Keith Trego
Executive Director
1605 East Capitol Avenue, Ste. 101
Bismarck, ND 58501-2102
(701) 223-8501
FAX: (701) 223-6937

April 27, 2009

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 E. Boulevard Avenue, Dept. 405
Bismarck, North Dakota 58505-0840

Transmittal Letter: "Evaluation of Perennial Herbaceous Biomass Crops in North Dakota for Production of Ethanol and other Value-Added Products and for Use in Coal Plant Co-Firing"

Dear Ms. Fine:

Enclosed please find the above referenced project proposal which the North Dakota Natural Resources Trust, Great River Energy, North Dakota Farmer's Union, North Dakota Game and Fish Department, and Natural Resources Conservation Service are submitting for consideration by the North Dakota Renewable Energy Council.

This transmittal letter represents a commitment by the North Dakota Natural Resources Trust and the parties for completion of the project as described in the proposal. The North Dakota Natural Resources Trust will provide $50,000 cash in support of the project. Letters of commitment from our partners are provided as an attachment to the proposal.

Sincerely,

Keith Trego
Executive Director

enclosure

"Dedicated to the preservation, enhancement, restoration and management of wetlands and associated wildlife habitat, grasslands, and riparian areas in the state of North Dakota."

TITLE PAGE

Project Title: Evaluation of Perennial Herbaceous Biomass Crops in North Dakota for Production of Ethanol and other Value-Added Products and for Use in Coal Plant Co-Firing

Applicant: North Dakota Natural Resources Trust

Partners:

- Great River Energy
- North Dakota State University Research Extension Service Centers
- USDA, Natural Resources Conservation Service
- North Dakota Farmers Union
- USDA, Agriculture Research Station, Northern Great Plains Research Laboratory
- North Dakota Commerce Department
- North Dakota Game and Fish Department
- Great Plains Institute
- North Dakota Association of Rural Electric Cooperatives

Principal Investigator: Keith Trego, North Dakota Natural Resources Trust

Date of Application: May 1, 2009

Amount of the Request: $280,000

Table of Contents

Abstract 4

Project Description 5

Standards of Success 11

Background/Qualifications 12

Management 14

Timetable 14

Budget 14

Patents and Rights to Technical Data 15

Appendices 15

Appendix 1. Tax Liability Information 16

Appendix 2. Letters of Commitment 17

Appendix 3. Biomass Plot Treatments 21

Appendix 4. References 22

Abstract

Great potential exists in North Dakota to diversify rural economies by building biorefineries that convert biomass into renewable energy, as well as numerous value added products. Prior to building a conversion plant, data is needed on the chemical composition of harvested biomass relative to conversion to bio-oil and/or chemicals. In 2006, the ND Natural Resources Trust (Trust) initiated a ten-year study to evaluate the potential of dedicated perennial herbaceous biomass crops that would accomplish the dual purpose of providing sustainable renewable energy and be beneficial to wildlife.

Phase I (2006-2008) of the project focused on establishment of biomass plots containing ten mixes of perennial grass mixtures and collection of baseline data on soil quality, including carbon sequestration. Data was also collected on biomass yield and chemical properties of harvested biomass. Phase II (2009-2011) involves data collection on soil quality for comparison to baseline values and data on yield and chemical composition of harvested biomass produced under varying climatic conditions.

Great River Energy (GRE) is building a coal-fired power plant at Spiritwood, North Dakota, and is evaluating the feasibility of co-firing with 10 percent biomass. With the advent of GRE's Spiritwood Power Plant project in geographic proximity to many of the study plots, the importance of the perennial herbaceous biomass crop evaluation has escalated and the need to collect additional data related to the crops has become apparent.

REC and match funds will extend data collection on biomass yields/chemical composition and soil quality, as well as result in additional data on silica, BTU, chlorine/chloride, and alkalinity of biomass harvested from plots.

Project Description

This project will determine the appropriate grass species, harvest methods, and practices to maintain productive perennial biomass stands that would accomplish the dual purpose of providing sustainable renewable energy crops and be beneficial to wildlife. The evaluation will be conducted during 2009-2011 at five North Dakota State University Research Extension Centers where biomass plots have been established. Data will be collected on soil quality for comparison to baseline values. We will also collect data on the yield and chemical composition of harvested biomass produced under varying climatic conditions. A list of soil quality parameters and chemical properties that will be analyzed is provided in Attachment 1. Maintenance of biomass plots will continue.

This project will help tie together several separate, but interrelated, biomass energy studies and projects that have potential to benefit North Dakota's rural economy, agricultural producers, traditional energy, and conservation. Specific projects related to the dedicated perennial herbaceous biomass crops study and funded, or to be considered, by the Renewable Energy Council include 1) The feasibility study of co-firing a 10% biomass stream with coal at Great River Energy's Combined Heat and Power Plant (CHP) at Spiritwood, ND; 2) Testing of a proto-type biomass compaction machine by Federal Machine Company; and 3) North Dakota State University's proposal to develop a portable biomass demonstration plant and ensuing education program.

Specific Project Objectives

1. Determine if switchgrass and other grasses can be established as bioenergy crops west of the 100th meridian.

2. Determine the biomass yield and select chemical composition of perennial herbaceous crops at several North Dakota State University (NDSU) Extension Service Research Experiment Stations. (No one has evaluated the wheatgrasses or wildrye for bioenergy crop production in the western or northern areas of North Dakota.)

3. Determine the optimum harvest dates and frequency for maximum biomass yield and maintenance of the stands. (No one has looked at how to maintain maximum biomass yield beyond five (5) years.)

4. Compare annual and biennial harvests on biomass yield and maintenance of the stands. (A biennial harvest would have environmental and wildlife benefits, save the producer one harvest cost, and provide a drought safety net.)

5. Evaluate carbon sequestration and storage of the various perennial crops. (These grasses should store major quantities of carbon even when harvested.)

6. Assess chemical properties of biomass harvested from plots to determine potential effects on Spiritwood power plant equipment. (No information is available on chemical properties of biomass grown within a 50-mile radius of the plant which is the desired range from which to obtain feedstock).

Methodology

The study will be carried out on five NDSU Research Extension Service Center sites during 2006 to 2015. Study site 1 is located three miles north of Carrington in Foster County. Site 2 is located one mile west of Hettinger in Adams County on HEL soil. Site 3 is located two miles south of Minot in Ward County on HEL soil. Site 4 is in Stutsman County, five miles

northwest of Streeter on a marginal soil, and Site 5 is on marginal soil and irrigated crop land four miles west of Williston.

Seven perennial species will be evaluated including three cultivars of switchgrass (*Panicum virgatum*), “Sunburst,” “Trailblazer” and “Dakota,” “Sunny view” a big bluestem (*Andropogon gerardii*); Four cool-seasons species including “Alar” tall wheatgrass (*Agropyron elongatus*), “Haymaker” Intermediate wheatgrass (*Agropyron intermedium*), “Mustang” altos wildrye (*Leymus augustus*), “Magnar” basin wildrye (*Leymus cinereus*); and a CRP mixture (Intermediate wheatgrass, tall wheatgrass, alfalfa [*Medicago sativa*] and sweet clover [*Melilotus officinalis*]).

Eighty 15 foot by 30 foot plots have been established at each site by research station personnel. This will allow 20 treatments replicated four times at each site in a split-block, split plot design, as outlined in Appendix 3. All plots will have 20 lbs. nitrogen/ton of biomass produced applied each spring starting in 2007. Weed control and maintenance of plots and alleyways will be carried out by personnel at each station.

Plots will be harvested with plot harvesters and the Streeter and Hettinger stations will harvest plots at all the sites. The harvested area will be 3 by 10 feet. Biomass of each plot harvested will be weighed, sampled for moisture, and the sample dried in a force-air oven at 50°C. Cool season plots will be harvested during late August to early September, warm season plots will be harvested in October. During the third, sixth, and ninth year of the study, samples will be ground to pass a 1 mm screen, mixed thoroughly, sub-sampled, and stored in sealed plastic or glass containers until chemical analyses are preformed to determine nitrogen, carbon, potassium, and ash content of each plot. Chemical analysis will be done at North Dakota State University.

Chemical analysis of biomass harvested from plots will also be analyzed for BTU, alkalinity, silica, and chlorine/chloride by a qualified testing facility using approved American Society for Testing Materials methods. All remaining biomass in the plots after harvest will be removed.

Baseline soil samples were collected before planting using a deep core probe and divided into seven depths (0-5, 5-10, 10-20, 20-30, 30-60, 60-90, and 90-120 cm) or collected using an Oakfield soil probe for the surface depths (0-5, 5-10 cm). These samples were processed for gravimetric water content and soil bulk density before air drying for soil quality parameters or sub-sampling for two major pools of glomalin (citrate-extractable and recalcitrant) and water stable aggregation (WSA). Glomalin and WSA will be evaluated for the top two surface depths, while the other soil quality parameters will be measured on all seven depths. Soil quality measurements include electrical conductivity, soil pH, total carbon and nitrogen, soil inorganic carbon, particulate organic matter, and extractable nitrate and phosphorus. Soils data from the various treatments will be compared within and across the location using PROC MIXED in SAS (SAS Institute, 1990). Multivariate analysis will be used to identify inherent and management related factors contributing to enhanced soil quality under bioenergy crops. As part of the ten-year project plan, soil samples will be collected again in years five and ten.

Anticipated Results

This project will identify the most productive perennial herbaceous crops in North Dakota; the most appropriate harvest dates, including annual or biennial, to maximize yield and maintain stands; identify perennial herbaceous crops capable of most favorably affecting soil quality (ex. carbon storage rates and glomalin production); determine if legumes will reduce the

need for nitrogen fertilizer. Data will be obtained on the chemical composition of harvested biomass relative to conversion to bio-oil and/or chemicals and to assess any potential effects to the Spiritwood power plant equipment, particularly the boilers.

Facilities

Existing facilities at North Dakota State University Research Extension Service Centers will be used to conduct the biomass plots studies. Analysis of soil samples will be conducted at USDA, Agricultural Research Station, Northern Great Plains Research Laboratory. Chemical analysis of harvested biomass plots for BTU, silica, alkalinity, and chlorine/chloride will be conducted at a qualified testing lab in North Dakota using approved American Society for Testing Materials methods.

Resources

This project will primarily rely on staff of North Dakota State University, partner institutions, and project contracts.

Techniques to be Used

See methodology above.

Environmental Impacts

Conservation advantages of energy produced from prairie grasses include low energy input, high carbon storage rates, excellent soil and water conservation benefits, good wildlife benefits, and high potential yield.

Technological and Economic Impacts – Ultimate

Adaptation of dedicated energy crops as a major crop in North Dakota, as suggested by several publications, could provide an additional 134 million dollars in net profit for North

Dakota producers and have a positive economic impact on rural communities. The potential for 20-25 perennial biomass conversion plants in North Dakota would provide approximately 800 to 1,000 high paying jobs with a payroll of around 25 million dollars. Plants would be located in small rural towns near the biomass source. North Dakota alone has 25 counties with sufficient **highly erodible** or **saline** crop land acres to support a plant using 1,000 tons of biomass a day.

In addition to ethanol, many other useful and potentially more profitable products can be produced from prairie grasses including natural resin, paper, lignin (market in Norway is $500-$2,500/ton), lignin derived surfactants, synthetic wood, bio-oil and high-value bio-oil chemical derivatives used in food flavoring, fiberboard and deicers, and many others. Great potential exists in North Dakota to diversify rural economies by building biomass conversion plants.

The year 2008 was a roller coaster ride for agricultural producers and significant uncertainty exists in 2009. Advantages of grass-based energy products for agriculture producers occurs through local ownership opportunities of smaller regional refineries; lowering energy input costs; obtaining additional income through carbon credits; reducing herbicide and fertilizer costs for growing annual crops; lowering risk associated with growing annual crops; diversifying rural agriculture; and gaining income from marginal crop land (i.e., cropped wetlands, flooded areas around wetlands, and highly erodible or saline soils).

Why Project is Needed

Based on a 1999 study of biomass feedstock availability in the United States, North Dakota ranks first in potential energy crops, such as switchgrass and other prairie grasses. Despite this potential, the suitability of North Dakota for production of bioenergy crops has yet

to be thoroughly assessed. In addition to ethanol, many other useful and potentially more profitable products can be produced from prairie grasses. Prior to building a conversion plant or bio-refinery, data is needed on appropriate grass species, harvest methods, chemical composition of harvested biomass, and practices to maintain productive perennial biomass stands.

Study results will provide information agricultural producers need to make an informed decision about production of perennial bioenergy crops. Great River Energy will gain data on the chemical composition of harvested biomass needed to understand any potential effects to the Spiritwood power plant. No information is currently available on chemical properties of biomass grown within a 50-mile radius of the plant which is the desired range from which to obtain feedstock for the plant.

Standards of Success

The project will be successful if it meets the following criteria:

- **Agricultural Producer Information and Education** – Information generated from this project should provide a significant part of the information producers need to make an informed decision about production of perennial energy crops.
- **Agricultural Producer Risk Reduction and Income Opportunities -** Growing perennial energy crops on marginal soil should generate additional income for producers while decreasing input costs and lowering risk.
- **Economic Development and Diversification** – This study should provide information on chemical properties of harvested biomass needed by entities interested in building biomass conversion plants.

- **Wildlife and Conservation Benefits** - Perennial herbaceous biomass crops should have significant environmental and wildlife advantages in comparison to traditional row crops such as corn and soybeans.
- **Energy Industry Information –** Great River Energy should have information needed on the chemical composition of harvested biomass to assess potential effects on their power plant equipment.

Background/Qualifications

North Dakota Natural Resources Trust

The North Dakota Natural Resources Trust is dedicated to the preservation, enhancement, restoration and management of wetlands and associated wildlife habitat, grasslands, and riparian areas in the state of North Dakota. The Trust's broad constituency is made up of private landowners, agricultural producers, outdoor users, conservation and environmental groups, agricultural groups, and policy makers at both the state and federal level.

Great River Energy

Great River Energy is a not-for-profit wholesale electric cooperative, serving 28 distribution cooperatives in Minnesota and covering 60 percent of the state geographically. It is the second largest power supplier in Minnesota. Great River Energy owns and operates two power plants in North Dakota: Stanton Station, located near Stanton, ND, and operational since 1966 and Coal Creek Station, located near Underwood, ND, and operational since 1979.

GRE has made important commitments to renewable energy development, including a waste-to-energy plant at its headquarters in Elk River, MN, a landfill gas project in Elk River, MN,

anaerobic digestion projects in Princeton and St. Peter, MN, four wind projects in MN totaling 118 MW with plans for an additional 100 MW and hydroelectric power.

North Dakota Farmers Union

North Dakota Farmers Union, the largest general farm organization in the state, has been interested in the issues of renewable energy for years, and policy adopted by its members in recent years supports research and development of all kinds of renewable fuels, especially if nontraditional feedstocks can be utilized. NDFU has actively supported long-term research projects through ND Natural Resources Trust specifically aimed at studying whether various cultivars of switchgrass are suited to the northern plains.

ND Farmers Union manages the carbon credit program for National Farmers Union and has over three million acres of no-till, seeded grasses, and managed rangeland enrolled for carbon offsets trading through the year 2010 and will continue to be a leader in helping producers market greenhouse gas offsets.

North Dakota Game and Fish Department

The North Dakota Game and Fish Department's mission is to protect, conserve, and enhance fish and wildlife populations and their habitats for sustained public use. The Private Land Initiative (PLI) is the Department's overall mechanism for applying this mission onto the private landscape of North Dakota. The program was established in 1981 and is very popular with agricultural producers; as of March 11, 2009, 1,041,611 acres have been enrolled. The Department will likely have opportunities to discuss with agricultural producers production of perennial bioenergy crops that can also be beneficial to wildlife and provide public use.

Management

The Trust will serve in a lead role in managing the overall project, including administration, coordination with project partners, assessment of the wildlife and conservation benefits of the project, and managing contractors to conduct chemical analyses.

Timetable

Action	06	07	08	09	10	11	12	13	14	15
Plots marked and seeded and stand established	X	X								
Carbon (C) sampled and chemical (A) analysis	C		A		C	A			A	C
Chemical (B) analysis – Spiritwood power plant				B	B					
Plots maintained, fertilized, and harvested	X	X	X	X	X	X	X	X	X	X
Annual progress report completed	X	X	X	X	X	X	X	X	X	X
Draft report to project partners for review						X				
Final report						X				

Activities and timeframe covered by REC grant in relation to ten-year project.

Budget

Grant Work	**Who Will Do Work**	**Cost**
Administration, coordination, assessment of wildlife/conservation benefits	NDNRT	$20,000
Biomass plot maintenance, harvest, and chemical data collection and analysis	NDSU	$295,000
Soil Chemical data collection and analysis	USDA, Agriculture Research Station, Mandan, ND	$40,000
Additional Chemical Analysis (BTU, silica, chlorine/chloride, alkalinity)	Testing Facility To Be Determined[1]	$65,000
		TOTAL $420,000

[1] Potential test facilities include University of North Dakota Energy and Environmental Research Center, North Dakota State University, or Minnesota Valley Test Lab, Bismarck, ND.

Agency/Organization	Grant Request	Cash Match	In-kind Match	Total
NDNRT		$50,000 (NRCS CIG)	$2,500	$52,500
NRCS CIG		$50,000		$50,000
Great River Energy		$15,000	$2,500	$17,500
ND Farmers Union		$5,000		$5,000
ND Game & Fish		$12,500		$12,500
NDSU			$2,500	$2,500
Renewable Energy Council	$280,000			$280,000
	$280,000	**$132,500**	**$7,500**	**$420,000**

Tax Liability

Please see Appendix 1.

Patents and Rights to Technical Data

Not applicable.

Appendices

Appendix 1. Tax Liability Information

Appendix 2. Letters of Commitment

Appendix 3. Biomass Plot Treatments

Appendix 4. References

Appendix 1. Tax Liability

STATE OF NORTH DAKOTA

OFFICE OF STATE TAX COMMISSIONER

Cory Fong, Commissioner

April 28, 2009 Ref: L1558838272

NORTH DAKOTA NATURAL RESOURCE TRUST
1605 E CAPITOL AVE STE 101
BISMARCK ND 58501-2102

I, Myles S. Vosberg, Director of Tax Administration for the North Dakota Office of State Tax Commissioner, certify that the records in the North Dakota Office of State Tax Commissioner do not show any indebtedness owed to the State of North Dakota by NORTH DAKOTA NATURAL RESOURCE TRUST, with respect to income taxes, sales and use taxes, or any other taxes collected by and payable to the Tax Commissioner's office. This company is, therefore, in good standing with the North Dakota Office of State Tax Commissioner. This certification does not include ad valorem property taxes collected by the respective county treasurers.

Dated this April 28, 2009 at Bismarck, North Dakota.

/s/Myles S. Vosberg
Myles S. Vosberg
Director, Tax Administration

600 E. BOULEVARD AVE., DEPT. 127, BISMARCK, NORTH DAKOTA 58505-0599
701.328.7088 FAX: 701.328.3700 HEARING/SPEECH IMPAIRED: 800.366.6888 WWW.ND.GOV/TAX TAXINFO@ND.GOV

Appendix 2. Letters of Commitment

GREAT RIVER
ENERGY®

12300 Elm Creek Boulevard • Maple Grove, Minnesota 55369-4718 • 763-445-5000 • Fax 763-445-5050 • www.GreatRiverEnergy.com

April 23, 2009

Karen Kreil
NAWCC Staff/ND NAWMP Coord/Trust Biologist
North Dakota Natural Resources Trust
1605 E. Capitol Avenue, Suite 101
Bismarck, ND 58501

RE: REC Grant Proposal "Evaluation of Perennial Herbaceous Biomass Crops in North Dakota"

Dear Ms. Kreil,

Great River Energy is pleased to confirm our commitment to fund up to $15,000 toward the above mentioned project, if successful. We are particularly interested in the chemical analysis of the crops at various cycles throughout the growing and harvesting seasons. Additionally, this information will be valuable to biofuels processors who may be interested in co-locating at Spiritwood.

Sincerely,

GREAT RIVER ENERGY

Sandra Broekema

Sandra Broekema
Manager, Business Development

c: Al Christianson

A Touchstone Energy® Cooperative

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NORTH DAKOTA Farmers Union

PO Box 2136 • 1415 12th Ave SE
Jamestown, ND 58401
800-366-8331 • 701-252-2341
ndfu.org

April 27, 2009

Karlene Fine, Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Dept. 405
Bismarck, ND 58505-0840

RE: Evaluation of Perennial Herbaceous Biomass Crops in North Dakota for Production of Ethanol and other Value-Added Products and for Use in Coal Plant Co-Firing

Dear Ms. Fine:

North Dakota Farmers Union is the state's largest general farm organization with more than 42,000 member families. NDFU works through the legislative process to develop economic and social policies, provides services to start and sustain cooperatives and related initiatives, and offers educational programs to benefit farmers, ranchers and rural communities.

We are pleased to support North Dakota Natural Resource Trust's efforts to gather information needed by agricultural producers to make informed decisions about production of perennial bioenergy crops.

North Dakota is the nation's sixth largest energy producer, per capita, and our state is will positioned to continue growing our traditional energy industries along with supporting our emerging renewable energy industries. North Dakota is also a major agricultural state. We rank first in the nation in the production of fourteen commodity categories. We also rank first in the potential to produce perennial crops for energy. The crop residues from existing commodities, coupled with our potential to grow new sources of biomass, provide signification opportunity for industry development of energy from biomass.

We are pleased to be a project partner and commit to provide $5,000 financial support to the project.

Sincerely,

NORTH DAKOTA FARMERS UNION

Robert L. Carlson

Robert L. Carlson
President

NORTH DAKOTA GAME & FISH DEPARTMENT

"Variety in Hunting and Fishing"

GOVERNOR, John Hoeven

DIRECTOR, Terry Steinwand
DEPUTY, Roger Rostvet

100 North Bismarck Expressway
Bismarck, North Dakota 58501-5095
Phone: (701) 328-6300
FAX: (701) 328-6352

April 27, 2009

Karlene Fine, Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Dept. 405
Bismarck, ND 58505-0840

RE: North Dakota Game and Fish Department Commitment Letter
"Evaluation of Perennial Herbaceous Biomass Crops in North Dakota for Production of Ethanol and other Value-Added Products and for Use in Coal Plant Co-Firing."

Dear Ms. Fine:

I am writing in support of North Dakota Natural Resources Trust's efforts to gather information needed by agricultural producers and the energy industry to make informed decisions about production and use of perennial bioenergy crops.

Production and use of perennial dedicated energy crops have significant potential to benefit wildlife, especially if they are planted on existing cropland with marginal soil. Before this potential can be realized, agricultural producers need information on the most appropriate grass mixtures, harvest methods, and practices to maintain productive perennial biomass stands.

As a project partner, the North Dakota Game and Fish Department will commit $12,500 of cash support for the project.

Sincerely,

Terry Steinwand

Terry Steinwand, Director

cc: Paul Schadewald
Keith Trego

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
PO Box 1458
Bismarck, ND 58502-1458

April 30, 2009

Karlene Fine, Executive Director
North Dakota Industrial commission
State Capitol – 14 Floor
600 East Boulevard Avenue, Dept. 405
Bismarck, ND 58505-0840

Re: Evaluation of Perennial Herbaceous Biomass Crops in North Dakota for Production of Ethanol and other Value-Added Products and for Use in Coal Plant Co-Firing

Dear Ms. Fine:

USDA Natural Resources Conservation Service (NRCS) has had the opportunity to partner with the North Dakota Natural Resources Trust on their Perennial Herbaceous Biomass Crop Project in North Dakota. The Trust has utilized the Conservation Innovation Grants (CIG) Program, funded by NRCS, to complete two phases of their 10 year study. The purpose of the study is to determine the appropriate grass species, harvest methods, and practices to maintain productive perennial biomass stands that would accomplish the dual purpose of providing sustainable renewable energy crops and be beneficial to wildlife.

The Trust has proved to be extremely responsive and accountable in managing these grants and provided our Agency with excellent technical information that will help "grow" sustainable biomass resources for North Dakota.

We are pleased to be a partner of this study from project inception and look forward toward its future accomplishments and opportunities in the future.

Sincerely,

JENNIFER C. HEGLUND
Assistant State Conservationist and CIG Program Manager

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Appendix 3: Biomass Plot Treatments

1 and 2	Sunburst Switchgrass	Annual & Biennial harvest
3 and 4	Trailblazer* or Dakota* Switchgrass	Annual & Biennial harvest
5 and 6	Alkar Tall Wheatgrass	Annual & Biennial harvest
7 and 8	Haymaker Intermediate Wheatgrass	Annual & Biennial harvest
9 and 10	CRP mix (Intermediate & Tall Wheatgrass)	Annual & Biennial harvest
11 and 12	CRP mix (Intermediate, Tall, alfalfa, & sweet clover)	Annual & Biennial harvest
13 and 14	Sunbusrt switchgrass & Tall wheatgrass	Annual & Biennial harvest
14 and 16	Sunburst switchgrass & Sunnyview big bluestem	Annual & Biennial harvest
17 and 18	Sunburst switchgrass & Mustang alti wildrye	Annual & Biennial harvest
19 and 20	Magnar basin wildrye & Mustang alti wildrye	Annual & Biennial harvest

*Trailblazer was seeded at Hettinger, Streeter, Carrington, and Williston irrigated; Dakota was seeded at Williston dry land and Minot.

All biomass plots were seeded in May 2006 by the Central Grasslands Research Extension Service Center staff.

Appendix 4. References

Amos, Wade A. 2002 Draft. Summary of Chariton Valley Switchgrass Co-Fire Testing at the Ottumwa Generating Station in Chillicothe, Iowa. NREL.

Archer, David Dr. 2009. Designing Cropping Systems for Sustainable Bioenergy Production. Northern Great Plains Integrator. USDA Northern Great Plains Research Laboratory.

Biomass Research and Development Board. 2008. National Biofuels Action Plan.

Biomass Research & Development Technical Advisory Committee. 2007. Roadmap for Bioenergy and Biobased Products in the United States. Biomass Research & Development Initiative.

Campbell, Ken. 2007. A Feasibility Study Guide for an Agricultural Biomass Pellet Company. Agricultural Utilization Research Institute.

Carolan, Joseph E., Satish V. Joshi, and Bruce E. Dale. 2007. Technical and Financial Feasibility Analysis of Distributed Bioprocessing Using Regional Biomass Pre-Processing Centers. Journal of Agricultural & Food Industrial Organization. Special Issue: Explorations in Biofuels Economics, Policy, and History. Vol. 5. Article 10.

De La Torre Ugarte, Daniel G., Marie E. Walsh, Hosein Shapouri, Stephen P. Slinsky. 2003. The Economic Impacts of Bioenergy Crop Production on U.S. Agriculture. USDA. Agricultural Economic Report Number 816.

Downing, Mark, Marie Walsh, and Sandy McLaughlin. Perennial Grasses for Energy and Conservation: Evaluating Some Ecological, Agricultural, and Economic Issues. *Environmental Enhancement Through Agriculture: Proceedings of a Conference, Boston, Massachusetts, November 15-17, 1995*, Center for Agriculture, Food and Environment, Tufts University, Medford, MA.

Earley, Jane and Alice McKeown. 2009. Smart Choices for Biofuels. A joint project of the Worldwatch Institute and the Sierra Club.

English, Burton C., Daniel G. De La Torre-Ugarte, Kim Jensen, Chad Hellwincketl, Jamey Menard, Brad Wilson, Rolad Roberts, and Marie Walsh. 2006. 25% Renewable Energy for the United States by 2025: Aricultural and Economic Impacts. The Univ. of Tennessee, Agricultural Economics.

Fargione, Joseph, Jason Hill, David Tilman, Stephen Polasky, and Peter Hawthorne. 2008. Draft: Land Clearing and the Biofuel Carbon Debt.

Foster Wheeler Environment Corporation. 1997. Biomass Cofiring Guidelines. EPRI TR-108952. Prepared for Electric Power Research Institute, Palo Alto, CA.

Great Plains Institute. 2007. Powering the Plains: Energy Transition Roadmap.

Great Plains Institute. 2007. Home Grown Energy Security: The Potential for Chemicals, Fuels and Power from Prairie Grass.

Gunderson, Carla A., Ethan B. Davis, et al. 2008. Exploring Potential U.S. Switchgrass Production for Lignocellulosic Ethanol. Prepared by Oak Ridge National Laboratory, managed by UT-BATTELLE, LLC for the U.S. Department of Energy under contract DE-AC05-00OR22725. ORNL/TM/2007/183.

Hettenhaus, J. 2006. Achieving Sustainable Production of Agricultural Biomass for Bio-Refinery Feedstock. Biotechnology Industry Organization, Industrial and Environmental Section.

Hill, Jason, Stephen Polasky, Erik Nelson, David Tilman, Hong Huo, Lindsay Ludwig, James Neumann, Haochi Zheng, and Diego Bonta. 2009. Climate Change and Health Costs of Air Emissions From Biofuels and Gasoline. PNAS. February 10, 2009. Vol. 106, no. 6. pp. 2077-2082.

Johnston, Matt, Jonathan A. Foley, Tracey Holloway, Chris Kucharik, and Chad Monfreda. 2009. Resetting Global Expectations From Agricultural Biofuels. Environ. Res. Lett. 4 (2009) 014004 (9pp). DOI: 10.1088/1748-9326/4/1/014004.

Leistritz, F. Larry, Nancy M. Hodur, Donald M. Senechal, Mark D. Stowers, Darold McCalla, and Chris M. Saffron. 2007. Biorefineries Using Agricultural Residue Feedstock in the Great Plains. Presentation at the Western Regional science Association 2007 Annual Meeting, February 21-24, Newport Beach, CA. AAE 07001.

Liebig, M.A., M.R. Schmer, K.P. Vogel, and R. Mitchell. 2008. On-Farm Research Highlights Capacity of Switchgrass to Sequester Soil Carbon *in* Soil Carbon Storage by Switchgrass Grown for Bioenergy. Bioenergy Research. 1:215-222.

Marshall, Liz, Zachary Sugg. 2008. Finding Balance: Agricultural Residues, Ethanol, and the Environment. WRI Policy Note. Energy: Biofules, no. 3. World Resources Institute.

Marshall, Liz, Zachary Sugg. 2009. Corn Stover for Ethanol Production: Potential and Pitfalls. WRI Policy Note. Energy: Biofuels, no. 4. World Resources Institute.

McLaughlin, S. B., M. E. Walsh. Evaluating Environmental Consequences of Producing Herbaceous Crops for Bioenergy. *Biomass and Bioenergy* Vol. 14, no. 4, pp. 317-324. 1998.

Morey, R.V., D.G. Tiffany, and D.L. Hatfield. 2006. Biomass for Electricity and Process Heat At Ethanol Plants. Applied Engineering in Agriculture 22(5): 723-728.

Perlack, Robert D., et al. 2005. Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply. A Joint Study Sponsored by U.S. Department of Energy and U.S. Department of Agriculture.

Renewable Fuels Association. 2008. Changing the Climate. Ethanol Industry Outlook 2008.

Renewable Fuels Association. 2008. Summary of the Cellulosic Biofuels Provisions. The Energy Independence and Security Act of 2007 – H.R. 6.

Ringelman, Jim, Scott Stephens, and Scott McLeod. 2008. Biofuels: Impacts on Prairie Pothole Wetlands. National Wetlands Newsletter, Vol. 30, no. 2. Publ. by the Environmental Law Institute.

Schmer, M. R., K. P. Vogel, R. B. Mitchell, and R. K. Perrin. 2008. Net energy of cellulosic ethanol from switchgrass. PNAS. Vol. 105. no. 2, pp. 464-469.

Searchinger, Timothy, Ralph Heimlich, R.A. Houghton, Fengxia Dong, Amani Elobeid, Jacinto Fabiosa, Simla Tokgoz, Dermot Hayes, Tun-Hsiang Yu. 2008. Use of U.S. Croplands For Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change. *Science* Express 7 February 2008. *Science* 29 February 2008: Vol. 319. no. 5867, pp. 1238-1240. DOI: 10.1126/Science. 1151861.

Smith, J. Read, William Richards, Ernest C. Shea, et al. 2007. 25x'25 Action Plan. Charting America's Energy Future.

Solow, John L., Richard A. Nev, Michael S. Balch, Jerald L. Schnoor, and Ori J. Sivan. 2005. Estimating the Economic Impact of Substituting Swithgrass for Coal for Electric Generation in Iowa. Center for Global and regional Environmental Research University of Iowa.

Tilman, David. 2008. Carbon-Negative Biofuels: Can Biofuels Help Solve our Linked Energy, Food and Environmental Needs? Initiative on Renewable Energy and the Environment.

Tiffany, Douglas G., R. Vance Morey, and Matthew De Kam. 2008. "Use of Distillers By-Products & Corn Stover as Fuels for Ethanol Plants," Farm Foundation, Proceedings For Integration of Agricultural and Energy Systems.

Tiffany, Douglas G., R. Vance Morey, and Matthew De Kam. 2007. "Economics of Biomass Gasification/Combustion at fuel Ethanol Plants," ASABE Proceedings Paper #076233.

Tiffany, Douglas G., Vance Morey, and Matt De Kam. 2007. "Economics of biomass Gasification/Combustion at Fuel Ethanol Plants," Proceedings of Fifth International Starch Technology Conference, Champaign-Urbana, Illinois.

Tiffany, Douglas G., Brendan Jordan, Erin Dietrich, Becca Vargo-Daggett. "Energy and Chemicals from Native Grasses: Production, Transportation, and Processing Technologies Considered in the North Great Plains." Dept. of Applied Economics. U of Minnesota. http://agecon.lib.umn.edu/mn/p06-11.pdf

U.S. Climate Change Technology Program. 2006. Strategic Plan. DOE/PI-0005.