Renewable Energy Program

Application

Project Title:

Energy Beet Research

Applicant:

Maynard Helgaas
Green Vision Group

Principal Investigator:

Maynard Helgaas

Date of Application:

December 31, 2009

Amount of Request:

$ 165,000

Total Amount of Proposed Project:

$330,000

Duration of Project:

2 years

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ABSTRACT

Objective: This project has four specific objectives that are designed to advance the creation of an energy beet biofuel industry in five regional locations across North Dakota:

1) Conduct a commercial scale burn test of the combustion properties and lifecycle impacts of spray dried waste broth produced as co-products of energy beet biofuel production.

2) Conduct dryland and irrigated energy yield trials at five regional locations across North Dakota.

3) Develop processing methods to improve storage life of sugarbeet juice.

4) Conduct producer and community education programs in up to five targeted regions, initially focused in Griggs and Steele counties.

Expected Results: This study will answer core questions presently constraining development of an energy beet biofuel industry in North Dakota. Commercial scale testing of the patented spray drying stillage process will confirm earlier lab scale tests showing that 75 percent of plant thermal needs can be provided. Regional yield trials will show energy beets are agronomically suited to a wide range of North Dakota soils and climatic conditions. Storage research will identify methods which extend the life of beet juice which will enable extended processing season and distributed production regions. The education program will inform producers, community leaders, investors, along with sugar beet and renewable energy industries of the economic development opportunity. Each biofuel plant will require up to 754,717 tons of energy beets annually from 23,585 acres of irrigated farm land. Farm income increases $12.72 million based on historical returns. Assuming an average plant net profit of $0.39/gal., a 20 MGY plant would generate an additional $7.34 million and 36 jobs. The secondary economic impact from plant expenditures totals $34.66 million.

Duration: 2 years

Total Project Cost: $330,000

Participants; (Pending): North Dakota State University, Green Vision Group, Heartland Renewable Energy, AgCountry, Amity Technology, Beta Seeds, Carrington Econ. Dev., Garrison Diversion, Griggs/Steele Wind, ND Water Foundation, RRV Sugar Beet Growers, Ottertail Power, Stanley Consultants, and Syngenta.

PROJECT DESCRIPTION

Objectives: North Dakota State University (NDSU), Green Vision Group (GVG) and Heartland Renewable Energy (HRE) are partnering to develop an energy beet biofuel industry in five regional locations with 20 million gallon per year (MGY) production facilities across North Dakota. At this stage, four specific tasks need to be completed before capitalization and commercialization can occur:

1) Conduct a commercial scale burn test of the combustion properties, determine boiler equipment materials and lifecycle impacts of spray dried stillage produced as co-products of energy beet biofuel production. The burn test will also provide critical information regarding the choice of combustion equipment for the processing plants.

2) Conduct dryland and irrigated energy beet yield trials at five regional locations across North Dakota.
3) Develop processing methods to improve storage life of energy beet juice.
4) Conduct producer, community and investor education programs in five targeted regions, initially focused on Griggs and Steele Counties.

Methodology: The research approaches to accomplish each of the project's four objectives are described in the following subsections:

Burn test Heartland Renewable Energy is one of the project partners and has patented a novel process for spray drying stillage that is produced after fermentation of the energy beets for biofuel production. This process has been tested at lab scale, but not commercially. GVG will retain Stanley Consultants to investigate various biomass boiler options capable of burning the dry fuel (e.g. spray dried yeast broth); conceptualize plant auxiliaries; perform screening to determine environmental feasibility of each option; and develop conceptual cost estimates. A high level 10-year life-cycle cost analysis will be prepared for comparing the different biomass boiler options. A burn test will be completed on the option deemed most viable.

The study will utilize 1,800 gallons of residual fuel (e.g. waste broth) produced at HRE's pilot plant in Muscatine, Iowa from beet molasses. The energy/carbon content and composition of this material has been analyzed using proximate analysis, sulphur forms, ultimate analysis, mineral analysis of ash, water soluble alkalies, and fusion temperature of ash for both powder and benchmark cola samples for comparison.

HRE will arrange to ship the stillage to EERC, Grand Forks, ND in preparation for drying. All inputs and energy consumed in the drying process will be tallied. After preliminary research outlined above is completed, but prior to the burn test, the advisory council (described later) will review progress and identify the most viable biomass boiler option. A burn test will then be completed for flame stability, fly ash particulate characterization, ash deposit characterization, and fouling tendency.

During the tests, oxygen (O_2), carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) will be measured and recorded at the furnace exit and after any emission control equipment specified for the test. Other emissions (such as mercury and acid gases) can also be measured at additional cost, but are not expected to be needed. Results from the burn test will be provided for publication in the final report. The final study will follow and will incorporate mutually agreed upon changes from the review. Stanley Consultants will perform the services described above for $85,000, which includes the following breakdown of fees; $12,000 material testing (SDK lab), $3,000 administration & misc., an estimate of 233 hrs. at $150/hr average for review, analysis and generating report, and $35,000 for the burn test (performed by the EERC facility at Grand Forks, ND) .

Yield Trials Energy beet yield trials have been conducted at Oakes for 4 years and Carrington 1 year. GVG will subcontract with NDSU to continue these trials in 2010 with additional trials located in Griggs/Steele county, Turtle Lake and Williston. Griggs/Steele and Turtle Lake will be conducted jointly with farm cooperators. Sixteen varieties, four replications with 30 foot length rows and six row plots will occur on level ground with 5-6 replications on sloped locations. Carrington and Williston Research Extension Centers will oversee all trials, perform machinery operations, and provide research and technical support. Both dryland and irrigated trials will be conducted. Seed company sponsors will provide seed, plant the crop, harvest the crop, ship samples to their testing location, and test samples for sugar content and quality. Research results will be published in periodicals and the station's annual research summary; presented to producers during annual field days, dedicated plot tours, and winter crop improvement meetings; and posted on the station's website.

Juice Storage GVG will subcontract with NDSU for this study. Methods to improve beet juice storage life will be evaluated at the NDSU Pilot Plant under the direction of Dr. Dennis Wiesenborn and a M.S. graduate student. Preservation methods that will be tested include acidulation, thermal pasteurization, and partial concentration by multiple-effect evaporation. All three methods will be evaluated at the NDSU Pilot Plant using available equipment, which includes plate heat exchangers, centrifugal pumps, climbing-film evaporator and datalogger system.

Acidulation is the simplest method, and simply requires lowering pH through acid addition to a level that inhibits microbial growth. The acid is easily neutralized when the juice is needed for fermentation and will not generally interfere with fermentation. Pasteurization can be accomplished in compact plate heat exchangers with very high energy efficiency via regenerative heating and cooling. One drawback is that the pasteurized juice must be maintained under aseptic conditions throughout the storage period. Concentration can be achieved with high efficiency via a multiple-effect evaporation system, resulting in high storage life, as well as reduced storage and transportation costs.

The primary drawback of evaporation is increased equipment cost.
All three preservation methods will be tested at multiple degrees of treatment to be determined. The primary indicators of storage stability are pH and temperature, both of which will be logged hourly via an automated system. Sucrose content will be checked weekly by Refractometer as a further stability check.

Educational Program_ To date, internal resources of NDSU, GVG, and HRE have been utilized to inform farmers, sugar beet and renewable energy industries, local economic developers, potential investors, finance companies, and related industries of the project opportunity. In total, more than 100 personal visits and presentations were delivered in 2008 and 2009. The need for focused local education initially be targeted for Griggs and Steele Counties.

GVG will utilize $ $49,100 of funds and $24,929 of unallocated funds to deliver 25 similar educational programs in 2010-2015, secure investment funding to construct commercial scale plant, begin negotiation of long term price contracts, investigate potential of sweet sorghum, obtain additional grant funding for demonstration plant (if needed), and organize advisory council. In addition to delivering results of NDSU research studies outlined above, GVG will create original educational content and instructional aides to assist learning and understanding. The new education programs differ from the past and will place more emphasis on direct personal contact and individual learning. A key aspect of this activity will be analysis of individual economic benefits and risk, capitalization of the plant and risk reduction stemming from long-term price contracts. GVG will create programmatic learning objectives and document the impact of their educational activities including number of people attending and behavioral changes undertaken.

Anticipated Results: Results of this study will answer four of the core questions presently constraining creation of an energy beet biofuel industry in North Dakota: Results of the burn test are expected to confirm prior lab scale results and further document the thermal and lifecycle value of co-products arising from energy beet biofuel production. Project investors have great interest in utilizing energy beet waste streams for plant heat, but are uncertain of potential value under differing national carbon and energy policies. Utilizing plant waste streams is expected to not only be more economical, but also reduce energy market price and supply risk exposure. Selection of a specific commercial boiler system will guide developers in construction of commercial production facilities. In addition, opportunities to utilize other feedstocks, such as sweet sorghum, can then be evaluated once technical details of the plant are determined.

Results of the energy beet yield trials will demonstrate to potential growers that they are agronomically suited to a wide range of North Dakota soils and climatic conditions. Growers will become familiar with the cultural practices, machine operation and labor requirements to produce the crop.

Local investors will utilize energy beet production and quality data to design optimal feedstock supply networks, storage facilities, and plant locations. Energy beets are strong candidates for biofuel feedstock relative to other crops as a result of more efficient water use, higher yield potential, and lower land use per gallon of biofuel. However, their performance outside the Red and Yellowstone River Valleys are unknown. In African trials, irrigated energy beets did not require water application during the last two months of growth, significantly reducing energy demand and lifecycle impacts. Additionally, the environmental sustainability of energy beet production relative to other biofuel crops (e.g. corn, sugar cane) is expected to be more favorable due to lower fertility requirements, especially nitrogen. Yield trials are expected to assist crop breeders with further engineering of energy beet varieties for specific end uses, such as biofuel production. Doney and Theurer note that breeding for ethanol fuel might be quite different than breeding for sucrose crystallization. High sucrose concentration and low impurities, essential for sucrose crystallization, is unimportant in the fermentation process. Increased total sugar production might be easier and faster if selection criteria focus on fermentable sugars rather than sucrose crystallization.

Results of the juice study are expected to identify new, improved processes that extend the storage life of energy beet juice. Being able to store beet juice will extend the processing season which spreads plant fixed investment over more production, increases plant efficiency, lowers overall production costs, and increases the comparative advantage of energy beet biofuel relative to other renewable energies. Extended storage will also enable evaluation of distributed supply systems. Rather than source energy beets from a surrounding area to supply a single plant, distributed supply systems extend and diversify feedstock supply regions. Local farmers supply energy beets to regional preprocessing plants where they are juiced. The beet juice is then stored and shipped to a central biofuel facility. A key advantage is that transportation costs are reduced because only liquid is shipped, not the entire plant, dirt or other foreign matter. The diversification aspect is also keenly important because a region targeted for development may have needed infrastructure (rail lines, natural gas, etc.) located in a trade center, but preferable soils maybe located at a distance.

GVG will continue to inform potential energy beet growers, community leaders, sugar beet and renewable energy industries, and investors of the project's merits. It is expected that GVG's success will parallel the creation of the irrigated potato and processing industry surrounding Jamestown, ND. GVG efforts will lead to three key accomplishments. First, a cohesive group of progressive growers will be identified in each production region, informed of current energy beet production methods, and committed to delivering initial production to their local plant. Second, GVG will partner with key local community leaders to identify regional plant locations and overcome infrastructure hurdles so that adequate resources (etc., water, transportation, energy, labor supply, etc.) exist for plant operation. GVG will oversee local economic development activity, develop a comprehensive capital plan leading to plant construction, and secure both public and private investment monies to accomplish funding.

Negotiations on long-term price contracts for both input supplies and product sales will begin. Finally, the suitability of raising sweet sorghum as an energy crop to provide additional processing capability during summer months will be evaluated.

Overall results of the project will be published in a report for each project objective. However, the most important means of disseminating project results will be by GVG in public presentation or individual work sessions to key farmers, community leaders and investors.

Facilities: Sufficient facilities are available to ensure a successful project at Stanley Consultants, NDSU main station, Carrington and Williston Research Extension Center, North Dakota EERC and collaborating sponsors.

Resources: GVG in partnership with HRE have sufficient resources to conduct their share of the study. GVG's experiences and leadership in rural Minnesota and North Dakota as Extension Agents in agricultural finance, agricultural and energy project development and consultants, coupled with HRE's background in agricultural processing provide excellent qualifications for a successful project. The chemistry of GVG, HRE and NDSU for this project could not be better. In addition, extensive discussions have occurred with other project partners and they are committed to providing pledged resources.

Techniques to Be Used, Their Availability and Capability: The burn test, yield trials, and juice storage studies will all use standardized research protocols and techniques prescribed by their profession. Those procedures are detailed above in the methodology description. With respect to the burn test, several alternative vendors exist. Stanley Consulting was chosen based on their experience and proximity. NDSU's Carrington Research Extension Center and Agricultural and Biosystems Engineering Departments have considerable prior experience conducting similar yield and storage studies, respectively. Competition among seed companies, preliminary interest expressed by several farm cooperators and graduate students provide contingency options and ensure adequate resource supplies. GVG educational methods rely on individual and small group programs. While novel, the accomplishments they have achieved to date, as evidenced by their sponsorship funding and programmatic successes, document the availability and capabilities of their group. Their successes developing a similar irrigated potato processing industry near Jamestown further validates their efforts. This is GVG's top initiative and they are making themselves fully available to the project.

Environmental and Economic Impacts while Project is Underway: No negative environmental impacts are expected as a result of project activity. Prescribed agronomic fertility and chemical handling and application protocols will be followed in energy beet yield trials. Likewise, institution approved protocols will be followed in all laboratory activities for the burn test and juice storage studies. Positive environmental impacts are expected long term from introduction of a new deep rooted crop in rotation with traditional small grain and oilseed crops. Energy beets break disease cycles and increase fertilizer efficiency. Production of a low carbon biofuel reduces greenhouse gas emissions.

Economic impacts are expected to be modest when the project is underway. Local communities will benefit from project monies spend for yield trials and educational programs.

Ultimate Technological and Economic Impacts: North Dakota would realize several key comparative advantages with respect to energy beet biofuel production. First, total costs of producing biofuel are lower from energy beets than sugar cane (USDA 2006, BBI, 2008). For both crops, molasses by-products were found to be lowest cost feedstock. Second, the Upper Midwest has the lowest worldwide cost of producing beets due to cool summer evening temperatures. Third, unlike corn and other grass crops, beets produce higher sugar in soils with minimal nitrogen, a key contributor to greenhouse gases (GHG). Fourth, the North Dakota's long winters will lower costs of beet storage which extends the processing season. Thus, fixed costs of biofuel infrastructure can be spread over more production which lowers final production costs on a per gallon basis. Fifth, North Dakota has great potential to expand irrigation. Production of beets on newly developed irrigated lands would lessen land competition with existing crop production. Sixth, given nearly twice the production of biofuel per acre when compared with corn, energy beets would require less farm and land infrastructure development to meet EISA. Finally, ND has a large military presence which seeks a reliable supply of advanced biofuels. The military supply chain differs from commercial channels creating a unique market opportunity.

With respect to technology, local farmers would harvest 35-40 tons of energy beets per irrigated acre, with an average sucrose content of 18 percent, by weight. Using HRE's proprietary conversion process, ethanol yield potential is 927-1,060 gallons of anhydrous ethanol per acre, assuming an average yield of ethanol 26.5 gallons per ton. Expected break-even ethanol cost of production is $1.57 and each plant would create 36 new jobs (excluding secondary economic impacts).

According to Maung and Gustafson (2009), a 20 MGY plant would require 754,717 tons of energy beets annually from 23,585 acres of irrigated farm land. Historical returns of $539 per acre result in additional farm income of $12.72 million. Assuming an average plant net profit of $0.39/gal., a 20 MGY plant would generate $7.34 million net profit. The secondary economic impact from plant expenditures would total $34.66 million.

Energy beet biofuel co-products do not compete directly with corn ethanol co-products. One of the primary co-products is spray-dried yeast (4.5 percent of molasses processed). In addition to meeting plant thermal needs, the product can be included in poultry and swine diets up to 10 percent. Feed costs for these animal species have risen on a relative basis because of difficulty digesting distillers dried grains. Second, a 20 mgy energy beet plant will produce 28,000 tons of potash from the energy generation unit as another co-product. Potash resources are very limited worldwide and the industry is highly concentrated with Potash Corp. controlling 22 percent of world supply (Swenson, 2008). A final co-product is beet pulp; 1.8 pounds of pulp are produced from each biofuel gallon. Unlike other areas of the country, livestock feeders in the region are familiar with the merits of feeding beet pulp.

Why the Project is Needed: NDSU, GVG, and HRE have conducted considerable background work leading to creation of an energy beet biofuel industry in North Dakota and preliminary research described elsewhere quantifies the economic potential. In particular, HRE has invested more than $1 million to develop the modular design of the processing plant, test their patented technology, and build a small fermentation pilot plant to produce stillage for a commercial burn test. At this stage, several hurdles exist. First, potential investors and financial institutions are reluctant to offer investment capital in volatile times, especially for a project that relies on patented technology that has not been commercially tested (e.g. burn test). Second, farmers in targeted production areas do not have experience with energy beet production. Third, the storage life of pre-processed beet juice is unknown which impacts plant design, transportation and logistics, local infrastructure needs, and community planning.

NDSU has submitted two prior grant proposals to Sungrant and the Department of Energy for funding. Both were not accepted because preferences were given to other biomass feedstocks (cellulosic and algae) and fundamental scientific research. Sugar to biofuel production is viewed as a mature process given existing industrial activity in other countries (Europe, Brazil and India). Therefore, while the overall technology is proven, North Dakotan's are not familiar with it, creating need for an educational program.

Funding obtained from this proposal would enable the project to overcome present hurdles and alleviate immediate investor, farmer, and community leader concerns. The monies would also serve as matching funds enabling preparation of grant proposals leading to project implementation. In particular, USDA Rural Development funding will be pursued.

STANDARDS OF SUCCESS

This project has four deliverables – 1) A report summarizing the performance of the patented spray dried yeast broth in a commercial boiler, 2) A research report describing the yield performance of energy beet varieties at five regional North Dakota locations, both under irrigation and dryland, 3) A research report evaluating storage properties of energy beet juice and strategies to extend processing life as a biofuel, and 4) a report of educational meetings held with farmers, community leaders, sugar beet and biofuel industries, potential investors, and financial institutions to inform them of the merits and risks following creation of an energy beet biofuel industry.

The first three deliverables are essentially university-based studies. Academic protocols in place within each of their institutions will ensure project completion and success. The effectiveness and success of GVG's educational program will be evaluated using existing Extension methods of program assessment including measurement of participant awareness, learning, and behavioral change.
The advisory council and NDSU, especially Dr. Cole Gustafson, will independently develop evaluation tools and compile performance indicators. Information from study results will inform state citizens of the energy beet biofuel opportunity and alleviate present concerns that are constraining advancement.

Results of the project will lead to formation of a capital plan, organization of local project developers, and energy beet feedstock supply capability as outlined above. Economic and environmental impacts were also summarized above.

Creation of an energy beet industry would compliment and diversify North Dakota's agricultural, renewable energy, and rural community sectors. A new industrial agricultural product (energy beets) would provide another tool for risk management outside the traditional food commodity markets. While the state's agricultural and energy sectors are presently strong, production of a new biofuel would diversify production, lessen risks from localized crop failures (e.g. corn), and enable the state to provide a broader array of energy products. Moreover, advanced biofuel produced from energy beets is expected to be a niche market and command a market premium further reducing industry risk. Being the first state to produce energy beet biofuel would solidify its leadership stature as an advanced renewable energy provider. In addition to complimenting and diversifying North Dakota's existing renewable energy supplies which are dominated by corn ethanol and wind, the project will strengthen 5 local communities which in turn will increase their capacity to develop new additional renewable energy resources. Each plant will create 36 new employment positions on-site and numerous additional opportunities in support industries.

BACKGROUND/QUALIFICIATIONS

Principal investigator: Maynard Helgaas. He serves as president of GVG, and will be conducting the administration of the project. He will coordinate the activities of lead investigators for the four objectives described in the application. He will lead project review activities including intermittent reports on progress and results of the projects. He has a background in business, finance and organizational development. He was chairman of the Central Dakota Growers who successfully organized the development of a French fry potato processing plant (Cavendish Farms) for Central North Dakota. He also was President and founder of the North American Farm Equipment Dealers Education Foundation. He was president and manager of five John Deere family owned dealerships for 30 years.

Lead investigator for commercial burn test: Rick Whittaker, CEO, HRE will superintend the commercial burn test to be managed by Stanley Consultants and performed by EERC at Grand Forks. Rick has had 39 years of experience managing projects, plant design manager, steel fabrication and erection of a $200 million dollar wet milling plant in Indiana. He managed HRE's construction of a sugar feedstock ethanol plant in Muscatine, IA, and operated it as a beet molasses pilot plant that produced the fermentation waste material which will be used to do the commercial burn test.

Lead investigator for yield trials: Blaine Schatz, NDSU Researcher and Director of the Carrington Research Extension Center will conduct the trial plots and his assistant, Paul Hendrickson will manage the plots.

He managed the plots for the project in 2008 and worked with Syngenta Seeds in performing the energy beet yield and test analysis. This year he will manage two additional yield and demonstration plots in cooperation with Beta seeds. Beta Seeds will do the plot energy beet yield and test analysis at two farmer cooperator locations.

Lead investigator for juice storage research: Lloyd Anderson, GVG partner will manage and oversee the research activities conducted by Dennis Wiesenborn, NDSU researcher. Lloyd has his M.S. degree in Industrial Engineering and Management, NDSU and is the owner of Anderson Consulting. He also serves on the board of M-Power, a wind power company which recently completed a large wind farm project in the Luverne, ND community. Lloyd has been in the consulting business for 32years and is very knowledgeable with project organization and reporting requirements.
Lead investigator for the education program: Rudy Radke and Rod Holth, GVG partners will provide the leadership in developing the information and education needs of the project. Rod has a background in agriculture financing, farming, and consulting. He was CFO for a large potato farm in the Red River Valley and a partner in a large potato operation for 12 of years producing potatoes for two large French fry plants in North Dakota. Rudy Radke , NDSU Extension Service, has been with the Extension service for 39 years, working with farmers and organizations in development of high value irrigated crops, developing market organizations and consulting with farmers. He was a key leader and coordinator in bringing the $70 million French fry plant to Central North Dakota. He will assist Rod in planning and developing educational material and serve as a resource for the program

Green Vision Group (GVG), Heartland Renewable Energy (HRE), and North Dakota State University (NDSU) have partnered to develop an energy beet advanced biofuel industry in North Dakota to expand economic opportunities for both agricultural producers an struggling rural communities. HRE has patented a novel process for spray drying waste fermentation broths and utilizing the energy powder for 75 percent of plant thermal needs which lessens oval greenhouse gas (GHG) emissions. Unless energy beet biofuel exceeds EPA's 50 percent GHG reduction for advanced biofuels, lack of a market premium will impact economic viability. Europe presently has found GHG reduction to be 52 percent (Biofuels Digest, 2008). Highlands Enviro Fuels,LLC has found that sugar biofuels results in 80 percent lower GHG emissions that gasoline (Krohn, 2009)

NDSU, GVG, and HRE have utilized internal funds to conduct over 100 meetings and informed various groups of the opportunity. The project also received $61,245 from North Dakota's Agricultural Products Utilization Commission (APUC) plus several private contributions to conduct 2009 energy beet yield trials and a preliminary economic feasibility study. Maung and Gustafson (2010) have draft results available summarizing the economic opportunity.

GVG and HRE have the leadership and with NDSU research facilities and staff will successfully complete this project. Eleven diverse public and private groups from across the state have pledged matching funds and will provide technical guidance when needed.

MANAGEMENT

GVG and other project collaborators have a proven track record of outstanding performances across the state. GVG will oversee all aspects of the project. The chemistry of GVG, HRE and NDSU for this project could not be better.

A number of the project sponsors serving on the advisory council have agreed to act as resource companies for information and presentations in their field of expertise. Our lead investigators will draw on this resource when needed for a successful project. The advisory council will guide implementation of the study review procedures, assist with data collection, and critique study results and aid in the dissemination of conclusions. The advisory council will be comprised of one representative from farmers, finance, NDSU, targeted rural communities, seed companies, consultants, irrigation districts, wind energy developers, utilities, equipment manufacturers, farm organizations, and sugar beet industry.

A Reporting Plan will be developed for each objective. The Reporting Plan will consist of 1) an initial detailed work plan outlining key performance benchmarks and timeline, 2) an interim report prepared halfway through each objective documenting activity and initial accomplishments, and 3) a final report summarizing study conclusions. The timeline for each objective will vary. The first object is expected to be completed in 6 months whereas the last objective requires 24 months. At the completion of each benchmark identified in the Reporting Plan, the entire group will be convened and updated to coordinate project activities. A final report will contain all study results and program adjustments made.

Results of this study will be analyzed, assessed, and interpreted at several key stages of the project. First, the advisory panel will oversee development of the project and provide guidance when major questions arise. Later, periodic benchmark results will be evaluated by the principal investigator, collaborators, and advisory panel during the entire research period. Assumptions, data sources, and methods will all be carefully documented so peer reviewers and others can fully reproduce results at a later date if needed. The two year timeframe affords opportunity for redirection of yield trials and refinement of other study procedures, if needed. Preliminary results will continue to be reviewed and updated following feedback obtained from presentation of conclusions to producer workshops, peers and industry conferences. Finally, peer reviewers will evaluate the quality of results produced before publication in a scientific journal.

TIMETABLE

The project will commence Apr. 1, 2010 and end two years later on Mar. 31, 2012. The four objectives of the project will be conducted concurrently but have individual completion dates. The first two objectives, burn test and yield trials, will be completed Dec. 31, 2010 while the last two objectives, juice storage and education program, will be completed Mar. 31, 2012. Interim reports for the first two objectives will be compiled Sept. 1, 2010 while interim reports for the last two projects will be compiled Dec. 31, 2010. A final report will be prepared Mar. 31, 2012.

BUDGET

Item	Project Associated Expense	NDIC's Share	Other Sponsor's Share (Cash)	Other Sponsor's Share (In-Kind)	Sponsor
Burn Test	$85,000	$2,500	$10,000		AgCountry (pending)
			5,000		Amity Tech. (pending)
			1,000		Carrington Econ. Dev. (pending)
			2,500		Garrison Diversion (pending)
			40,000		Griggs/Steele Wind (pending)
			5,000		ND Water Foundation (pending)
			500		RRV Sugar Beet Growers Ass'n.
			5,000		Ottertail Power (pending)
			8,500		Stanley Consultants (pending)
			5,000		Beta Seed (pending)
Yield Trials					
Field Labor	24,444	24,444			
Fringe Benefits (35%)	8,556	8,556			
Production Costs	7,000	7,000			
Plant, Harvest, Quality Testing	54,500			41,700 12,800	Beta Seed Syngenta
Juice Storage					
M.S. Student, 2 yrs.	34,000	34,000			
Fringe Benefits (2%)	680	680			
Research Supplies	5,000	5,000			
Travel	2,000	2,000			
Publication Cost	1,000	1,000			
Education Program					
GVG/HRE	28,000			28,000	Mgmt, admin, & education
GVG/HRE travel/ Supplies	21,100	21,100			
Unallocated funding	24,929	24,929			
NDSU Indirect Cost	**33,791**	**33,791**			
Total	**$330,000**	**$165,000**	**$82,500**	**$82,500**	

Budget Justification:

Funding is required to meet project objectives because sufficient internal resources are not available and external entities view project as too risky without additional research support. If funding fails to materialize project objectives will be delayed and other sources pursued. Project is scalable and modular so progress can proceed with reduced funding.

The burn test will be a fixed price $85,000 subcontract to Stanly Consultants (see attached letter). Match funding commitments have been obtained from sponsors listed. This test in a commercial scale facility is required to determine plant energy supplies and validate results of prior laboratory scale tests.

GVG will issue subcontracts to Carrington and Williston Research Extension Centers. Technical labor to conduct yield trials costs $11/hour and requires 1,000 hours. In addition, 537.75 research assistant hours at $25/hour are needed to design, manage, and prepare report of trial results. Fringe benefits of $8,556 are computed at institutional rate of 35 percent of total labor cost. Production expenses for field trials include fertilizer, fuel, herbicides, equipment repairs and other crop inputs. These expenses total $7,000 of which $5,000 are provided by a seed company's cash contribution. The seed companies will be responsible for providing seed, planting, harvesting and testing of energy beets upon harvest. Post harvest tests follow industry standard protocols and determine both sugar quantity and quality. These in-kind contributions total $17,800.

The juice storage study subcontract will be conducted by a M.S. student in the Department of Agricultural and Biosystems Engineering under the direction of Dr. Dennis Wiesenborn. The 2-year value of their assistantship is $34,000 plus $680 fringe benefits calculated at the institutional rate of 2 percent. Research supplies including storage containers, reagents, labware, and sensors total $5,000. Travel for the student and Dr. Wiesenborn to present results at a national professional conference total $2,000 for airfare ($800 apiece) and hotel ($100 per night@2nights apiece). Page charges to publish results in peer-reviewed journal total $1,000.

Finally, GVG will obtain $74,029 to assist with delivery of the educational program, secure investment funding to construct commercial scale plant, begin negotiations of long-term fixed price contracts, analyze the agronomic potential of sweet sorghum, obtain additional grant funding for demonstration plant (if needed), ,create an on advisory board and pay indirect costs on NDSU sub-contracts. GVG will provide at least two people for 100 educational programs and individual meetings at a direct rate of $50.00 per in-kind hour. The remaining $120 covers miscellaneous costs for long distance phone calls, copying, mileage for personal use of car, and office supplies. All costs will be reimbursed at state institutional rates. GVG will not charge for any direct labor, overhead, or indirect costs on its portion of grant proceeds. Indirect costs of $29,229 are requested for NDSU sub-contracts ($77,680) at their federal rate of 43.5%..

This project does not have any confidential information.

PATENTS/RIGHTS TO TECHNICAL DATA

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

TAX LIABILITY STATEMENT

December 29, 2009

Green Vision Group, Inc. has no unpaid outstanding taxes to the State of North Dakota or its political subdivisions.

Maynard Helgaas, President
Green Vision Group, Inc.

Appendices

Letter from Betaseed Inc. – can be placed on Betaseed letterhead as necessary

December 30, 2009

Mr. Maynard Helgaas
Green Vision Group
"Architects for Rural Development"
412 19th Ave W. Unit E
West Fargo, ND 58078

Dear Mr. Helgaas,

Please accept this letter as Betaseed, Inc's intent to contribute to and support the NDSU Green Vision Group project planned throughout North Dakota. While the trial locations are not yet finalized, our intent is to support trial locations in the areas around Hannaford, Turtle Lake and Williston, ND. The trials currently planned are the following:

Hannaford, ND (farmer cooperator) 1- dryland and one irrigated yield trial plots for demonstration purposes – 2 trials.

Turtle Lake, ND (farmer cooperator) 1- irrigated yield plots for demonstration purposes – 1 trial.

Williston, ND (Research Center) 1 - irrigated varietal yield plots, replicated 4X –1 trial.

We believe it will be important to conduct these trials for a minimum of two years to prove repeatability. Therefore some expenses are extended into 2011. The expenses included in the "in-kind" contribution include, cost of seed and Tech Fee (if RR seed is used), planting, crop monitoring, progress reports of the trials and trial harvesting with yield and sugar analysis. Land rent, if any, thinning, irrigation expense, herbicides and chemicals, and chemical applications will be the responsibility of the project coordinators.

In addition to supporting the trials, we propose sponsoring an educational tour to Europe to visit existing bio-energy facilities. We suggest a minimum of two people participate and be hosted by staff of Betaseed and/or KWS. Details and actual travel schedule to be arranged at a later date.

The estimated amount that Betaseed Inc. is contributing to this project is as follows:

Cash	In Kind
$5,000.00	$145,455.00
Total	$150,445.00

We are excited to see this project develop, advance and succeed.

Sincerely,

Steve Libsack
Director of Business Development
Betaseed Inc.

Estimated In-Kind Project Contributions

Experimental Trial Seed	Varieties	# of Trials	$/entry	Sub-Total	Total
Sorghum - 2010	3	4	280	3,360.00	
Energy Beets - 2010	4	4	350	5,600.00	
Sorghum - 2011	4	5	300	6,000.00	
Energy Beets - 2011	6	5	375	11,250.00	
					$ 26,210.00
Agronomic Support	**Days**	**Rate/day**	**Benefits @ 32%**	**Sub-Total**	
2010 - Agronomist	50	560	8960	36,960.00	
2011 - Agronomist	60	580	11136	45,936.00	
					$ 82,896.00
Harvest Expense & Variety Analysis	**# Samples**	**Cost/Sample**		**Sub-Total**	
2010 - Samples (4/plot)	112	7		784.00	
2011 - Samples (4/plot)	200	7		1,400.00	
					$ 2,184.00
Meal Expense	**Meals**	**Days**	**$/Meal**	**Sub-Total**	
2010	2	25	75	3,750.00	
2011	2	30	80	4,800.00	
					$ 8,550.00
Hotel Expense	**Hotel**	**Nights**	**$/night**	**Sub-Total**	
2010	1	10	120	1,200.00	
2011	1	12	120	1,440.00	
					$ 2,640.00
Automobile/Mileage Expenses	**Days**	**$/Day**		**Sub-Total**	
2010	20	75		1,500.00	
2011	25	75		1,875.00	
		Air Travel			$ 3,375.00
Germany Trip for Training/Educ	**People**	**Days**	**Per/Diem Hotel, Meals, Travel, etc**	**Sub-Total**	
2010	2	6	500	6,000.00	
2010 - Hosting group (BTS staff)	2	6	500	6,000.00	
					$ 12,000.00
Germany Trip for Training/Educ	**People**	**Travel**		**Sub-Total**	
2010	2	1900		3,800.00	
2010 - Hosting group (BTS staff)	2	1900		3,800.00	
					$ 7,600.00
Contribution Total					**$ 145,455.00**

Stanley Consultants INC.
A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

September 17, 2009

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

Dear Dr. Gustafson:

Heartland Renewable Energy (HRE) requested engineering services from Stanley Consultants to evaluate renewable energy opportunities using the stillage from the Sugar-to-Ethanol process that has been dried according to HRE's patented spray drying process as the primary feedstock. These services are intended to support HRE's mission of sustainability and the desire to create nearly all the energy required to operate the plant.

The effort is a feasibility study investigating various biomass boiler options capable of burning the dry fuel, conceptualizing plant auxiliaries, performing screening to determine environmental feasibility of each option, and developing conceptual cost estimates. A high level 10-year life-cycle cost analysis will be prepared for comparing the different biomass boiler options. A test burn will be completed on the option deemed most viable.

The study will be based on using the residual fuel from a 10 million gallon-per-year ethanol facility utilizing imported molasses as the sugar feedstock.

The study will include an intermediate review with HRE after the life-cycle cost analysis is complete. The review will be used to identify the most viable biomass boiler option. A test burn will then be completed for flame stability, fly ash particulate characterization, ash deposit characterization, and fouling tendency. During the tests, oxygen (O_2), carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) will be measured and recorded at the furnace exit and after any emission control equipment specified for the test. Other emissions (such as mercury and acid gases) can also be measured at additional cost. Results from the test burn will be included as an attachment to the draft study provided to HRE for review. The final study will follow and will incorporate mutually agreed upon changes from the review.

This document was sent electronically

Stanley Building • 225 Iowa Avenue • Muscatine, IA 52761-3764 • phone 563.264.6600 • fax 563.264.6658
internet: www.stanleyconsultants.com

Stanley Consultants will perform the services described above for a lump sum fee of Eighty-Five Thousand Dollars ($85,000), which includes an allowance of Thirty Five Thousand Dollars ($35,000) for the test burn (performed by others) and miscellaneous expenses, per negotiated terms and conditions.

Sincerely,

Stanley Consultants, Inc.

Doug Einck
Senior Mechanical Engineer

cc: Russ Price, Stanley

de:ds:0EBMR-16226 Energy1 HRE ltr2

NDSU NORTH DAKOTA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering
Research–Teaching–Extension
NDSU Dept. 7620
P.O. Box 6050
Fargo, ND 58108-6050

701.231.7261
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www.ageng.ndsu.nodak.edu
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www.ag.ndsu.edu/extension

December 29, 2009

Maynard Helgaas
Green Vision Group
412 19th Ave W. Unit E
West Fargo, ND 58078

Dear Mr. Helgaas:

Effective and affordable process methods are needed to extend the storage life of beet juice, in order to establish an energy beet industry in North Dakota. Therefore, I propose to supervise research procedures outlined under Objective 3 of the project proposal, "Energy Beet Research."

Briefly, preservation methods that will be tested include acidulation, thermal pasteurization, and partial concentration by multiple-effect evaporation. All three methods will be evaluated at the NDSU Pilot Plant using available equipment, which includes plate heat exchangers, centrifugal pumps, climbing-film evaporator and datalogger system. All three preservation methods will be tested at multiple degrees of treatment to be determined. The primary indicators of storage stability are pH and temperature, both of which will be logged hourly via an automated system. Sucrose content will be checked weekly by Refractometer as a further stability check.

The funds requested to support this project total $42,680, which includes a graduate research assistantship for a Master of Science student ($34,680); research supplies such as storage containers, reagents, labware, and sensors ($5,000); travel ($2,000); and publication charges ($1,000).

This objective will be accomplished by March 31, 2012, given a project start date of April 1, 2010. I will cooperate fully with the other partners of the project to assure the success of the full project. Interim reports will be gladly furnished, in accordance with the wishes of GVG and the North Dakota Industrial Commission.

I look forward to participating in this exciting project, which will develop sugar beets as a viable renewable biofuels feedstock in North Dakota.

Sincerely,

Dennis Wiesenborn

Dennis Wiesenborn
Professor

NDSU NORTH DAKOTA STATE UNIVERSITY

Vice President for Agriculture and University Extension

NDSU Dept. 7520
314 Morrill Hall
P.O. Box 6050
Fargo, ND 58108-6050

701.231.7656
Fax 701.231.7566

November 6, 2009

Maynard Helgaas
Green Vision Group
412 19th Ave. W, Unit E
West Fargo, ND 58078

Dear Maynard:

I am writing to pledge NDSU's continued support for your "Energy Sugar Beet to Biofuel" economic development project in North Dakota. As you are aware, sugar beet biofuels uniquely qualify as an "advanced biofuels" under the Energy Independence and Security Act which creates a niche market opportunity for the region.

Dr. Cole Gustafson, co-leader of NDSU's Bio-Energy and Product Innovation Center (BioEPIC), is actively involved with your project. BioEPIC is a university-wide center involving over 70 faculty from across campus that is dedicated to developing new bio-energy markets and products from agricultural materials.

Dr. Gustafson has already obtained $70,000 of external funding support for the project. He is just completing an initial economic feasibility of the project and preliminary results look very favorable. Especially attractive is a novel patented process whereby 75 percent of plant thermal needs are provided from spray-dried yeast stillage.

Please keep me abreast of your progress and any further research support that may be needed.

Sincerely,

D.C. Coston, Vice President
Agriculture and University Extension

NDSU NORTH DAKOTA STATE UNIVERSITY

Carrington Research Extension Center
North Dakota Agricultural Experiment Station
663 Hwy. 281 N., P.O. Box 219
Carrington, ND 58421-0219

701.652.2951
Fax 701.652.2055
NDSU.Carrington.rec@ndsu.edu
www.ag.ndsu.nodak.edu/carringt/

November 5, 2009

To: Whom it may concern.

Re: Non-Food Sugarbeet Feedstock Project

This letter is coming to you to share some of my perspectives related to Green Vision's sugarbeet for bio-fuel project. I have become familiar with this project through meetings where I have heard presentations from Green Vision relative to the project objectives and more directly as a researcher investigating sugarbeet production specifically for this project.

The first comments I would share are more related to my own thoughts concerning the concept of producing sugarbeets for bio-fuel production. In recent years, I have participated in research related to many of the approaches of using agricultural crops for potential processing into a bio-fuel. These crops have included corn for ethanol, selected oilseeds for biodiesel, and various forms of biomass for cellulosic ethanol. As I have become more familiar with the production potentials and projected fuel yields related to these primary approaches, I become especially enthusiastic about Green Vision's sugarbeet project. The projected amount of bio-fuel that may be produced from an acre of sugarbeets is a very significant volume. This fuel yield coupled with the expected efficiencies of their proposed processing plants would distinguish Green Vision's project as a break through toward attaining an efficient renewable fuel supply model.

The production potential of sugarbeet across the state of North Dakota has historically been limited by the specific needs of the sugar industry. This need is annually achieved with sugarbeet production based in the Red River Valley and selected irrigated acres in the Mon-Dak region. However, the state of North Dakota has significant sugarbeet production capacity beyond these traditional production regions. Past research lead by the Carrington Research Extension Center has shown that sugarbeet is very much adapted to both dryland and irrigated environments across the broad Drift Prairie Region of North Dakota. This region of the state presents a tremendous production potential for sugarbeet as it includes the majority of the states irrigated acres along with vast acreage of highly productive dryland farms. Our current research substantiates the projected sugarbeet yields that the Green Vision project is using in their projections. Our researchers expect to continue to document and refine sugarbeet production potential across these non-traditional areas of the state in the years ahead.

Although the potential for viable sugarbeet production in the Drift Prairie Region is significant, the likely benefits extend beyond its value as a cash crop for bio-fuel production. Production of sugarbeet on the lands of this region could ultimately contribute toward an improvement in soil quality and land productivity. The deep tap root of sugarbeet is capable of utilizing water and nutrients at depths of the soil much deeper than the primary crops that predominate cropping systems of the region. Sugarbeet would positively contribute toward addressing some of the soil health concerns that the agricultural community is only now becoming familiar with. One important soils issue that sugarbeet may help to alleviate is the expansion of saline seeps. Sugarbeets ability to extract moisture from the soil and to improve internal drainage directly addresses some of the factors the foster saline seeps.

I would conclude my comments by indicating that I believe the proposed sugarbeet to bio-fuel project being lead by the Green Vision Group has great potential toward the development of a sound and efficient renewable fuel industry. The expected benefits of using sugarbeet in crop rotations along with the projected efficiencies of sugarbeet as a feedstock for bio-fuel production warrant positive consideration toward empowering the continuation of this project.

Sincerely,

Blaine G. Schatz
Director, CREC

STATE OF NORTH DAKOTA
DEPARTMENT OF AGRICULTURE
600 E BOULEVARD AVE, DEPT 602
BISMARCK, ND 58505-0020

DOUG GOEHRING
COMMISSIONER

November 4, 2009

Mr. Maynard D. Helgaas
Green Vision Group
412 19th Avenue West, Unit E
West Fargo, ND 58078

Dear Maynard:

I am pleased to hear you are moving forward with plans to establish a plant to convert sugar beets to ethanol. I am optimistic about this new potential source of ethanol production and hopeful you will find support to complete some of the necessary testing.

Our state has and will continue to play a major role in building a national renewable energy system. We know that we can profitably raise sugar beets and I am encouraged by the non-food varieties that yield more sugar, thus producing more ethanol per acre.

Statistics from F. O. Licht indicating an acre of sugar beets can produce significantly more ethanol than other grain based ethanol crops are promising. I think sugar beet ethanol has the potential to give a major boost to North Dakota's agriculture economy.

Best wishes as you proceed.

Sincerely,

Doug Goehring
Agriculture Commissioner

NORTH DAKOTA
Farmers Union

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

December 11, 2009

Dr. Cole R. Gustafson
Professor, Agribusiness and Applied Economics
NDSU Dept 7610
North Dakota State University
Fargo ND 58108-6050

Dear Dr. Gustafson:

On behalf of the 42,000 members of NDFU, this letter is to support the concept of the ND Renewable Energy Council Sugar Beet proposal.

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.

The mission and goals of our organization support this proposal. We believe the study has merit and should be funded.

Thank you for your efforts, Cole. We look forward to hearing about the progress of the study.

Sincerely,

NORTH DAKOTA FARMERS UNION

Robert L. Carlson
President

Tyler Ring
Head of Sales & Marketing

Hilleshög-Syngenta
PO Box 7
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syngenta

December 19, 2009

Green Vision Group
412 19th Ave W. Unit E
West Fargo, ND 58078

Dear Maynard,

Please find the estimated costs for the 2010 trialing work.

The estimated costs: 4 trial locations, 16 varieties replicated 4 times.

- Oakes, North Dakota – (1 dry land location, 1 irrigated location)
- Carrington, North Dakota – (1 dry land location, 1 irrigated location)

The costs are for seed, planting, harvesting and performing the sugar analysis.

- 16 varieties X 4 reps = 64 plots/site
- 64 plots/site X 4 locations = 256 total plots
- 256 total plots X $50/plot = **$12,800**

Land rent, thinning and chemical applications are not included in the price.

If you have any further questions, please feel free to give me a call.

Best Regards

Tyler Ring
Head of Sales & Marketing
Hilleshög-Syngenta

HILLESHÖG

GVG and HRE In-Kind Labor and Projected Supply Budget for 2010 – 2012 Energy Beet Project

December 29, 2009

Advisory Board Development	**Hours**	**Travel & Supplies**	**In-Kind**
Introductory Luncheon	4	$300	
Information Packet	6	300	
Web Site	6	1,000	
Monthly Reports	24		
Total	40		$2,000.
Education Information and Financial			
Griggs & Steele County targeted area Average Distance from GVG =160 miles.@ $ .51/ mile = ($163./trip)	40	$6,000.	$2,000.
Out of state & in-state travel Driving time = 4.5 hrs. GVG & HRE labor rate/ hour = $50. HRE travel $1,000 per trip	30	$4,000.	$1,500.
2010 – 1st Qtr. – 4th Qtr. Supplies • Planning education , information and financial program • Introduction of project to community and growers • Introduce crop budgets to Ag. lenders, growers & Ag. suppliers • Introduction of processing performas to community economic development leadership.	20	$6,000. $500.	$1,000.
2011 – 1st Qtr. – 4th Qtr. Supplies • Determine level of grower ownership interests • Introduce and discuss grower long term (5 yr)contracts with escalator clause • Introduce Grower ownership letters of intent • Introduce capital formation ownership and financing plan	150	$1,500.	$7,500.
2012 – 1st Qtr. – 3rd Qtr. Supplies • Work with new owners on permitting, RFP – engineering plant design, timelines etc.	150 130	$1,500.	$7,500. $6,500.
Total	**560**	**$21,100**	**$28,000**