

**Environment and Natural Resources Trust Fund  
2011-2012 Request for Proposals (RFP)**

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**LCCMR ID: 162-F3+4**

**Project Title:** Bio-char: An Under-utilized Resource to Enhance Biofuel Crops

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**Category:** F3+4. Renewable Energy

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**Total Project Budget:** \$ \$324,860

**Proposed Project Time Period for the Funding Requested:** 3 yrs, July 2011 - June 2014

**Other Non-State Funds:** \$ 0

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**Summary:**

Leverages under-utilized sources of bio-char in the central sand plains to enhance biofuel crop yields, improve sandy soils, increase soil water retention and quality, and sequester carbon.

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**Sponsoring Organization:** Central Lakes College

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Staples MN 56479

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**Location**

**Region:** Central

**Ecological Section:** No. Minnesota Drift and Lake Plains (212N), Minnesota and NE Iowa Morainal (222M)

**County Name:** Becker, Benton, Cass, Crow Wing, Douglas, Hubbard, Isanti, Morrison, Otter Tail, Sherburne, Stearns, Todd, Wadena

**City / Township:** Staples/ Thomas

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_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ Employment	_____ TOTAL _____%

# 2011-2012 MAIN PROPOSAL

## PROJECT TITLE: Bio-char: An Under-Utilized Resource to Enhance Biofuel Crops

### I. PROJECT STATEMENT

1) Bio-char is an unrealized resource that could rapidly improve the production and environmental benefits of biofuel crops on the central sand plains. Every day 15 semi-truck loads of wood chips are delivered from the Staples area to Benson Mn. This transportation resource could be used to back-haul bio-char that is currently being disposed of in a landfill, from Chippewa Valley Ethanol Company. Research is needed to develop guidelines for bio-char use on the central sand plains. We will integrate:

- **Application Rates**— Little is known about which levels of bio-char application are best for improving biofuel yields and soil quality. We will determine recommended bio-char application rates for three biofuel crops currently under consideration.
- **Carbon Sequestration**— Bio-char amendments can replenish soil carbon in depleted agricultural soils and sequester atmospheric carbon. Using life cycle analysis we will determine carbon sequestration associated with biofuel crops and bio-char application.
- **Enhanced Environmental Benefits**— Bio-char can enhance biofuel crops by reducing fertilizer needs, improving water quality and retention, and increasing resiliency of biofuel crops to drought and climate change. We will test fertilizer requirements and water impacts for several biofuel crops amended with bio-char.
- **Emerging Biofuel Markets**— The Central Minnesota Ethanol Coop will gasify biomass to power the first commercial cellulosic ethanol plant in the state, located in Little Falls on the central sand plains. Also, a 15 MW Cogen plant gasifying biomass is under development in Brainerd. These facilities will need a large area to dispose of their bio-char. We will support them by testing bio-char application, regional biomass production, and farm-scale operation costs associated with five biofuel crops

2) This research will advance a community-based and sustainable biofuel industry for the central sand plains. We will collaborate with the university, federal and state agencies, private industry and local producers in a comprehensive effort to revitalize rural economies and protect marginal, erodible lands. At the core of this project is the Energy and Agricultural Center of Central Lake College in Staples, Minnesota. The Energy Center is well connected to regional producers, agriculture, and bioenergy facilities.

### II. DESCRIPTION OF PROJECT ACTIVITIES

#### Activity 1: Bio-char Effects on Biofuels

**Budget:** \$227,402

We focus on biomass production and bio-char amendments in diverse prairie (25 species) versus monoculture grass crops. We will plant 324 plots to one of three biofuel crops: diverse prairie, switchgrass, and non-native Miscanthus. Biofuel plots will be assigned to fertilization (2 levels) and bio-char (3 levels) treatments. Plots will be established on a landscape scale and include six production fields throughout the sand plains (3 replications for each treatment/ field).

Plot establishment will be evaluated 2011 and biofuel production in 2012 and 2013. We will determine net energy yields and environmental benefits: soil nutrient retention, water quality effects, and carbon sequestration. Using life cycle analysis we will evaluate the effect of bio-char amendments and biofuel crops on greenhouse gas emissions.

Outcome	Completion Date
Quantify net energy yields and environmental benefits.	December 1, 2013
Communicate relevance to Minnesota biofuels through peer-reviewed journals, websites and field days,	December 1, 2011, 2012, 2013

**Activity 2: Farm-Scale Assessment of Biomass Production Budget: \$97,458**

In 2009, we obtained a NextGen grant to establish biomass crops in five acre plots across nine locations. Each 5 acre plot contains 1 acre of switchgrass, big bluestem, diverse prairie, cordgrass and intermediate wheatgrass. By 2013, we will produce a five year expense table covering costs of establishment, maintenance, fertilization and harvest. These plots will test economic feasibility of biomass production on a landscape level. Results from activity #1 will be integrated with #2 to develop best management practices on a farm-scale.

<b>Outcome</b>	<b>Completion Date</b>
Quantify net energy yields, develop five-year expense table, and test economic feasibility for each biofuel crop.	December 1, 2013
Communicate relevance to Minnesota biofuels through peer-reviewed journals, websites and field days.	December 1, 2011, 2012, 2013

**III. PROJECT STRATEGY**

**A. Project Team/Partners**

- Robert Schafer, Director-Central Lakes College Ag & Energy Center, Staples MN  
*The Energy Center will be supplying project management, equipment, labor, established perennial plots, financial accounting with MNSCU system, field days and publicity.*
- Jim Eckberg, Research Fellow, (Soil, Water and Climate) – University of MN.  
*Lead scientist, technical writing, develop protocols, and supervisory services.*
- Michelle Johnson, Technician – Central Lakes College Ag & Energy Center  
*Establish experimental plots and treatments, data collection*
- Ron Nelson, Farm Manager – Central Lakes College Ag & Energy Center  
*Equipment operation, plot management*
- Andrew Zurn, Project Mgr – Chippewa Valley Ethanol Coop, Benson MN  
*Supplier of Gasifier Biochar and market for Biomass crops.*
- Central Minnesota Irrigators Corporation – Member landowners  
*Members can provide land for demonstration plots; Information dissemination through local and state wide irrigator newsletters; Funding for member demonstration plots.*
- Dr. Carl Rosen, Professor, (Soil, Water and Climate) – University of MN  
*Consulting on research protocols, biochar use, data collection and management*
- Dr. John Moncrief, Professor, (Soil, Water and Climate) – University of MN  
*Consulting on soil fertility, nutrient leaching and water quality issues.*
- Dr. Tim Smith, Associate Professor, (Bioproducts and Biosystems Engineering) – Univ. of MN  
*Consulting on life cycle analysis.*
- Dr. Erik Sacks, Manager of Plant Breeding – Mendel Biotechnology  
*Provide cold strain varieties of Miscanthus*

**B. Timeline Requirements**

- Spring 2011— Establish experimental treatments.
- Summer 2011-winter 2013— Maintain experimental treatments, collect data, conduct field demonstrations, and provide annual reports.

**C. Long-Term Strategy and Future Funding Needs**

In 2009, a NextGen grant was obtained to conduct preliminary studies on camelina and perennial grass crops. The funding requested here is essential to expand these studies and address the potential use of bio-char in biofuel crops. Funding beyond the scope of this proposal will be important to understanding the long-term dynamics of perennial grassland biofuel production and carbon sequestration.

## 2011-2012 Detailed Project Budget

### IV. TOTAL TRUST FUND REQUEST BUDGET

Three years

<b>BUDGET ITEM</b>	<b>Grant</b>
<b>Personnel:</b>	
Robert Schafer, Project Manager Annual Salary \$56,523 plus fringe \$24,916 = \$81,439 x .20 FT = \$16,287.80 x 3 years	\$ 48,863
Michelle Johnson, Research Technician Annual Salary \$27,266 plus fringe \$19,463 x .20FT = \$9,345.80 x 3 years	28,037
Ron Nelson, Farm Manager - Equipment Operator Annual Salary \$27,266 plus fringe \$19,670 x .20FT = \$9,387.20 x 3 years	28,162
<b>Contractual / Professional Services:</b>	
Jim Eckberg, Research Fellow / Ecologist - will oversee the project consultation, research protocols and publications and professional writing	\$ 82,250
Dr. John Moncrief, Fertility, Soils and Water Consulting	10,000
Dr. Carl Rosen, Bio-char consulting	10,000
Oak Creek Pellets, Buckman MN - Pelletize Grasses for fuel	7,500
Meadowbrook Landscaping, Mike Roelofs-labor & equipment for plot maintenance	12,000
Central MN Irrigators, Inc. Members, land rent for 100 acres @ \$50/A	15,000
<b>Equipment/Tools/Supplies:</b>	
Seed, Fertilizer, Herbicides	\$ 9,000
Equipment repair/Parts/Tools/Misc supplies:	\$ 20,000
Equipment rent	\$ 12,000
Tillage, planting, spraying, fertilization, harvesting equipment	15,000
<b>Travel:</b>	
Ag Center Travel for Project Manager, Research Technician and Equipment Operator between off site plots for project purposes. Anticipated number of sites 8 x 24 mile average RT x (3 times/month x 7 mo) = 6,912 miles annually x .50/mile	\$ 6,048
<b>Additional Budget Items:</b>	
5 Field Days annually (3yr total of 15 Field Days) will include Tours, educational seminars for farmers, educators, industry and Gov't Agencies estimated cost per event including guest speakers, facilities and set-up = \$200/event	\$ 3,000
Materials and publication of newsletters (4 issues per year)	3,000
Repair and Maintenance of equipment and general farm supplies \$5,000 per year	15,000
<b>TOTAL ENVIRONMENT &amp; NATURAL RESOURCES TRUST FUND \$ REQUEST</b>	<b>\$ 324,860</b>

### V. OTHER FUNDS

<b>SOURCE OF FUNDS</b>	<b>AMOUNT</b>	<b>Status</b>
<b>Other Non-State \$ Being Applied to Project During Project Period:</b>		
USDA New Era Rural Technician Competitive Grant Program (RTP)	43,000	Pending
<b>Other State \$ Being Applied to Project During Project Period:</b>		
Do you have any other funds that you are applying for from the state?		
<b>In-kind Services During Project Period:</b>		
Central MN Irrigators, Inc.	3,000	Secured
NRCS - Environmental Assessments of plantings on Water Quality, Soil Erosion and Wildlife Habitat	2,000	Secured
Central Lakes College Ag Center land, facilities and incidental equipment	6,000	Secured
<b>Funding History:</b>		
Next Gen Grant - "Dedicated Energy Crop Production"	100,000	Awarded Nov '08



Switchgrass: One acre plot after first year of growth



Miscanthus plot after first year of growth



Perennial biomass crops will provide permanent cover and protect soil against intense wind erosion



Bio-char is a carbon by-product of biomass gasification that can be used to improve sandy soil

## **Project Manager Qualifications**

Robert Schafer, Central Lakes College Ag and Energy Center, Director. Bob is a former high school Vo-Ag instructor from the Brainerd area with twenty five years of experience in the food, dairy, and livestock feeding industry and five years in the biofuels industry. He will be coordinating the Ag Center's resources allocated toward the project, the education and outreach efforts, and the activities of all participants.

Supporting activities include work as the Project Manager for a NextGen grant titled "Dedicated Energy Crop Production". Bob has established working relationships with companies like Mendel Biotechnology for cold strain Miscanthus varieties, NRCS Plant Materials Center for native perennials and woody plants, Sustainable Oils for camelina technology and seed, MCGYAN Biodiesel LLC for fuel production technology and equipment, and Circle Energy for oilseed pressing equipment.

Bob participated in starting three dry grind corn ethanol plants in five years while previously employed in the biofuels industry. He progressed from shift supervisor to production manager to plant manager with the different ethanol companies. These duties involved hiring and training the production crews, overseeing plant construction, establishing standard operating procedures for each process, optimizing production and eliminating operating costs.

## **Organization Description**

The Ag and Energy Center is a 500 acre research and demonstration station located in the central sand plains. The sand plains are a potential epicenter for perennial biofuel crops given the wide availability of marginal, sandy land. The mission of the Ag and Energy Center is to lead the development of a community-based and sustainable biofuel industry. Current research on perennial grass suitability for biofuel is being funded through a NextGen Grant. The Ag and Energy Center is well connected to regional producers, agriculture, bioenergy facilities and the University of Minnesota.

The Ag and Energy Center is equipped with a full line of farm production equipment for tillage, seeding spraying, fertilization and harvesting. It is also equipped with Almaco plot seeding equipment, combine, forage harvester, forage drying system etc needed for accurate research and demonstration work. As a former Irrigation training center it is equipped with multiple irrigations systems, wells and ponds. An on-site biomass heated greenhouse adds plant propagation capacity and demonstration value. A 100,000 gal/yr biomass fueled ethanol plant is also located on site. The Center's office heating system is a biomass boiler able to utilize pelletized grasses.

The Center has an established array of biomass demonstration plots containing hybrid poplar, survivor false indigo, hazelnut, Miscanthus, switchgrass, big bluestem, mixed prairie, prairie cordgrass, wheatgrass and many more. Approximately twenty five acres of wasteland are planted to annual and perennial biofuel crops to test their drought tolerance, growth characteristics, nutrient requirements, economic value and environmental benefits.