pledged $745,000 in cost share.

2. Project Summary

AmeriCarbon is working to design, construct, and operate a commercial scale carbon products manufacturing facility in McLean County, North Dakota ("McLean Plant"). The McLean Plant will use North Dakota lignite in AmeriCarbon's patented and proprietary Liquid Carbon Process to manufacture *Eco-Pitch™*, a 100% domestically sourced alternative to coal tar pitch, a critical supply material for the production of synthetic graphite, asphalt binder, and other carbon materials.

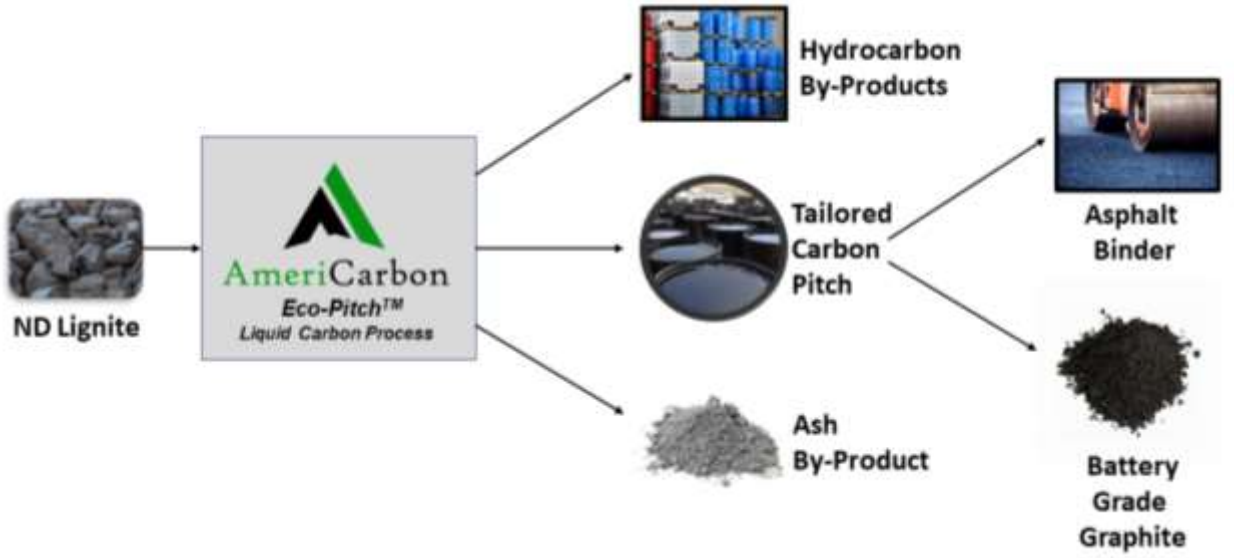

Figure 1. *Simplified overview of AmeriCarbon's Liquid Carbon Process.*

Comprising more than a dozen unit operations, AmeriCarbon's Liquid Carbon Process employs predominantly off-the-shelf, proven technologies. This approach leverages existing, proven methodologies to ensure operational efficiency, scalability, and cost-effectiveness. Having completed our third stage of engineering design (FEL2), AmeriCarbon has identified the conversion reactor as a critical area for enhancement to optimize the efficiency and cost effectiveness of the overall process. **This project is to optimize the commercial reactor design of the Liquid Carbon Process that will be used in the McLean Plant.**

The project will entail the following tasks (further detailed in the Project Description section):

- TASK 1: Analysis of AmeriCarbon Concept/Prototype Reactor Design
- TASK 2: Identify/Develop Reactor Preliminary Design Specifications
- TASK 3: Engineering Analysis and Prototype Design
- TASK 4: Fabricate, Install and Commission Prototype Reactor
- TASK 5: Generate Lignite-Based Pitch Material with Prototype Reactor

Based on work performed to date, AmeriCarbon has developed a preliminary design for the conversion reactor. To complete the project, AmeriCarbon will contract with Worley Parsons, a global engineering, procurement, and construction (EPC) company specializing in providing innovative solutions for complex projects across various industries, including energy, resources, and infrastructure. After creating the modified reactor, a range of lignite coal-derived pitches will be made in AmeriCarbon's pilot manufacturing facility using the prototype reactor to validate its efficacy. These pitch samples will be distributed to prospective customers and collaborators for feedback and evaluation.

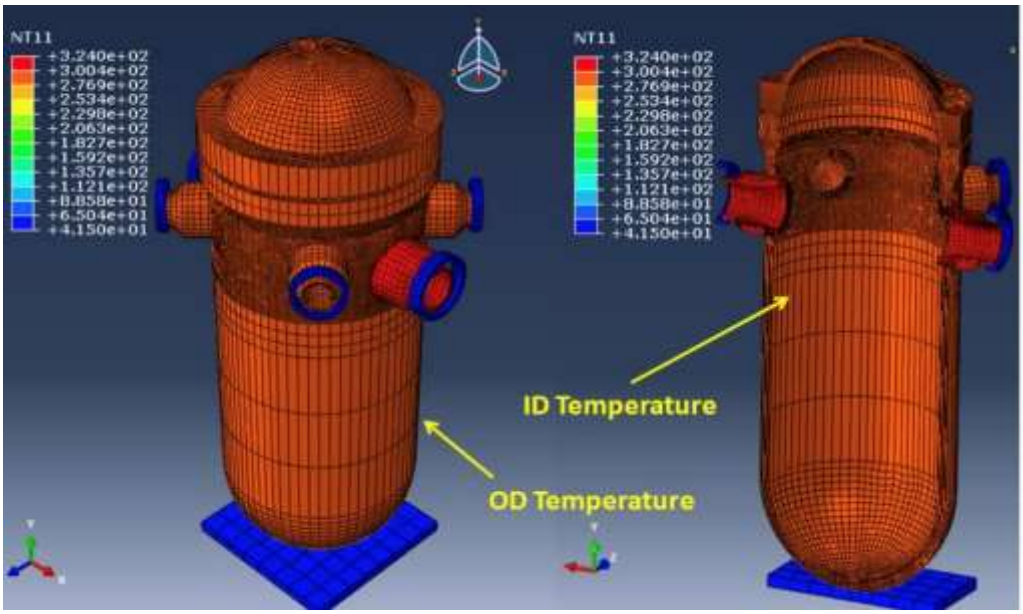

Figure 2. *Hypothetical reactor illustration (stock image only).*

Optimization of the reactor is imperative for integrating lignite processing seamlessly into AmeriCarbon's base module design. Lignite presents unique coal conversion differences, such as extensive volatile gas formation relative to other coal types, which must be addressed to harness the distinctive

beneficial carbon structures inherent in lignite. By optimizing the reactor, AmeriCarbon can overcome these challenges and ensure the efficient utilization of lignite in its processes. This project will not only enhance operational efficiency but will facilitate the seamless integration of the lignite conversion reactor into AmeriCarbon's base module design.

The overall objectives of this project are as follows:

1. Optimizing the commercial engineering design and scale-up of AmeriCarbon's Liquid Carbon Process to manufacture Eco-Pitch™, utilizing an optimized reactor configuration tailored for lignite coals.

2. Incorporating insights from previous NDIC-supported efforts to successfully convert lignite coal into specialty pitches, asphalt, and graphite into the improved design of the optimized reactor.

3. Validating the innovative reactor design and generating a variety of lignite-based pitches to expand the market base for North Dakota lignite coal.

4. Strengthening the domestic production capabilities of critical carbon materials, reducing reliance on foreign sources, and enhancing economic and defense security in the United States.

5. Enhancing customer feedback mechanisms and market viability for Eco-Pitch™ and other lignite-based products, fostering economic growth and job creation in North Dakota's lignite industry.

In summary, the project aims to optimize the commercial reactor design of AmeriCarbon's Liquid Carbon Process, enhancing domestic production capabilities, strengthening economic security, and expanding the market for North Dakota lignite coal.

3. Project Description

Project Objectives

As stated in the Project Summary section, the overall objectives of this project are the following:

1. Optimizing the commercial engineering design and scale-up of AmeriCarbon's Liquid Carbon Process to manufacture Eco-Pitch™, utilizing an optimized reactor configuration tailored for lignite coals.

2. Incorporating insights from previous NDIC-supported efforts to successfully convert lignite coal into specialty pitches, asphalt, and graphite into the improved design of the optimized reactor.

3. Validating the innovative reactor design and generating a variety of lignite-based pitches to expand the market base for North Dakota lignite coal.

4. Strengthening the domestic production capabilities of critical carbon materials, reducing reliance on foreign sources, and enhancing economic and defense security in the United States.

5. Enhancing customer feedback mechanisms and market viability for Eco-Pitch™ and other lignite-based products, fostering economic growth and job creation in North Dakota's lignite industry.

Critical Need / Technological and Economic Impacts

The optimization of the reactor is vital for seamlessly integrating lignite processing into AmeriCarbon's base module design. Lignite's material properties pose distinctive challenges, notably the significant volatile gas formation/evolution, necessitating solutions to harness lignite's unique structures effectively. By optimizing the reactor for lignite conversion, AmeriCarbon's Liquid Carbon Process can overcome these obstacles to unlock the unique material properties of lignite, ensuring the efficient utilization of lignite in the carbon materials supply chain. This project will not only bolster operational efficiency of the reactor itself, but also streamline the integration of the lignite conversion reactor into AmeriCarbon's base module design, contributing to a cohesive and efficient manufacturing process.

More broadly, AmeriCarbon's efforts to onshore the production of critical carbon materials such as coal tar pitch and graphite carries significant national security and geopolitical implications. These materials serve as essential components in various industries critical to national defense, infrastructure, energy storage, and transportation. Currently, the United States heavily relies on imports, particularly from China, for these materials, leaving its supply chains vulnerable to global tensions and disruptions. By establishing domestic production capabilities for coal tar pitch and graphite, AmeriCarbon is not only contributing to the nation's economic resilience but also helping to reduce its dependence on foreign sources for strategic materials. This strategic shift towards onshoring production aligns with broader efforts to bolster national security by securing essential supply chains and ensuring a reliable and uninterrupted supply of critical carbon materials essential for defense and industrial applications. By mitigating supply chain risks and

strengthening domestic manufacturing capacity, AmeriCarbon's commercial efforts (including the planned McLean Plant) help to safeguard the nation's security interests and promote economic sovereignty.

Current Industrial Reliance on Coking Ovens

The supply chain for coal tar pitch is characterized by its critical dependence on coal tar, a by-product derived from the coking process in steel manufacturing blast furnaces, constituting a by-product that is approximately 5% of the total output. However, the dominance of steel production by China, Russia, and other Asian countries underscores the vulnerability of the global coal tar pitch supply chain. In the United States, the steel industry experienced a significant decline in the 1970s and 1980s, resulting in a steep reduction in domestic capacity. Moreover, with the majority of U.S. steel production now reliant on recycled materials rather than coking ovens, the availability of domestic coal tar has dwindled to near-negligible levels, further exacerbating the challenge of sourcing coal tar pitch domestically.

Figure 3 shows China's dominance in steel manufacturing, which (prior to the scaling of AmeriCarbon's alternative approach) translates to China's dominance in the supply chain for advanced carbon materials.

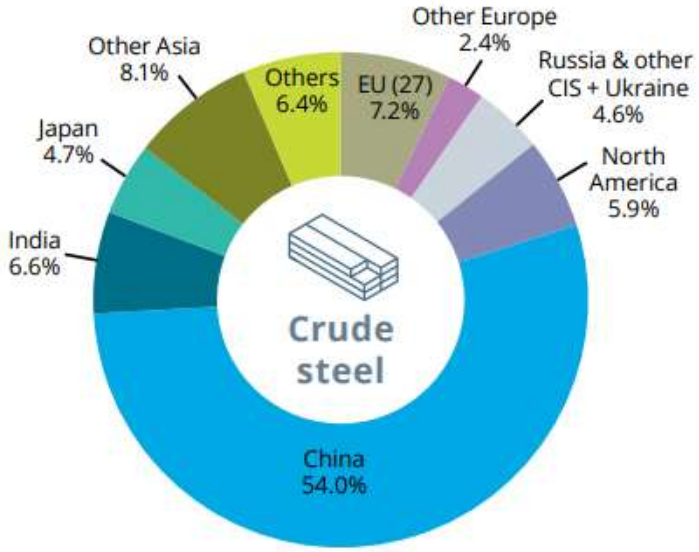

Figure 3. *China dominates world crude steel production, leading to dominance in carbon supply chains. (Source: 2023 World Steel in Figures, World Steel Association, 18 May 2023)*

The dynamic gets worse, however, for U.S. carbon supply chains. The blast furnace manufacturing method, utilizing coking ovens, is the process that produces coal tar as a by-product, unlike other methods which do not yield coal tar. Projections indicate a notable decrease in the utilization of the blast furnace method in the future (due to environmental concerns, among other things), further tightening the supply of coal tar. Meanwhile, the Electric Arc Furnace method – one of the primary alternatives to the blast furnace method of steelmaking – actually *consumes* substantial volumes of coal tar pitch (instead of producing coal tar as a by-product), exacerbating the increasing supply and demand imbalance for coal tar and coal tar pitch.

The looming supply / demand crisis in coal tar pitch was the primary driver in AmeriCarbon's entry into the market. We have targeted a manufacturing capacity of approximately 30,000 tons per year (measured in coal feedstock) for our base pitch manufacturing module, which represents an approximate 10x scaleup of our pilot manufacturing facility (described elsewhere herein). According to our research,[1] AmeriCarbon could construct approximately 20 to 25 base modules of the size planned for the McLean Plant over the next few years, just to keep up with the incremental growth in demand compared to a projected flat supply.[2] By 2029, this shortfall is estimated to be 500,000 tons in North America alone, which would require approximately 35 AmeriCarbon modules to match the incremental growth in demand (Figure 4). The estimated global shortfall is 4.5 million tons by 2029, based on management estimates using data from Market Insights and Benchmark Week 2022.

[1] Management estimates using data from Market Insights and Benchmark Week 2022
[2] Our assumption for flat supply does not factor in the projected decline in use of blast furnace method, likely underestimating the shortfall for coal tar pitch supply, nor the prospect that China and other producers of coal tar will consume their coal tar pitch to make higher value products.

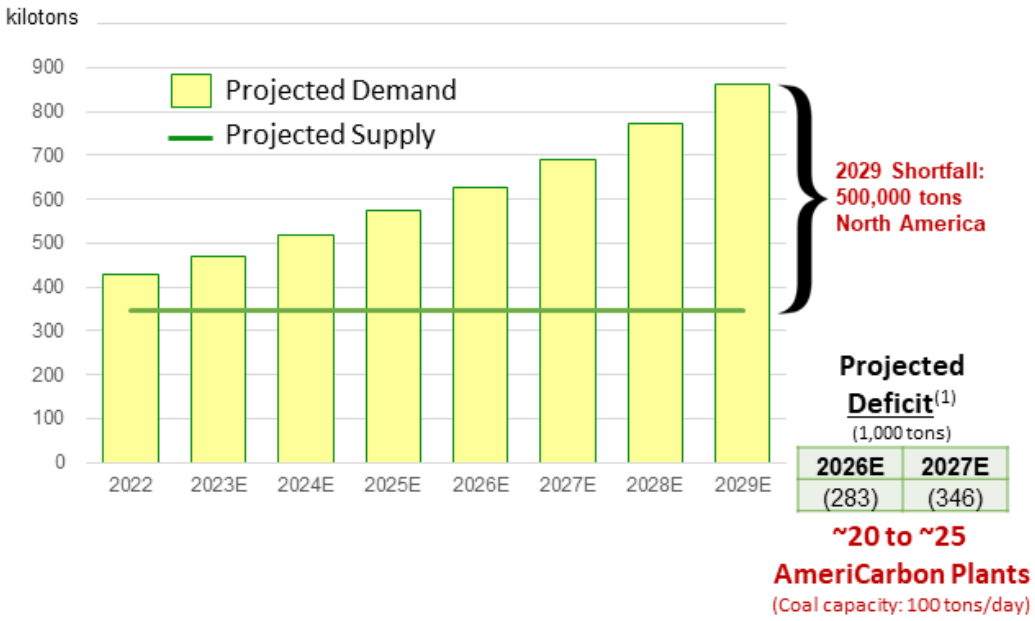

Figure 4. *The United States has begun facing a major supply shortage for coal tar pitch.*

With rapidly growing demand for advanced carbon products and dwindling supply, what are the solutions? Additional coking ovens will not be constructed to produce a ~5% by-product. One idea would be to replace a small subset of applications that currently require coal tar pitch and seek to use petroleum-based pitch as a replacement. This may work in certain instances, but petroleum pitch supply does not come in abundance, and has its own set of environmental concerns and unfavorable domestic supply / demand curve dynamics.

The other consideration – which is the one AmeriCarbon has been pursuing since 2020 – is the development of an alternative chemical pathway to produce coal tar pitch. However, to do so requires a pilot manufacturing facility that would cost ~$20 million to design and construct, and require several years to design, build, and learn how to operate. This puts AmeriCarbon and its collaborators – and the McLean Plant – in pole position to help our nation address these concerning supply chain dependencies. **The currently proposed project is on the critical path to entering the coal tar pitch market as a scalable solution.**

Project Methodology / Statement of Work

The project methodology outlines a comprehensive approach to optimize AmeriCarbon's reactor design for lignite coal processing, comprising a series of tasks executed in collaboration with Worley. These tasks encompass a thorough analysis of the existing reactor design, identification of operational parameters, engineering analysis, prototype design, fabrication, installation, and commissioning. The ultimate goal is to generate lignite-based pitch materials with enhanced performance characteristics, validating the effectiveness of the optimized reactor design and advancing AmeriCarbon's mission of onshoring critical carbon material production.

TASK 1: Analysis of AmeriCarbon Concept/Prototype Reactor Design – A thorough concept design review and analysis of the AmeriCarbon reactor will be conducted to evaluate both process and mechanical constraints for optimization of lignite coal processing. This will include, but not be limited to:

- Operating pressures / temperatures
- Process operability requirements
- Heat transfer and flow requirements / limitations of design
- Materials of construction (MOC) requirements
- Fabrication complexities / requirements

The output from this task will inform activities in Task 2. *(Performers: AmeriCarbon/Worley)*

TASK 2: Identify/Develop Reactor Preliminary Design Specifications – Operational parameters will be identified and factored into preliminary design specifications for the optimized reactor. Targeted experimental reaction studies utilizing lignite coal will be conducted at AmeriCarbon's pilot manufacturing facility to inform necessary specification details. The design and throughput of the prototype reactor to be built and demonstrated will be based on the current AmeriCarbon pilot facility and concomitant integration into the Liquid Carbon Process. *(Performers: AmeriCarbon/Worley)*

TASK 3: Engineering Analysis and Prototype Design – Analysis of the new AmeriCarbon reactor will be conducted that may include, but not be limited to: flow studies, heat and mass transfer, structural, thermal stress, etc. These analyses will establish the initial design basis that will result in development of fabrication drawings, including all test/certification requirements for its construction. *(Performers: AmeriCarbon/Worley)*

TASK 4: Fabricate, Install and Commission Prototype Reactor – Per the design and fabrication drawings developed in Task 3, the prototype reactor will be fabricated and installed in the AmeriCarbon pilot facility. A number of testing procedures will be conducted to commission the reactor for safe pilot operations and verify effective operability range. *(Performers: AmeriCarbon/Worley)*

TASK 5: Generate Lignite-Based Pitch Material with Prototype Reactor – A variety of pitches made from lignite coal will be processed with the new prototype reactor to further validate its performance. Further, these pitch materials will be sent to existing AmeriCarbon customers/collaborators for feedback and continuous customer development such as the University of North Dakota, defense contractors, and carbon materials manufacturers. *(Performer: AmeriCarbon)*

Anticipated Results

AmeriCarbon seeks the following results from the proposed project:

- **Optimized Reactor Design.** Through thorough analysis and engineering efforts, AmeriCarbon anticipates achieving an optimized reactor design tailored in a manner to enable the optimal processing of lignite coal. This optimized design will address unique challenges such as the formation of gas pockets due to volatiles, ensuring efficient utilization of lignite while maximizing operational efficiency.
- **Enhanced Process Performance.** The implementation of the optimized reactor design is expected to result in enhanced process performance, including improved heat transfer, flow dynamics, and materials of construction (MOC) compatibility. This enhancement will enable AmeriCarbon to

overcome existing process limitations and leverage the unique structures present in lignite for the production of tailored and advanced carbon materials.

- **Streamlined Integration.** By dovetailing the lignite reactor into the base module design, AmeriCarbon aims to streamline integration efforts and improve uniform operation with its existing manufacturing processes. This integration will facilitate a more efficient production workflow and minimize downtime associated with reactor modifications or retrofits.
- **Market Expansion and Customer Satisfaction.** The successful optimization of the reactor design will enable AmeriCarbon to expand its market base for lignite-derived products, including Eco-Pitch™ and other carbon materials. By generating lignite-based pitches with improved performance characteristics, AmeriCarbon anticipates attracting new customers and collaborators while satisfying the needs of existing partners, including defense contractors, carbon materials manufacturers, and academic institutions.
- **Economic and Environmental Benefits.** AmeriCarbon expects the optimized reactor design to yield significant economic benefits by reducing production costs, enhancing product quality, and increasing overall competitiveness in the carbon materials market. Additionally, by utilizing lignite, an abundant and domestically sourced resource, AmeriCarbon aims to contribute to regional economic development while minimizing environmental impact through sustainable resource utilization practices.
- **Advancement Toward Commercialization.** The successful optimization of the reactor design represents a crucial milestone in AmeriCarbon's progress toward the commercial development and finance of the McLean Plant. By demonstrating the feasibility and efficacy of its technology at scale, AmeriCarbon will be better positioned to attract private investment, secure partnerships, and advance toward the realization of a commercially viable lignite processing facility.

Overall, AmeriCarbon anticipates that the optimization of the reactor design will not only strengthen its position as a leader in carbon materials innovation but also enable additional beneficial use cases for lignite.

Facilities & Equipment

The project will be conducted at existing facilities that are operated by the project's performers. The facilities are outlined below.

AmeriCarbon Research and Pilot Demonstration Facility

Figure 5: *AmeriCarbon's Research and Pilot Demonstration Facility in Morgantown, West Virginia.*

AmeriCarbon operates a state-of-the-art 12,000 sq-ft facility in the Morgantown Industrial Park (Morgantown, West Virginia) that contains infrastructure for laboratory through pilot-scale R&D. The facility contains six commercial flame suppression laboratory hoods and a wet chemistry area along with multiple high-bay areas for pilot-level research and demonstration.

Figure 6: *AmeriCarbon's pilot scale unit operations that underpin the LCP process.*

AmeriCarbon Equipment

Figure 7: *AmeriCarbon's pilot scale and research equipment.*

AmeriCarbon's equipment includes: coal liquefaction & coker trains capable of processing 10 tons per day; capable of producing custom coal pitch, needle coke, and advanced carbon products; product separation and collection train; both trains are fully automated and managed by an industry standard computer / software system; six commercial hood laboratory with flame suppression and exhaust system; fully equipped for benchtop lab research and development. The facility is heavily instrumented and managed by a PLC control system with continuous monitoring.

Environmental and Economic Impacts of the Project

With respect to the conduct of the proposed project, environmental impact will be minimal. Existing facilities will be used. The facilities used in the project will operate within reasonable parameters of waste and energy consumption that are consistent with their current usage levels.

In terms of immediate economic impact, the project budget of $1,488,809, which includes cost share of $745,000, includes $280,000 to Worley Parsons and its contractors. Success of the project will contribute to the establishment of the McLean Plant, projected to result in several tens of millions of dollars of investment and the creation of 40-70+ long term jobs.

Future environmental impacts are also significant. *Eco-Pitch*^{TM} is a quantum leap forward in terms of improved environmental impact compared to current supplies. Due to AmeriCarbon's efficient and non-

combustible low temperature process, greenhouse gas emissions are reduced by more than 92% compared to coal tar pitch produced as a by-product of coking ovens in the steelmaking process (Downstream Strategies, 2021 and 2023). Further, because AmeriCarbon's process operates at lower temperatures, certain carcinogenic compounds and other harmful chemicals are not generated in the process.

4. Standards of Success

The project aims to bolster the domestic production of advanced carbon products, a strategic sector in the United States poised for substantial growth. Leveraging lignite coal as a primary raw material, AmeriCarbon and its collaborators seek to onshore the supply chain for advanced carbon material applications, enabling the creation of valuable finished products while dramatically reducing greenhouse gas emissions compared to existing industrial processes.

This project and the McLean Plant will play a pivotal role in establishing the foundation for the emergence of commercial-scale manufacturing facilities in North Dakota, aimed at seizing the economic potential presented by the onshoring of advanced carbon product production. Serving as a cornerstone, the production of carbon pitch from lignite coal will unlock additional manufacturing prospects, where lignite-derived carbon pitch serves as the basis for further refinement into high-value carbon materials and products. Over time, this endeavor has the potential to attract substantial capital investment, generate thousands of sustainable jobs, and contribute to the reduction of greenhouse gas emissions within the U.S. manufacturing sector.

The long-term success of this project, therefore, will be measured by the following:

1. *Commercial pitch production facilities*. How many commercial scale pitch production facilities will be located in North Dakota and in what time frame? Our hope, pending successful technical results, would be to enable at least one commercial facility located in North Dakota by 2026 with an installed capacity of 28,500 tons of production annually (including all products and by-products).

2. *Downstream manufacturing facilities*. How many additional advanced carbon products manufacturing facilities will be located in North Dakota that use carbon pitch as a feedstock, and what will be their economic impact? Our hope is that by 2030, there could be a network of manufacturers locating in North Dakota, leading to hundreds of jobs during construction and facility operations.

In order to evaluate the success of the proposed project, specific criteria need to be met:

- **Technical Milestones.** The project aims to achieve several technical milestones crucial for optimizing AmeriCarbon's reactor design and integrating it into the base module. These milestones include conducting a detailed concept design review and analysis of the AmeriCarbon reactor to evaluate process and mechanical constraints, identifying and developing preliminary design specifications for the optimized reactor, conducting engineering analysis and prototype design to establish the initial design basis, fabricating, installing, and commissioning the prototype reactor, and generating lignite-based pitch materials with the prototype reactor to validate its performance and gather feedback from stakeholders.

- **Operational Efficiency.** A key measure of success will be the operational efficiency achieved through the optimized reactor design. This involves maximizing throughput while minimizing energy consumption, waste generation, and overall production costs. The project will strive to achieve a significant improvement in process efficiency, ensuring that the reactor operates reliably and consistently at optimal performance levels.

By meeting these standards of success, the project will not only advance the domestic production of advanced carbon products but also contribute to job creation, economic growth, and environmental sustainability in North Dakota and beyond.

5. Background

Existing AmeriCarbon Facility and Background

The roots of AmeriCarbon's proprietary and patented Liquid Carbon Process date back to 2009, when a predecessor organization built a pilot-scale unit for broad coal liquefaction applications. AmeriCarbon re-engineered the facility to create the Liquid Carbon Process for intentional production of

tailored isophase and mesophase coal pitch intermediates and needle cokes. AmeriCarbon has produced pitch from lignite, bituminous and sub-bituminous coals and has also produced needle coke in the facility.

AmeriCarbon has the only known pilot-scale, coal liquefaction-based, pitch production facility in the world. The facility, detailed in the Project Description section, is a 12,000 sq-ft facility that contains infrastructure for laboratory through pilot-scale research and development. This allows for immediate and directly scalable engineering data from applied research generated to be confidently translated to a commercial scale plant. In our discussions with prospective customers, nearly all have expressed concerns about a lack of supply availability and desire to secure a domestic source of economical coal-derived pitch/chemical intermediate.

The Initial NDIC Project: Technical and Economic Feasibility Assessment

From January 2022 through June 2023, AmeriCarbon executed a project titled ***North Dakota Lignite Coal-Based Pitch for Production of High Value Carbon Products via AmeriCarbon Liquid Carbon Pitch (LCP) Process***, which was funded in part by NDIC. At the onset of that project, AmeriCarbon and its collaborators had technical theories and reason to believe that it would be technically feasible to convert North Dakota lignite coal into a coal tar pitch product. Implementation of the project has yielded the following results:

- ✓ Identified and quantified specific market applications
- ✓ Gained an understanding of desired product specifications
- ✓ Conducted chemical formulation and process evaluation studies
- ✓ Produced carbon products from lignite coal that have been tested and confirmed to meet market and customer specifications
- ✓ Evaluated by-products that contribute to the commercial viability of the liquid carbon process
- ✓ Developed a technoeconomic model that meets investor return thresholds

Under the initial project, AmeriCarbon and its project collaborators demonstrated that the production of carbon pitch from North Dakota lignite coal is technically feasible for multiple applications.

Engineering Design of AmeriCarbon LCP Base Module

In October 2022, AmeriCarbon engaged an engineering design contractor to develop an engineering design for the AmeriCarbon LCP process, focused on the production of *Eco-Pitch*™, hydrocarbon by-

products, and ash by-product. Under that ongoing effort, which has been funded to date exclusively by AmeriCarbon, preliminary engineering designs have been developed for AmeriCarbon's base module to produce Eco-Pitch™ from coal; the effort includes establishing cost estimates for equipment and other capital expenses required for construction and operation of the base module to produce *Eco-Pitch™* and its referenced by-products. The work product from this effort will achieve one of the key critical requisites for developing a commercial scale facility such as the McLean Plant. AmeriCarbon recently completed its third phase of engineering design (FEL2), which was completed by Worley Parsons.

Engineering Design of Asphalt and Graphite Modules

In 2023, NDIC contributed funding support to a second project with AmeriCarbon, titled ***Engineering Design and Feasibility Analysis for Commercial Graphite and Asphalt Manufacturing from Lignite-Derived Carbon Pitch,*** to initiate engineering design and validate economic viability for the asphalt and battery modules of the McLean Plant. This second project builds on the prior effort funded by the NDIC in January 2022, which identified and demonstrated the technical potential of asphalt and battery grade graphite derived from lignite coal utilizing AmeriCarbon's patented/proprietary LCP process. The following are expected project results and deliverables:

- Front End Loading Engineering (FEL 1) to provide opportunity assessment and design basis for a commercial plant in North Dakota;
- Experimental process development studies to provide basis for the engineering design/study, technology readiness and the supply of product samples for customer assessment; and
- Technoeconomic evaluation study to verify business case for commercial plant.

The project currently being proposed builds on the prior work funded in part by NDIC, further improving the technical and economic viability of the conversion of lignite coal to coal tar pitch, thereby accelerating the development and finance of the planned McLean Plant, a commercial scale pitch manufacturing facility planned in North Dakota.

Prior Background

The basis for AmeriCarbon's Liquid Carbon Process was derived from long-standing coal liquefaction technology. Coal liquefaction was first successfully developed and implemented in Germany around the time of World War I because of abundance of coal reserves and the need to find alternative resources to petroleum-based transportation fuel for military vehicles like tanks, airplanes and warships. Friedrich Bergius, a German chemist, was the first to invent direct coal liquefaction to convert lignite to fuel in 1913 [22]. Bergius developed a process that required high pressure (70 MPa) and temperature (> 500^{0}C) using iron-based catalyst. The indirect coal liquefaction process was later developed in 1923, famously known as Fischer-Tropsch process. In this process, the coal is first converted into "synthesis gas" (syngas) which is mainly a mixture of H_2 and CO, which is then converted into light hydrocarbon liquid fuel through a series of steps. Both these methods, direct and indirect coal liquefactions, were developed primarily to covert different types of coal into a fuel source[23, 24]. The third method is pyrolysis in which coal is converted partly into liquid hydrocarbon and remining into gaseous hydrocarbon and coke. This liquid hydrocarbon is commonly known as "coal tar", which served as a starting material for lot of chemical and material development[25, 26]. After Germany, United States and Japan also embarked on all three different ways of coal liquefaction; direct, indirect and pyrolysis simultaneously. Unfortunately, the research exploration in this field started to cease as an enormous supply of petroleum was identified in Middle East in 1950. Currently, the only major liquefaction plants worldwide are operated by Sasol (syngas, indirect liquefaction) in South Africa and by Shenhua (direct liquefaction) in China[27].

Until recently (driven by AmeriCarbon's efforts to adapt the process for pitch production), there has not been a critical demand to pursue coal liquefaction technology in the United States. However, recent efforts both in the United States and globally to exploit the superior properties of advanced carbon materials have prompted AmeriCarbon to leverage prior liquefaction efforts with its own innovations to produce the key intermediate chemical linking carbon-rich coal to manufactured carbon products…coal tar pitch. In the past, the United States had significant coking ovens for steel making that also produced coal tar pitch as a

by-product. This was sufficient at the time, but two things have since changed that caused a shortage in U.S. coal-tar pitch supply:

- US-based coke ovens have largely closed due to loss of the US steel industry and environment challenges with the coke ovens;
- Rapid and projected exponential growth of the carbon-based materials industry

AmeriCarbon is on an aggressive path to commercialize this technology and is currently focused on completing research/development and optimizing the process to allow intentional pitch plants to be scaled for specific coals.

Please refer to the Project Summary section for additional background regarding the project and the associated technologies.

6. Qualifications

AmeriCarbon Team Members

AmeriCarbon has assembled a credentialed project team and has developed a portfolio of strategic alliances with innovative developers, research institutions, and industry partners. Its executives bring expertise in the technical subject matter of hydrocarbon conversion, advanced coal products, technology scaleup and commercialization, and business and project finance.

Our team contributes the following to the proposed project:

- Technical Expertise. The AmeriCarbon team is led by **David Berry**, who is serving as principal investigator for the project. Dave has numerous patents and patents pending through more than three decades of institutional research experience with the U.S. Department of Energy and U.S. Department of Defense that are focused on hydrocarbon conversion technologies. Dave has extensive experience from the laboratory through the pilot-scale and has surrounded himself with world class researchers and innovative thinkers which have contributed to AmeriCarbon's unique technology. **Dr. Chetan Tambe** will serve as a senior researcher during the project. Dr. Tambe has a decade of experience in process design and development with a

focus on hydrocarbon liquid processing. **Mark Scafella** will serve as senior chemical technician. Mr. Scafella constructed the AmeriCarbon LCP pilot facility and has 10 years operating experience in the facility conducting coal liquefaction to various fuels, chemicals and pitch.

- Scale Up Capability. AmeriCarbon's business executives have spent the majority of their decades-long careers working in the realm between laboratory scale research and industrial development. The skills required to commercialize technology through the pilot demonstration phase are invaluable and contribute to AmeriCarbon's special capabilities in technical innovation and application.
- Commercial Track Record. Implementing innovation at pilot and industrial scale requires experience in large commercial transactions and the ability to manage capital with discipline. These qualities are the hallmark of AmeriCarbon's financial and commercial team members, who have raised and managed several hundred million dollars in the energy and materials sectors. **Greg Henthorn** formally serves as AmeriCarbon's vice president of business development and will continue to lead these activities in addition to providing project management and business operations support for the project. **Chad Green** is the company's CFO and has been involved in several billion dollars in commercial finance, including private equity and public markets.

Worley Parsons Team Members

Art Lucas has built a record of engineering accomplishments within various engineering disciplines, with experience at MATRIC, Marathon Ashland Petroleum, Akzo Nobel, Sunoco Chemicals, and DuPont Chemicals. He has provided engineering support for propylene purification and polymerization, polymer extrusion technology, process debottlenecking, solid handling and material transfer operations. He also has experience in simulating chemical processes with engineering software to develop a complete understanding of system dynamics. Art has been heavily involved in the design and detailed engineering for a biodiesel plant based on novel continuous technology. Art has a BS in Chemical Engineering from West Virginia University Institute of Technology.

Note: Detailed resumes from AmeriCarbon and Worley Parsons are included in Appendix 7-I.

7. Value to North Dakota

The proposed project will contribute to onshoring the supply chain of advanced carbon products – with current feedstock demand being largely met by China – and connect the dots all the way from raw materials (in the form of lignite coal) all the way to a finished product, reducing our nation's reliance on foreign suppliers to fuel growth in this strategic area. This economic activity can leverage North Dakota's rich and abundant supply of lignite by using it as a highly valuable raw material feedstock for value-added manufacturing.

The proposed project plays a necessary and critical role in the development of the McLean Plant. Upon breaking ground, the McLean Plant will have immediate, near term, and long-term impacts with respect to the creation of high wage employment for McLean County, North Dakota and the surrounding region. The facility is projected to create 40 high wage full time jobs when the facility opens, with growth to 70 jobs at full capacity. The created jobs will be manufacturing and engineering jobs with high wages and located in and near economically distressed regions. The company has entered into a Memorandum of Understanding regarding a Project Labor Agreement regarding the McLean Plant. AmeriCarbon is committed to workforce development as a major pillar of the company's activities in North Dakota.

The proposed project will enhance the use of North Dakota lignite coal by providing an alternative commercial use other than electricity. In the event that coal-fired electricity generation remains steady over time, this project could also lead to an opportunity to grow the coal industry and provide funds for increased research, jobs, and economic growth and development.

Products of the McLean Plant can be used to create electric vehicles parts and electrodes as well as to keep up with the growing demand for charging stations around the state. It can also lead to additional asphalt production that could extend beyond the state's borders. The McLean Plant will help to preserve existing coal jobs by ensuring demand for the product in case of an economic downturn in the coal industry. The proposed project will also lead to job growth in the coal sector due to the additional demand for lignite

coal to be used for carbon pitch. Demand for advanced carbon products is growing annually and when combined with the AmeriCarbon LCP process, the underlying opportunity is to convert lignite coal into valuable products worth several thousand dollars per ton. Job growth can also come from the resurgence of domestic production of carbon pitch in the United States.

8. Management

From an organization/company point of view, AmeriCarbon will serve as the point organization and will manage the project, including all vendors and personnel who are performers under the project. From an individual perspective, David Berry will be the Principal Investigator and lead the project team.

The project will have a flat organizational structure reporting to a single authority, the Principal Investigator. This is intended to streamline project communication and decision making, facilitating the performance of the tasks and achievement of the objectives described in the proposal, including in the Methodology section in a timely and efficient manner, and in the timeframe outlined in the proposal.

The project team's flat organizational structure will allow for efficient and rapid response to questions and challenges that may arise in the performance of the project. Communication will occur largely via videoconferences and telephonic conferences on regularly scheduled and ad hoc bases throughout the project as needed. The principal investigator has considerable experience in managing teams in different locations, managing project scope, and ensuring technical direction without veering off track. This will provide a disciplined approach to project timelines and budgeting while avoiding scope creep challenges. The principal investigator will be responsive to incoming requests from NDIC and is prepared to schedule videoconferences, telephonic meetings, or in-person meetings as desired.

As noted in the attached resumes, which may be found in Appendix 7-1, the principal investigator has more than three decades of research experience, including the management of cross functional teams

with diverse skills and competencies. All members of the team have considerable experience managing and performing in similar teams spanning multiple decades.

Risk Management Plan

AmeriCarbon continually identifies risks and challenges to the project, including financial, technical, performance, schedule, and regulatory compliance. Strategies for mitigating and managing these risks include developing contingency plans, conducting risk assessments, and implementing quality assurance and quality control measures. Regular communication and collaboration with stakeholders and team members is essential to keep everyone informed of progress and address any issues or concerns.

The following risks and contingencies have been identified for consideration with respect to the scope of work of the proposed project:

1. ***Technical Complexity and Uncertainty:***

- Risk: The project involves complex technical processes such as reactor design, engineering analysis, and prototype fabrication, leading to uncertainties in outcomes.
- Mitigation: Conduct thorough research and feasibility studies before initiating each task. Engage subject matter experts and leverage advanced simulation tools to predict potential challenges and optimize design parameters. Implement agile project management methodologies to adapt to changing requirements and mitigate technical risks incrementally.

2. ***Operational Challenges:***

- Risk: Operating pressures, temperatures, and flow requirements may pose challenges in achieving desired process performance and operability.
- Mitigation: Implement rigorous testing protocols during the fabrication and commissioning of the prototype reactor to validate its operational capabilities. Conduct comprehensive training for operators and maintenance personnel to ensure efficient operation and troubleshooting of the reactor. Establish contingency plans to address potential operational disruptions and minimize downtime.

3. ***Materials Selection and Compatibility:***

- Risk: Selection of suitable materials of construction (MOC) for the reactor may pose challenges due to compatibility issues with process conditions and materials handling requirements.
- Mitigation: Engage materials engineers and experts in corrosion science to assess MOC requirements and compatibility with the process environment. Conduct thorough testing and qualification of selected materials to ensure their suitability for long-term use in the reactor. Establish quality control measures to monitor material performance and address any issues proactively.

*4. **Supply Chain and Fabrication Risks:***

- Risk: Delays or disruptions in the supply chain for critical components and materials may impact the fabrication and installation schedule of the prototype reactor.
- Mitigation: Diversify the supply chain and establish alternate sourcing options for critical components to reduce dependency on single suppliers. Maintain open communication channels with suppliers to anticipate potential bottlenecks and address them proactively. Implement project scheduling and tracking tools to monitor progress and identify any deviations from the timeline early on.

*5. **Feedback and Collaboration Challenges:***

- Risk: Limited or inadequate feedback from customers and collaborators could hinder the validation and refinement of the prototype reactor's performance.
- Mitigation: Establish clear communication channels with customers and collaborators to facilitate timely feedback on pitch materials processed with the prototype reactor. Organize regular meetings, workshops, and surveys to gather input and insights from stakeholders. Foster a collaborative and transparent working environment to encourage active participation and engagement in the project.

9. Timetable

The proposed project is anticipated to take 18 months from project initiation. The following is a timeline Gantt chart with milestones, milestone table and suggested deliverables:

#	Task	Perfomer	Months from Project Start
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
1	**Analysis of AmeriCarbon Concept/Prototype Reactor**	AmeriCarbon/Worley	
M1.1	Complete concept design review and analysis		
2	**Identify/Develop Reactor Preliminary Design Specifications**	AmeriCarbon/Worley	
M2.1	Initial Preliminary Design Spec		
M2.2	Final Reactor Design Specification for Prototype Build		
3	**Engineering Analysis and Prototype Design/Drawings**	AmeriCarbon/Worley	
M3.1	Preliminary drawings complete		
M3.2	Final fabrication drawings for construction issuance.		
4	**Fabricate, Install and Commission Prototype Reactor**	AmeriCarbon/Worley	
M4.1	Order materials/equipment		
M4.2	Install reactor		
5	**Generate Lignite-Based Pitch Material with Prototype Reactor**	AmeriCarbon/Worley	
M5.1	Initial Samples		
M5.2	Final Samples for Customer Evaluation		

Figure 8. *Project timetable.*

The following are the deliverables and timeline:

#	Deliverables	Due Date
D1	Quarterly Reports	Per Quarter End
D2	Pitch Samples	Per Request
D3	Final Report Submission	End of contract

Figure 9. *Table of project deliverables.*

10. Budget

The project budget totals $1,488,809, with $743,809 being requested from NDIC, $20,000 in in-kind services provided by NACoal, and $725,000 provided as in-kind services from AmeriCarbon. A detailed budget was prepared using the standard U.S. Department of Energy budgeting model. Key tables from the budget are included in Appendix 11-1. Where the tables reference “Federal Share”, it is intended to indicate the proposed “NDIC Share”.

11. Matching Funds

Support letters for matching funds are included in Appendix 12-1, including a cost share commitment of $20,000 from NACoal and $725,000 from AmeriCarbon, for a total cost share resulting in a combined cost share of $745,000, representing greater than 50% of the overall budget.

12. Tax Liability

The applicant does not have any past due tax liability with the State of North Dakota. An affidavit is attached in Appendix 13-1.

13. Confidential Information

Not applicable.

14. References

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7. Garcia, J.L. Crespo, S.C. Martin, C.E. Snape, S.R. Moinelo, "Development of Mesophase from a Low-Temperature Coal Tar Pitch", Energy & Fuels 2003, 17, 291-301

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15. Appendices

Attached.

Appendix 6-1

DAVID A. BERRY

EDUCATION AND TRAINING

West Virginia University, Chemical Engineering, B.S. (1984)
West Virginia University, Chemical Engineering, M.S. (1999)

RESEARCH AND PROFESSIONAL EXPERIENCE

CEO/CTO – AmeriCarbon LLC, Morgantown, WV, 2020 – current:
Leading the commercialization of coal conversion to enabling carbon pitch intermediate for high-value carbon product manufacturing such as arc furnace carbon electrodes, advanced battery storage electrodes, carbon fibers, carbon foams, computer chips and other carbon-based products for commercial and defense sector. owns and operates a 12,000 ft2 research/production facility with full laboratory facilities (vented hoods, wet chemistry, etc.) as well a continuous PLC controlled pilot scale hydrocarbon processing train for high temperature/high-pressure chemical conversion and other PLC controlled pilot space.

Associate Director – National Energy Technology Laboratory, Morgantown, WV, 2009 – 2020:
Managed a multi-million-dollar research program of engineers and scientists with primary expertise in catalysis, reaction engineering, surface science, electromagnetic energy, plasma chemistry, hydrocarbon conversion (coal, oil, NG) and materials science. Major focus in the development of fossil energy conversion technologies involving fuels/chemicals production, gas cleanup, power-generation cycles (turbines, fuel cells, hybrids), syngas conversion and hydrocarbon fuel reforming (i.e. diesel, logistic fuels, natural gas, coal-derived, bio-fuel…) including coal/biomass & methane gasification. Responsible for oversight of >36 laboratories ranging from bench-scale to small pilot operations.

Research Leader – National Energy Technology Laboratory, Morgantown, WV, 1992 – 2009:
Managed/conducted research for a $10 Million per year, multi-disciplined research team (engineers, scientists, technicians) in the development of fuel processing technology involving projects ranging in size from $200,000 – $500,000 per year. Focus involved developing capability and technology for processing of hydrocarbon fuels (i.e. diesel, logistic fuels, natural gas, coal-derived, bio-fuel…) for integrated operation with fuel cell systems. Developed program for coal/biomass & methane gasification. Established new science capability development with plasma and electromagnetic frequency technologies. Construction & operations of multiple laboratories from laboratory through small pilot scale. Processes include test reactors (fixed, fluid, and transport), catalyst and sorbent preparation and an array of analytical characterization equipment/methods.

Technology Manager – National Energy Technology Laboratory, Morgantown, WV, 1986 – 1992:
Managed a $10 million per year research and development program for the development of advanced high temperature solid oxide fuel cell power generation systems. Conducted all phases of planning (vision/objectives/requirements), budgeting, patents/license and functional management of multiple development projects with values ranging from $200 k to $150 M. Interfaced with academia, government (civilian & defense), industrial, and utility groups, both foreign and domestic, to accomplish and facilitate the development. Facilitated technology development and demonstration through coordinated cost participation between industrial participants, natural gas utilities and electrical power generation utilities.

Project Manager – Belvoir R&D Center, Fort Belvoir, VA, 1984 – 1986:
Managed and conducted engineering for development effort between various military groups and industrial companies (Allied Signal, Goodyear, OPW…) for a turbine-based helicopter and ground vehicle refueling system for use in extreme arctic conditions from development stage through conduct of end user/military acceptance testing and eventual acceptance into official army inventory.

PUBLICATIONS - Selected

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3. Ping Wang, Nicholas Means, Bret Howard, Dushyant Shekhawat, and David Berry, The Reactivity of CuO Oxygen Carrier and Coal in Chemical-Looping with Oxygen Uncoupled (CLOU) and In-situ Gasification Chemical-Looping Combustion (iG-CLC), Fuel 217 (2018) 642-649).
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PATENTS - Selected

1. U.S. Patent # 9,935,318 SOFC Cathode with Oxygen Reducing Layer, (2018)
2. U.S. Patent 9,598,644 Method of CO and/or CO2 hydrogenation to higher hydrocarbons using doped mixed metal oxides, (2017).
3. U. S. Patent 9,562,203 Methane-rich syngas production from hydrocarbon fuels using multi-functional catalyst/capture agent, (2017).
4. U.S. Patent 9,126,833 Process for continuous synthesis of mixed oxide powders, (2015).
5. U.S. Patent 8,486,301 Method for designing a reforming and/or combustion catalysts system, (2013).
6. U.S. Patent # 7,442,353 "Heat Recirculating Reformer for Fluid Stream Pollutant Removal, (2008).

SYNERGISTIC ACTIVITIES

- Editorial Board Member, "Catalysis Today", January 2006-2009.
- Distinguished Visiting Scientist, Oak Ridge National Laboratory, April 2002.
- Research Management Board Member, Army Core Technology Program (CTP) for Power Systems, June 2005 / 2006.

GREGORY G. HENTHORN

EDUCATION

West Virginia University, Morgantown, WV, Executive MBA (2003);

West Virginia University, Morgantown, WV, J.D. (2000)

West Virginia University, Morgantown, WV, B.S., Chemical Engineering (1995)

RESEARCH AND PROFESSIONAL EXPERIENCE

AmeriCarbon Products, LLC; VP of Corporate Development; Morgantown, WV; 2020-present; Focuses on commercial transactions; investor relations, capital attraction and management; business development with customers and collaborators; administrative and financial oversight.

West Virginia University; Associate Professor (Adjunct); Morgantown, WV; 2019-present; Energy Production and Operations (ENLM 220)

Flat Rock Energy; EVP of Business Development; Morgantown, WV; 2010-2020; Flat Rock is a private equity funded oil and gas exploration and production company that develops, funds, and implements drilling programs in the Appalachian Basin. Founder of company, securing more than $100 million in private equity funding; Negotiated commercial transactions with investors and other oil and gas operators.

Kinetic Clean Energy; Managing Partner; Morgantown, WV; 2007-2010; The company coordinated the origination, development, and finance of several methane-based renewable energy projects. Financed more than $50 million in renewable electric power facility construction projects; Organized facility to convert fleet vehicles to compressed natural gas; Assisted in the formation of a team to commercialize ethane-to-plastics technology.

Fourth Venture Group; Vice President; Morgantown, WV; 2000-2007; Fourth Venture was an angel capital and early stage venture capital firm that served as a launching pad for technology commercialization and economic development. Served as Chief Operating Officer for a 500,000-

member online portal that integrated with hundreds of brick-and-mortar merchants; Worked with DOE laboratories and NGOs to commercialize technologies developed in former Soviet military research institutes; Explored development of a liquefaction facility to convert coal to liquid transportation fuels; Co-founded an enterprise-class business-to-business software company that was focused on the surveying and construction sectors, from establishment of the business to its divestiture; Held executive management positions in two specialized manufacturing companies.

SELECTED PUBLICATIONS & PRESENTATIONS

- "New Business Opportunities in TransTech Energy Technologies", West Virginia Senate Economic Development Committee Meeting, West Virginia State Capitol, January 18, 2011.
- "Opportunities for the Coal Industry to Create Revenue from Carbon Offsets", 36th Annual West Virginia Mining Symposium, West Virginia Coal Association, Civic Center, Charleston, WV, February 18, 2009.
- Bai, Xingji and Henthorn, Greg. "13 Per Day." *Capacity Magazine* Spring (2007): 77-79. Print.

SYNERGISTIC ACTIVITIES

1. **TechConnectWV**, Charleston, WV; Member, Board of Directors, 2004-present; Member, Executive Committee, 2010-present. TechConnectWV is a non-profit, 501(c)(3) organization dedicated to the advancement of science, technology, and the innovation economy in West Virginia.
2. **West Virginia University**, under contract with Kinetic, 2012-2016; *Feasibilities of a Coal-Biomass to Liquids Plant in Southern West Virginia* (Award DE-FE0009997).
3. National Research Center for Coal & Energy, West Virginia University, Morgantown, WV; Consultant, Energy Efficiency Division, under contract with Kinetic, 2010-2011; *Supported establishment of initial TransTech Energy Conference.*
4. **West Virginia High Technology Consortium Foundation**, Fairmont, WV; Consultant, INNOVA Commercialization Group, 2010-2011; *Identification of technology commercialization and investment opportunities at NETL and WVU*

Art Lucas

Senior Principal Process Engineer

Summary

Mr. Lucas has more than twenty-two years of process design and research experience in the Chemical and Polymer industries. Responsibilities have included process engineer, research engineer and other roles.

Education

2000 B.S. Chemical Engineer, West Virginia Institute of Technology, Montgomery, WV

Experience

2023-Present Senior Principal Process Engineer, Worley, Charleston, WV

- Air Permitting & Emissions for Blue Ammonia Technology
- Proposal and Scope Work OSBL Blue Ammonia Technology
- Plastics Recycling Technology
- UniSim Modeling with OLI Software
- Worley Education Passports in Low Carbon Hydrogen, Ambition, Sustainability, Energy

2006-2023 Senior Research Engineer, MATRIC, South Charleston, WV

Technology development and deployment of various technologies at both laboratory and pilot scale as listed below.

- Batch polymerizations with novel technologies
- Liquid-Liquid Extractions
- Membrane technology and filtrations
- High Molecular weight polymerization
- Pyrolysis Technology
- Agitated filter drying and precipitations
- Adsorption Technologies
- Renewable Energy Technology
- Recycle Technology for various consumer products
- Chlorination reactions with shock sensitive byproducts
- Algae processing to make nutraceuticals

- Wiped Film evaporation and azeotropic distillations
- Slurry handling of both miscible and immiscible solutions.
- Solids handling of pseudoplastics and high viscosity polymers

Responsibilities included the following:

- Technical liaison with customers technical staff to develop scope of work, project execution plans and testing protocols.
- Developed all documentation for pilot scale operations. This included but not limited to, P&IDs, mass and energy balances, operating procedures, EHS, Safety assessments, emergency response and daily operational plans.
- Managed customer projects from concept to completing. A Dual role as Senior Research Engineer and Project Manager. Managed average capital expenditures of $500K to as excess of $1.5MM.
- Technical documentation for patent filing for successful technology for both the customer and internal research projects.
- Trained the operation workforce on the new technology deployments. This includes sample methodology as well as operation know how.
- Developed technology packages for renewable energies as part of the Renewable Fuel Standard.
- Worked with customer to mitigate risk for large scale fermentation to acid technology hurdles. Solutions were adopted and customer deployment commercial scale implementation in excess of $300MM.
- Developed and patented technology in Pyrolysis and Reverse Osmosis Membranes.
- Lead engineer for design and implementation of patented continuous biodiesel facility. Overseen technology transfer, prepared design and bid packages and orchestrated project implantation in a cradle to grave role. This also included writing all Standard Operation procedures an defining the safety and compliance issues for the facility.

2006 – 2006 Process Engineer, DuPont Chemical Company, Belle, WV

- Debottlenecking process by redeveloping process conditions.

Solid Handling and Material Transfer

Vacuum Operations

Slurry Transfer

Batch Processing

Blending and Conveying

- Responsible for all activities surrounding production metrics of the unit.
- Provided 24hr coverage for area of unit responsibility to provide direction as require for all production problems.
- Organized a process workflow system that directed the human interfaces with the process for optimal performance.
- Educated/Trained operations on critical paths for success and very instrumental in fostering a higher standard ow work practices of operational employees.
- Developed and implemented new process guidelines and control limits.
- Responsible for operational instructions for evening and night shift employees.

2001 – 2005 Project/Process Engineer, Sunoco Chemical – Kenova, WV

Extrusion Process

- Implemented Rheology technologies for improved process control.
- Project engineer for de-bottlenecking extrusion line.

Capital $1.75 MM

Designed and implemented Master Batch Additive System

- Rotating equipment

Twin Screw Extruders

Gear pumps

Blenders

Conveyors

Rotary valves

Pelletizers

Bulk material transfer

Gravity and pneumatic conveying systems

- Decreased off spec product by improving raw additive blend methods.
- Fully utilized new and existing PLC components for decreasing labor efforts along additive system.
- Orchestrated work efforts with hourly group to obtain new process workflow and procedure for new equipment.
- Preventative maintenance routines and monitoring for new equipment.
- Daily engineering support to production. Organized and developed "Best Practices" along extrusion line using root cause analysis.

300% increase in reliability

Increased first pass prime material from 93% to 98.2%.

Polymerization Process:

- Improved first stage reaction control by installing a refrigerated water/glycol system.
    - Twin screw and reciprocating compressor technology
- Operating Discipline Rollout member
- Spheripol Catalyst Technologies
- Provided engineering support to operations for high activity catalyst trials.
- Combined reaction kinetics and catalyst technologies to minimize byproduct formation.
- Decreased off-spec product by 50% by developing and implementing IMR models for online Rheology measurement.

Propylene Purification:

- Catalyst technologies for feedstock purifications
- Installed and commissioned first Nickel catalyst bed within Chemicals division ($100K capital).

- Utilized regeneration techniques to improve Lead Oxide catalyst bed life.
- Replaced and re-commissioned Lead Oxide beds ($250K capital).
- Replaced and re-commissioned Alumina Oxide/Mole Sieve catalyst beds ($100K capital).
- Installed various pumps and valves to maintain and improve operation.

Facility Wide Accomplishments

- Engineering member for Honeywell DCS Fail Safe Controller Installation
- Flare monitoring and reporting for WV Department of Air Quality
- Site Process Hazard Analysis leader for HAZOP studies
- Design member for new Management of Change procedure for Sunoco Chemicals Ohio Valley Region
- ISO auditor

2000 – 2001 Process Engineer, AKZO Nobel Functional Chemicals, Gallipolis, WV

- Identified and resolved heat load bottlenecks for increased throughput.
- Optimized CSTR's to produce higher yields while minimizing raw material.
- Served as team leader and engineering supervisor during two new product campaigns to market.
- Plant liaison for third party engineering capital project: $150K
- Multiple small capital projects under $50K

1997 – 1999 Chemical Engineer Co-Op, Marathon Ashland Petroleum, Ashland, KY

- Optimization of fired heaters and steam utilities at the refinery
- Reclaimed precious metal catalyst from large reactors.
- Prepared daily reports for energy economics within refining operations.
- Worked with EPA on conditions to obtain environmental compliance.

Appendix 10-1

Instructions and Summary

Award Number: | **Date of Submission:** 10/1/2021

Award Recipient: AmeriCarbon Products LLC | **Form submitted by:** AmeriCarbon Products, LLC

(May be award recipient or sub-recipient)

Please read the instructions on each worksheet tab before starting. If you have any questions, please ask your DOE contact!

1. If using this form for award application, negotiation, or budget revision, fill out the blank white cells in workbook tabs a. through j. with total project costs. If using this form for invoice submission, fill out tabs a. through j. with total costs for just the proposed invoice and fill out tab k. per the instructions on that tab.
2. Blue colored cells contain instructions, headers, or summary calculations and should not be modified. Only blank white cells should be populated.
3. Enter detailed support for the project costs identified for each Category line item within each worksheet tab to autopopulate the summary tab.
4. The total budget presented on tabs a. through i. must include both Federal (DOE) and Non-Federal (cost share) portions.
5. All costs incurred by the preparer's sub-recipients, vendors, and Federal Research and Development Centers (FFRDCs), should be entered only in section f. Contractual. All other sections are for the costs of the preparer only.
6. Ensure all entered costs are allowable, allocable, and reasonable in accordance with the administrative requirements prescribed in 2 CFR 200, and the applicable cost principles for each entity type: FAR Part 31 for For-Profit entities; and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.
7. Add rows as needed throughout tabs a. through j. If rows are added, formulas/calculations may need to be adjusted by the preparer. Do not add rows to the Instructions and Summary tab. If your project contains more than three budget periods, consult your DOE contact before adding additional budget period rows or columns.
8. ALL budget period cost categories are rounded to the nearest dollar.

BURDEN DISCLOSURE STATEMENT

Public reporting burden for this collection of information is estimated to average 3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of Information Resources Management Policy, Plans, and Oversight, AD-241-2 - GTN, Paperwork Reduction Project (1910-5162), U.S. Department of Energy, 1000 Independence Avenue, S.W., Washington, DC 20585; and to the Office of Management and Budget, Paperwork Reduction Project (1910-5162), Washington, DC 20503.

SUMMARY OF BUDGET CATEGORY COSTS PROPOSED

The values in this summary table are from entries made in subsequent tabs, only blank white cells require data entry

Section A - Budget Summary

	Federal	Cost Share	Total Costs	Cost Share %	Proposed Budget Period Dates
Budget Period 1	$743,809	$745,000	$1,488,809	50.04%	
Budget Period 2	$0	$0	$0	0.00%	
Budget Period 3	$0	$0	$0	0.00%	
Total	$743,809	$745,000	$1,488,809	50.04%	

Section B - Budget Categories

CATEGORY	Budget Period 1	Budget Period 2	Budget Period 3	Total Costs	% of Project	**Comments** (as needed)
a. Personnel	$409,200	$0	$0	$409,200	27.49%	
b. Fringe Benefits	$72,948	$0	$0	$72,948	4.90%	
c. Travel	$10,088	$0	$0	$10,088	0.68%	
d. Equipment	$96,779	$0	$0	$96,779	6.50%	
e. Supplies	$17,450	$0	$0	$17,450	1.17%	
f. Contractual						
Sub-recipient	$0	$0	$0	$0	0.00%	
Vendor	$280,000	$0	$0	$280,000	18.81%	
FFRDC	$0	$0	$0	$0	0.00%	
Total Contractual	$280,000	$0	$0	$280,000	18.81%	
g. Construction	$0	$0	$0	$0	0.00%	
h. Other Direct Costs	$0	$0	$0	$0	0.00%	
Total Direct Costs	$886,465	$0	$0	$886,465	59.54%	
i. Indirect Charges	$602,344	$0	$0	$602,344	40.46%	
Total Costs	$1,488,809	$0	$0	$1,488,809	100.00%	

Additional Explanation (as needed):

a. Personnel

INSTRUCTIONS - PLEASE READ!!!

1. List project costs solely for employees of the entity completing this form. All personnel costs for subrecipients and vendors must be included under f. Contractual.

2. All personnel should be identified by position title and not employee name. Enter the amount of time (e.g., hours or % of time) and the base pay rate and the total direct personnel compensation will automatically calculate. Rate basis (e.g., actual salary, labor distribution report, state civil service rates, etc.) must also be identified.

3. If loaded labor rates are utilized, a description of the costs the loaded rate is comprised of must be included in the Additional Explanation section below. DOE must review all components of the loaded labor rate for reasonableness and unallowable costs (e.g. fee or profit).

4. If a position and hours are attributed to multiple employees (e.g. Technician working 4000 hours) the number of employees for that position title must be identified.

5. Each budget period is rounded to the nearest dollar.

SOPO Task #	Position Title	Budget Period 1			Budget Period 2			Budget Period 3			Project Total Hours	Project Total Dollars	Rate Basis
		Time (Hrs)	Pay Rate ($/Hr)	Total Budget Period 1	Time (Hrs)	Pay Rate ($/Hr)	Total Budget Period 2	Time (Hrs)	Pay Rate ($/Hr)	Total Budget Period 3			
1	Sr. Engineer **(EXAMPLE!!!)**	2000	$85.00	$170,000	200	$50.00	$10,000	200	$50.00	$10,000	2400	$190,000	Actual Salary
2	Technicians (2)	4000	$20.00	$80,000	0	$0.00	$0	0	$0.00	$0	4000	$80,000	Actual Salary
1,2,3,4,5	Principal Investigator	875	$175.00	$153,125			$0			$0	875	$153,125	
1,2,3,4,5	Chemical Engr Executive	125	$125.00	$15,625			$0			$0	125	$15,625	
1,2,3,4,5	Chemical Engineer	1395	$60.00	$83,700			$0			$0	1395	$83,700	
1,2,3,4,5	Chemical Technician (2)	2950	$45.00	$132,750			$0			$0	2950	$132,750	
1,2,3,4,5	Project Manager	320	$75.00	$24,000			$0			$0	320	$24,000	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
				$0			$0			$0	0	$0	
	Total Personnel Costs	**5665**		**$409,200**	**0**		**$0**	**0**		**$0**	**0**	**$409,200**	

Additional Explanation (as needed):

b. Fringe Benefits

INSTRUCTIONS - PLEASE READ!!!

1. Fill out the table below by position title. If all employees receive the same fringe benefits, you can show "Total Personnel" in the Labor Type column instead of listing out all position titles.
2. The rates and how they are applied should not be averaged to get one fringe cost percentage. Complex calculations should be described/provided in the Additional Explanation section below.
3. The fringe benefit rates should be applied to all positions, regardless of whether those funds will be supported by Federal Share or Recipient Cost Share.
4. Each budget period is rounded to the nearest dollar.

Labor Type	Budget Period 1			Budget Period 2			Budget Period 3			Total Project
	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	Personnel Costs	Rate	Total	
EXAMPLE!!! Sr. Engineer	$170,000	20%	$34,000	$10,000	20%	$2,000	$10,000	20%	$2,000	$38,000
Principal Investigator	153,125	12.34%	$18,896	0	12.34%	$0			$0	$18,896
Chemical Engr Executive	15,625	13.61%	$2,127	0	13.61%	$0			$0	
Chemical Engineer	83,700	17.85%	$14,940	0	17.85%	$0			$0	$14,940
Chemical Technician (2)	132,750	25.40%	$33,719	0	25.40%	$0			$0	$33,719
Project Manager	24,000	13.61%	$3,266	0	13.61%	$0			$0	$3,266
Total:	**$409,200**		**$72,948**	**$0**		**$0**	**$0**		**$0**	**$72,948**

A federally approved fringe benefit rate agreement, or a proposed rate supported and agreed upon by DOE for estimating purposes is required at the time of award negotiation if reimbursement for fringe benefits is requested. Please check (X) one of the options below and provide the requested information if not previously submitted.

_____ **A fringe benefit rate has been negotiated with, or approved by, a federal government agency. A copy of the latest rate agreement is/was included with the project application.***

__X___ **There is not a current federally approved rate agreement negotiated and available.****

*Unless the organization has submitted an indirect rate proposal which encompasses the fringe pool of costs, please provide the organization's benefit package and/or a list of the components/elements that comprise the fringe pool and the cost or percentage of each component/element allocated to the labor costs identified in the Budget Justification.

**When this option is checked, the entity preparing this form shall submit an indirect rate proposal in the format provided in the Sample Rate Proposal at http://www1.eere.energy.gov/financing/resources.html, or a format that provides the same level of information and which will support the rates being proposed for use in the performance of the proposed project.

Additional Explanation (as necessary): Please use this box (or an attachment) to list the elements that comprise your fringe benefits and how they are applied to your base (e.g. Personnel) to arrive at your fringe benefit rate.

c. Travel

INSTRUCTIONS - PLEASE READ!!!

1. Identify Foreign and Domestic Travel as separate items. Examples of Purpose of Travel are subrecipient site visits, DOE meetings, project mgmt. meetings, etc. Examples of Basis for Estimating Costs are past trips, travel quotes, GSA rates, etc.

2. All listed travel must be necessary for performance of the Statement of Project Objectives.

3. Federal travel regulations are contained within the applicable cost principles for all entity types. Travel costs should remain consistent with travel costs incurred by an organization during normal business operations as a result of the organizations written travel policy. In absence of a written travel policy, organizations must follow the regulations prescribed by the General Services Administration.

4. Each budget period is rounded to the nearest dollar.

SOPO Task #	Purpose of Travel	Depart From	Destination	No. of Days	No. of Travelers	Lodging per Traveler	Flight per Traveler	Vehicle per Traveler	Per Diem Per Traveler	Cost per Trip	Basis for Estimating Costs
	Domestic Travel	**Budget Period 1**									
1	**EXAMPLE!!!** Visit to PV manufacturer			2	2	$250	$500	$100	$160	$2,020	Current GSA rates
1-5	Project Kickoff	Pittsburgh, PA	North Dakota	4	2	$450	$800	$150	$236	$3,272	
4	Inspections/Drawing Reviews	Morgantown,	Charleston, WV	2	2	$450	NA	$200	$236	$1,772	
4	Inspections/Drawing Reviews	Morgantown,	Charleston, WV	2	2	$450	NA	$200	$236	$1,772	
1-5	Project Review	Pittsburgh, PA	North Dakota	4	2	$450	$800	$150	$236	$3,272	
	International Travel										
										$0	
	Budget Period 1 Total									**$10,088**	
	Domestic Travel	**Budget Period 2**									
										$0	
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 2 Total									**$0**	
	Domestic Travel	**Budget Period 3**									
										$0	
										$0	
	International Travel										
										$0	
	Budget Period 3 Total									**$0**	
	PROJECT TOTAL									**$10,088**	

Additional Explanation (as needed):

d. Equipment

INSTRUCTIONS - PLEASE READ!!!

1. Equipment means tangible personal property (including information technology systems) having a useful life of more than one year and a per-unit acquisition cost which equals or exceeds the lesser of the capitalization level established by the non-Federal entity for financial statement purposes, or $5,000. Please refer to the applicable Federal regulations in 2 CFR 200 for specific equipment definitions and treatment.

2. List all equipment below, providing a basis of cost (e.g. vendor quotes, catalog prices, prior invoices, etc.). Briefly justify items as they apply to the Statement of Project Objectives. If it is existing equipment, provide logical support for the estimated value shown.

3. During award negotiations, provide a vendor quote for all equipment items over $50,000 in price. If the vendor quote is not an exact price match, provide an explanation in the additional explanation section below. If a vendor quote is not practical, such as for a piece of equipment that is purpose-built, first of its kind, or otherwise not available off the shelf, provide a detailed engineering estimate for how the cost estimate was derived.

4. Each budget period is rounded to the nearest dollar.

SOPO Task #	Equipment Item	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
Budget Period 1						
3,4,5	**EXAMPLE!!!** Thermal shock chamber	2	$70,000	$140,000	Vendor Quote - Attached	Reliability testing of PV modules- Task 4.3
4,5	Lignite coal dryer - nitrogen	1	$15,779	$15,779		
4	Reactor instrumentation (flow, level probe, etc.)	1	$21,000	$21,000		
4	High capacity slurry pumps	2	$12,500	$25,000		
4	Reactor hot oil/heat transfer fluid heating system	1	$35,000	$35,000		
				$0		
				$0		
	Budget Period 1 Total			$96,779		
Budget Period 2						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 2 Total			$0		
Budget Period 3						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 3 Total			$0		
	PROJECT TOTAL			**$96,779**		

Additional Explanation (as needed):

e. Supplies

INSTRUCTIONS - PLEASE READ!!!

1. Supplies are generally defined as an item with an acquisition cost of $5,000 or less and a useful life expectancy of less than one year. Supplies are generally consumed during the project performance. Please refer to the applicable Federal regulations in 2 CFR 200 for specific supplies definitions and treatment. A computing device is a supply if the acquisition cost is less than the lesser of the capitalization level established by the non-Federal entity for financial statement purposes or $5,000, regardless of the length of its useful life.

2. List all proposed supplies below, providing a basis of costs (e.g. vendor quotes, catalog prices, prior invoices, etc.). Briefly justify the need for the Supplies as they apply to the Statement of Project Objectives. Note that Supply items must be direct costs to the project at this budget category, and not duplicative of supply costs included in the indirect pool that is the basis of the indirect rate applied for this project.

3. Multiple supply items valued at $5,000 or less used to assemble an equipment item with a value greater than $5,000 with a useful life of more than one year should be included on the equipment tab. If supply items and costs are ambiguous in nature, contact your DOE representative for proper categorization.

4. Add rows as needed. If rows are added, formulas/calculations may need to be adjusted by the preparer.

5. Each budget period is rounded to the nearest dollar.

SOPO Task #	General Category of Supplies	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
Budget Period 1						
4,6	**EXAMPLE!!!** Wireless DAS components	10	$360.00	$3,600	Catalog price	For Alpha prototype - Task 2.4
	Chemicals, solvents and lubricants	1	$3,750.00	$3,750		
	Heat tracing and insulation	1	$6,350.00	$6,350		
	Piping, fittings, seals, gaskets	1	$7,350.00	$7,350		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 1 Total			**$17,450**		
Budget Period 2						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 2 Total			$0		
Budget Period 3						
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 3 Total			$0		
	PROJECT TOTAL			**$17,450**		

Additional Explanation (as needed):

f. Contractual

INSTRUCTIONS - PLEASE READ!!!

1. The entity completing this form must provide all costs related to subrecipients, vendors, and FFRDC partners in the applicable boxes below.

2. Subrecipients (partners, sub-awardees): Subrecipients shall submit a Budget Justification describing all project costs and calculations when their total proposed budget exceeds either (1) $100,000 or (2) 50% of total award costs. These subrecipient forms may be completed by either the subrecipients themselves or by the preparer of this form. The budget totals on the subrecipient's forms must match the subrecipient entries below. A subrecipient is a legal entity to which a subaward is made, who has performance measured against whether the objectives of the Federal program are met, is responsible for programmatic decision making, must adhere to applicable Federal program compliance requirements, and uses the Federal funds to carry out a program of the organization. All characteristics may not be present and judgment must be used to determine subrecipient vs. vendor status.

3. Vendors (including contractors): List all vendors and contractors supplying commercial supplies or services used to support the project. For each Vendor cost with total project costs of $250,000 or more, a Vendor quote must be provided. A vendor is a legal entity contracted to provide goods and services within normal business operations, provides similar goods or services to many different purchasers, operates in a competitive environment, provides goods or services that are ancillary to the operation of the Federal program, and is not subject to compliance requirements of the Federal program. All characteristics may not be present and judgment must be used to determine subrecipient vs. vendor status.

4. Federal Funded Research and Development Centers (FFRDCs): FFRDCs must submit a signed Field Work Proposal during award application. The award recipient may allow the FFRDC to provide this information directly to DOE, however project costs must also be provided below.

5. Each budget period is rounded to the nearest dollar.

SOPO Task #	Sub-Recipient Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Project Total
2,4	**EXAMPLE!!!** XYZ Corp.	Partner to develop optimal lens for Gen 2 product. Cost estimate based on personnel hours.	$48,000	$32,000	$16,000	**$96,000**
						$0
						$0
						$0
						$0
						$0
						$0
						$0
		Sub-total	**$0**	**$0**	**$0**	**$0**

SOPO Task #	Vendor Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Project Total
6	**EXAMPLE!!!** ABC Corp.	Vendor for developing robotics to perform lens inspection. Estimate provided by vendor.	$32,900	$86,500		**$119,400**
1,2,3,4	Worley	Engineering support/services for reactor design, installation and	$250,000			**$250,000**
4	Nitro Steel Fabrication	Certified Stainless Steel Reactor Fabrication - Coded vessel	$30,000			**$30,000**
						$0
						$0
						$0
						$0
		Sub-total	**$280,000**	**$0**	**$0**	**$280,000**

SOPO Task #	FFRDC Name/Organization	Purpose and Basis of Cost	Budget Period 1	Budget Period 2	Budget Period 3	Project Total
						$0
						$0
		Sub-total	**$0**	**$0**	**$0**	**$0**

	Total Contractual		**$280,000**	**$0**	**$0**	**$280,000**

Additional Explanation (as needed):

g. Construction

PLEASE READ!!!

1. Construction, for the purpose of budgeting, is defined as all types of work done on a particular building, including erecting, altering, or remodeling. Construction conducted by the award recipient is entered on this page. Any construction work that is performed by a vendor or subrecipient should be entered under f. Contractual.

2. List all proposed construction below, providing a basis of cost such as engineering estimates, prior construction, etc., and briefly justify its need as it applies to the Statement of Project Objectives.

3. Each budget period is rounded to the nearest dollar.

Overall description of construction activities: Example Only!!! - Build wind turbine platform

SOPO Task #	General Description	Cost	Basis of Cost	Justification of need
Budget Period 1				
3	EXAMPLE ONLY!!! Three days of excavation for platform site	$28,000	Engineering estimate	Site must be prepared for construction of platform.
	Budget Period 1 Total	**$0**		
Budget Period 2				
	Budget Period 2 Total	$0		
Budget Period 3				
	Budget Period 3 Total	$0		
	PROJECT TOTAL	**$0**		

Additional Explanation (as needed):

h. Other Direct Costs

INSTRUCTIONS - PLEASE READ!!!

1. Other direct costs are direct cost items required for the project which do not fit clearly into other categories. These direct costs must not be included in the indirect costs (for which the indirect rate is being applied for this project). Examples are: tuition, printing costs, etc. which can be directly charged to the project and are not duplicated in indirect costs (overhead costs).

2. Basis of cost are items such as vendor quotes, prior purchases of similar or like items, published price list, etc.

3. Each budget period is rounded to the nearest dollar.

SOPO Task #	General Description and SOPO Task #	Cost	Basis of Cost	Justification of need
	Budget Period 1			
5	**EXAMPLE!!!** Grad student tuition - tasks 1-3	$16,000	Established UCD costs	Support of graduate students working on project
	Budget Period 1 Total	$0		
	Budget Period 2			
	Budget Period 2 Total	$0		
	Budget Period 3			
	Budget Period 3 Total	$0		
	PROJECT TOTAL	**$0**		

Additional Explanation (as needed):

i. Indirect Costs

INSTRUCTIONS - PLEASE READ!!!

1. Fill out the table below to indicate how your indirect costs are calculated. Use the box below to provide additional explanation regarding your indirect rate calculation.

2. The rates and how they are applied should not be averaged to get one indirect cost percentage. Complex calculations or rates that do not do not correspond to the below categories should be described/provided in the Additional Explanation section below. If questions exist, consult with your DOE contact before filling out this section.

3. The indirect rate should be applied to both the Federal Share and Recipient Cost Share. **4.**

NOTE: A Recipient who elects to employ the 10% de minimis Indirect Cost rate **cannot claim resulting costs as a Cost Share contribution, nor can the Recipient claim "unrecovered indirect costs" as a Cost Share contribution.** Neither of these costs can be reflected as actual indirect cost rates realized by the organization, and therefore are not verifiable in the Recipient records as required by Federal Regulation (§200.306(b)(1)).

5. Each budget period is rounded to the nearest dollar.

	Budget Period 1	Budget Period 2	Budget Period 3	Total	Explanation of BASE
Provide ONLY Applicable Rates:					
Overhead Rate	50.89%				**Direct Wages**
General & Administrative (G&A)	31.54%				**Total Program Costs**
FCCM Rate, if applicable					
OTHER Indirect Rate					
Indirect Costs (As Applicable):					
Overhead Costs	$245,365			**$245,365**	
G&A Costs	$356,979			**$356,979**	
FCCM Costs, if applicable				**$0**	
OTHER Indirect Costs				**$0**	
Total indirect costs requested:	**$602,344**	**$0**	**$0**	**$602,344**	

A federally approved indirect rate agreement, or rate proposed (supported and agreed upon by DOE for estimating purposes) is required if reimbursement of indirect costs is requested. Please check (X) one of the options below and provide the requested information if it has not already been provided as requested, or has changed.

_____ An indirect rate has been approved or negotiated with a federal government agency. A copy of the latest rate agreement is included with this application, and will be provided electronically to the Contracting Officer for this project.

__X___ There is not a current, federally approved rate agreement negotiated and available*.

***When this option is checked, the entity preparing this form shall submit an indirect rate proposal in the format provided by your DOE contact, or a format that provides the same level of information and which will support the rates being proposed for use in performance of the proposed project. Additionally, any non-Federal entity that has never received a negotiated indirect cost rate, except for those non-Federal entities described in Appendix VII to Part 200—States and Local Government and Indian Tribe Indirect Cost Proposals, paragraph D.1.b, may elect to charge a de minimis rate of 10% of modified total direct costs (MTDC) which may be used indefinitely.As described in §200.403 Factors affecting allowability of costs, costs must be consistently charged as either indirect or direct costs, but may not be double charged or inconsistently charged as both. If chosen, this methodology once elected must be used consistently for all Federal awards until such time as a non-Federal entity chooses to negotiate for a rate, which the non-Federal entity may apply to do at any time.**

You must provide an explanation (below or in a separate attachment) and show how your indirect cost rate was applied to this budget in order to come up with the indirect costs show

Additional Explanation (as needed): *IMPORTANT: Please use this box (or an attachment) to further explain how your total indirect costs were calculated. If the total indirect costs are a cumulative amount of more than one calculation or rate application, the explanation and calculations should identify all rates used, along with the base they were applied to (and how the base was derived), and a total for each (along with grand total).

Cost Share

PLEASE READ!!!

1. A detailed presentation of the cash or cash value of all cost share proposed must be provided in the table below. All items in the chart below must be identified within the applicable cost category tabs a. through i. in addition to the detailed presentation of the cash or cash value of all cost share proposed provided in the table below. Identify the source organization & amount of each cost share item proposed in the award.

2. Cash Cost Share - encompasses all contributions to the project made by the recipient, subrecipient, or third party (an entity that does not have a role in performing the scope of work) for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment, etc. for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project. Any partial donation of goods or services is considered a discount and is not allowable.

3. In Kind Cost Share - encompasses all contributions to the project made by the recipient, subrecipient, or third party (an entity that does not have a role in performing the scope of work) where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. In Kind cost share items include volunteer personnel hours, the donation of space or use of equipment, etc. The cash value and calculations thereof for all In Kind cost share items must be justified and explained in the Cost Share Item section below. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out In Kind cost share in this section. Vendors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

4. Funds from other Federal sources MAY NOT be counted as cost share. This prohibition includes FFRDC sub-recipients. Non-Federal sources include any source not originally derived from Federal funds. Cost sharing commitment letters from subrecipients and third parties must be provided with the original application.

5. Fee or profit, including foregone fee or profit, **are not allowable** as project costs (including cost share) under any resulting award. The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

6. NOTE: A Recipient who elects to employ the 10% de minimis Indirect Cost rate **cannot claim the resulting indirect costs as a Cost Share contribution.**

7. **NOTE:** A Recipient **cannot claim "unrecovered indirect costs"** as a Cost Share contribution, **without prior approval.**

8. Each budget period is rounded to the nearest dollar.

Organization/Source	Type (Cash or In Kind)	Cost Share Item	Budget Period 1	Budget Period 2	Budget Period 3	Total Project Cost Share
ABC Company **EXAMPLE!!!**	Cash	Project partner ABC Company will provide 20 PV modules for product development at the price of $680 per module	$13,600			**$13,600**
AmeriCarbon	In Kind		$725,000			**$725,000**
NACoal	In Kind		$20,000			**$20,000**
						$0
						$0
						$0
						$0
						$0
						$0
		Totals	**$745,000**	**$0**	**$0**	**$745,000**

Total Project Cost: $1,488,809 **Cost Share Percent of Award: 50.04%**

Additional Explanation (as needed):

Appendix 11-1

March 29, 2024

AmeriCarbon Products, LLC
Attention: Mr. David A. Berry, CEO
3001 Cityview Drive
Morgantown, WV 26501

Subject: Matching Funds Commitment Letter

The North American Coal Corporation (NACoal), a NACCO Natural Resources company, is pleased to support your application for the AmeriCarbon Products, LLC ("AmeriCarbon") in its proposal to the Lignite Energy Council with respect to the North Dakota Industrial Commission (NDIC) research grant program under the title *Lignite Conversion Reactor Optimization for Commercial Carbon Pitch Manufacturing*. The conversion of coal resources into beneficial value-added products is an important area of interest for NACoal.

NACoal is the largest lignite producer in the United States and one of the top 10 coal producers in the United States. We mine and market coal for use in power generation, SNG production, activated carbon production, as well as, providing selected value-added mining services for other natural resources companies. Our corporate headquarters are in Plano, Texas, near Dallas, and we operate surface coal mines in North Dakota, Mississippi, Texas, and Louisiana

We support the NDIC's and AmeriCarbon's efforts of developing lignite coal as a feedstock for the manufacture of critical materials and advanced carbon products. Successful implementation of a strategic approach to developing this critical supply chain opportunity can lead to significant job creation and economic development in North Dakota.

If the grant is awarded to your project, NACoal will be pleased to provide up to $20,000 in in-kind support in the form of coal samples and time for the project that can be used as cost share. We look forward to working with the you on this exciting opportunity. If you have questions or require additional information, please do not hesitate to contact me at the letterhead address or Gerard Goven at 701-250-2604.

Very truly yours,
THE NORTH AMERICAN COAL CORPORATION

George Lovland, P.E.
Engineering Manager

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

Worley Group, Inc.
2910 Valley Forge St
Bismarck, ND 58503

28 March 2024

David A Berry, CEO
AmeriCarbon Products LLC.
3001 Cityview Drive
Morgantown, WV 26501

Subject: Letter of Support for the North Dakota Industrial Commission (NDIC) research grant program under the title *Lignite Conversion Reactor Optimization for Commercial Carbon Pitch Manufacturing*

Worley is pleased to express interest in supporting the efforts of AmeriCarbon Products, LLC in commercial engineering design & scaleup for its proprietary coal to pitch (EcoPitchTM) technology.

With an office in Bismarck, North Dakota, Worley is a global engineering, procurement, and construction company that provides innovative solutions in the energy, chemicals, resources, and infrastructure sectors. With a comprehensive range of services, our firm is known for our expertise in designing, managing, and implementing complex projects across the globe. Our firm is committed to sustainable practices and focuses on delivering projects that contribute to the development of a more sustainable and resilient future. Worley collaborates with clients to address challenges in areas such as oil and gas, mining, power generation, and environmental management.

Worley will provide engineering services to AmeriCarbon to help support the proposed project. Engineering services will include design, installation, and operational support throughout all phases of the reactor optimization project. Worley will offer this supporting service to AmeriCarbon at a budgeted value of $250K commensurate with the agreed upon project deliverables scope and projected timeline.

Worley is proud to support AmeriCarbon's cutting-edge research and development project to help accelerate the development of commercial scale production in North Dakota. Leveraging our extensive experience in the energy and resources sectors, Worley brings a wealth of knowledge and innovative engineering solutions to propel the project forward, contributing to the advancement of environmentally conscious technologies and resource utilization.

Respectfully,

DocuSigned by:
Richard Clay
839CE3643883468...

Richard Clay
Director of Operations, US East (Charleston WV Office)

cc: Scott Midle | Kevin Legg | Pete Cowger |

AmeriCarbon

April 1, 2024

State of North Dakota
The Industrial Commission
State Capitol
Bismarck, ND 58505
ATTN: Lignite Research Program

RE: Matching Funds Commitment Letter

This is to confirm that the applicant, AmeriCarbon Products, LLC, is committed to providing $725,000 in in-kind services, including personnel time, indirect, and overhead expenses, with respect to the project proposed with the title *Lignite Conversion Reactor Optimization for Commercial Carbon Pitch Manufacturing.* To the extent there are any shortfalls from the cost share to be provided by The North American Coal Corporation, AmeriCarbon will provide additional cost share to address such shortfalls up to a total of $745,000.

We look forward to working with the North Dakota Industrial Commission and the Lignite Energy Council to discuss the enclosed proposal. If you have any questions, I may be reached at (304) 685-6017 or greg.henthorn@americarbon.com.

Sincerely,

Greg Henthorn
Vice President of Corporate Development
AmeriCarbon Products, LLC

(888) 367-1650
www.americarbon.com
3001 City View Drive
Morgantown, WV 26501

Appendix 13-I

AFFIDAVIT

In reference to Section 43-03-04-01, North Dakota Century Code, the undersigned, Gregory Henthorn, Vice President, Corporate Development of AmeriCarbon Products, LLC, a West Virginia limited liability company with a tax mailing address of 3001 Cityview Drive, Morgantown, West Virginia, 26501, being first duly sworn according to law, deposes and states as follows:

1. I am at least 18 years of age.

2. I have personal knowledge regarding the facts as set forth herein.

3. I am the Vice President, Corporate Development of AmeriCarbon Products, LLC, a West Virginia limited liability company ("**AmeriCarbon**").

4. AmeriCarbon does not have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

5. I declare under penalty of perjury under the law of North Dakota that the foregoing is true and correct.

Further Affiant sayeth naught.

Executed and acknowledged by:

Gregory Henthorn

[Continued on the following page.]

JURAT

STATE OF WEST VIRGINIA :

:

COUNTY OF MONONGALIA :

The foregoing instrument was subscribed to and sworn before me this 1st day of April, 2024, by Gregory Henthorn.

[Notarial Seal]

Roger Wilkins
Notary Public

My Commission Expires: 02/07/2029

This instrument was prepared by:
AmeriCarbon Products, LLC, 3001 Cityview Drive, Morgantown, West Virginia, 26501

Lignite Research Council
May 9, 2024

Reice Haase – Deputy Executive Director – ND Industrial Commission

Claire Vigesaa – Executive Director -ND Transmission Authority

North Dakota Transmission Authority

NORTH Dakota Be Legendary.

IIJA Grid Resilience Grant Round 1

DOE Award (FY22 & FY23) -May 2023	$7,499,037
68th ND Legislative Assembly (15%) Match	$1,124,856
	$8,623,893

Administrative Contract - EERC

IIJA Grid Resilience Grant Round 1

- ❑ Twelve Applications Received (Nov 2023)
- ❑ Total Project Costs $33,102,334
- ❑ Total Grant Request - $17,355,257
- ❑ **Total Grant Dollars Available $8,183,093**

IIJA Grid Resilience Grant Round 1 Highlights

Utility	Award ($)	Project Description
Capital Electric Cooperative	$321,930	Converting OVHD to URD State/Fed Hwy Crossings
Otter Tail Power Company	$4,432,088	Next-Generation Grid Resiliency
Northern Plains Electric Cooperative	$586,000	Electronic SCADA Recloser Installation
McKenzie Electric Cooperative	$2,843,075	Capacitor Banks, Communications, SCADA Controls

$21 invested for every state dollar appropriated

Over 750 miles of power line upgrades

54 overhead crossings converted to underground

Deployment of new technologies for inspections and vegetation management

FY24 IIJA Grid Resilience Grant Round 2

January 2024 ND Industrial Commission

Gave NDIC staff authority to pursue FY24 Formula Grant

DOE IIJA FY24 Formula Grant	$3,885,295
State (15% Match required)	$ 582,795

15% Match

Timing “off” for Legislative Appropriation

Emergency Commission Funding Limited

Therefore: Request gap coverage for the 15% match from the Lignite Research Council until a request can be made to the 69th ND Legislature.

Likely not drawn upon…timing of the Legislature and project award construction…spring 2025?

NORTH
Dakota

Be Legendary.

NDTA North Dakota Transmission Authority