Renewable Energy Program

North Dakota Industrial Commission

Application

Project Title:

Biomass Testing Laboratory for Physical and Thermal Characteristics of Feedstock of North Dakota

Applicant:

Dr. Cole Gustafson
Dept. of Agribusiness and Applied Economics
North Dakota State University

Principal Investigators:

Dr. Igathinathane Cannayen
Agricultural and Biosystems Engineering, NDSU
Dr. Cole Gustafson
Agribusiness and Applied Economics, NDSU

Date of Application:

December 31, 2009

Amount of Request:

$255,990

Total Amount of Proposed Project:

$511,980

Duration of Project:

2 years

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ABSTRACT

A substantial void exists among producers and processors of North Dakota biomass regarding its quality, suitability for densification, and energy applications. North Dakota State University (NDSU) Research Extension Centers (REC) have initiated 10-year biomass research trials at 5 locations and 50 alternative mixtures. However, facilities to test these materials are scarce. Moreover, new processors in the state (GRE and Inbicon) also have need for independent material testing in advance of market development.

This two year, $511,980 project proposes to establish a "Biomass Testing Laboratory." The lab would evaluate physical and thermal characteristics of diverse ND feedstock and densified biomass. Evaluation of the physical and thermal characteristics of raw and processed biomass forms the important phase of evaluation of baseline data. This information guides various efficient operations of biomass processing and handling as well as aiding in development of new processes. In addition to being a new resource available to researchers, the equipment would be available to producers and processors seeking biomass quality information.

The project will be lead by North Dakota State University in collaboration with USDA-ARS at Mandan.

Objective:

Establish a Biomass Testing Laboratory to evaluate physical and thermal characteristics of diverse ND feedstock and the densified biomass products.

Expected Results:

The expected results are in-state capabilities to measure dimensional, physical, and thermal properties of biomass and their products that find application in aiding efficient industrial operations, handling, and quality control. Creation of the testing lab will secure North Dakota's leadership in the biomass industry and facilitate commercialization of its abundant biomass resources.

Duration:

Two years.

(Once established, the Biomass Testing Laboratory will continue to function continuously, well beyond the project duration, serving the needs of the region and people from the support of NDSU and USDA-ARS)

Total Project Cost:

$255,990 Requested cost Total Project Cost = $511,980

Participants:

NDSU and USDA-ARS

PROJECT DESCRIPTION

Objectives:

Establish a Biomass Testing Laboratory to evaluate physical and thermal characteristics of diverse North Dakota feedstocks and densified biomass products that have commercial market potential.

Methodology:

Measurement of relevant physical, mechanical and thermal properties of North Dakota's biomass resources is the first essential stage towards market development, commercialization, and formation of purchase contracts. These biomass characteristics influence a) design and development of biomass processing machinery, b) optimized operation of processing machinery, c) mechanical strength of biomass and products, d) economics of product and energy production, and e) feasibility of alternative biomass species for densification and energy applications.

Raw biomass is low value, bulky, and expensive to transport. Yet, processors seek to diversify biomass purchases regionally to minimize production disruptions due to adverse weather and spread economic impacts of their activity farther. Consequently, a need exists to densify biomass and reduce transportation costs. However, optimal densification often requires pre-grinding.

Mechanical properties of biomass, such as compression, tension, and shear strength directly influence the size reduction process (e.g. grinding), energy expended and economics. Proper mechanical strength analysis of biomass helps in identifying the best method for efficient grinding and possible development of an efficient grinder. Biomass testing and quality analyses will also be performed on densified products, such as stored compressed bales, pellets, and briquettes. The testing of material before and after a densification provides important information on energy and mechanical efficiency. The mechanical strength of products, such as pellets, can be well correlated to their durability (integrity) during handling and transportation.

Moisture content is the single most important characteristic that influences most physical, mechanical, and thermal properties of biomass. Hence moisture needs to be monitored over a broad range to insure adequate processing capability when adverse conditions arise. Extreme limits are the complete soaked condition (about 70% w.b.) and the driest condition (about 12% w.b.). Tests will be conducted, through moisture conditioning, selecting five moisture levels that include each limiting conditions. Storage duration is another factor that affects biomass quality and deterioration. It is important to determine how alternative storage regimes (open field with/without snow cover, storage under roof, etc) impact feedstock quality from the physical, mechanical, and thermal properties perspectives, both before and after processing. Feedstock materials stored both outdoors and indoors in our facility, and material received from users, will be used to determine the effects of storage. Interaction of storage and physical properties will help users identify optimal feedstock storage strategies. The possibility of blending feedstock during

densification can potentially enhance biomass quality and economic value. If required, a binding material (e.g. lignin, molasses) will be included in the densification study.

When developing an industry, biomass testing is an integral joint process that establishes quality benchmarks which facilitate trade, develops opportunities for additional value creation through blending and densification, and leads to systemic improvement in production efficiency and cost reduction. The various tests required to perform size reduction, densification (pelleting, compaction, etc), and energy characteristics of the biomass and the products are shown in Fig. 1.

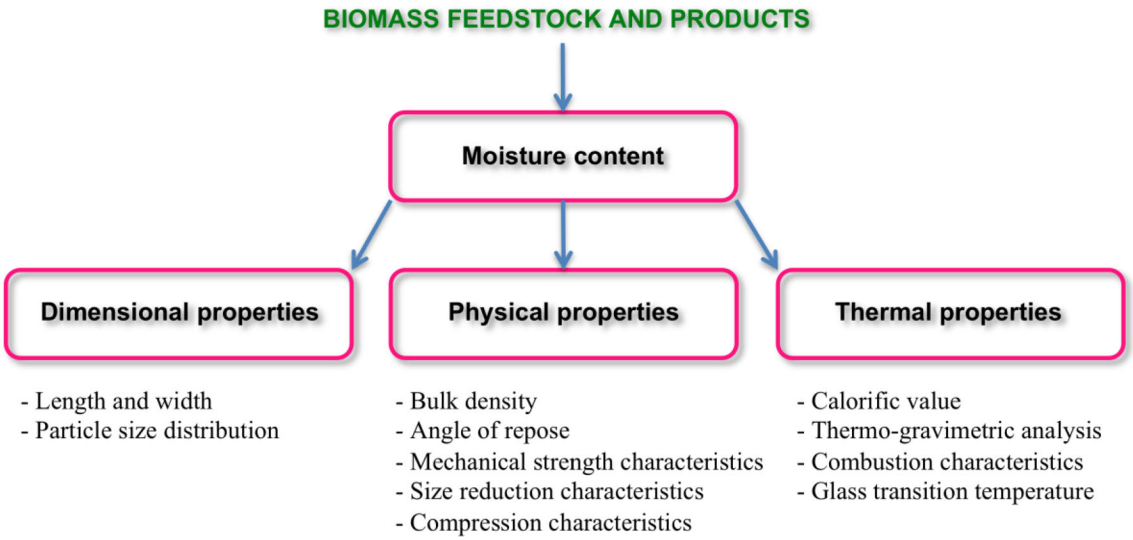

Fig. 1. Biomass testing laboratory activities on dimensional, physical, and thermal characteristics determination of selected biomass

Anticipated Results:

The anticipated results are standardized measurements of dimensional, physical, and thermal properties of biomass and densified products. Since measurements are based on standard protocols, the success is automatically guaranteed. The results will find application in aiding efficient industrial operations, handling, and quality control.

The results will give producers knowledge about the quality of their biomass product and its value. This provides a better understanding of how simple value-added steps, such as controlling moisture (drying) and pelleting would command a premium price. Similarly, the results will help the industrial processors know the quality of the material they receive from the producers and appropriately price the supplied biomass and their products. This is similar to the quality control laboratory of established industries such as grain, feed, and dairy processing. Thus, the laboratory will help ascertain the quality for both parties (farmers and industry) involved in biomass utilization in North Dakota. Hence, the laboratory forms a vital link in the ultimate goal of developing a bio-based industry and market in North Dakota.

Facilities:

Adequate facilities and resources are available to ensure a successful project. The presence of NDSU Extension across the state, a wealth of faculty research expertise, and contacts with agricultural leaders, energy firms, and environmental groups assure development and delivery of high quality educational materials targeted to the specific interests of potential attendees. To support the ongoing research activities on biomass feedstock process engineering, several laboratory items will be procured using NDSU funds that will also add to the capability of this proposed project.

Feedstock from ARS research plots, RECs, and agricultural suppliers will be used for biomass performance testing. Feedstock will be evaluated for potential renewable energy production and/or carbon credit generation. The laboratory will be able to analyze perennial grass and other feedstock for combustion properties and suitability for biomass densification. Four pieces of specialized equipment are requested – 1) Thermo-Gravimetric Analyzer (TGA) for thermal analysis, 2) Universal Testing Machine (UTM, high capacity MTI model) for mechanical strength testing, and 3) Bomb Calorimeter for quantification of feedstock energy content. This equipment will complement other equipment that the Northern Great Plains Research Laboratory (USDA/ARS) is committing to the project. A new NDSU faculty member in Agricultural and Biosystems Engineering is stationed at the USDA-ARS facility in Mandan, and is working exclusively on biomass feedstock process engineering.

The central location of this testing facility will provide ready access to all state residents and researchers. The site also offers ample acreage for biomass production studies and the new faculty member is expected to collaborate with other NDSU and ARS scientists already working there on various biomass production trials. This growing network of scientists and engineers includes: 1) agronomists working on biomass production and ecological modeling, 2) engineers working on biomass harvest, densification, and storage, and 3) end users, such as GRE testing biomass co-firing and other NDSU researchers in Fargo using materials for fermentation to ethanol. This collaboration will help integrate results across the biomass supply chain to show producers and processors which crops will be most desirable in North Dakota. While other sites in the state are capable of performing these tests, they do not have the capacity to handle the increasing volume of biomass expected. The bulky nature of the product also precludes shipment over great distance.

This project is a companion project to the mobile biomass demonstration grant which is also being proposed for funding consideration. Creation of the Biomass Testing Laboratory would complement both the research and educational efforts described.

Techniques to Be Used, Their Availability and Capability:
Following is a brief description of how these devices will be used in the proposed project:

Thermo Gravimetric Analyzer (TGA):

The TGA analyzer will produce thermal characteristics curves of biomass samples. The device records the weight and temperature of the sample continuously, when it is heated by the system. The heating can be continuously increased (ramping up) or kept at a

constant high temperature (isothermal) during the experiment. From the generated thermal curves, the combustion behavior of the sample (combustion temperature, glass-transition temperature, moisture loss regime, ash point, etc.) can be obtained.

Universal Testing Machine (UTM):

The high capacity universal testing machine (Model - MTI) is a standard device for quantifying mechanical strength characteristic of biomass materials. The UTM essentially applies force to the sample (load) with precision movement (deformation or displacement) and records the force and displacement. Computer software controls the device. The UTM, with suitable attachments, can produce load-deformation curves of biomass samples during compression, tension, and shear modes. From these load-deformation curves, the mechanical strength (e.g. cutting, crushing, shearing, friction, tensile, breaking, bending) of the biomass materials and associated energy can be obtained for analysis. These results can be used to evaluate the energy requirement for grinding and densification of biomass material.

Bomb Calorimeter:

The calorific value (heating value) of a biomass is the amount of heat released during combustion, which is specific to the material, can be measured using an oxygen bomb calorimeter. The lower heating value (LHV) or net heating value, represents the available energy from the material. Determination of LHV forms the baseline energy content of the materials. The LHV varies with moisture content, differences in crops, and processing stages. The calorimeter can measure raw biomass and other densified products; e.g. pellets.

Established procedures and analytical methods available in the form of standards (ANSI, ASABE, ISO, etc.), instruction manuals, and published research articles will be followed.

Environmental and Economic Impacts while Project is Underway:

Knowledge of the biomass material from the standpoint of producers and processors is highly important in supporting and sustaining the supply and production of bio-based industrial development. The outputs of the Biomass Testing Laboratory influence all the processing, handling, and utilization activities of biomass based industries. Quality attribute determination also guides efficient operations at every stage thereby improving the economic impact of biomass utilization. Cataloging the physical and thermal characteristics will also lead to the establishment of biomass quality standards that will be useful to both producers and processors.

Quality assessment of feedstocks and densified products is of prime importance to the biomass industry. Hence for the development of biobased industries, the quality attributes of the feedstock, various intermediate products of processing stages, and the final product need to be assessed to ensure overall success of the industrial operation. The producers need to know about the quality attributes of their produce to meet the requirements of processing industries. Producers will also recognize the value of their feedstock from the quality attributes for proper pricing of their produce, and possible premium if their

produce exceeds set quality standards. Biomass characterization procedures and results of the laboratory will be useful to the entrepreneurial and established industries equally. Therefore the proposed Biomass Testing Laboratory will have a supporting role in the development of biobased industries of the state. Thus, the activities of the project are expected to have a significant economic effect both to the producer and industrial processors.

Ultimate Technological and Economic Impacts:

Development of bio-based industries in the state, including allied industries of supply, logistics, and product streams of bioenergy and bioproducts, is a positive step towards clean, renewable, and home-grown energy and products. The activities of the Biomass Testing Laboratory that supports North Dakota biomass and their products is an integral part of establishing a biomass industry in the state. Thus, the ultimate goal of this laboratory project is to serve as an important component of biomass input and product quality evaluation in biomass processing in the state. Since the quality of the biomass raw material and their products is the yardstick for material value assessment and pricing, the activities of the proposed laboratory have a direct impact.

Technical data in a form that guides efficient and economical market development at every process step is not readily available. This proposed laboratory will address bridging this gap, and positively impact the establishment of bio-based industries in the state. Creation of this laboratory will help producers determine the quality of their products and learn how they will be compensated for their resources. Similarly, the processors can assess the quality and value of their products. The laboratory will continue to serve as a testing facility to serve the needs of farmers, researchers, industrial personnel, entrepreneurs, and general public of the state. Consolidated results will be published as factsheets, extension bulletins, journal articles, demonstrations, and presentations for everyone to use.

Once established, the Biomass Testing Laboratory will continue its mission after the project duration. NDSU and USDA-ARS will provide the necessary aid to cover the cost of maintenance and repairs and manpower involved in managing the functioning of the laboratory.

Why the Project is Needed:

Characterization of the input and output material determines whether a particular process is yielding the desired outcome. Because the cellulosic biomass based industry is in its infancy in the state, special emphasis needs to be given to characterization of locally available, home-grown biomass crops, and assess their suitability for value-added processing. Although knowledge generated from other parts of the country serves as a basic guideline, the proposed Biomass Testing Laboratory addresses specific local biomass production opportunities and the individual needs of local proprietary processing methods. Various component operations of the whole processing chain need to be properly understood, developed, and efficiently operated. Since such facilities do not exist in North Dakota, this project assumes greater importance serving to the benefit of

the local communities and the state. Needless to say, establishment and maintenance of this laboratory is the initial, yet indispensable, step in creating North Dakota's future cellulosic biomass based industry and economy.

STANDARDS OF SUCCESS

The investigators have the capability of conducting, directing, overseeing, analyzing, and reporting the results. The investigators have a proven track record of performing such activities. After the establishment of the proposed Biomass Testing Laboratory, various dimensional, physical, and thermal characteristics determination activities (Fig. 1) will be performed based on well-established standardized procedures. Since characterization of raw biomass and their products follow prescribed technical measurements and standard protocols, the opportunity for overall success of the project is increased.

The deliverables of this project are the dimensional, physical, and thermal properties of various North Dakota biomass. These characterization data, originating from a wide variety of diverse North Dakota biomass, from geographically disparate locations, and under a wide range of environmental conditions, will produce a unique industry and market database of performance characteristics. This information will guide efficient industrial development and creation of new value-added renewable resources. These standard protocols of dimensional, physical, and thermal characteristics determination activities of the laboratory also serves as an educational and training platform for students and aspiring technicians to strengthening their knowledge base in renewable biomass energy resources fields. This education and training is an essential component of human resource development leading towards creation of a future bio-based energy economy.

NDSU has formal criteria of monitoring grant projects, results reporting, and evaluating the long-term progress and achievements of new activities. Individual test results and analysis of the measured properties will be reported in proper format and units, along with interpretations and suggestions for possible applications and handling. The consolidated results will be reported to the funding REP, NDIC in the form of interim and final reports.

BACKGROUND/QUALIFICIATIONS

Dr. Igathinathane Cannayen and Dr. Cole Gustafson will serve as project principal investigators. They will oversee all aspects of the project, such as data collection, and analysis, and they will be involved in reporting, technical publications development, and presentation of the results.

Dr. Cannayen, Assistant Professor with research (60%) and extension (40%) appointment, currently focuses on engineering related issues of harvest, collection, preprocessing, storage, and transport of biomass. Dr. Cannayen has a BE degree in Agricultural Engineering, a M.Tech. degree in Post Harvest Engineering, and a doctorate

in Agricultural Process and Food Engineering. He was involved in biomass feedstock engineering and related fields, such as harvest, collection, preprocessing, storage, machine vision application, and transport of biomass for over five years at the North America universities (University of Tennessee, Mississippi State University, and University of British Columbia, Canada). He conducted research on the physical and mechanical properties of plant stalks and biomass pellets, aboveground biomass quantification, drying of biomass in the field, equilibrium moisture contents, hydration and storage behavior of corn stalk components, size reduction and separation of biomass, biomass densification, image processing for size and size distribution of particulate biomass and airborne dust, and thermal processing of biomass. Dr. Cannayen has authored or co-authored 34 peer-reviewed articles (8 under review), 40 papers/posters presented in technical meetings, 3 laboratory manuals, and 1 textbook. He is well recognized among the scientific community and served as a reviewer for more than 62 articles from high quality journals.

Dr. Gustafson has just received $80,000 from a nationally competitive SUNGRANT to investigate harvest timing of corn stover in the northern plains for biomass processing. Results of that national research study will be refined, tailored to North Dakota, and delivered to producers through extension program. He is currently co-director of NDSU BioEPIC, which provides him ready access to all NDSU bio-product researchers. In addition, he is keenly aware of the project need having received the sub-contract for Step 5 of Great River Energy's biomass assessment study. Dr. Gustafson has an international reputation in biomass research with a bi-weekly news column, development of Biomass Compare and Biomass Inventory decision tools, and more than 60 professional and lay presentations on the topic of biomass in 10 states last year.

MANAGEMENT

Dr. Igathinathane Cannayen and Dr. Cole Gustafson will serve as project principal investigators. They will oversee all aspects of the project. Dr. Cannayen will perform, train the technician, analyze, and oversee the experiments in the proposed Biomass Testing Laboratory. Once trained, the technician will perform the experiments with only supervision. Dr. Cannayen will be responsible for necessary analysis and preparation of the biomass test analysis reports.

Summarized project reports will be prepared by the investigators and periodically submitted to the REP, NDIC and other authorities for record and use throughout the project period. Investigators also strive to publish the results in appropriate peer-reviewed journals and present results in other technical meetings with acknowledgement to the funding agencies. A final report of all activities performed and the data generated will be submitted by the investigators to REP, NDIC at the end of the project.

TIMETABLE

The project will begin May 1, 2010 and end two years later on April 3, 2012. Interim and final reports summarizing laboratory activities and accomplishments will be provided at the end of each phase – Oct. 31, 2010, April 30, 2011, and April 30, 2012.

Following are the planned activities for each phase:

May-Oct. 2010 (6 months)

In the first three months the purchase and installation of the devices will be completed. The experimental plan and protocols of various experiments will also be documented during this period. Some of the physical properties tests, such as moisture content, dimensional properties, bulk density, and angle of repose will be performed. In the fourth month, initial trials of all equipment will be completed.

In the fifth and sixth months, biomass feedstock will be secured from external parties. Initial samples will be identified and their dimensional, physical, and thermal properties determined. The technician will participate with the investigator during installation, initial trials and measurements.

After the first six months, the technician will have the necessary training to perform measurements with supervision. The investigators will prepare the first-interim report.

Nov. 2010-April 2011 (6 months)

By this time the laboratory will be fully operational. Completion of the dimensional, physical, and thermal properties of all the selected major biomass (crops and residues) will be completed. Samples from other projects, and other requesting users, industries, and agencies, will be given priority. The investigators will prepare the second-interim report.

May 2011-May 2012 (12 months)

Identification of other minor biomass sources and their dimensional, physical, and thermal properties will be completed on a crop-by-crop basis. Varietal differences of major biomass and replications will also be performed in parallel. Samples from producers and processors will be measured and analyzed. Regular measurement and analysis will be recorded and reported. The investigators will prepare the third- and forth-interim reports, and the final project report.

BUDGET

Item	Project Total Expense	NDIC's Share Year 1	NDIC's Share Year 2	Other Project Sponsor's Share (Cash)	Other Project Sponsor's Share (In-kind)	Sources of Other Project Sponsor's Share
Capital Items						
TGA analyzer	$74,000	$74,000				
MTI universal testing machine	60,000	60,000				
Bomb calorimeter	26,000	26,000				
Other Sponsor's Share						
Office, staff, lab, basic equipment and facilities* (2 years)	127,200				127,200	NGPRL USDA-ARS
Specific Cooperative Agreement, between NDSU and USDA-ARS* (2 years)	128,790			128,790**		NGPRL USDA-ARS
Supplies						
Digital balance (0.0001g)	2,800	2,800				
Operating Costs						
Repairs	7,732	4,200	$3,532			
Travel	2,900	1,500	1,400			
Labor						
Technician (1st year)	22,800	22,800				
Fringe benefits (@35%)	7,980	7,980				
Research Assistant (2nd year)	16,800		16,800			
Fringe benefits (@35%)	5,880		5,880			
Indirect Costs (@43.5%)	29,098	17,087	12,011			
Total	**$511,980**	**$216,367**	**$39,623**	**$128,790**	**$127,200**	

* Details in the enclosed Letter of Support by the NGPRL-ARS Lab Director.
** Major categories were – *First year*: Total salaries and fringe benefits for one graduate student and one part time helper = $41,540; Operating expenses includes supplies = $7,000 and travel = $3,250.
Second year: Total salaries and fringe benefits for two graduate students = $48,960; Operating expenses includes supplies = $17,500, travel = $4,500, and maintenance = $6,000.

Justification (Other Project Sponsor's Share – Cash and In-Kind)

The cash match (total of $128,790) from the Specific Cooperative Agreement (SPA) between NDSU and USDA-ARS was included as material and manpower (Research Assistant - graduate student) will be directly shared with the proposed project. This sharing is possible because Dr. Cannayen (NDSU faculty at USDA-ARS) is involved in both the projects in the capacity of principal investigator. The in-kind match ($127,200) is the ongoing support directly available to all the employees of USDA-ARS, hence

extended to the investigator of this proposed project as well. If funded, those monies will be used dedicated to this project.

Justification (Technician and Research Assistant)

The technician will be responsible for performing the tests under the supervision of the PIs and help in analyzing the results and report preparation. The technician will be based at USDA-ARS, Mandan and will report to the investigator. After the first year, a research associate will be recruited to conduct the experiments for the second year. Later the investigator with the help of graduate research assistants will continue to conduct the laboratory activities.

If reduced funding is made available, one of the lower priority equipment will be dropped from the list and the activity related to that equipment would be delayed. Efforts will be made to secure funds from other possible sources to cover the cost of that equipment. Even though this will obviously delay the expected outcome of the project, it will not totally upset the other planned activities of the proposed laboratory.

CONFIDENTIAL INFORMATION

As a non-profit state institution of higher learning, NDSU has no outstanding tax liability.

PATENTS/RIGHTS TO TECHNICAL DATA

NDSU reserves the right to all intellectual property developed as part of this project.

RESPONSE TO EARLIER COUNCIL QUESTIONS

What will happen to the equipment at the end? Who will own it?
The equipment will remain property of the Biomass Testing Laboratory at USDA-ARS, Mandan, ND. The Department of Agricultural and Biosystems Engineering, NDSU, Fargo, ND will actually own the equipment. This project equipment, along with others of the laboratory, will continue to serve the objectives of the project.

What biomass types will you work with?
The biomass crop and crop residues of ND (e.g. corn stover, wheat straw, hay, corn cobs, switchgrass, etc.) will be tested. Initially, the major biomass types of ND will be tested, and then the study will be extended to the rest of the potential biomass sources of ND.

How will you dispense information from the project?
Information from this project will be the characterization results of biomass and their products (dimensional, physical, and thermal properties). These results will be dispensed

directly to the requesting party in the usable form. Specific analysis requests will also be addressed and they will be directly communicated to the user with our recommendations. Overall result summaries will be created including a database of biomass properties, made available online though website, factsheets, extension publications, presentations, as well as in appropriate peer-reviewed journals.

Will farmers get charged for tests?
During the project period all the requests (farmers, industries and others) will be handled free of charge. After the project period, the farmers will be served free of charge as well; however, the number of requests that can be handled will be one per two weeks. The biomass properties database development covering all the sources of ND biomass will continue as a routine research, irrespective of the requests received, in the laboratory.
If we ever decide to charge the other users (industries), it will be nominal and be based on NDSU policy.

APPENDICES

United States Department of Agriculture

Research, Education and Economics
Agricultural Research Service

December 17, 2009

SUBJECT: Support for "Biomass Testing Laboratory" Proposal

TO: Dr. Cole Gustafson and Dr. Igathinathane Cannayen

FROM: Dr. Jon D. Hanson, Laboratory Director, NGPRL

The USDA-ARS Northern Great Plains Research Laboratory (NGPRL) has been working on the development of new cropping systems that incorporate perennial crops in otherwise annual cropping systems. We have formed the Agroecosystems Research Group to provide a vehicle by which we have entered into a collaborative research relationship with the North Dakota State University BioEnergy and Products Innovation Center (EPIC). This relationship is necessary to 1) develop sustainable agricultural systems that support biomass crops, 2) handle bulky biomass products post-harvest, and 3) develop process to convert biomass to energy. With these objectives in place we eagerly support the efforts of EPIC to acquire funding toward the development of a "Biomass Testing Laboratory" as part of USDA-ARS, Mandan.

Sustainability of agricultural production systems is of primary importance to the regional economy. Expanding interest and growth in biobased energy, bioproducts, and other emerging technologies will create multiple economic and environmental tradeoffs for the North Dakota family farmers, ranchers, and industries. The distinctiveness of these risks and benefits are not well understood. To excel in creating new sustainable production systems involving family farmers in U.S. and global energy and industrial raw material production, successful collaboration and communication between federal and state research organization becomes essential. The collaboration of scientific organizations will provide opportunities for broader impact and greater significance for North Dakota family farmers. The establishment of the "Biomass Testing Laboratory" in establishing the quality of feedstocks and products is a positive step towards biobased economy and activities in the state.

To that end, NGPRL will provide office space, laboratory space, staff services, and equipment for the support of the NDSU Bioprocess Engineer faculty. Specifically USDA-ARS will provide in-kind:

Northern Plains Area • Northern Great Plains Research Laboratory
P.O. Box 459 • Highway 6 South • Mandan, ND 58554-0459
Voice: 701-663-6445 • FAX: 701-667-3054
www.mandan.ars.usda.gov
An Equal Opportunity Employer

In-Kind Support	
Item	Approximate Value
Office	$4,200/yr
Laboratory	$30,000/yr
Basic Laboratory Equipment	$10,000/yr
Use of Feedstock Processing Equipment	$15,000/yr
Telephone/Internet Access	$2,400/yr
Staff Services	$2,000/yr
Sub-total	$63,600/yr
2 year Total In-Kind Contribution	$127,200

In another collaborative effort, North Dakota State University entered into a Specific Cooperative Agreement (SPA) with USDA-ARS for the development and analysis of systems for efficient production and processing of biomass to be used as a feedstock for liquid transportation fuels, biobased electricity, or other biobased energy and products. This cooperation will include work in biomass production, harvest, densification, storage, and processing or conversion. Attention will be given to both economic and ecological sustainability of biomass production.

USDA-ARS will jointly fund the research effort. Funds for the first year (2009-2010) has been finalized and the approval process. USDA-ARS is expected continue its support of this research. The approved and anticipated (subject of approval) support for the two years (2009-2011) are as follows:

Cash Support		
Year	Funding Amount	Remarks
1st year (2009-2010)	$51,790	In process for final approval
2nd year (2010-2011)	$77,000	Anticipated and subject to approval
2 year Total Cash Contribution	$128,790	

Through this collaborative effort, we will enhance the capacity of our two organizations to develop environmentally sound practices and add value to agricultural systems in the Great Plains in terms of food, feed, and biomass by conducting team-focused, systems-oriented research and technology transfer.

United States Department of Agriculture
Research, Education and Economics
Agricultural Research Service

December 30, 2009

Dr. Cole R. Gustafson
Co-Director, BioEnergy and Products Innovation Center Professor
Agribusiness and Applied Economics NDSU Dept 7610
628 Barry Hall
811 2nd Ave. N.
North Dakota State University
Fargo, ND 58108-6050

Dr. Igathinathane Cannayen, Ph.D.
Northern Great Plains Research Lab.
USDA-ARS, Room 208
1701 10th Avenue SW
P.O. Box 459
Mandan, ND 58554-0459

Dr. Gustafson and Dr. Cannayen:

The USDA-ARS is fully supportive of the effort by the Northern Great Plains Research Laboratory (NGPRL), Mandan and North Dakota State University in the joint development of the Agroecosystems Research Group (ARG) as a component of the NDSU BioEnergy and Products Innovation Center (EPIC). As part of this effort, research will be conducted to 1) develop sustainable agricultural systems that support biomass crops, 2) handle bulky biomass products post-harvest, and 3) develop processes to convert biomass to energy. With these objectives in place we eagerly support the efforts of ARG and EPIC to acquire funding toward the development of a "Biomass Testing Laboratory" as part of USDA-ARS-NGPRL.

To that end, NGPRL will provide office space, laboratory space, staff services, and equipment for the support of the NDSU Bioprocess Engineer faculty valued at approximately $63,600 per year. We do not ask for funds from NDSU to cover these expenses. Additionally, NGPRL is providing $51,790 for the fiscal year 2010 (October 1, 2009 – September 30, 2010) and it is anticipating providing $77,000 for fiscal year 2011 through a specific cooperative agreement.

Through this collaborative effort, we will leverage the capacity of our two organizations to develop environmentally sound practices and add value to agricultural systems in the Great Plains in terms of food, feed, and biomass by conducting team-focused, systems-oriented research and technology transfer.

Northern Plains Area ◦ Office of the Area Director
Natural Resources Research Center ◦ 2150 Centre Ave ◦ Bldg D ◦ Suite 300 ◦ Fort Collins, CO 80526-8119
Telephone: 970-492-7057 ◦ Fax: 970-492-7065 ◦ Email: Will.Blackburn@ars.usda.gov

Therefore, USDA-ARS approves Dr. Cole Gustafson and Dr. Igathinathane Cannayen for the use of $128,790 in cooperative agreement funds and $63,600 in kind support as matching funds regarding their proposed grant request.

Sincerely,

Dr. Will Blackburn
Area Director
USDA-ARS-Northern Plains Area

cc:
Michael McGuire
James Quaratino
Marcie Currie-Gross