AmeriCarbon

October 1, 2021

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

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AmeriCarbon

Submitted To: State of North Dakota
The Industrial Commission
State Capitol
Bismarck, ND 58505
ATTN: Lignite Research Program

Project Title: North Dakota Lignite Coal-Based Pitch for Production of High Value Carbon Products via AmeriCarbon Liquid Carbon Pitch (LCP) Process

Applicant: AmeriCarbon Products, LLC

Principal Investigator: David A. Berry

Date of Application: October 1, 2021

Amount of Request: $550,000

Table of Contents

1. Abstract

The primary project objective is to utilize AmeriCarbon's pilot-scale, patented/proprietary LCP (Liquid Carbon Pitch) process to demonstrate the successful and economically viable conversion of North Dakota lignite coal into a valuable pitch intermediate chemical used in carbon products manufacturing. A secondary objective will be to outline a development pathway based on performance and technoeconomic results for a next-stage commercial pitch plant based in North Dakota to enhance lignite coal production, high-wage jobs and increased economic opportunities with pitch and downstream carbon manufacturing.

There are a number of expected project results, including:

- Demonstrating the ability to convert North Dakota lignite into tailored pitch chemical intermediate using the environmentally-superior AmeriCarbon LCP technology
- Generation of pitch samples to be offered/provided to carbon product manufacturers for their evaluation/use (pitch customer engagement)
- Technoeconomic evaluation study on a lignite-pitch specific AmeriCarbon LCP process
- Defined development pathway based on performance and technoeconomic results for a next-stage commercial pitch plant based in North Dakota

The proposed $1.2 million project (with $550,000 requested from NDIC) is anticipated to span 18 months upon initiation and involves the following primary participants:

- ***AmeriCarbon Products LLC.*** Company is based in Morgantown, WV and focused on commercialization of coal-to-pitch technology to enable the coal-to-carbon product supply chain. AmeriCarbon is utilizing its 10 ton/day pilot-scale LCP process, the only known in the United States, to generate engineering-scale data to allow direct commercial scale-up.
- **The North American Coal Corporation (NACoal).** Is a large coal operations company with extensive activity throughout the United States and over 100 years of mining experience. NACOAL will support and contribute cost-share to the effort with coal supply, conditioning and other various aspects.

2. Project Summary

AmeriCarbon is onshoring the production of advanced carbon products, connecting the supply chain from raw material to finished products by filling in the "missing link" in the domestic supply chain – the production of tailored carbon pitch in the United States with properties that are optimized for particular specifications and applications. The roots of AmeriCarbon's proprietary and patented Liquid Carbon Pitch (LCP) process dates back to 2009, when a predecessor organization built a pilot-scale unit for broad coal liquefaction applications. AmeriCarbon has re-engineered the facility to create the LCP 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.

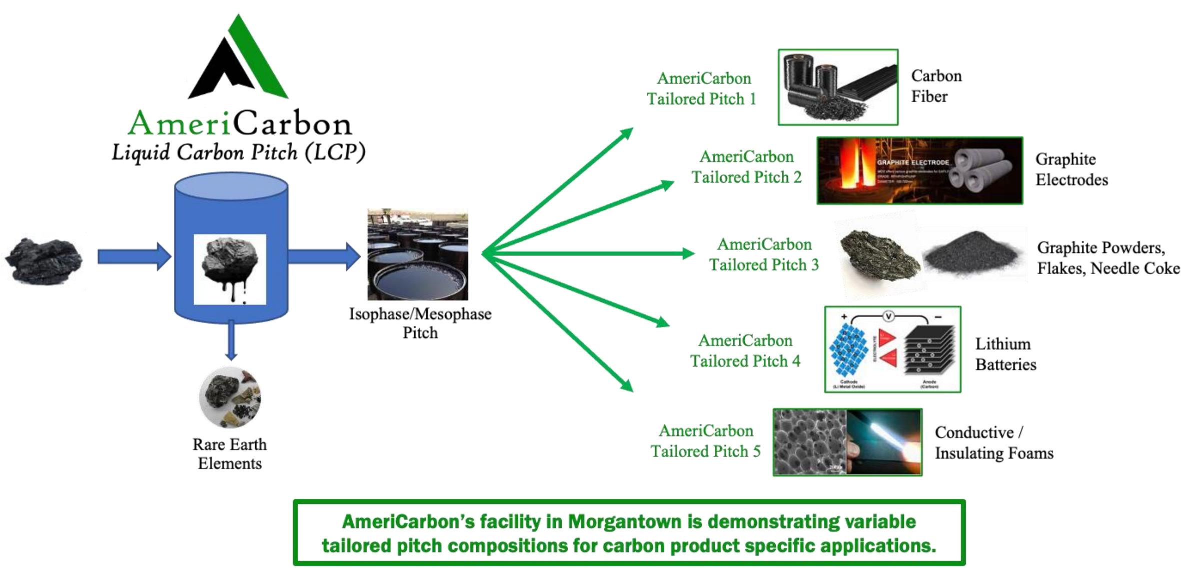


Figure 1 – Coal to Advanced Carbon Products – AmeriCarbon LCP Process

The majority of coal to advanced carbon product routes will largely proceed through some type of intermediate conversion or chemical intermediate; ***direct coal-to-end product conversion routes are rarely achievable.*** Coal tar pitch or its variants will be a common path to manufacturing advanced carbon products. An analogy exists with produced ethylene in the petrochemical industry that also serves as the building block for vast array of products. Figure 1 depicts that progression along the coal supply & manufacturing chain:

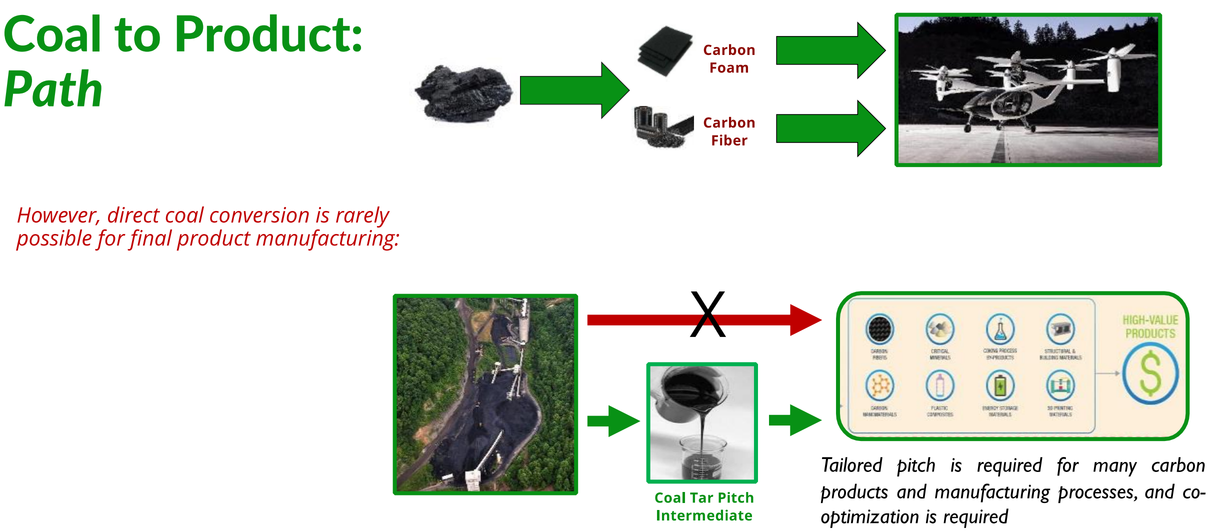


Figure 2 – Route for Coal to Advanced Carbon Products

Low cost, coal-derived carbon and carbon-containing intermediate precursor materials such as pitch, are superior in several ways in addition to being more economical to those typically derived from petroleum feedstocks. However, current supply of coal-derived pitch feedstock is a by-product of coke ovens used to support steel making. As a result, there are serious problems that now exist with that supply and threaten to jeopardize the U.S. coal-based advanced carbon product opportunity:

- As a by-product, it is difficult in coke ovens to control the pitch properties, which require differing specifications for various desired high value carbon products.
- The majority of steel and coking plants in the United States have closed due to environmental pressures on steel production; the primary source of those products and the required by-product pitch now comes from China (~72%) [1]. Europe faces a similar situation.
- Coke ovens operate at very high temperatures (>1200 C) and have significant environmental footprints. In contrast, AmeriCarbon's process typically operates <500 C with minimal environmental signature.

- AmeriCarbon LCP Process generates 99% less carbon dioxide emissions than state-of-the art (SOA) coking ovens (See Appendix 2-1 – Downstream Strategies report)

So, despite the vast and superior coal resources in the United States, this country will suffer supply chain restrictions that will ultimately both limit and threaten its ability to capture the downstream, high value advanced carbon product opportunity that is exponentially growing around the world. It is vital for both U.S. capital returns and job creation that a secure supply chain is achieved and that the availability of enabling, domestically-produced coal-derived pitch technology is realized soon.

AmeriCarbon has the only known ***continuous*** pilot-scale, coal liquefaction-based, pitch production facility in the world. This allows for immediate and directly scalable engineering data from applied research generated to be confidently translated to a commercial scale plant. AmeriCarbon is currently in discussion with engineering, procurement and construction (EPC) firms to initiate scale-up and pre-construction activity that will allow for rapid near-term plant build and commercialization in various coal-rich regions around the country. AmeriCarbon is on an aggressive path to identify specific sites for the most near-term opportunities for those initial plants.

AmeriCarbon has established relationships with several carbon product manufacturers who utilize pitch and needle coke/graphite. Nearly all have expressed similar concerns and desire to secure a domestic source of economical coal-derived pitch/chemical intermediate. Collaborative agreements are being formulated to pursue those opportunities.

AmeriCarbon's approach and activity to date is consistent with and directly supports the primary objective of this proposal:

Our objective is to demonstrate the successful and economically viable conversion of North Dakota lignite coal into a valuable pitch intermediate chemical used in carbon products manufacturing.

3. Project Description

AmeriCarbon has been producing pitch from coal utilizing its 10-ton/day pilot coal-to-pitch facility. AmeriCarbon's proprietary and patented LCP process involves the following principal steps (Figure 3 below):

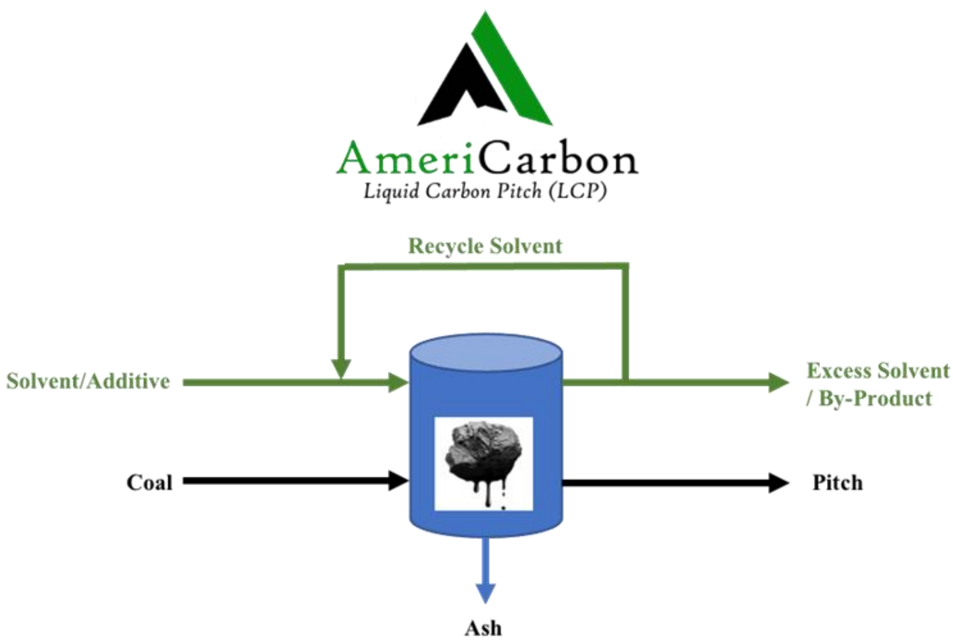


Figure 3. LCP Simplified Process Flow Diagram

- Coal is selected according to desired pitch type/specification and prepped as primary feedstock into the LCP process.
- A solvent/carrier is selected and mixed with the coal in appropriate proportions to achieve proper formulation based on coal properties/characteristics and coal/solvent reactivity target.

- Primary process parameters (e.g., velocity, residence time, temperature, pressure) are established and parametric analysis conducted to define operational setpoints to achieve pitch specifications; this includes distillation parameters and isophase/mesophase splits.
- By-product rare-earth elements are separated with the ash fraction/removal subsystem.
- Solvent recovery fraction is identified and established to define solvent recycle ratios; this process variable is primarily dependent upon input feedstock and desired produced pitch specifications.
- AmeriCarbon's LCP process is extremely environmentally sound. It is a completely contained and controlled process with minimal waste streams. Rare earth containing ash is saleable by-product as is any excess output solvent. Less than 0.4% of input feedstock is converted into exhaust gases which are scrubbed with commercially available EPA attaining technology. AmeriCarbon's LCP process results in greater than 99% reduction in greenhouse gas emissions relative to the current state-of-art technology suppling the current pitch markets.

AmeriCarbon has successfully conducted operations on various coals and coal types for conversion into pitches. Some of those pitches have also been further converted into needle coke in Ameri-Carbon's facility. Production trials to-date indicate 65%-80% conversion of coal/feedstock to pitch. This percentage is greatly impacted by the characteristic and type of pitch specified and required process requirements for continuous commercial operations. As the AmeriCarbon LCP unit is a continuous commercially representative unit, this project will allow an accurate assessment of coal-to-pitch conversion and opportunity to optimize throughout. Bench or laboratory scale units are typically batch systems that are difficult to simulate continuous operating processes. The results can be much different and not representative of commercial production. Therefore, it is critical to conduct research conversion trials of lignite in a commercially-representative pilot unit to assess potential and maximize development efficiencies and commercialization timeline for commercial lignite pitch plants.

Production of both isophase and mesophase pitch is a key aspect of this project as it maximizes downstream market diversity and potential (maximization of pitch customers). Both coal-type, solvent and operational parameters can factor into quality and the ability to produce. The LCP process is highly flexible and produces a primary isophase pitch intermediate that is then converted into a mesophase pitch composition within the LCP unit operations envelope allowing for varying tailored pitch production. Extensive research and technical discussion has been written about this subject, which AmeriCarbon factored into its technology.[2-21]

As will be mentioned in the Background section later, AmeriCarbon has been conducting small-scale scoping trials on both North Dakota & Mississippi lignite supplied by North American Coal. Efforts to date resulted in North Dakota pitch generation with a softening point >100 C, which is a base specification of certain commercial pitches utilized in the carbon electrode industry. This is a good indicator of the potential for lignite-based commercial pitches.

Project Objective

The primary project objective is to utilize AmeriCarbon's pilot-scale, patented/proprietary LCP (Liquid Carbon Pitch) process to demonstrate the successful and economically viable conversion of North Dakota lignite coal into a valuable pitch intermediate chemical used in carbon products manufacturing. A secondary objective will be to outline a development pathway based on performance and technoeconomic results for a next-stage commercial pitch plant based in North Dakota to enhance lignite coal production, high-wage jobs and increased economic opportunities with pitch and downstream carbon manufacturing.

There are a number of expected project results:

- Demonstrated ability to convert North Dakota lignite into tailored pitch chemical intermediate using the environmentally-superior AmeriCarbon LCP technology
- Generation of pitch samples to be offered/provided to carbon product manufacturers for their evaluation/use (pitch customer engagement)
- Technoeconomic evaluation study on a lignite-pitch specific AmeriCarbon LCP process

- Defined development pathway based on performance and technoeconomic results for a next-stage commercial pitch plant based in North Dakota

Methodology – Task Statements

Task 1: Pitch Specification and Customer Engagement – AmeriCarbon will initiate the project by engaging partners/customers to identify pitch requirements and specifications that will be used to establish targets to drive the research and process evaluation activities throughout the project. The Lignite Energy Council and the Industry Commission will be consulted to identify their partners/projects with synergy to produced lignite pitch to develop desired pitch specifications as well as to establish a relationship for assessing pitch generated during the project.

Task 2: Coal Feedstock Supply and Characterization – North American Coal will supply North Dakota lignite coal to AmeriCarbon for processing into pitch at their Morgantown, WV facility. Select other coals will be identified for potential pitch conversion to provide baseline comparisons (IE. Mississippi lignite). Shipped coal shall be dried to lower moisture levels prior to shipping. Potential inerting with nitrogen will be discussed to minimize degradation of the lignite. Ultimate and proximate analysis will be conducted and supplied with the coal.

Task 3: Chemical Formulation and Process Evaluation Studies - AmeriCarbon will conduct a large experimental matrix evaluation to assess lignite pitch generation with their LCP pilot unit. Parameters such as chemical formulation, water content, temperature, pressure and residence time across the LCP multi-unit operation train will be varied and evaluated. Initial pitch specifications defined in Task 1 will be used as an early target. Both isophase and mesophase pitches will be generated. Select pitches will be sent to interactive customers/partners identified in Task 1 for evaluation. AmeriCarbon will conduct the necessary analysis to characterize the pitches and will be responsible for all associated chemicals (beyond supplied coal), shipping of samples (including ash) and disposal of process wastes.

Task 4: Pitch Evaluation and Process Optimization Studies – Customer/partner evaluation of pitch samples generated in Task 3 will be conducted with feedback to AmeriCarbon on suitability. AmeriCarbon will factor in that feedback into their process further optimize those pitches. This will be an iterative and interactive approach towards process and product optimization throughout the project. Results from this Task will feed into and establish parameters for the technoeconomic evaluation in Task 5.

Task 5: Technoeconomic Study – A study will be conducted to evaluate the commercial potential of a lignite-specific AmeriCarbon LCP process. Input will be based on existing AmeriCarbon information, prior studies and results from Task 4 using their pilot LCP process.

Task 6: Technology Development and Commercialization Path – Based on the experimental, customer evaluation and technoeconomic results of Tasks 1-5, a gap analysis approach will be taken to identify a technology development and/or commercialization path leading to a commercial lignite pitch plant to be located in North Dakota. This will involve potential plant site identification and preliminary evaluation.

Deliverables:

- Pitch Samples: Identified in Task 1 and as necessary throughout the project
- Interim Reports as Requested by LEC
- Task 5: Technoeconomic Report
- Task 6: Technology Development and Commercialization Path Report
- Final Report

4. Facilities & Equipment

The project will be conducted at AmeriCarbon's $17 million facility at the Morgantown Industrial Park in Morgantown, West Virginia, which includes the following.

AmeriCarbon Research and Pilot Demonstration Facility

AmeriCarbon operates a state-of-the-art 12,000 sq-ft facility 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.

AmeriCarbon Equipment

AmeriCarbon's equipment includes: coal liquefaction & coker train 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.

5. Standards of Success

The project will support the onshoring of the manufacture of advanced carbon products, an emerging industry in the United States which has the potential to grow to 480,000 jobs over the next three decades, according to April 2021 testimony in the U.S. Senate Energy and Natural Resources Committee. By using lignite coal as a raw material for manufacturing and connecting the dots in the supply chain all the way to valuable finished products, AmeriCarbon and our collaborators have the potential to significantly reduce the amount of embedded carbon in a wide array of finished products with double digit compound annual growth rates.

This project will serve a foundational role in laying the groundwork for the development of commercial scale manufacturing facilities in North Dakota to capture the state's rightful share of the economic opportunity brought about by the onshoring of advanced carbon product manufacturing. The production of carbon pitch from lignite coal is a linchpin that will lead to additional manufacturing opportunities where lignite-derived carbon pitch is the feedstock for further value-added refinement into valuable carbon materials and products. Long term, this can lead to several million dollars of capital investment, the creation of thousands of new jobs with sustainable employment, and reduced greenhouse gas emissions from 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 within three years with an installed capacity of 100 tons of production per day.

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 within five years, there could be a network of manufacturers locating in North Dakota, leading to hundreds of jobs during construction and facility operations.

In order to achieve the desired economic impacts, the project must produce certain tangible technical results. Specifically, these can be summarized as follows:

a. *Technical results*. AmeriCarbon has already converted North Dakota lignite coal into carbon pitch with a melting point above 100 C, one of the key determinants in considering carbon pitch to be suitable for certain market applications. This project will enable the project participants to take a deeper dive into additional performance metrics, in cooperation with future customers, to further validate commercial value for lignite-derived pitch for various market applications. Determining the target specifications in collaboration with the potential customers will be one of the key outcomes of this project, as well as understanding the operational configurations needed to meet the desired specifications.

b. *Techno-economic results*. The outcomes of the technical results described above will be evaluated in the context of techno-economics to be able to project the commercial viability of the different carbon manufacturing applications. The first question referenced above is whether lignite-derived carbon pitch can meet the required specifications; the follow up question then becomes whether the conversion of lignite coal to the desired carbon pitch be performed in a manner that is cost competitive (i) compared to the existing supply, and (ii) compared to other future alternatives.

The standards success for the technical results will be binary with respect to each end use application that is explored. A positive answer to only one of those applications could alone likely justify the investment in the project, depending on the market value of the application(s).

With respect to techno-economic results, we would consider the project a success if we can reasonably project at least one carbon pitch application, or a combination of multiple applications, that would support the construction of a 1000 ton per day production facility in North Dakota with a capital investment of approximately $25-$35 million. We believe that financial projections for such a facility would target an internal rate of return

(IRR) of at least 15% to attract private sector financing of a first-of-its-kind facility; in the alternative, a lower projected IRR could also be considered successful if certain federal incentives and subsidy (such as Opportunity Zone financing, New Markets Tax Credits, etc.) could be leveraged.

6. Background

The basis for AmeriCarbon's LCP process is derived from long-standing coal liquefaction technology. Coal liquefaction was first successful developed and implemented in Germany around the time of the World War 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 (> 500^0C) 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 way of coal 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 is 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].

To date, 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 has caused a shortage in US 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

China has significant coke oven operations and currently supplies over 72% of the worlds pitch supply. AmeriCarbon has recognized this opportunity and is applying its 10-yr liquefaction background in coal-to-chemicals to demonstrate its innovative pilot-scale coal-to-pitch process…liquid coal pitch (LCP).

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. This past year, AmeriCarbon has conducted studies on lignite, sub-bituminous and bituminous coals. AmeriCarbon has the only known pilot-scale liquefaction pitch plant in the world, which allows immediate commercially-relevant data generation/demonstration for rapid scale-up and commercialization.

Recently, AmeriCarbon entered into a collaboration with North American Coal to conduct a contracted effort to assess the potential of utilizing the AmeriCarbon LCP process to convert both North Dakota and Mississippi lignite coals into pitch. Thus far, AmeriCarbon has been successful in converting North Dakota coal into pitch with a commercially-representative softening point of > 100 C. This pitch has been sent to the University of North Dakota, who is conducting a project to make high-energy density lithium batteries with anodes derived from coal. AmeriCarbon has also sent samples to collaborative private sector carbon products company for evaluation and feedback. This interim result has given very favorable indication of the potential for successful lignite to pitch conversion. Coupled with low lignite feedstock costs, this has the potential to be a very viable economic opportunity and impetus behind AmeriCarbon's interest along with North American coal to pursue through the North Dakota Industrial Commission.

7. Qualifications

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 AmeriCarbons 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.

Note: Detailed resumes are available in Appendix 7-1.

8. Value to North Dakota

As part of Task 6 of this project, AmeriCarbon and NACoal will explore the location and development of a commercial scale pitch facility in North Dakota in reasonable proximity to one of NACoal's mining operations. Active mine sites in North Dakota include the Coyote Creek Mine, the Falkirk Mine, and the Freedom Mine. Subject to favorable technical feasibility results and favorable techno-economics, AmeriCarbon's intention would be to develop and finance such a commercial facility in North Dakota within the next three years.

More generally, the parts of the public and private sector that will use the results of the project are industrial and commercial sectors; there are also potential applications with respect to producing materials for military applications. Commercial and industrial sectors are likely to use the carbon pitch produced in a facility to manufacture items like carbon fiber, computer chips, solar panels and wind turbine blades, and various structural and building materials like roofing tiles and insulative foams.

State government agencies and military sectors could utilize carbon pitch to create items like drones, supersonic aircraft wings, and 3D printing materials as that application becomes more common in the future. The commercial potential behind AmeriCarbon's carbon pitch is evident with its specialized properties that enable superior performance, including high strength-to-weight ratio, radar absorbency, electrical conductivity, and thermal conduction.

The AmeriCarbon coal tar pitch project will enhance the use of North Dakota lignite coal and products 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.

Lignite coal used for coal tar pitch 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. This project will preserve existing coal jobs by ensuring demand for the product in case of an economic downturn in the coal industry. However, the likelihood of that downturn is very unlikely with growing support in North Dakota for coal-based electricity generation due to education efforts by the Lignite Energy Council.

This 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 a $50-150/ton resource into a $5,000-$25,000/ton product. Job growth can also come from the resurgence of domestic production of carbon pitch in the United States.

Currently, coal tar pitch is a by-product of the steel industry supply chain and is typically sourced from China; however, AmeriCarbon's ability to produce a competitive product but with a lessened environmental impact could displace Chinese supply due to the growth in concern for environmental issues across the globe. This leaves open space in the United States – and North Dakota in particular – to increase domestic manufacturing output.

9. 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 as shown in Figure 2.

Figure 2. Organizational chart of key project team members.

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 Statement of Project Objectives section in a timely and efficient manner, and in the timeframe outlined in the proposal.

The following are key members of the project team:

- David Berry, Principal Investigator. As principal investigator, Berry will lead the project, oversee project execution, and manage communication among the companies and individuals.

- Greg Henthorn, Project Management & Business Operations. Mr. Henthorn will support Mr. Berry in terms of managing tasks, timelines, and project performers. Mr. Henthorn will lead the preparation of project documentation, written deliverables, and manage the business & financial aspects.

- Dr. Chetan Tambe, Chemical Engineer. The chemical engineer will work closely with the principal investigator to implement processes and manage operations.

- Mark Scafella, Chemical Technician. Mr. Scafella will be responsible for startup, maintenance, and operations of AmeriCarbon's Liquid Carbon Pitch (LCP) process.

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.

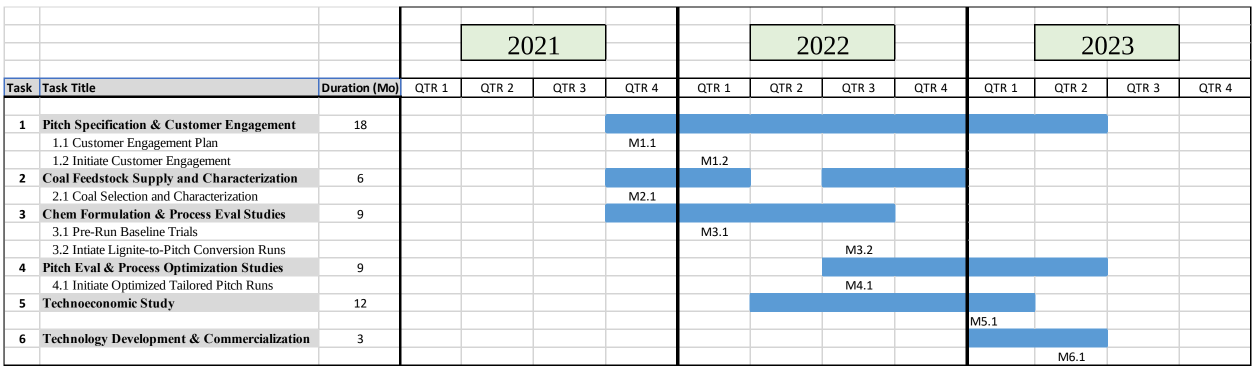
Risk Management Plan

Table 1. Perceived Risks and Mitigation Strategies

Perceived Risk	**Risk Rating**			**Mitigation/Response Strategy**
	Probability	**Impact**	**Overall**	
	(Low, Med, High)			
Financial Risks:				
Vendors or supplies	Low	Med	Med	*Alternate suppliers.* Although the technology and research is at cutting edge, alternative vendors/suppliers have been identified for most equipment utilized and carbon processing companies.
Cost/Schedule Risks:				
Major equipment failure	Low	High	Med	*Alternate funding sources.* Pilot-scale facilities can be costly to repair. The majority of project equipment utilized on this project is comprised of multiple smaller components and often can be repaired or replaced in reasonable fashion. AmeriCarbon is sufficiently capitalized to have near-term ability to mitigate most facility failures of this nature.

10. 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 (higher resolution versions are found in Appendix 10-1):



Task	Milestone Title & Description	Planned Completion Date	Verification Method
1	M1.1 - Customer Engagement Plan	30 d after award	Interim Meeting
1	M1.2.1 - Initiate Customer Engagement	45 d after award	Interim Meeting
2	M2.1 - Coal Selection & Characterization Plan	30 d after award	Interim Meeting
3	M3.1 - Pre-run Baseline Trials	3 mo after award	Interim Meeting
3	M3.2 - Lignite to Pitch Conversion Runs	12 mo after award	Interim Meeting
4	M4.1 - Pitch Eval & Process Opt Runs	Project Completion	Final Report
5	M5.1 - Technoeconomic Results	Project Completion	Final Report
6	M6.1 - Tech Dev & Commercialization Path	60 d after Start	Topical Report

Deliverables

- Interim Report – Semi-annually or otherwise specified
- Technology Development Status Report – Project Completion
- Final Report – Project Completion

11. Budget

The project budget totals $1,209,794, with $550,000 being requested from NDIC, $25,000 in in-kind services provided by NACoal, and $634,794 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.

12. Matching Funds

Support letters for matching funds are included in Appendix 12-1, including a cost share commitment of $25,000 from NACoal and $634,794 from AmeriCarbon, for a total cost share resulting in a combined cost share of $659,794, representing 54% of the budget.

13. 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.

14. Confidential Information

Not applicable.

15. References

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16. Appendices

Appendix 2-1

Technical Summary
Estimated Greenhouse Gas Emissions for AmeriCarbon's Coal Tar Pitch Versus Coal Tar Pitch Produced in China

September 27, 2021

Introduction

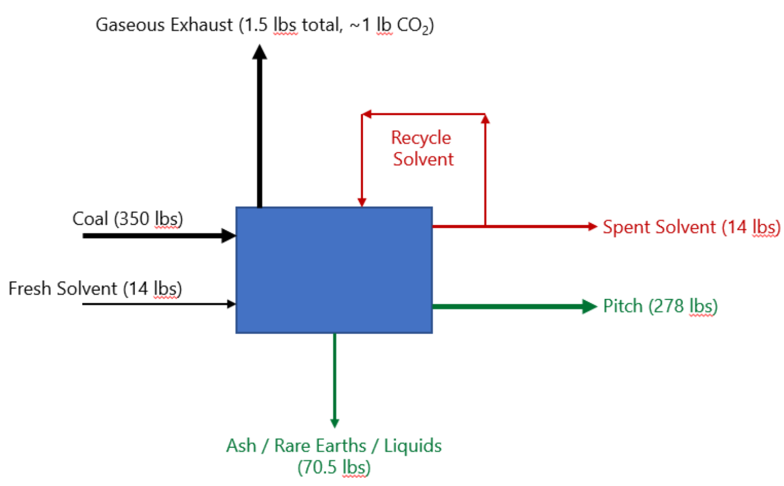
AmeriCarbon Products, LLC has developed technology to cost-effectively convert coal to coal tar pitch, a key component in the manufacture of advanced carbon products. AmeriCarbon's coal tar pitch will compete based on cost, performance, efficiency, and supply chain resilience. This report documents the calculations that determined that the use of Americarbon's coal tar pitch in the United States—as compared with the use of coal tar pitch produced in China—would reduce greenhouse gas emissions. It includes estimates for (1) the coal tar pitch production process itself and (2) coal tar pitch transportation to the United States.

Emissions related to coal tar pitch production

AmeriCarbon pitch

AmeriCarbon produces coal tar pitch at its research facility in Morgantown, West Virginia. As illustrated in Figure 1, approximately 1 pound of CO_2 is released for every 278 pounds of coal tar pitch produced. An emission factor of 0.0036 pounds CO_2/pound pitch (or 0.0036 tons CO_2/ton pitch) is calculated by dividing these two numbers.

Figure 1: Process flow diagram for AmeriCarbon's LCP process



Source: Berry (2021). Note: This analysis is based on actual multi-day liquefaction run data.

Chinese pitch

In China, coal tar pitch is produced as a byproduct in coke ovens that, in addition to coke, produce a number of products including coal tar pitch, coke breeze, light oil, and coke oven gas. An estimated 10 gallons of coal tar pitch is produced for every 1,300 pounds of coke. (Coopers Creek Chemical Corporation, 2021)

Coal tar pitch is assumed to have a density of 1.25 grams/cubic centimeter (Berry, 2021b), which converts to 10.43 pounds/gallon. Applying this density, approximately 104.3 pounds of coal tar pitch is produced in a coke oven as a byproduct with every 1,300 pounds of coke.

Emission factors for Chinese-specific coke ovens were not found; however, the IPCC (2019) provides default emission factors for coke production. The emission factor for coke production using byproduct recovery technology is 0.51 tonnes CO_2/tonne coke (or 0.51 pounds CO_2/pounds coke).

Our upper-bound emission factor assigns all emissions from a coke over to the production of coal tar pitch, as follows:

> *0.51 pounds CO_2/pound coke * 1,300 pounds coke / 104.3 pounds of coal tar pitch = 6.36 pounds CO_2/pound coal tar pitch (or 6.36 tons CO_2/ton coal tar pitch).*

A more conservative estimate would only assign a portion of the emissions from the coke ovens to the production of coal tar pitch. This lower-bound emission factor assigns the emissions based on the ratio of the mass of the coal tar pitch versus the total mass of pitch and coke produced in the coke oven, as follows:

> *6.36 tons CO_2/ton coal tar pitch * 104.3 pounds of coal tar pitch / (104.3 pounds of coal tar pitch + 1,300 pounds of coke) = 0.47 tons CO_2/ton coal tar pitch*

Emissions related to coal tar pitch transportation to the United States

AmeriCarbon pitch

Our analysis assumed that any greenhouse gas emissions from the transport of coal tar pitch from a domestic facility to its customers would be equivalent to the emissions resulting from transport from a port of entry.

Chinese pitch

Client-supplied information indicated that the primary competition for AmeriCarbon's product was produced in China and that Chinese pitch primarily departs from the northern port of Tianjin, a very large and busy port city on the Bohai Sea, southeast of Beijing. For this analysis, we quantify the carbon dioxide equivalent (CO_2e) emissions per ton of coal tar pitch for transport from Tianjin to western United States ports, with San Diego and Seattle as our example destinations.

The most widely accepted methodology for calculating the carbon footprint of a vessel or some portion of container cargo aboard a vessel was developed by BSR, a non-profit focused on sustainable business practices,[1] and the Clean Cargo Working Group,[2] a consortium of global shipping concerns. This methodology is based on data collected by its member companies that together account for 85% of global maritime container shipping. Each year, they voluntarily report key data about shipping conditions, fuel consumption, and other important metrics, which are used to update emissions estimates as well as the key variables for emissions calculations: trade lane emissions factors. (BSR, 2015)

[1] https://www.bsr.org/en/

[2] https://www.clean-cargo.org/about-clean-cargo

This methodology utilizes real data to calculate emissions factors per vessel/voyage as follows:

$$\frac{\left(total\ kg\ fuel\ consumed\ for\ containers\ * IMO\ factor\ \frac{gCO2}{kg} fuel\right)}{(maximum\ nominal\ TEU\ capacity\ *\ total\ distance\ sailed\ [km])}$$

These calculations are made separately for dry and refrigerated vessels. Each of these vessels and voyages is associated with one of 32 specific trade lanes. The relevant trade lane for this analysis is “Asia to-from North America WC [West Coast].”

The most recent emission factor for this trade lane for dry shipments is 67.1 grams of CO_2e emissions per 20-foot equivalent unit (TEU)-kilometer, slightly higher than the global fleet average of 66.2 (Clean Cargo, 2020). A TEU is a maritime transport term designating a single common 20-foot shipping container, which is assumed to weigh 10 tons. The most recently published emissions factors (published in 2020 using data from 2019) assume a utilization factor of 70%. Sea distances are from an online tool for calculating distances between seaports (SEA-DISTANCES.ORG, 2021).

Using these data and assumptions, we calculate four emission factors, and then take the average, as illustrated in Table 1. For example, the emission factor for the “Asia to-from North America WC” trade lane from Tianjin to Seattle is calculated as follows:

> *9,788 kilometers * 1.15 * 67.1 grams CO_2e /TEU-kilometer * 1 tonne/106 grams * 1.10231 tons/1 tonne * 1 TEU / 10 tons coal tar pitch = 0.083 tonne CO_2e/ton coal tar pitch*

Table 1: Emission factors for transportation to the United States (tons CO_2/ton pitch)

Ports	“Asia to-from North America WC” trade lane	Global fleet average
Tianjin to Seattle	0.083	0.082
Tianjin to San Diego	0.094	0.093
Average	**0.088**	

Total emissions

Table 2 summarizes total emission factors—which include both production and transportation—for AmeriCarbon pitch and Chinese pitch. As shown, greenhouse gas emissions are reduced by more than 99% by shifting production from Chinese pitch to AmeriCarbon’s process, whether the low or high emissions estimate is used for Chinese pitch production.

Table 2: Emission factor summary (tons CO_2/ton pitch)

	AmeriCarbon pitch	Chinese pitch: Low estimate	Chinese pitch: High estimate
Production	0.0036	0.47	6.36
Transportation	0	0.088	0.088
Total	0.0036	0.56	6.45
Percent reduction in emissions		99.4%	99.9%

Conclusions

Based on this analysis, AmeriCarbon's coal tar pitch production will significantly reduce greenhouse gas emissions as compared with the production and transport of Chinese pitch for use in the United States. These calculations suggest that greenhouse gas emissions will be reduced by more than 99%.

This result can be fine-tuned in several ways:

- **AmeriCarbon pitch production**. Additional measurements can be taken to refine the emission estimate from AmeriCarbon's pitch production process. Refinements may include: (1) measuring CO_2 emissions, (2) measuring any other significant greenhouse gases, and (3) taking measurements at a yet-to-be-built production facility as opposed to the research facility.
- **Chinese pitch production**. China-specific data would be helpful for refining this calculation, including emission data from Chinese coke ovens as well as data demonstrating the amount of pitch produced per pound of coke.
- **Transportation of Chinese pitch**. The transportation figures may be refined based on a better understanding of the weight of pitch transported in a TEU. Also, if the BSR and Clean Cargo Working Group update their methodology, new pitch emission estimates can be calculated.
- **Coal mining**. This analysis does not include greenhouse gas emissions from coal mining: carbon dioxide from machinery and equipment and fugitive methane from mines. As a first order approximation, emissions from mines in China and the United States are assumed to be roughly equal, or at least similar enough not to impact this report's general conclusion. This assumption can be verified if emission factors from appropriate types of coal mines in China and the United States are available.

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Appendix 7-1

DAVID A. BERRY

EDUCATION

West Virginia University, Morgantown, WV, M.S., Chemical Engineering (1999)

West Virginia University, Morgantown, WV, B.S., Chemical Engineering (1984)

RESEARCH AND PROFESSIONAL EXPERIENCE

AmeriCarbon Products, LLC; CEO; Morgantown, WV; 2020-present; Company established to advance the development and demonstration of conversion of coal to advanced carbon products using the proprietary AmeriCarbon Liquid Carbon Pitch (LCP) process; Founded company, established corporate and technical vision, and oversees company operations.

National Energy Technology Laboratory (NETL); multiple positions; Morgantown, WV; 1986-2019

NETL; Associate Director, Energy Conversion Engineering Directorate / Research & Innovation Center; 2015-2020; 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 (e.g., 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.

NETL; Director, Energy & Innovative Processes Division /Office of Research & Development; 2009-2015; Managed a multi-million dollar research program of engineers and scientists with primary expertise in catalysis, reaction engineering, surface science, electromagnetic energy, plasma chemistry and materials science. NETL; Research Leader, Fuel Processing /Office of Research & Development; 1996-2009; Managed a $2 million per year, 10-15 person, 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. NETL; Chemical Engineer/Office of Science and Technology; 1992-1996; NETL; Project Manager/Office of Power Systems; 1986-1992.

Belvoir Research and Development Center; Project Manager/Chemical Engineer/Fuels Handling Team; Fort Belvoir, VA; 1985-1986; Managed development effort between various military groups and industrial companies.

SELECTED PUBLICATIONS, PATENTS, ETC.

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2. Shadle, L.J., Berry, D.A., and Syamlal, M., "Coal Gasification", *Encyclopedia of Chemical Technology*, *Concise*, *5th Edition (ISBN 978-0-470-04748-4)*. , John Wiley & Sons, Inc., NY, NY, May 2007.
3. Ping Wang, Bret Howard, Nicholas Means, Dushyant Shekhawat, David Berry. "*Coal chemical-looping with oxygen uncoupled (CLOU) using a Cu-based oxygen carrier derived from natural minerals". *Energies 2019, 12, 1453, doi:10.3390/en12081453.
4. Ping Wang, Nicholas Means, Bret Howard, Dushyant Shekhawat, and David Berry, Chemical-Looping Combustion and Gasification of Coals and Oxygen Carrier Development: A Brief Review, *Energies*, *September 24, 2015.*
5. Surdoval, W.A., Berry, D.A , Shultz, T, SOFC Cathode With Oxygen Reducing Layer. ***US Patent #*** **9,935,318;** ***Issued U.S. Patent Office, April 3, 2018***
6. Shekhawat D., Berry D. A., Haynes D. J., Abdelsayed V., Smith M. W., Spivey J. J., Method of CO and/or CO2 hydrogenation to higher hydrocarbons using doped mixed metal oxides, ***U.S. Patent# 9,598,644 (2017).***
7. Siefert N. S., Shekhawat D., Berry D. A., Surdoval W. A., *Methane-rich syngas production from hydrocarbon fuels using multi-functional catalyst/capture agent*, ***U. S. Patent# 9,562,203 (2017).***

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*

Appendix 7-1

CHETAN TAMBE, Ph.D.

622 Hummingbird Lane, Bensalem, PA 19020, USA
E-mail: chetantambe@gmail.com | **LinkedIn:** www.linkedin.com/in/chetan-tambe | **Phone:** +1(517) 897-3253

SUMMARY OF PROFESSIONAL EXPERIENCE

- **Experience:** Technical Research: 8+ years; Industrial R&D experience: 5+ years
- **Expertise:** 8+ years of experience in process optimization, heterogenous catalytic reactions, polymer synthesis and characterization, high pressure reactions, reactive extrusion, structure-property performance relationships
- **Applications:** Coatings, Thermoplastics, Adhesives and Sealants, Elastomers, Packaging, 3-D Printing
- **Leadership:** Project lead at Cardolite, Mentored 4 undergraduate students
- **Publications: Total-23:** Patents: 5; Papers: 5; Book Chapter: 1; Presentations: 12

TECHNICAL (R&D) EXPERIENCE

Research Scientist, AmeriCarbon Products LLC, Morgantown, WV 9/2011-Present

Research Scientist, Cardolite Corporation, Bristol, PA 3/2017-8/2021

Project management:

- Initiated and developed a hydrogenation technology platform in the company, enabling a new product line based on different derived building blocks from Cashew Nut Shell Liquid (CNSL)
- Identified opportunities for new products in the area of bioplastics, fibers and polyurethanes
- Generated data on synthesis and application using design of experiments for marketing team to present in conferences
- Filed provisional patents for company and managing the IP portfolio

Process Development:

- Developed and established high pressure reactor capabilities for various processes like hydrogenation, silylation, amination
- Built a continuous flow reactor capabilities for chemistries like ozonolysis (patent filed on process and application)
- Troubleshooted customer issues modifying process variables in the synthesis of epoxies and epoxy curing agents.
- Supervised pilot scale up of developmental products at Cardolite's manufacturing location at Mangalore, India

Outreach:

- Represented Cardolite and presented work on the oxidized CNSL (through Ozonolysis) at Bio-Environmental Polymer Society (BEPS) conference in Troy, NY

Post Graduate Research Intern: Global Packaging, The Coca Cola Company, Atlanta, GA 5/2016-1/2017

- Identified and addressed issues in the synthesis of next-generation polyester for developing global product packaging
- Worked on optimization of the polymerization process parameters for the scale-up of polyester synthesis
- Studied reaction kinetics and performed catalyst screening using UV-Vis, FTIR, ^{1}H-NMR and GPC analysis
- Assisted in strategic mining of patents and scientific publications for intellectual property opportunities

Graduate Research Intern: Product Development, Sherwin-Williams Company, Cleveland, OH 5/2015- 8/2015

- Developed an innovative characterization method to analyze moisture barrier for architectural paints
- Initiated a project to understand the temperature effect on paint rheology by establishing structure-property relationship

Graduate Research Intern: Polymers and Materials Technology, Sherwin-Williams Company, Cleveland, OH 5/2014-8/2014

- Assessed the feasibility of synthetic procedure for a proprietary biobased epoxy for scale-up
- Formulated latexes by emulsion polymerization technique for intumescent (heat resistant) coating applications for automotive

Graduate Research Assistant: Biobased Materials Research Group, Michigan State University 1/2012-4/2016

1. Process development for a novel biobased organosilicon product for solvent-free paper coatings and personal care applications

- Designed and engineered a novel method of preparation of organo-silicon hybrid compounds from natural oils
- Analyzed the performance of coated paper substrates for moisture resistance for paper packaging applications
- Scaled up the material synthesis and paper coating process in collaboration with NTIC (Circle Pines, MN)
- Supervised the paper coating trials using industrial scale (~50,000 sq. ft.) gravure roll coaters (Sierra Coatings, WI)
- Extended the silylation process to other biobased oils for personal care applications (e.g., shampoo, hair gels etc.) in collaboration with Proctor & Gamble and L'Oréal

2. Development of value added products from modified natural oils for industrial applications (e.g., adhesives, sealants etc.)

- Developed a novel elastomer based on silylated natural oil and silicates for applications in coatings, adhesives and sealants etc.
- Studied the kinetics of the crosslinking process using rheology and differential scanning calorimetry
- Studied the mechanical and barrier properties of the material and performed a competitive market analysis

3. Synthesis of biobased and biodegradable polyesters and copolymers

- Designed a reactive extrusion polymerization process for the preparation of poly(p-dioxanone), three-arm polycaprolactone and their copolymers using aluminum-tri-sec-butoxide catalyst
- Conducted lab scale synthesis of p-dioxanone monomer from by heterogeneous catalytic dehydrogenation

TECHNICAL SKILLS

- **Process Equipment:** Polymer/monomer synthesis (High pressure reactor, glass reactor, plug flow reactors), Polymer Extrusion (Single and Twin-screw extrusion), Biodegradation
- **Process chemistry:** Hydrogenation, Polyesterification, Ozonolysis, Amination, Silylation, Epoxidation, Polyurethane
- **Characterization**: ^{1}H NMR, ^{13}C NMR, FTIR, GC, SEM/EDX, TEM, UV-Vis, Raman Spectroscopy
- **Polymer Characterization:** DSC, TGA, Tensile testing, DMA, Rheometer, GPC, Contact angle, WVTR, OTR, Viscometer
- **Applications:** Dip coating, spray coating, adhesion, hardness, corrosion, impact, moisture resistance
- **Software:** Chem-Bio Draw, OMNIC, MATLAB, Minitab, Design Expert, Microsoft Office, Microsoft Visio

EDUCATION

- **Ph.D. Chemical Engineering**, Michigan State University, East Lansing, MI (Advisor: **Prof. Ramani Narayan)** 10/2016
- B.E. Chemical Engineering Institute of Chemical Technology (formerly UDCT), India 5/2011

SELECTED AWARDS

- Outstanding poster award, MSU Engineering Graduate Research Symposium, Michigan 3/2015
- Best poster award at Michigan Green Chemistry and Engineering Conference, 2014 organized by DEQ, Michigan 9/2014

LIST OF PUBLICATIONS

PATENTS:

1. **C. Tambe,** A. Natesh, T. Stonis, P. Campaner, Composition, synthesis and uses of hydrolyzable silane modified Cashew Nut Shell Liquid derivatives, US Patent Serial No. 16/128,971 (2018)
2. **C. Tambe,** F. Dinon, P. Campaner A. Natesh, T. Stonis, Oxidized Cashew Nut Shell Liquid and uses thereof, US Patent Serial No. 16/106,627 (2018)
3. **C. Tambe**, P. Campaner, A. Natesh, F. Tavares, T. Stonis, Novel Cashew Nut Shell Liquid derivatives and their use as polymer building blocks, US Patent Application No. 62/930,744 (2019)
4. **C. Tambe**, J. Mauck, P. Campaner, A. Natesh, F. Tavares, T. Stonis, Cashew Nut Shell Liquid derivatives and methods for making and using same, US Patent Application No. 16/863,755 (2020)
5. **C. Tambe**, J. Mauck, P. Campaner, A. Natesh, F. Tavares, T. Stonis, Cashew Nut Shell Liquid based substituted cyclohexene derivatives and uses thereof, US Patent Application No. 63/064,473 (2020)

PAPERS:

1. **C. Tambe**, S. Dewasthale, X. Shi, D. Graiver, R. Narayan, Silylation of non-terminal double bonds of natural oils, *Silicon* **8**, 87-98 (2016).
2. **C. Tambe**, J. Kaufmann, D. Graiver, R. Narayan, Reactive blends derived from modified soybean oil and silicone, *Journal of Polymer Science: Part A Polymer Chemistry* **54 (19)**, 3086-3093 (2016),
3. **C. Tambe**, D. Graiver, R. Narayan, Silylated soybean oil coating with high moisture resistance for use in paper packaging, *Progress in Organic Coatings* **101**, 270-278 (2016) *(Most read article from journal after a month it was published online)*
4. C. B. Gale, B. Chin, **C. Tambe**, D. Graiver, M. A. Brook, Silicone structurants for soybean oil: foams, elastomers, and candles. *ACS Sustainable Chemistry & Engineering*, *7*(1), 1347-1352 (2018).
5. P. Campaner, **C. Tambe**, YM Kim, A. Natesh, Evaluation of Cashew Nut Shell Liquid Derived Isocyanate Blocking Agents, *International Journal of Advanced Science and Engineering* 7(2), 1642-1651 (2020)

BOOK CHAPTER:

1. P. Giri, **C. Tambe**, R. Narayan, Using reactive extrusion to manufacture greener products: from laboratory fundamentals to commercial scale, Biomass Extrusion and Reaction Technologies: Principle to Practices and Future Potential, ACS Symposium Series vol. **1304,** 1-23 (2018).

SELECTED PRESENTATIONS (5/12):

1. **C. Tambe**, A Natesh, T. Stonis, New biobased polymer building blocks from Cashew Nut Shell Liquid (CNSL), 25th Bio-Environmental Polymer Society (BEPS), Troy, NY, **59** (2018)
2. **C. Tambe**, D. Graiver, R. Narayan, Elastomers derived from reactive blending/crosslinking of modified soybean oil and silicone, 2016 AIChE Annual Meeting, San Francisco, CA, 472896 (2016)
3. **C. Tambe**, D. Graiver, R. Narayan, "Solvent free process for preparing soybean oil-based moisture resistant coating for packaging paper", 107th American Oil Chemical Society (AOCS) Annual Meeting and Expo, Salt Lake City, UT 67212 (*Selected as a featured article for **Inform** magazine by AOCS*) (2016)
4. **C. Tambe**, D. Graiver, S. Manjure, R. Narayan, "Moisture resistant coatings from silylated soybean oil" at 13th TAPPI Advanced Coating Fundamentals Symposium, Minneapolis, MN, S7-2 (2014)

Appendix 7-1

5. **C. Tambe**, D. Graiver, R. Narayan, "Synthesis of silylated soybean oil for coating applications" at Michigan Green Chemistry and Engineering Conference, Department of Environmental Quality, East Lansing, MI, 20 (2014) (*Best Poster Award)*

Mark Scafella

401 Aurora Avenue; Terra Alta, WV 26764; (304) 288-2846

EDUCATION AND TRAINING:

B.S. (1988), Architecture, Fairmont State University

Licensed/certified:

- General Contracting
- Electrical
- HVAC
- Welding
- High-Pressure Vessel Fabrication

RESEARCH AND PROFESSIONAL EXPERIENCE:

AmeriCarbon Products, LLC

2020-Present

Oversees operation of AmeriCarbon’s Liquid Carbon Pitch (LCP) process and equipment; responsible for equipment startup and operation; oversees third party contractors.

Marksman Contracting LLC

2009-2020

Owner/CEO

Managed a multi-employee company for design/construction of small chemical operations and commercial businesses. Certified and provided general contracting, electrical, HVAC, welding and high-pressure vessel fabrication.

Appendix 7-1

Chapman Corporation

1988-2009

Superintendent, Chemical Processes

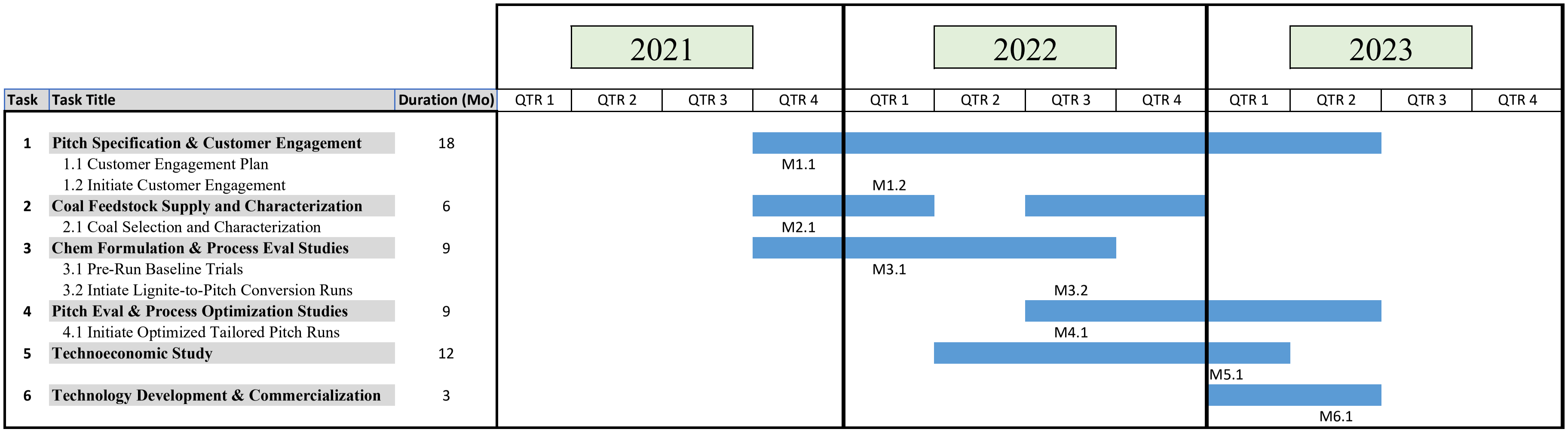
Managed projects for the construction of chemical plants and thermal/electric power plants. Involved and coordinated efforts throughout design, installation and plant startup. Processes typically involved high temperature and pressure highly automated operations.

SYNERGISTIC ACTIVITIES:

1. More than a decade of experience in construction and operation of coal liquefaction and carbon pitch production processes. Constructed and operated a 10-ton/day coal conversion plant for the production of jet fuel. Resulted in specification jet fuel demonstration from coal at a $45/bbl crude oil equivalent on effort for U.S. Air Force, Wright-Patterson Air Force Base.
2. Assisted in design and construction of 50-foot dual circulating integrated transport reactor for the Department of Energy's National Energy Technology Laboratory. Automated unit was designed for desulfurization of coal gas and other sulfur containing industrial gas processes.
3. In charge of maintenance programs and outages for various chemical plant operations in the Morgantown Industrial Park for 7 years.
4. Conducted multiple rebuilds for local glass and pulp/paper plants.
5. Built and operated an innovative pilot plant process to convert steel waste to magnetite for environmental clean-up and magnetic/electronic applications.

Appendix 10-1

Appendix 10-1



Appendix 10-1

Task	Milestone Title & Description	Planned Completion Date	Verification Method
1	M1.1 - Customer Engagement Plan	30 d after award	Interim Meeting
1	M1.2.1 - Initiate Customer Engagement	45 d after award	Interim Meeting
2	M2.1 - Coal Selection & Characterization Plan	30 d after award	Interim Meeting
3	M3.1 - Pre-run Baseline Trials	3 mo after award	Interim Meeting
3	M3.2 - Lignite to Pitch Conversion Runs	12 mo after award	Interim Meeting
4	M4.1 - Pitch Eval & Process Opt Runs	Project Completion	Final Report
5	M5.1 - Technoeconomic Results	Project Completion	Final Report
6	M6.1 - Tech Dev & Commercialization Path	60 d after Start	Topical Report

Deliverables

- Interim Report – Semi-annually or otherwise specified
- Technology Development Status Report – Project Completion
- Final Report – Project Completion

Appendix 11-1

Instructions and Summary

Award Number:

Award Recipient: AmeriCarbon Products LLC

Date of Submission: 10/1/2021

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 imust 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	$550,000	$659,794	$1,209,794	54.54%	
Budget Period 2	$0	$0	$0	0.00%	
Budget Period 3	$0	$0	$0	0.00%	
Total	$550,000	$659,794	$1,209,794	54.54%	

Section B - Budget Categories

CATEGORY	Budget Period 1	Budget Period 2	Budget Period 3	Total Costs	% of Project	Comments (as needed)
a. Personnel	$471,175	$0	$0	$471,175	38.95%	
b. Fringe Benefits	$117,925	$0	$0	$117,925	9.75%	
c. Travel	$0	$0	$0	$0	0.00%	
d. Equipment	$19,500	$0	$0	$19,500	1.61%	
e. Supplies	$42,333	$0	$0	$42,333	3.50%	
f. Contractual						
Sub-recipient	$0	$0	$0	$0	0.00%	
Vendor	$170,000	$0	$0	$170,000	14.05%	
FFRDC	$0	$0	$0	$0	0.00%	
Total Contractual	$170,000	$0	$0	$170,000	14.05%	
g. Construction	$0	$0	$0	$0	0.00%	
h. Other Direct Costs	$0	$0	$0	$0	0.00%	
Total Direct Costs	$820,933	$0	$0	$820,933	67.86%	
i. Indirect Charges	$388,861	$0	$0	$388,861	32.14%	
Total Costs	$1,209,794	$0	$0	$1,209,794	100.00%	

Additional Explanation (as needed):

Appendix 11-1

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
	Principal Investigator	1485	$175.00	$259,875			$0			$0	1485	$259,875	
	Chemical Engr Executive	382	$125.00	$47,750			$0			$0	382	$47,750	
	Chemical Engineer	1678	$50.00	$83,900			$0			$0	1678	$83,900	
	Chemical Technician	1770	$45.00	$79,650			$0			$0	1770	$79,650	
				$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	
				$0			$0			$0	0	$0	
	Total Personnel Costs	**5315**		**$471,175**	**0**		**$0**	**0**		**$0**	**0**	**$471,175**	

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	350,000	12.34%	$43,190	0	12.34%	$0			$0	$43,190
Chemical Engr Executive	250,000	13.61%	$34,025	0	13.61%	$0			$0	
Chemical Engineer	100,000	17.85%	$17,850	0	17.85%	$0			$0	$17,850
Chemical Technician	90,000	25.40%	$22,860	0	25.40%	$0			$0	$22,860
			$0			$0			$0	$0
Total:	**$790,000**		**$117,925**	**$0**		**$0**	**$0**		**$0**	**$117,925**

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
										$0	
	International Travel										
										$0	
	Budget Period 1 Total									**$0**	
	Domestic Travel	Budget Period 2									
1										$0	
5										$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									**$0**	

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
	Drying oven	1	$19,500	$19,500		
				$0		
				$0		
				$0		
				$0		
				$0		
	Budget Period 1 Total			$19,500		
				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			**$19,500**		

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
	Solvents	1	$4,775.00	$4,775		
	Replacement pump seals	1	$8,718.00	$8,718		
	Heat tracing	1	$6,772.00	$6,772		
	Hot oil skid / heat transfer fluid	1	$2,860.00	$2,860		
	Insulation	1	$4,265.00	$4,265		
	Thermocouples	1	$3,168.00	$3,168		
	Replacement fittings	1	$3,840.00	$3,840		
	Replacement bearings	1	$6,655.00	$6,655		
	Vacuum pump oil	1	$1,280.00	$1,280		
	Budget Period 1 Total			**$42,333**		
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			**$42,333**		

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**
	The North American Coal Corporation		$25,000			$25,000
	Consultants		$145,000			$145,000
						$0
						$0
						$0
						$0
		Sub-total	$170,000	$0	$0	$170,000

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		$170,000	$0	$0	$170,000

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):

Appendix 11-1

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)	31.64%				**Total Program Costs**
FCCM Rate, if applicable					
OTHER Indirect Rate					
Indirect Costs (As Applicable):					
Overhead Costs	$239,781			**$239,781**	
G&A Costs	$149,080			**$149,080**	
FCCM Costs, if applicable				**$0**	
OTHER Indirect Costs				**$0**	
Total indirect costs requested:	**$388,861**	**$0**	**$0**	**$388,861**	

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 shown

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 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 fro 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**
NACCO	In Kind		$25,000			**$25,000**
AmeriCarbon	In Kind		$634,794			**$634,794**
						$0
						$0
						$0
						$0
						$0
						$0
						$0
						$0
		Totals	**$659,794**	**$0**	**$0**	**$659,794**

Total Project Cost: $1,209,794

Cost Share Percent of Award: 54.54%

Additional Explanation (as needed):

Appendix 12-1

NACCO NATURAL RESOURCES

September 28, 2021

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 *North Dakota Lignite Coal-Based Pitch for Production of High Value Carbon Products via AmeriCarbon Liquid Carbon Pitch (LCP) Process*. 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, New Mexico, 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 $25,000 in in-kind support in the form of lignite 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.

Regards,
The North American Coal Corporation

George Lovland

George Lovland, P.E.
Engineering Manager

NACCO Natural Resources Corporate Office

5340 Legacy Drive, Suite #300
Plano, TX 75024

972.448.5400

nacco.com

Catapult Mineral Partners | Mitigation Resources of North America | North American Coal | North American Mining

AmeriCarbon

October 1, 2021

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 $634,794 in in-kind services, including personnel time, indirect, and overhead expenses, with respect to the project proposed with the title *North Dakota Lignite Coal-Based Pitch for Production of High Value Carbon Products via AmeriCarbon Liquid Carbon Pitch (LCP) Process.*

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

Appendix 13-1

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 October, 2021, by Gregory Henthorn.

[Notarial Seal]

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
Kevin Amos
714 Venture Drive
Morgantown, WV 26508
My Commission Expires Feb. 8, 2025

Notary Public

My Commission Expires: Feb 8, 2025

This instrument was prepared by:
AmeriCarbon Products, LLC, 3001 Cityview Drive, Morgantown, West Virginia, 26501