



## Environment and Natural Resources Trust Fund

### M.L. 2021 Approved Work Plan

#### General Information

**ID Number:** 2021-463

**Staff Lead:** Corrie Layfield

**Date this document submitted to LCCMR:** August 27, 2021

**Project Title:** Forest Health: Development and Demonstration of Biochar Opportunities

**Project Budget:** \$340,000

#### Project Manager Information

**Name:** Eric Singsaas

**Organization:** U of MN - Duluth - NRRI

**Office Telephone:** (218) 788-2648

**Email:** esingsaa@d.umn.edu

**Web Address:** <https://www.nrri.umn.edu/>

#### Project Reporting

**Date Work Plan Approved by LCCMR:** August 26, 2021

**Reporting Schedule:** December 1 / June 1 of each year.

**Project Completion:** June 30, 2023

**Final Report Due Date:** August 14, 2023

#### Legal Information

**Legal Citation:** M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 19

**Appropriation Language:** (a) The following amounts, totaling \$840,000, are transferred to the Board of Regents of the University of Minnesota for academic and applied research through the MnDRIVE program at the Natural Resources Research Institute to develop and demonstrate technologies that enhance the long-term health and management of Minnesota's forest resources, extend the viability of incumbent forest-based industries, and accelerate emerging industry opportunities. Of this amount, \$500,000 is for extending the demonstrated forest management assessment tool to statewide application:

- (1) the unencumbered amount, estimated to be \$250,000, in Laws 2017, chapter 96, section 2, subdivision 7, paragraph (e), Geotargeted Distributed Clean Energy Initiative;
  - (2) the unencumbered amount, estimated to be \$20,000, in Laws 2017, chapter 96, section 2, subdivision 8, paragraph (g), Minnesota Bee and Beneficial Species Habitat Restoration;
  - (3) the unencumbered amount, estimated to be \$350,000, in Laws 2018, chapter 214, article 4, section 2, subdivision 9, paragraph (e), Swedish Immigrant Regional Trail Segment within Interstate State Park; and
  - (4) the unencumbered amount, estimated to be \$220,000, in Laws 2019, First Special Session chapter 4, article 2, section 2, subdivision 5, paragraph (a), Expanding Camp Sunrise Environmental Program.
- (b) The amounts transferred under this subdivision are available until June 30, 2023.

**Appropriation End Date:** June 30, 2023

## Narrative

**Project Summary:** This project is an expansion of the work began under LCCMR 2019 Forest and Bioeconomy Research. NRRI is requesting continuing Legislative support for two strategic applied research and demonstration projects

**Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.**

Minnesota's forest products industries, sawtimber, paper, pulp and engineered wood products, contributed \$9.8 billion in forest product shipments and \$3.4 billion in direct value to Minnesota's economy in 2019 (Bergstrand 2019). Declining demand for forest products, a changing climate and new opportunities like carbon markets will require forest managers to think differently about how they manage forest lands and forest products industry about the potential products they can produce.

This equipment will support ongoing research programs, such as a project to develop materials to treat stormwater contaminants; develop a portable field demonstration unit to demonstrate stormwater best management practices; and field scale testing of biochar materials for stormwater treatment along the Mississippi river. The current state-of-the-art research in these areas is done by purchasing commercial biochars and evaluating their performance by trial and error. Instead, incorporating the ability to make and test custom biochars will enable researchers to engineer biochars that are fit for purpose to each situation, leading to more effective engineered stormwater treatment technologies.

**What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.**

We have identified the field of functional biocarbon materials as a major research opportunity to add value from Minnesota's forest and agricultural resources. Functional biocarbon materials include biochar, which is used as a soil amendment in agricultural, horticulture, and forestry, but also includes many other functional materials such as sorbents for water and air purification, composite fillers, and battery components. This current project will enhance this program by adding a needed piece of equipment capable of processing biomass at higher temperatures and assist with process scale-up. This mid-scale kiln will also provide valuable information on the transition from the laboratory bench scale (grams) to the pilot scale (tons) production rates while also being able to produce sufficient quantities of functional biocarbon materials to demonstrate their utility in water treatment and other materials applications. We will develop design criteria, solicit bids for the equipment and then purchase and install it.

**What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?**

This project will provide a foundation for new types of products made from Minnesota's natural resources, which have a high fixed carbon content to store atmospheric carbon dioxide in soils or are used in environmentally relevant industries, such as in soil and water remediation and energy systems. This equipment will be used by NRRI and University of Minnesota researchers to support the R&D needed to deploy these materials with the help of industry, agency, and NGO partnerships.

## Project Location

**What is the best scale for describing where your work will take place?**

Statewide

**What is the best scale to describe the area impacted by your work?**

Statewide

**When will the work impact occur?**

During the Project and In the Future



## Activities and Milestones

### Activity 1: Forest Health: Development and Demonstration of Biochar Opportunities

**Activity Budget:** \$340,000

**Activity Description:**

This current project will enhance this program by adding a needed piece of equipment capable of processing biomass at higher temperatures and assist with process scale-up. This mid-scale kiln will also provide valuable information on the transition from the laboratory bench scale (grams) to the pilot scale (tons) production rates while also being able to produce sufficient quantities of functional biocarbon materials to demonstrate their utility in water treatment and other materials applications. We will develop design criteria, solicit bids for the equipment and then purchase and install it. These funds will also allow us to develop safety and quality management documents and test the equipment with preliminary run data by producing sample materials for some small project from Minnesota resources. Once installed and qualified, we will produce and evaluate sample sorbent materials to support ongoing research into developing fit-for-purpose materials to treat stormwater for metal and organic contaminants with additional funding by MN Drive, the Minnesota Coastal Wetland Program, and the Mississippi Watershed Management Organization.

**Activity Milestones:**

Description	Completion Date
Milestone 1: Equipment specification for competitive bid	November 30, 2021
Milestone 2: Equipment purchase decision	April 30, 2022
Milestone 3: Equipment installation	September 30, 2022
Milestone 4: Safety and Quality documentation	December 31, 2022
Milestone 5: Materials production and evaluation for stormwater programs	June 30, 2023

## Dissemination

**Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.**

We will communicate with industry and academic partners through technical presentations, marketing materials, and mass media to advertise the availability of this equipment for collaborative research. All public-facing research dissemination for projects using this equipment, including scientific publications, presentations, and technical reports, will acknowledge the ENRTF contribution to the equipment.

## Long-Term Implementation and Funding

**Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?**

We will continue to use this equipment for both discovery science and material R&D programs as well as industry support. These programs will be funded by federal and state grants, industry sponsored research, and service contract work.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
John Du Plissis		Du Plissis will serve as principal investigator and be responsible for general project management and reporting.			25.09%	0.1		\$12,946
Eric Singsaas		Singsaas will serve as project manager and coordinate equipment selection, purchase, installation, and manage the safety and quality management of research.			25.09%	0.1		\$17,723
Timothy Hagen		Chemical Engineer/Agglomeration Specialist			25.09%	0.02		\$2,501
Matthew Young		Research Engineer			22.3%	0.02		\$1,557
Cally Hunt		Biomass Process Engineer			22.3%	0.02		\$1,496
Brian Barry		Chemistry & Materials Science Program Leader			25.09%	0.1		\$11,689
Sergiy Yemets		Senior Research Scientist			25.09%	0.06		\$4,476
Oksana Kolomitsyna		Senior Research Scientist, Organic Chemistry			25.09%	0.02		\$1,413
TBD Post Doc		Postdoc to work on development of sorption materials development.			17.28%	0.2		\$12,271
Matthew Mlinar		Mlinar will provide project management support and serve as a part of the project management team for this grant			25.09%	0.1		\$13,091
							<b>Sub Total</b>	<b>\$79,163</b>
<b>Contracts and Services</b>								
Twin Ports Testing	Professional or Technical Service Contract	Proximate/ultimate analysis by Twin Ports Testing. They will perform some routine analysis on sample biochars.				0.01		\$3,090
Entity TBD; Ventilation and Power Work	Professional or Technical Service Contract	The heat and potentially explosive vapors produced through biomass processing will require a ventilation hood above the kiln with ductwork necessary to tie into existing upgraded building ventilation ductwork		X		0.01		\$20,500

		recently installed in the NRRI process development area.						
							<b>Sub Total</b>	<b>\$23,590</b>
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Laboratory supplies - biochar analysis	Chemicals, gases, and other reagents needed to operate biochar analytical equipment.					\$5,150
	Tools and Supplies	Chemistry Lab Consumables	General supplies for laboratory analyses and performance testing of biochars.					\$2,197
	Tools and Supplies	Safety equipment for kiln	Installation of this equipment will require safety equipment to protect users against fire and burning hazards while handling equipment, including fire suppression personal protective equipment, and physical barriers.	X				\$4,500
							<b>Sub Total</b>	<b>\$11,847</b>
<b>Capital Expenditures</b>								
		The requested equipment is a mid-scale indirectly heated kiln	The requested equipment is a mid-scale indirectly heated kiln with add-on equipment for pilot-scale production of carbonized materials from Minnesota-based forest biomass. This is necessary to produce sufficient quantities of these materials under controlled conditions to develop new value-added materials from woody biomass for markets such as water treatment. air filtration, energy storage, and minerals processing. As part of the capital equipment, building modifications will be necessary.	X				\$225,000
							<b>Sub Total</b>	<b>\$225,000</b>



Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
							Sub Total	-
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
		Shipping costs	Shipping of samples for analysis	X				\$400
							Sub Total	\$400
							Grand Total	\$340,000

## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
<b>Contracts and Services</b> - Entity TBD; Ventilation and Power Work	Professional or Technical Service Contract	The heat and potentially explosive vapors produced through biomass processing will require a ventilation hood above the kiln with ductwork necessary to tie into existing upgraded building ventilation ductwork recently installed in the NRRRI process development area.	The equipment will require wiring of dedicated 240V electrical circuits into the process development area, tying into the existing electrical panels.
<b>Capital Expenditures</b>		The requested equipment is a mid-scale indirectly heated kiln	This equipment will enhance the capabilities of NRRRI to engage in collaborative research with academia, industry, and agencies to develop and demonstrate new materials from Minnesota resources. <b>Additional Explanation :</b> The objective of this project is to obtain and install equipment that will be used to support research on this topic into the future.
<b>Equipment, Tools, and Supplies</b>		Safety equipment for kiln	This cost is necessary for the safety of personnel using this equipment.
<b>Other Expenses</b>		Shipping costs	Sample shipping to external labs for samples not able to be analyzed internally

## Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

## Attachments

### Required Attachments

#### *Visual Component*

File: [340c36f4-963.pdf](#)

#### *Alternate Text for Visual Component*

The graphic describes the goal, opportunities benefits of biochar opportunities...

### Optional Attachments

#### *Support Letter or Other*

Title	File
Institutional Letter	<a href="#">0c0a6f90-902.pdf</a>
Background Check	<a href="#">83814f65-cf0.pdf</a>

## Difference between Proposal and Work Plan

#### *Describe changes from Proposal to Work Plan Stage*

N/A

## Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

**Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?**

Yes

**Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?**

N/A

**Does your project have potential for royalties, copyrights, patents, or sale of products and assets?**

No

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**

N/A

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**

N/A

**Does your project include original, hypothesis-driven research?**

No

**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

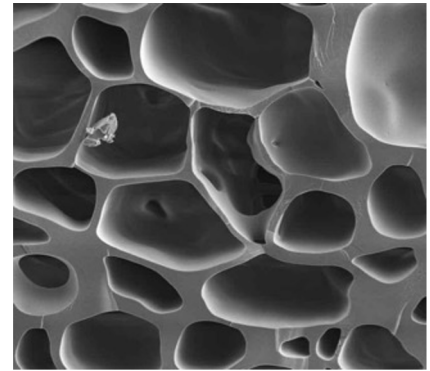
# Biochar

## WHAT IS BIOCHAR?

**Biochar is a charcoal-like material most commonly made by heating plant matter, or biomass, in the absence of oxygen.**

### Biochar Primary Sources

- Forest/Mill Residuals
- Low value species
- White-wood pellets
- Pest-killed Trees



### NRRI Thermal Processing



### Biochar Secondary Sources

- Agricultural residues
- Water treatment biosolids
- Manure management

### Beneficial Attributes

- Stable carbon
- Absorption
- Water retention
- Microbial habitat
- Soil structure

**Natural Resources  
Research Institute**

UNIVERSITY OF MINNESOTA DULUTH  
Driven to Discover

**NRRI Duluth**  
(218) 788-2694  
5013 Miller Trunk Hwy, Duluth, MN 55811

**NRRI Coleraine**  
(218) 667-4201  
One Gayley Avenue, Coleraine, MN 55722

[nrriinfo@d.umn.edu](mailto:nrriinfo@d.umn.edu) • [www.nrri.umn.edu](http://www.nrri.umn.edu)