



## Renewable Energy Program

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North Dakota Industrial Commission

## Application

**Project Title:**

Energy Beet Research, Phase II

**Applicant:**

Lloyd Anderson  
Green Vision Group

**Principal Investigator:**

Lloyd Anderson

**Date of Application:**

July 1, 2011

**Amount of Request:**

\$ 500,000

**Total Amount of Proposed Project:**

\$ 1,000,000

**Duration of Project:**

2 years

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## **ABSTRACT**

**Objective:** The Energy Beet Research Project - Phase II has six specific objectives that must be accomplished before energy beet biofuel production can be commercialized in North Dakota:

- 1) Engineering design and evaluation of alternative front end technologies and equipment for processing whole energy beets prior to ethanol fermentation.
- 2) Continue statewide energy beet yield trials in 2012 and 2013 crop years.
- 3) Qualify energy beets for federal crop insurance in North Dakota.
- 4) Stakeholder communication activities.
- 5) Scale up and expand whole beet and juice storage research.
- 6) Project management.

**Expected Results:** Phase II will provide core answers needed to finalize cost effective and energy efficient plant design and advance development for North Dakota's first 20 MGY energy beet biofuel plant. The front end engineering study will provide design parameters for preprocessing equipment that will extract juice prior to ethanol production. Regional yield information will demonstrate the suitability of sugar beet production in non-traditional areas and qualify energy beets for federal crop insurance in advance of commercial production so growers and agricultural lenders have adequate risk management tools available. The communication program will inform producers, community leaders, investors and the renewable energy industries leading to commercial economic development opportunity. The Phase II of beet and juice storage study will take bench scale laboratory results from Phase I and conduct demonstration scale evaluations needed for feedstock storage (both whole beets and juice) and plant design for construction of a commercial facility (Phase III).

**Duration:** 2 years

**Total Project Cost:** \$1,000,000

**Participants; (Pending):** Project participants include North Dakota State University, Green Vision Group, Heartland Renewable Energy, Betaseed, and Syngenta.

## PROJECT DESCRIPTION

**Objectives:** North Dakota State University (NDSU), Green Vision Group (GVG), Heartland Renewable Energy (HRE), Betaseed, and Syngenta are partnering to develop an energy beet biofuel industry in North Dakota. In a broad sense, the objective of Phase II is to undertake research oriented development tasks which must be completed before project commercialization can occur. The specific objectives of Phase II development are: 1) engineering design and evaluation of alternative front end beet processing equipment, 2) continue regional yield trials in 2012 and 2013, 3) qualify energy beets for federal crop insurance in North Dakota, 4) stakeholder communications, 5) whole beet and juice storage research, and 6) project management.

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

1) *Front end processing* – described in Appendix I.

2) *Statewide yield trials* – GVG will continue to partner with NDSU, Betaseed and Syngenta to conduct regional dryland and irrigated yield trials. 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. The Carrington and Williston Research Extension Centers of NDSU will oversee all trials 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 NDSU research 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.

3) *Federal crop insurance* – GVG and NDSU will continue their dialogue with USDA and follow USDA's Risk Management Agency section 508(h) procedures to qualify energy beets for federal crop insurance. NDSU and GVG have initiated discussions with both USDA/RMA's regional office in Billings, MT, National Crop Insurance Services (NCIS), and two local crop insurance companies. Both are receptive to internal or 508(h) policy development.

Overall performance of regional yield trials and market potential will dictate the development path.

Dr. Gustafson has served as USDA/RMA expert reviewer and is intimately familiar with the development process. Each year he partners with NCIS to deliver national risk management education programming. He and a colleague initiated NDSU's highly successful Annual Crop Insurance Conference which is dedicated to providing continuing education credits for agents in the 4 state region. Finally, he has obtained USDA/RMA grants for potato, livestock, and renewable energy, and farm women crop insurance education.

The procedure for obtaining federal crop insurance is described in Appendix III.

4) *Stakeholder communication activities* – A part-time communications specialist will be retained to develop communication materials targeted to farmers, industry, rural communities and other key stakeholders. Grower outreach will be conducted following identification of the site of the first energy beet biorefinery. Key stakeholder outreach will include communication with the state of North Dakota, prospective equity and debt sources as well as community relations. GVG's principals will be primarily responsible for direct communications.

5) *Whole beet and juice storage studies* – described in Appendix II.

6) *Project management* – GVG and HRE members will plan and coordinate all activities associated with this proposal, including reporting. Moreover, GVG and HRE will develop Phase III plans for either a co-located or stand-alone 20 MGY commercial plant and energy beet feedstock supply.

**Anticipated Results:** Results of this Phase II study will enable final development and design of a 20 MGY energy beet biofuel project in North Dakota: 1) Front end engineering research and evaluation will lead to equipment specifications for extracting juice from energy beets and prepare the juice for fermentation. 2) Regional yield trials will provide energy beet yield and quality information for federal crop insurance rating and for communications to prospective growers who will need production information to make their commitments. 3) Qualification for federal crop insurance will result in a new policy available to regional farmers interested in

raising energy beets. 4) Growers, the biofuel industry, rural communities and other stakeholders will be informed of energy beet production and advanced biofuel processing opportunities.

5) Results of the beet and juice storage study will identify optimal feedstock storage and processing methods leading to year-round biofuel processing and production. And, 6) GVG will manage and perform the critical planning/design/development activities necessary to begin Phase III leading to the construction of the 20 MGY energy beet biofuel plant.

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 and individual work sessions with farmers, community leaders and investors.

**Facilities:** Sufficient facilities are available at GVG, HRE, NDSU main station, and collaborating sponsors to ensure a successful project.

**Resources:** GVG and HRE have sufficient resources to conduct their study responsibilities. GVG's experiences and leadership in rural North Dakota development projects coupled with HRE's background in agricultural processing provide excellent qualifications for a successful project. NDSU has both staff and program resources to conduct its research studies. Betaseed and Syngenta have the staff resources and facilities for managing the plot trials.

**Techniques to Be Used, Their Availability and Capability:**

The front end beet processing, yield trial, and whole beet and juice storage research will all use standardized research protocols and techniques prescribed by their profession. Those procedures are detailed above in the methodology description. NDSU's Carrington Research Extension Center and Agricultural and Biosystems Engineering Departments are both highly regarded and have considerable prior experience conducting similar research studies. A communications expert with prior commercial experience will be selected through an interview process. GVG and NDSU will conduct the crop insurance and managerial tasks internally. Their proven accomplishments 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 as a team.

Each of GVG's principals have demonstrated professional successes in their individual business careers. This is GVG's only initiative and their principals are committed to the project.

**Environmental and Economic Impacts while Project is Underway:** No negative environmental impacts are expected as a result of project activity. Likewise, institution approved protocols will be followed in all laboratory activities. 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, increase fertilizer efficiency and help to break up the soils and mitigate excess moisture conditions. Production of a low carbon advanced biofuel reduces greenhouse gas emissions. Positive economic impacts to investors, farmers, and communities were evaluated in Phase I and will continue to be updated by NDSU.

**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 other sugar crops (USDA 2006, BBI, 2008). 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, North Dakota's long winters will lower costs of beet storage and extend the ethanol processing season. Thus, fixed costs of biofuel infrastructure can be spread over more production volume 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 ethanol per acre when compared with corn, energy beets would require less farm and land infrastructure development to meet EISA. Finally, Canada has a renewable fuel standard which seeks a reliable supply of advanced biofuels and creates a unique market opportunity.

With respect to technology, local farmers would harvest 28-38 tons of energy beets per acre, with an average sucrose content of 18 percent, by weight. Using HRE's proprietary conversion process, ethanol yield potential is 991 gallons of anhydrous ethanol per acre for

irrigated land or 668 gallons per acre if dryland is used to grow energy beets. According to Maung and Gustafson (2011), a 20 MGY plant would require 754,717 tons of energy beets annually from 20,180 acres of irrigated land or 29,949 acres of dryland. Net farm income increases up to \$15.5 million for irrigated energy beets or \$13.9 million for dryland energy beets based on historical returns. The economic impact from farm expenditure totals \$16.2 million for irrigated energy beets or \$17.8 million for dryland energy beets. Assuming an average plant net profit of \$0.38 per gallon, a 20 MGY plant would generate an additional \$7.3 million net profit annually and create 23 direct new jobs. In addition, the economic impact from plant expenditure totals about \$35 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. In addition to meeting plant thermal needs, the extracted pulp 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 over four years leading to the creation of an energy beet biofuel industry in North Dakota. 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. Since 2007 GVG's principals have committed thousands of non-compensated hours in the development of this project. When implemented, the project will generate positive impacts across much of North Dakota.



In Phase I, this project received \$61,245 funding from APUC to evaluate the economic feasibility of an energy beet biofuel plant. With positive results, the North Dakota Renewable Energy Council provided an additional \$165,000 funding (matched in cash and in-kind by the project's sponsors) to commercially test energy powder produced as a co-product of the biofuel process, establish energy beet yield trials at five regional locations, initiate a juice storage study, and develop a grower education program. Research results from all these objectives are encouraging and publicly available.

Phase II research is needed to research and evaluate efficient alternatives for the front end design of biofuel plant that will process energy beets. The beet and juice storage study is needed to determine A) that adequate beets or beet juice can be stored to enable profitable operation of the biofuel plant year-round, and B) the best way to store the feedstock for processing. Continuation of the regional yield trials and pursuit of federal crop insurance will provide risk management protection to both growers and lenders. Since most North Dakota farmers participate in federal crop insurance, energy beet crop insurance is a prerequisite to commercial feedstock production. The communication and project management funds are needed to implement Phase II and advance the development stage industry to Phase III. A companion \$73,000 APUC grant is under review to qualify energy beet ethanol as an advanced biofuel.

## **STANDARDS OF SUCCESS**

Each project step will have a deliverable – 1) Engineering research reports containing recommended equipment and processing procedures will be provided following completion of front end processing and the beet and juice storage studies, 2) Research reports documenting energy beet yield and quality characteristics in regional yield trials will be published, 3) Reports summarizing progress on obtaining federal crop insurance and communications with farmers, rural community leaders, and sugar beet and biofuel industries will be prepared, and finally an overall report summarizing managerial and development stage tasks and accomplishments will be prepared.

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. Each objective is expected to require the full 24 months for completion. However, intermediate performance benchmarks will be established to assure progress and overall project success. At the completion of each benchmark identified in the Reporting Plan, the entire group will be convened and updated to coordinate remaining project activities. A final report will contain all study results and program adjustments made.

An advisory council has been formed to guide implementation of Phase I of the project. Those members will be asked to continue through Phase II to review procedures, assist with data collection, critique study results, aid dissemination of conclusions and provide direction for Phase III. The advisory council is comprised of representatives from farmers, finance, industry, NDSU, targeted rural communities, seed companies, consultants, irrigation and water conservancy districts, renewable energy developers, utilities, equipment manufacturers, farm organizations, and the sugar beet industry.

## **BACKGROUND/QUALIFICATIONS**

The Energy Independence and Security Act (EISA) of 2007 defines three categories of biofuel based on potential reduction of GHG emissions – conventional (20 percent), advanced (50 percent), and cellulosic (60 percent). Two crops, sugar beets and sugar cane, have been identified as primary feedstock sources for advanced biofuels with expected production of 21 billion gallons per year (BGY) by 2022. Commercialized sugar beet biofuel production in France and Germany yields twice the volume of biofuel produced per hectare compared with other feedstocks. Despite the tremendous opportunity available to north central states that lead national sugar beet production, most biofuel research funding has targeted conventional and cellulosic biofuels (Ferrell, 2009). Scant attention has been focused on commercialization of advanced biofuel production, especially from sugar beets (USDA, 2006, Salassi, 2007) even though total costs of producing biofuel are lower from sugar beets than cane (USDA, 2006, BBI, 2008). North Dakota

has an opportunity to exploit its comparative economic advantages in producing energy beet biofuel as outlined above.

GVG, HRE, and NDSU have partnered to develop an energy beet advanced biofuel industry in North Dakota to expand economic opportunities for both agricultural producers and 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 overall 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 52 percent GHG reduction (Biofuels Digest, 2008). Highlands Enviro Fuels LLC has found that sugar biofuels result in 80 percent lower GHG emissions than gasoline (Krohn, 2009).

## **MANAGEMENT**

GVG and other project collaborators have a proven track record of outstanding performance across the state. GVG will oversee all aspects of the project. Dr. Cole Gustafson, NDSU biofuels economist and his staff (NDSUTeam), have been an integral part of the project to date. They were instrumental in obtaining the initial APUC and REC grants that provided project funding for Phase I. As a committed partner to the project, NDSUTeam continue to perform economic analyses as needed and have delivered numerous presentations/workshops on the topic. Although they are not requesting direct funding, NDSUTeam expects to continue their research and extension efforts in support of this program, serve on the advisory panel, and provide project leadership as requested. In fact, NDSUTeam was the lead author of this grant request. We are indebted to their diligence and support of this project. This project would not be as advanced as it is today without their significant efforts and encouragement.

Maynard Helgaas is the president of Green Vision Group, a Fargo-based company that has been studying sugar-based fuel production in North Dakota since 2008. He has an extensive agricultural, business and financial management background as a former potato producer, John Deere dealership owner, and longtime manager of Midwest Agri-Development Corp. He was

president and chairman of Central Dakota Growers in the early '90s that brought a potato processing plant to Jamestown. Helgaas has earned NDSU's Outstanding Agriculturist Award, Agribusiness Achievement award, and Outstanding Contributions to Agriculture award.

Lloyd Anderson is a partner in the Green Vision Group. His professional career has included positions in manufacturing engineering, food processing plant management, and as a principal (owner) and director of consulting in a multi-state CPA/business consulting firm. For the last 11 years, he has served as CEO or project manager for new ventures primarily aimed at rural development. These projects include the recently completed 170 MW Luverne wind farm. Anderson, a registered professional engineer (retired status), also was involved in bringing the potato processing plant to Jamestown.

Rod Holth is a partner in the Green Vision Group. He has a strong background in financial lending and institutional management, and is the founder of several value-added agribusinesses including an early pioneer potato farm that contracted potatoes with the plant at Jamestown. Holth is the founder of the Commercial Vegetable Growers of North Dakota as well as Northern Plains Market Development Company.

Rick Whittaker is co-founder, president and CEO of Heartland Renewable Energy of Muscatine, Iowa, a company formed to produce ethanol using alternative feedstocks. Whittaker has worked in the corn wet milling and distilling industry for 30 years and has extensive experience in construction management and alcohol plant design. He holds an associate civil engineering degree. He has performed project management and construction duties for multiple projects including a waste treatment facility in Muscatine and a new 100 MGY alcohol plant in Washington, Iowa.

## **TIMETABLE**

The project will commence Jan. 1, 2012 and end two years later on Dec. 31, 2013. The six objectives of the project will be conducted concurrently but have individual completion dates. Project meetings will be held quarterly and meetings with project advisory board will occur semiannually.

## Energy Beet Research Phase II Project Schedule

Activity	Start Date	End Date	Duration	2012 - 2013															
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
<b>Task 1. Front End Processing</b>	<b>Q1 2012</b>	<b>Q4 2013</b>	<b>2Y</b>																
Subtask 1.1 Literature Review	Q1 2012	Q1 2012	1Q																
Subtask 1.2 Identify Method, Order Equipment	Q2 2012	Q2 2012	1Q																
Subtask 1.3 Equipment Installation and Testing	Q3 2012	Q3 2012	1Q																
Subtask 1.4 Data Collection and Analysis	Q4 2012	Q3 2013	4Q																
Subtask 1.5 Final Report <i>Deliverable: Final Report</i>	Q4 2013	Q4 2013	1Q																
	Q4 2013																		
<b>Task 2. Statewide Yield Trials</b>	<b>Q1 2012</b>	<b>Q4 2013</b>	<b>2Y</b>																
Subtask 2.1 Year One Production	Q2 2012	Q3 2012	3Q																
Subtask 2.2 Summer Field Days	Q3 2012	Q3 2012	1Q																
Subtask 2.3 Fall Field Days	Q4 2012	Q4 2012	1Q																
Subtask 2.4 Year One Field Trial Report <i>Deliverable: Year One Field Trial Report</i>	Q4 2012	Q4 2012	1Q																
Subtask 2.5 Year Two Production	Q2 2013	Q3 2013	3Q																
Subtask 2.6 Summer Field Days	Q3 2013	Q3 2013	1Q																
Subtask 2.7 Fall Field Days	Q4 2013	Q4 2013	1Q																
Subtask 2.8 Year Two Field Trial Report <i>Deliverable: Year Two Field Trial Report</i>	Q4 2013	Q4 2013	1Q																
	Q4 2013																		
<b>Task 3. Federal Crop Insurance</b>	<b>Q1 2012</b>	<b>Q4 2013</b>	<b>2Y</b>																
Subtask 3.1 Meeting with RMA, Insurance Firms	Q1 2012	Q1 2012	1Q																
Subtask 3.2 Develop Risk Rating	Q1 2013	Q1 2012	1Q																
Subtask 3.3 Finalize Concept of Insurance <i>Deliverable: Concept of Insurance</i>	Q2 2012	Q2 2012	1Q																
	Q2 2013																		
<b>Task 4. Stakeholder Communications</b>	<b>Q1 2012</b>	<b>Q4 2013</b>	<b>2Y</b>																
Subtask 4.1 Project Management	Q1 2012	Q4 2013	2Y																
Subtask 4.2 Grower Outreach	Q1 2013	Q4 2013	4Q																
Subtask 4.3 Key Stakeholder Outreach	Q1 2012	Q4 2013	2Y																
<b>Task 5. Whole Beet and Juice Storage Studies</b>	<b>Q1 2012</b>	<b>Q1 2012</b>	<b>2Y</b>																
Subtask 5.1 Literature Review	Q1 2012	Q1 2012	1Q																
Subtask 5.2 Identify Methods	Q2 2012	Q2 2012	1Q																
Subtask 5.3 Data Collection	Q3 2012	Q4 2012	2Q																
Subtask 5.4 Analysis	Q1 2013	Q4 2013	4Q																
Subtask 5.5 Final Report <i>Deliverable: Final Report</i>	Q4 2013	Q4 2013	1Q																
	Q4 2013																		
<b>Task 6. Project Management</b>	<b>Q1 2012</b>	<b>Q4 2013</b>	<b>2Y</b>																
Subtask 6.1 Project Management	Q1 2012	Q4 2013	2Y																
Subtask 6.2 Site Selection	Q1 2012	Q4 2012	4Q																
<i>Quarterly Meetings</i>																			
<i>Quarterly Reports</i>																			
<i>Semiannual Advisory Meetings</i>																			

## BUDGET

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

Item	Project Associated Expense	NDIC's Share	Other Sponsor's Share (Cash)	Other Sponsor's Share (In-Kind)	Sponsor
<b>Front End Engineering</b>					
Salary	71,500	71,500			
Fringe	25,025	25,025			
Supplies	15,000	15,000			
Indirect Costs	28,997	28,997			
Major Equipment	54,450	54,450			
<b>Yield Trials</b>					
NDSU Direct Costs	89,100	89,100			
NDSU Indirect Costs	23,166	23,166			
Planting, Harvest	271,050		271,050		Industry Commitment
<b>Storage Study</b>					
Salary	45,000	45,000			
Fringe	900	900			
Supplies	10,000	10,000			
Indirect Costs	24,876	24,876			
<b>Project Management/ Crop Insurance/ Communication</b>	340,936	111,986		228,950	GVG/HRE
<b>Total</b>	<b>1,000,000</b>	<b>500,000</b>	<b>271,050</b>	<b>228,950</b>	

The front end engineering study will be conducted by a technician under the direction of Dr. Igathi Cannayen. The technician's salary for 22 months of effort is \$71,500 with fringe benefits of \$25,025. Research supplies are budgeted at \$15,000. Major equipment is budgeted at \$54,450. Indirect costs for off-campus research accrued at a rate of 26% total \$28,997.

GVG will issue subcontracts to Carrington and Williston Research Extension Centers to design, manage, and report on the beet field trials. Direct costs are \$89,100 including \$58,000 for staff salaries and benefits and \$31,100 for operations and supplies. Indirect costs will be \$23,166.

The juice storage study will be conducted by a M.S. and undergraduate student in the Department of Agricultural and Biosystems Engineering under the direction of Dr. Dennis Wiesenborn. The 2-year cost of their salary is \$45,000 plus \$900 fringe benefits calculated at the institutional rate of 2 percent. Research supplies including storage containers, reagents, labware, and sensors total \$10,000. Indirect costs of on-campus research at a rate of 44.5% total \$24,876.

GVG/HRE will commit a minimum of 3,358 hours of time valued at \$100 per hour to project management and multiple development task responsibilities over the project's two year timeframe. Included in the specifically identified GVG task responsibilities are the stakeholder communications and federal crop insurance objectives. In addition, GVG/HRE will continue to be directly responsible for all the planning and coordination requirements to direct the Phase II development activities and plan for Phase III. A significant portion of NDIC's cost responsibility for the project management line item in the budget will be committed to third-party costs for communications (approximately \$25,000) and out-of-pocket travel expenses for governmental, industry, producer, financial and other stakeholder meeting requirements.

### **CONFIDENTIAL INFORMATION**

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**

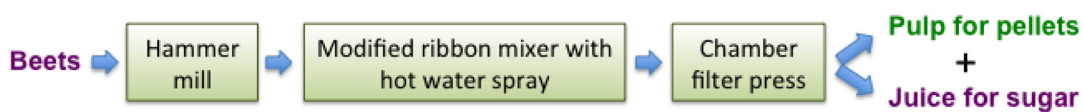
June 30, 2011

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.

## APPENDIX I: Front End Processing

Sugar beet processing, either for sucrose or biofuel application, is energy and capital intensive. It is always desirable to reduce both input energy and operational cost in any industrial venture. Traditionally, raw beets are size reduced by cossette slicer and juice extracted by vertical tower diffuser, while several other machines complete the process of producing granular sugar. If biofuel production is the goal, the beet processing can be simplified using other, more common, machine technologies. The overall goal of this objective is to extract the maximum possible sugar from energy beets with minimum energy input. Therefore, in the proposed process (figure), cleaned wet beets are hammer milled first, and then a custom-made ribbon mixer equipped with hot water spray softens the slush and which aids extraction of juice in the final chamber filter press stage.



### Beet to juice and pulp

During further downstream processing, the extracted juice will be fermented for biofuel and the compacted solids (pulp) will be densified as pellets for energy or feed applications. The success of this simplified process is ensured, as the end product is not the usual food grade crystal sugar that has to meet stringent product and process tolerances.

Process variables that will be studied in the hammer milling stage include the initial condition of the beets (fresh, frozen, and different levels of thawing), beet initial moisture and juice content, and dimensions of the size reduced beet after milling (influenced by the mill output screen). Variables studied at the mixer-sprayer stage include temperature of the slush and the pulp-moisture ratio. At the filter press, characteristics monitored include operating pressure and residence time. All these variables influence the final quantity and quality of the juice and pressed pulp produced. The quality of the extracted juice and pressed pulp will also be evaluated, as it affects the downstream processes and applications. Being an underground produce soil, small rocks, and other contaminants are integral part of beets production; therefore washing is an



essential process with high water demands and waste stream handling. In this proposal clean beets are considered as input; however, the effect of contaminants on front end as it affects downstream applications will also be studied through inclusion of controlled amount of rocks. Efficient wash water recovery and whole plant recirculation and handling will be considered in Phase III of the project.

This front end engineering approach poses several technical challenges and researchable questions that require a scientific investigation, which leads to feasibility evaluation and optimized process conditions. Thus this proposal establishes the feasibility of a simplified, energy efficient, and low cost technology for sugar beet preprocessing as a demonstration that can be up scaled to pilot plant.

## **APPENDIX II: Whole Beet and Juice Storage Study**

Modified atmosphere storage of whole beets will be optimized and scaled up. At the initial scale, washed beets will be stored in 5 gallon (20 L) containers for up to 12 months at both room temperature and refrigerated temperature in replicated trials. Containers will be modified to permit the continuous logging of container temperature, periodic analysis of gases within the container, and safe venting of gas produced from the beets. Storage variables will include time (0.5, 1, 2, 4, 6 and 8 months of storage), initial composition of the storage atmosphere with respect to carbon dioxide and nitrogen, and initial concentration of residual oxygen. Stored beets will be analyzed for change in mass, and content of water, sucrose and other fermentable sugars and monitored for visible spoilage. Juice from stored beets will be tested for fermentation yield (mass of ethanol per mass of beets processed). The results from the initial storage study will be used to design and execute up to three storage demonstrations at a scale of 200 to 500 pounds (90 to 230 kg) of beets for up to 12 months. Beets from this demonstration will be made available for process research. An NIR spectroscopic method will be evaluated for rapid, non-destructive analysis of stored beets for content of fermentable sugars. The use of an Instron or a Texture Analyzer-based method to evaluate firmness and cutting force for stored beets will also be evaluated.

### **APPENDIX III: Procedure for Obtaining Energy Beet Federal Crop Insurance**

The process of obtaining USDA/Risk Management Agency federal crop insurance coverage for energy beets is multi-step (<http://www.rma.usda.gov/policies/>). Depending on agency interest, capability, and potential market size, development may be initiated internally or by a private sector partner, a process referred to as 508(h). Similar information is required for each approach and begins with a “Concept of Insurance”.

First, sufficient production history must be obtained to quantify risks of production loss. Next, a “loss ratio” is calculated which is the ratio of indemnity payments to premiums collected. This is determined based on production risks, market potential, and policy pricing – all of which must be estimated for a new market. Finally, adverse selection, mitigation, and other important components of policy integrity are addressed. After a draft of the new Concept of Insurance is developed, it is submitted for expert review. Any comments received are incorporated. At this point, the proposal is submitted to RMA’s board of directors for consideration as a 508(h) or pilot program. If accepted, RMA evaluates performance of the pilot program and usually reimburses firms for development expenses. Following successful completion of a pilot program, it is submitted to the Board for approval as a new program.

## **Energy Beet Research, Phase II Budget Addendum**

NDIC's share of project communications are budgeted at \$35,000 for the two year period. These funds will cover the cost of a contract communications specialist who will assist in developing targeted information and educational materials for farmers, industry, rural communities and other stakeholders. One of the tools for accomplishing this task will be the use of a website. The communications specialist will also assist GVG with preparing interim and final project reports. GVG's time commitment to the communications line item is included under the project management category.

Crop insurance activities are budgeted at \$40,000. This includes the travel expenses to meet with the Risk Management Agency of the United States Department of Agriculture as well as the in-kind effort required of Green Vision Group for the quantification of production risk, development of a Concept of Insurance, development and evaluation of a pilot program, and approval.

Green Vision Group and Heartland Renewable Energy will commit a minimum of 2,290 hours of time valued at \$100 per hour to project management and multiple development task responsibilities over the project's two year timeframe. GVG/HRE will be directly responsible for all the planning, coordination and evaluation requirements of the Phase II development activities and results, and planning for Phase III. The ultimate objective of the GVG/HRE effort will be to develop renewable energy technologies utilizing energy beet feedstock, which is an industry that does not exist in North Dakota or the US. NDIC funds budgeted within the project management line item will be committed to actual travel expenses and other out-of-pocket costs directly related to the achievement of the project.

**Table 1. Energy Beet Research Phase II Budget**

<b>Item</b>	<b>Project Associated Expense</b>	<b>NDIC's Share</b>	<b>Other Sponsor's Share (Cash)</b>	<b>Other Sponsor's Share (In-Kind)</b>	<b>Sponsor</b>
<b>Front End Engineering</b>					
Salary	71,500	71,500			
Fringe	25,025	25,025			
Supplies	15,000	15,000			
Indirect Costs	28,997	28,997			
Major Equipment	54,450	54,450			
<b>Yield Trials</b>					
NDSU Direct Costs	89,100	89,100			
NDSU Indirect Costs	23,166	23,166			
Planting, Harvest	271,050		271,050		Industry Commitment
<b>Storage Study</b>					
Salary	45,000	45,000			
Fringe	900	900			
Supplies	10,000	10,000			
Indirect Costs	24,876	24,876			
<b>Communications</b>	35,000	35,000			
<b>Crop Insurance</b>	40,000	10,000		30,000	GVG
<b>Project Management</b>	265,936	66,986		198,950	GVG/HRE
<b>Total</b>	<b>1,000,000</b>	<b>500,000</b>	<b>271,050</b>	<b>228,950</b>	

# Cavalier County

Job Development Authority

901 3rd Street Suite 5 ∞ Langdon, ND 58249 ∞ Phone: 701-256-3475 ∞ Fax: 701-256-3536 ∞ E-mail: srmscdev@utma.com

August 9, 2011

Renewable Energy Council  
To Whom It May Concern

On behalf of the Cavalier County Job Development Authority, I am writing in support of the grant application submitted to the Renewable Energy Council by the Green Vision Group. As a community with a strong agricultural base, we are very interested in the potential of energy beets as a new crop that will allow more diversification for our producers as well as offering the potential for future processing. Energy beet production will be very conducive to the cropping systems here in northeastern North Dakota.

We encourage you to approve the Green Vision Group grant application.

Thank you!

Sincerely,



Carol Goodman, Exec. Dir.  
CCJDA



North Dakota Association of Rural Electric Cooperatives  
3201 Nygren Drive NW • P.O. Box 727 • Mandan, ND 58554-0727

Phone: 701.663.6501 or 800.234.0518  
Fax: 701.663.3745 • www.ndarec.com

August 4, 2011

Karlene Fine  
ND Industrial Commission  
State Capital, 14th Floor  
600 E. Boulevard Ave., Dept. 405  
Bismarck, ND 58505-0840

Dear Ms. Fine:

The Rural Electric and Telecommunications Development Center is a department within the North Dakota Association of Rural Electric Cooperatives that has been engaged in rural development since 1990. We are writing in support of Green Vision Group's grant application to the Renewable Energy Council.

We have worked with many of the individuals involved in the development of the energy beet research project. They are highly respected within the economic development field in North Dakota and have experienced several successes with their work.

As you are aware, significant work has already been completed for this project and the feasibility study shows promise. If successful, this project could bring new jobs and economic wealth to rural areas currently experiencing population declines. These are tough areas to develop and ideas are hard to come by. The fact that the facilities could be replicated across the state is an additional benefit. This could potentially reduce the development costs for other areas interested in the concept.

We encourage the Renewable Energy Council to approve a grant to the Green Vision Group for the Energy Beet Research Project – Phase II. We appreciate the work put forth to-date to develop this project and look forward to its continued development. If successful, we feel this project could have a significant economic impact in rural North Dakota.

Sincerely,

Lori Capouch  
Rural Development Director

August 10, 2011

To: Andrea Pfennig, Program Administrator  
Energy Outreach & Special Programs

Re: Letter of Support  
Energy Beet Research, Phase II

From: Rolla Job Development Authority  
P.O. Box 1200  
Rolla, ND 58367

This office, along with three other regional economic development entities in this north-central/north-east part of North Dakota, have for years sought out economic development opportunities in the agri-business and commercial industries. I have not followed any other opportunity for growth in North Dakota with as much excitement and anticipation as I have with the development of “energy beets” by the Green Vision Group.

With ND as the number one provider of 14 different commodities this office feels the potential for energy beet development will not only provide the producers in ND with another crop for local production but will, with value added processes, contribute to the regional and national economy as well as to help with the reduction of consumption of fossil fuels.

We strongly encourage the further development of “energy beets” by the Green Vision Group.

Sincerely,

*/s/George Youngerman*

George M. Youngerman  
Executive Director





Trent L. Wimmer  
Business Development Manager  
Sugar beet NAFTA

Tel: 303 776-1802 x241  
Fax: 303 776-0392  
Mobile: 303 601-2074  
Trent.wimmer@syngenta.com

**Syngenta**  
1020 Sugarmill Road  
Longmont, Colorado 80501  
United States of America  
[www.syngenta.com](http://www.syngenta.com)

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

July 18, 2011

**Green Vision Group Letter of Support - Syngenta**

To whom it may concern,

I am writing to express my company's support for the Green Vision Group (GVG) and their beets-to-ethanol project in North Dakota. Syngenta is a global agribusiness that provides seed, chemicals, and technology. One dedicated focus is the sugar beet; with over one hundred years of breeding experience within the crop. Our core competency is beet for sugar production, but the growth of energy from sugar is an emerging market that is global in scope.

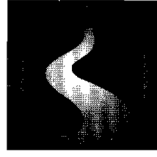
Today, the largest producer of ethanol in the world is Brazil; producing a majority of its ethanol with sucrose from sugar cane. Sucrose is an ideal feedstock for ethanol production, since it does not require heat or enzymes for fermentation. Because of this, renewable energy producers are looking for similar sources of sucrose in other parts of the globe. GVG is one of these progressive companies making the steps to commercialization of beets to energy.

Aiding in GVG's pursuit of success, we are currently in our third season of energy beet variety trials within North Dakota. For these trials, we have provided agronomic and technical expertise, seed, planting and harvesting crews, and processing for data accumulation. This has given us invaluable information for variety performance in North Dakota, the affects of dry land trials versus irrigated trials, and the ability to see year-to-year average production potential. Our breeding progress has been enhanced by these trials as we continue to fine-tune the best genetics for the North Dakota environment and maximizing the ethanol per acre potential.

GVG's management team is progressive and focused. We are excited with their current advancement and look forward to our future working relationship. Syngenta strongly supports GVG's beets to ethanol project.

Sincerely,

Trent L. Wimmer  
Business Development Manager



GREAT RIVER  
ENERGY®

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Bismarck Office • 1611 East Century Avenue • Suite 200 • Bismarck, North Dakota 58503 • 701-250-2165 • Fax 701-255-5405

Karlene Fine  
ND Industrial Commission  
State Capital, 14<sup>th</sup> Floor  
600 E. Boulevard Ave. Dept. 405  
Bismarck, ND 58505-0840

Friday, July 15, 2011

Dear Karlene:

Great River Energy supports the Green Vision Group Inc. application to the Renewable Energy Council for Phase II of the Energy Beet Research Grant. They have proven their ability to manage this large project in partnership with NDSU and Heartland Renewable Energy Inc.

We also recognize Phase II is critical in providing three years of yield data necessary for USDA risk management insurance, for the front-end design of the beet grinding process, and to conduct demonstration scale evaluation for feedstock storage and plant design for construction of a commercial facility.

We believe this project has tremendous potential for North Dakota as an advanced bio-fuel feedstock and could be very profitable for growers and processors.

Sincerely,

GREAT RIVER ENERGY

Al Christianson

Manager, North Dakota Business Development and Governmental Affairs

research breeds confidence



**Betaseed, Inc.**

1788 Marschall Road  
P.O. Box 195  
Shakopee, MN 55379  
952.445.8090

Betaseed, Inc. is pleased to be collaborating with Green Vision Group (GVG) based in Fargo, North Dakota. Betaseed has been supporting GVG in research and development of energy crops, primarily energy beets, in their efforts to build a bioethanol processing industry utilizing energy beet (sugarbeet species) as the feedstock for the project.

Betaseed, Inc. is a wholly owned subsidiary of KWS SAAT AG, Einbeck, Germany. KWS has been breeding and developing sugarbeet varieties for over 150 years. Nearly 12 years ago KWS began a breeding program specific to energy crops, in an effort to supply markets around the world with research, technologies and seeds that are specific to energy production. Today, the KWS group is the largest breeder and supplier of sugarbeet and energy beet seed in the world. Those efforts have evolved into technologies that range from seeds with exclusive biotechnology traits to long-term crop storage.

In North America, Betaseed maintains a broad-based research program that draws from our own genetics, our parent company KWS, and also from the USDA (Beltsville, MD; East Lansing, MI; Fargo, ND; Fort Collins, CO; Pullman, WA; Salinas, CA; Sidney, MT) and other worldwide sources. With all sources combined we have access to the world's largest vault of genetics.

Energy beets are currently being tested in many different climatic and environmental conditions throughout North America. These different regions require genetics with significantly different characteristics. The required characteristics are more varied and complex than those required for most European beet production. For this reason regional research and breeding programs are essential in order to meet the needs of the North American sugar and energy industries. Betaseed's breeding program meets these challenging requirements and is currently the only beet seed supplier that is conducting research and marketing seed in every growing region of North America.

Betaseed looks forward to continuing our support, and collaboration with GVG as we together develop and evaluate energy beets that will make energy production a viable industry for farmers, communities, our nation and, our environment.

Sincerely,

Steve Libsack



DEVELOPMENT  
JAMESTOWN / STUTSMAN COUNTY

August 25, 2011

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

Dear Maynard,

The Jamestown/Stutsman Development Corporation (JSDC) supports the Green Vision Group's (GVG) "Energy Beet Research Phase II" grant application to the Renewable Energy Council (REC), ND Industrial Commission. It is our understanding that this grant is to be used for engineering design and evaluation of front end technologies and equipment for processing whole energy beets prior to fermentation. We believe the continuation of the statewide energy beet yield trials for the next two years in the 12 unique locations is of utmost importance to this project. The need to qualify energy beets for federal crop insurance in ND is necessary for the protection of the farmers providing the feedstock for this venture. Communication with stakeholders and scale up and expansion of whole beet and juice storage research is very much needed. Overall management of the project will be vital to the eventual success.

We believe this project has good potential to be an economic driver for alternative cropping and renewable energy for the Jamestown and Stutsman County region as well as the State of North Dakota.

Sincerely,  


Connie J. Ova, CEO  
Jamestown/Stutsman Development Corporation



402 4<sup>th</sup> Street SW  
PO Box 553  
Cooperstown, ND 58425  
701-797-3712  
cooperedc@invisimax.com

August 24, 2011

Renewable Energy Council  
c/o North Dakota Industrial Commission  
Bismarck, ND

Dear Council Members,

The Cooperstown-Griggs County Economic Development Corporation strongly urges the council to support the grant application for \$500,000.00 for Phase II of the Energy Beet Research Project proposed by the Green Vision Group.

This project has shown significant potential for the production of ethanol within our state utilizing these energy beets, and our organization feels it is critical to support this next phase of the research project. With the funds from this grant, the Green Vision Group will be developing the design and evaluation of front end technologies for the processing of the beets, assist in continuing and expanding the energy beet yield trials statewide, and help qualify the beets for crop insurance in the state of North Dakota just to name a few of the objectives of this research.

Our economic development organization believes this project has great potential for our region and our state, and we feel it is important for the Renewable Energy Council to understand and support this project that will provide opportunities for energy production within the state. The plan allows for smaller, regional plants to be built once the research is completed and we feel this is critical in providing many of our rural communities the opportunity for sustainability and growth.

Thank you for your consideration of this letter, and we sincerely hope you will approve the grant application.

Best Regards,

A handwritten signature in black ink, appearing to read "Scott Lindemann".

Scott Lindemann, President  
Cooperstown-Griggs County EDC

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