Renewable Energy Program

North Dakota Industrial Commission

Application

Project Title: Application of Agricultural Byproducts for Energy Systems

Applicant: Woodshed Renewables LLC.

Principal Investigator: David Fiebelkorn

Date of Application: Sept 1, 2014

Amount of Request: $237,093

Total Amount of Proposed Project: $638,232

Duration of Project: 2.5 Years

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Application of Agricultural Byproducts for Energy Systems

ABSTRACT

Introduction:

It is expected that between 2010 and 2030, global biomass and waste power generation could grow from 62 to 270 gigawatts, with investments totaling between $21 billion and $35 billion [1]. The growth in the pellet production even triggered The Food and Agriculture Organization of U.N. to track international statistics for pellets, in 2012 global pellet production was 19 million metric tons, U.S. exported 1.49 million metric tons followed by Canada at 1.37 million metric tons. In 2014 the total value of U.S. wood pellets exports reached over $650 million. All these developments are expected to boost domestic pellet production by 33% in next two years [2]. These global factors further improve the economics of U.S. based pellet mills, including those that market their product regionally. This provides a unique opportunity to North Dakota solid biofuel producers to grow their business.

Researchers have shown significant economic incentives and reduction in greenhouse gas emissions with the use of biomass pellets [3]. USDA scientists have provided a complete cost-benefit breakdown of using agriculture biomass pellets, which are potentially a cheaper source of energy, instead of fuel oil to heat homes and businesses, especially in the Northeast (pellets are half the price of oil and emit one tenth of greenhouse gas). Last year the upper Midwest region of the U.S. saw a huge spike in the price of home heating fuels. The volatility in fuel prices can impact both residential and commercial sector growth. The 2014 Farm Bill promotes to incentivize the implementation of energy efficiency and renewable energy practices in rural small businesses and agricultural operations [4].

North Dakota is an agrarian state that produces and processes unique crops whose residue and co-products have beneficial properties that give North Dakota based solid biofuels a distinct advantage in the market place. The vision of this project is to define the market opportunity, optimize the production of solid fuels using standard equipment, and estimate the costs and returns to an expanded North Dakota-based biofuel producer.

Objectives:

The project's main objectives are to:

1. Identify price points and markets for new products.
2. Develop a regional urban wood waste and agricultural co-products supply schedule.
3. Estimate revenue, costs, and returns to pellet production using North Dakota-based, renewable feedstocks.
4. Characterization of agricultural processing byproducts in relation to energy applications. The specific products are urban wood waste, soybean stover, bean splits, and sunflower screenings.
5. Development of high energy density formulation for pellets and fire logs.

Expected Results:

The project will help **Woodshed Renewables LLC, a Finley, North Dakota-based Company** that currently manufactures and distributes wood fuel pellets, densified fire logs, skeetor logs, fire starters and animal bedding pellets, to develop a new line of products that compete in the fastest growing market of biomass pellets **(See Appendix B)**. The project will identify low value agri-processing byproducts available in North Dakota that can be utilized for energy generation. The project will support commercial-scale production of high quality pellets and logs that can be used in household, commercial and industrial applications and create demand for agricultural processing co-products creating an additional revenue stream for processors. The solid biofuels market research analysis conducted by Woodshed Renewables shows significant demand for densified energy products in 5 states (ND, SD, MN, WI, & MN) **(See Appendix C)**.

The direct economic impact of expanded operations is estimated to be more than $3 million per year with the procurement of 40,000 tons of biomass valued $75/ton. The new enterprise will create local jobs to support the harvest, collection, transportation, and conversion of feedstock to pellets and logs; provide additional income to area farmers, agricultural processors, and business owners; and generate additional tax revenue. Benefits of the enterprise include:

1. The company will use byproducts from existing North Dakota agricultural processors.
2. It will help the company to manufacture new lines of products using unique compositions or blends of materials. It will help the company to develop new products at a competitive price and sell regionally and nationwide.
3. The project will provide a low cost alternative fuel to compete with propane gas in the local market.
4. The blends will allow for some unique branding/marketing opportunities.
5. The project will contribute towards long term viability, stability and growth of the company.
6. It will create jobs at the processor and for third party biomass and waste wood aggregators and freight companies.
7. It will support the development of a biomass collection system that can be used by other new bioenergy and bioproducts ventures in the state.

Duration:

The expected duration of the project is 2 years 6 months (Task lead and site)

1. A market analysis to determine target markets and price points will be conducted in the first year. (Dr. Ripplinger, NDSU)
2. In the first year the economic analyses will focus on the identification of sources of waste wood and agricultural processing byproducts and the development of the preliminary process design and cost estimation model. (Dr. Ripplinger, NDSU)
3. The first year will also focus on characterizing feedstocks for energy applications. The biomass and targeted byproducts from processing plants will be analyzed for bulk density, moisture content, ash content, chemical constituents, calorific value, and thermal characteristics. The data collected will be helpful to understand the logistics of drying and refining cost of the agricultural byproducts. (Dr. Bajwa, NDSU)
4. In the second year detailed economic analyses will include the survey of wood waste and agricultural byproduct suppliers and estimation of feedstock transportation costs to derive

the supply schedule, survey of large commercial scale customers, and development of the new products pricing model and marketing strategy. (Dr. Ripplinger, NDSU)

5. Improved formulation development for pellets and logs, testing and commercial trials will be the focus in the second year. High energy density blends will be identified and evaluated in the laboratory. Commercial trials on high value formulations will be conducted at Woodshed Renewable plant. (Dr. Bajwa, NDSU and Mr. Fiebelkorn)
6. In the third year commercial production and product certification will be undertaken. (Mr. Fiebelkorn, Woodshed Renewables)

Total Project Cost:

The total estimated cost of the project is $632,732. Woodshed Renewables LLC, will contribute a total of $401,139 in cash (equipment, raw materials) and in kind (personnel time, technical support, as well as equipment time and facility use). We request ND Industrial Commission contribute $231,593 towards the research conducted at North Dakota State University to cover student and staff salary, local travel, equipment and supplies.

Participants:

- Woodshed Renewables LLC, Finley ND
- North Dakota State University, Fargo ND
  a. Department of Agribusiness and Applied Economics
  b. Department of Mechanical Engineering

PROJECT DESCRIPTION

Fuel pellets and fire logs (densified products) can be manufactured from mainly two types of biomass feedstocks, soft/hardwoods and/or agricultural crop biomass. Currently woody biomass dominates the market as it is easily obtained from biomass waste stream such as sawdust from a mill, or clean waste wood from construction or furniture making. In North Dakota, woody biomass is relatively scarce but can be complemented by crop residue, agricultural processing byproducts, urban waste wood, aging shelter belts, and winter storm wood.

A typical pellet or log manufacturing process involves, material sizing, drying, conditioning and densification using hydraulic press or extruder. Purchasing and transporting the biomass feedstock and drying the raw materials is the most costly aspect of pellet or briquette production. The nature of raw material defines the amount of grinding and drying time needed before the material can be processed. One advantage with agriculture byproducts is the ease of grinding and minimal drying as compared to woody biomass. Fuel pellets, logs, briquettes, pucks and other forms of densified fuel are produced by compressing the biomass to increase the energy density content of the biomass per unit weight so it can compete with synthetic oil, propane and other fuels. For proper densification particle size, moisture content and temperature are critical variables. In the U.S., the majority of the pellets and densified products are made from wood which has sufficient lignin to bind the fiber. According to literature lignin is responsible for solid bridges that largely contribute to pellet durability. Durability is a measure of the friability of the pellets. High temperatures during densification processes lead to partial melting of feedstock constituents facilitating diffusion and subsequent cooling leads to forming solid bridges [5]. It is

reported as particle size increases the forces between solid particles decrease [6]. Other factors impacting densification process include mechanical interlocking, and intermolecular attractive forces.

The characteristic of densified products primarily depend on the inherent properties of the raw materials and processing conditions. The variations in the material properties of crop biomass are widely reported [7]. Typically the heating values of crop biomass are comparable to woody biomass however ash content is much higher. The challenges with crop biomass lie in its variable lignin content (natural binder), tendency of biomass to spring back and puff up after leaving the pelletizer, clogging, and amount of fines. Crop based residues are increasingly becoming popular for energy and power applications. Researchers have looked into densifying crop residues, evaluating natural binders and bridge binding mechanisms in briquettes and pellets made from corn stover, wheat straw, sorghum and switch grass [8, 9]. Recently sunflower seed hulls have been used for co-firing with coal and agro-pellets for heating boilers [10, 11].

The Pellet Fuels Institute is the main body that dictates the quality of the pellets. The pellets are graded by bulk density in kg/m3, moisture content, size, durability, fines, ash content, chloride and energy content unit of MJ/kg-1. The energy of pellets in term of BTU/lb the energy ranges from 7,500 – 8,700 BTU/lb [12].

Therefore this study will focus on developing unique compositional blends for manufacturing pellets, briquettes, cubes by integrating crop biomass soybean stover, waste wood and agricultural byproducts (bean splits, and sunflower screenings). The primary market for these products includes residential households, commercial and agricultural facilities, public building and schools. Further it will also help to support the Federal mandate for Department of Defense to purchase 25 percent of its energy from renewable resources by 2025. ND's two defense facilities can be a beneficiary of this project.

Objectives:

The funds for this project will be used to determine feedstock supply, the cost of production, market for new products and development of new energy products from agricultural processing byproducts and waste wood. This project is expected to shed light on the densifying process and development of new commercial formulations for manufacturing pellets, logs and cubes for commercial and household applications. The performance characteristics of these residential and commercial grade pellets to be developed are shown in **Appendix D.** The scope of this project includes:

1. Identify price points and markets for new products.
2. To develop a regional urban wood waste and agricultural byproduct supply schedule.
3. Conduct cost projections of processing biomass into solid biofuels.
4. Characterization of agricultural biomass in relation to energy applications.
5. Development of high energy density formulation for pellets and briquettes.
6. Product testing and certification

Technological Novelty:

The novelty of this project lays in its integrated approach of developing value added densified energy products using agricultural byproducts and waste wood available in the North Dakota.

Methodology:

Task 1. Market Analysis. A market analysis will be conducted to identify target markets, price points, and quantity demanded. Retail sales data for wood pellets and logs will be used to determine demand for blended pellets. Commercial, institutional, and utility customers will be surveyed by phone to determine their willingness to buy [13]. A distance based transportation calculator will be developed to estimate the price of delivered product.

Task 2. Feedstock Supply Schedule. A supply schedule for ag-processing co-products and urban tree waste will be estimated. A phone survey of regional processers, cities, and tree removal services will be conducted to identify feedstock availability, characteristics including handling requirements, and prices [13]. Supply schedules for individual feedstocks, priced delivered to the factory gate will be estimated. These schedules will be joined with those currently being developed for North Dakota crop residue.

Task 3. Cost Estimation. A technoeconomic model will be developed to estimate fixed and operating costs for expanded production that utilizes ag-processing co-products, urban tree waste, and other feedstocks. Similar models have been used for traditional wood pellet and biopellet production [14, 15, and 16]. A linear program will be developed to determine lowest-cost feedstock blend ratios that can be used by the technology to manufacture on specification products under different feedstock prices. Given the limited number of feedstocks and parameters, a simplex algorithm is expected to provide an optimal solution. Design and parameters for the technoeconomic and blending models will be based on research findings, equipment specifications, and the literature as necessary. A sensitivity analysis will be conducted to determine the impact of price and parameter variation on plant economics.

Task 4. Material Characterization. The material properties of interest include:

a. The composition of feedstock has a significant impact on the quality of products. Summative mass closure laboratory analytical procedure (NREL 2011) will be adopted for characterizing cellulose, hemicelluloses, and lignin content [17].
b. Particle size distribution/Bulk Density will be determined by using a rotary sieve shaker and following ASTM D6913 standard. Bulk density will be calculated using ASTM D5057 method [18]. Previous studies have reported that particle size impacts processing and product quality [19, 20].
c. Calorific value or the heat content ranges of various biomass materials fuels (dry weigh basis) will be calculated using a Parr 6200 Calorimeter and following (ASTM D5865-07a).
d. Ash content of raw material will be analyzed following NREL/TP510-42622 test method.
e. Information Dissemination: The information will be disseminated through a technical report as well as presentations at local bioenergy oriented workshops and meetings.
f. Equilibrium moisture content (EMC) calculation will be conducted following guidelines of ASTM D4442 standard. Current research reports that MC from 10-15% increases durability from 62% to 84% (Obernberger and Thek 2004) and also moisture acts both as a binder and lubricant [8, 21].

Task 5. Development of High Energy Blends. The product quality, durability and production efficiency are all tied to the product formulation. A robust formulation can flow smooth without clogging the system and reduce any production downtime. Therefore a design of experiment

methodology will be used first to identify the optimal moisture content for efficient processing. The independent variables will be material type, moisture content and dependent variables include particle size and process time and final moisture content. The hammer mill and sieve shaker will be used to analyze the particle size. Formulation optimization studies will focus on identifying formulation that can produce highest grade pellets and logs. Pellets with diameter 5.84-7.25 and logs size (2.5-4 inch diameter) will be manufactured in laboratory using laboratory pelletizer and hydraulic press for preliminary results. The design of experiment for developing various formulations is shown in Table 1.

Table 1. Design of Experiment for Pellets and Densified Log Formulations

Independent Variables	**Levels & Description**	**Dependent Variables & Target values (PFI)**
Ag. Byproducts	(4) bean splits/ bean culls, sunflower screenings, waste wood and soy stover	Moisture Content (≤ 8%), Calorific Value (NA)
Bulk Densities/Particle size	Density (42 lbs/cu ft.)	Durability Index (≥96.5)
Moisture Content	(2) 10% and 20%	Inorganic Ash Content (≤ 1%)
Ag. Byproduct Loading	(2) 20%, 40%	Chloride, ppm (≤ 300)
Material Temperature	65 °F and 100 °F	Diameter & Fines (0.23 – 0.28 inch & ≤ 0.50%)

Replications – 4 (Depending on the availability of plant time)

Task 6. Product Testing and Certification. Evaluation of performance characteristics of the pellet and logs will be determined following Pellet Fuel Institute guidelines **(Appendix D).** Lists of physical and mechanical properties that will be evaluated include:

Calorific Value – The calorific value will be determined following ASTM E711 method.

Fines – It will be determined using the following procedure that incorporates the use of a 1/8-inch (3.18 mm) wire screen sieve.

Inorganic Ash – It will be determined in accordance with ASTM D 1102 standard.

Bulk Density - The fuel mass per cubic foot of the fuel sample will be determined in accordance with ASTM E 873.

Durability by Tumbler Unit – The test method is designed to simulate the forces induced on the pellets in the storage and handling process and to understand breakage in storage and handling as pellets are transported. Durability of pellets will be evaluated using the tumbling can tester in accordance with ASABE Standard S269.1 [22].

Moisture Content – The moisture content of the pellets will be determined in accordance with ASTM E871 method.

After the preliminary evaluation of selected physical and mechanical properties of different formulations, commercial scale trials will be conducted at the Woodshed's facility, Finley, ND.

Scalability: For the successful deployment of this technology the proposed scale up plan includes ramping production from 4K ton in year 1 to 40K ton by year 3. Ultimate goal is to reach 100K ton in 5 years.

Anticipated Results:

The project will result in the business expansion and commercialization of the new product in a short time. Results:

- The project will help the company to tap into local biomass feedstock and increase the production.
- The project will give a major financial boost to the net income of the company.
- It will help company to launch new products in the fast growing energy market.
- It will help Woodshed Renewables to competitively compete in the energy pellet market.
- It will give North Dakotans and Minnesota resident's protection against spike in heating fuel costs.
- Strengthen the local industry by providing safe renewable and stable raw material feedstock.
- The production facility will use locally produced biomass thereby supplementing the income of local farmers.
- Additional job opportunities for North Dakotans.
- The research may give more insight of agri-biomass use and lead to development of additional products and applications.
- It may attract other industries related to biomass application (liquid and gaseous fuels)

Facilities:

- Woodshed Renewable company's equipment and manufacturing plant in Finley, ND.
- Agribusiness and Applied Economics Modelling Facility, NDSU
- Material Testing Laboratory, Department of Mechanical Engineering, NDSU
- Materials Processing Laboratory, SpaceAge Synthetics (ME, NDSU), Fargo, ND

Resources:

- Woodshed Renewable LLC processing and manufacturing equipment at Finley, ND
- Material Characterization Equipment – Particle size analyzer, Fiber length, Bulk Density
- Biomass Processing Equipment – Hammer mill, Oven, Hot Press, Sieve Shaker, Mechanical Mixers.
- Mechanical Testing Equipment – Pellet Press, Calorimeter, Compression Tester, Pycnometer
- Data Analysis – SAS Software
- Research – Postdoc, Graduate and Undergraduate students

- Management and technical support from Woodshed Renewable LLC.

Techniques to Be Used, Their Availability and Capability:

A supply schedule will be developed by surveying existing and proposed regional agricultural processors, municipalities, and urban tree removal services. The survey will identify price, quantity, and quality attribute information. Products will be priced delivered to Finley using a transportation costing model. This information will be joined with crop residue supply data which is being assembled as part of an APUC funded project.

Processes will be designed to manufacture identified products at the existing Finley facility. Costs will be estimated by identifying and sizing required equipment. The analysis will include capital as well as fixed and variable operating costs. A sensitivity analysis will be conducted to determine the impact of changes of key parameters and prices. The value of biomass feedstock attributes will be priced using linear programming.

The market analysis will utilize scanner data for related products (e.g. Nielsen, Symphony IRI) to estimate the pricing and demand for the new products marketed through retail channels. A survey of potential commercial scale solid biofuel users will be conducted. Information will be used to price and market new products developed by sponsored activities.

Engineering changes to processing equipment will be facilitated in consultation with industrial partner Woodshed Renewables as well as commercial equipment manufacturers. Plant engineer, Principal Investigators and graduate students will be involved in this task. Formulation optimization work will be conducted as per design experiment shown in table 1. SAS statistical software will be used to analyze the data. Experimental and commercial trials will be conducted on the production lines of Woodshed Renewables facility. Testing will be conducted in the Materials Testing laboratory located in the Department of Mechanical Engineering, NDSU.

Environmental and Economic Impacts while Project is Underway:

1. All actionable market research will be immediately shared.
2. Additional employment will be created.
3. Sale of agriculture biomass will generate additional income for farmers.
4. Soil health may improve with the removal of biomass carrying disease pathogens.
5. Baling and transportation of the stalks will generate additional jobs.
6. The project will add to growth and long term viability of Woodshed Renewables in North Dakota.
7. Environment will benefit from locking the carbon in a sustainable product that will stay in place for a relatively long span of time.
8. The application of ag-byproducts will reduce landfills and other nuisances with disposal.
9. The research may lead to additional products and markets that will have positive impact on ND economy, and may attract new bio-based industries to ND.

Ultimate Technological and Economic Impacts:

The project will focus on identifying high energy density formulations for pellets, logs and related products that can be used for generating the energy and farm heating needs.

Technology: The project will promote innovation and may result in the development of new technology to process agri-byproducts for manufacturing high quality pellets and logs. The research will strengthen Woodshed Renewables knowledge about manufacturing densified products. This project will be a good example of mutually beneficial industry-university partnership that results in innovative technologies and economic development.

Economic Impacts:

1. Promote long term growth and stability of North Dakota biobased industry.
2. Create employment opportunities for the state, especially in rural, agricultural-based counties.
3. Generate additional tax dollars for local and state government.
4. Add wealth for landowners and agricultural processors.
5. Support a robust rural economy.
6. Add value to targeted agricultural processing co-products.

Information Dissemination: The information will be disseminated through a technical report as well as presentations at local bioenergy oriented workshops and meetings.

Why the Project is Needed:

The study will provide bioenergy experts and biomass related companies the first-hand knowledge of using agricultural byproducts for energy applications. North Dakota solid fuel producers can be part of the growing bioenergy market.

There are several reasons the project is needed in North Dakota.

1. It will help to identify, quantify and qualify sustainable **low value biomass** based feedstocks for industry, which is worried about finding enough traditional feedstock for their current operations in North Dakota.
2. It will give industry incentive to stay and expand in North Dakota.
3. It will create additional wealth for stakeholders/bioprocessing industries.
4. It will result in development of new technology.
5. It will create employment opportunities.

STANDARDS OF SUCCESS

Standards of Success should include: The measurable deliverables of the project that will determine whether it is a success; The value to North Dakota; An explanation of what parts of the public and private sector will likely make use of the project's results, and when and in what way; The potential that commercial use will be made of the project's results; How the project will enhance the education, research, development and marketing of North Dakota's renewable

energy resources; How it will preserve existing jobs and create new ones; How it will otherwise satisfy the purposes established in the mission of the Program.

The value to North Dakota:

- It will strengthen North Dakota's industry by helping them to utilize biomass (ag. byproducts and waste biomass) as a lower cost alternate fuel in the state. Local industry will be empowered to compete and serve a Billion dollar pellet industry.
- It will boost the income of North Dakota farmers; sourcing as much as 40,000 tons of biomass valued at $3 million annually.
- Increased industrial output will create additional tax revenue for the state. Over 3-4 million/yr revenue will be generated by use and sale of different materials. Typically an 8-ton/hr facility requires 23 employees so we could expect additional job opportunities and revenue generation.
- It will encourage biomass utilization and attract other companies to the state.

Public and Private Sector that would benefit (when and what way):

Public Sector:

- It will increase revenue of the state from a local industry. (Immediate)
- Create opportunities for education, research, training and improving technical skills of students (Immediate)
- It will help to market ND based agricultural byproducts for industrial use. (Future)
- Knowledge gained from project will be incorporated into NDSU engineering courses. (Future)
- The project will add wealth for landowners and agriculture producers to build and maintain a robust rural economy. (Immediate and Future)
- Project will create awareness about biomass utilization and environmental benefits.

Private:

- The project will help Woodshed Renewables to qualify new bioenergy products. (Immediate)
- The project will provide help to cut cost of their current raw material. (Immediate)
- It will help to improve their profit margin. (Immediate and Future)
- Project will help them to expand their production in ND. (Future)

Potential that commercial use will be made of the project:

It is a **low risk and high success** project as the company is located in North Dakota and they are strongly committed to invest in the success of this project. In the past one year the company has

expanded business to attract customers from five neighboring states. Woodshed Renewables has been manufacturing densified products for several years and has an extensive network to market this product throughout U.S. and Canada.

How project will enhance education, research and development and marketing of ND renewable resources:

Education – The investigators will employ postdoc, graduate and undergraduate students from North Dakota State University in the research work of this project. The project will help them to achieve their education goals, training, and improve their engineering skills relevant to this project.

How will it preserve jobs and create new ones:

The long term viability and stability of this company will help to preserve jobs and its growth will create future employment opportunities for North Dakotans. Biomass, byproducts collection and transportation will create additional jobs.

How it will serve the purpose and mission of the program:

The proposed project will serve the mission and program in the following ways:

- The project will significantly contribute towards economic development of ND.
- This research will foster efficient, economic and environmentally safe development of biomass based industry in ND.
- It will promote research, development and commercialization of unique biobased industrial products in the ND.
- It will create jobs and growth opportunities for renewable biobased industries in ND.
- This project will also lead to public awareness of the benefits and opportunities that are hidden in large volumes of renewable biomass in ND.

BACKGROUND/QUALIFICIATIONS

Please provide a summary of prior work related to the project conducted by the applicant and other participants as well as by other organizations. ***This should also include summary of the experience and qualifications pertinent to the project of the applicant, principal investigator, and other participants in the project.*** *(For detail CV's please see* ***Appendix E)***

David Fiebelkorn is a proven leader in the Midwest pellet fuel industry through his experience with Sunrise Agra-Fuels, MnVAP and most currently Chief Executive Officer of Woodshed Renewables, LLC. Fiebelkorn currently is an active member of Heating The Midwest, which is an organization, focused on developing renewable biomass fuel supplies and developing markets. He has served on the Standards committee as a member of the Pellet Fuel Institute and ISO committee. Fiebelkorn has extensive experience in building, managing renewable energy plants as well as previous experience in managing an EXCEL energy grant in Minnesota. Prior experience includes successful supply chain roles with Hearth & Home Technologies, Inc. and Frigidaire Corporation. With this experience, Fiebelkorn is the optimal Chief Executive Officer to lead the team as a Project Investigator.

David Ripplinger is an Assistant Professor and Bioenergy/Bioproducts Economist in the Department of Agricultural and Applied Economics at North Dakota State University (NDSU) where his research focuses on production and marketing economics. His most recent work has focused on economic, financial, and environmental analyses that support the commercialization of new bioenergy pathways and existing pathway profitability. Dr. Ripplinger has been the Principal Investigator for a portfolio of nearly a dozen research projects whose total budgets exceed $1 million.

Dilpreet Bajwa is an Associate Professor in the Department of Mechanical Engineering at NDSU. He has worked on densified biomass products since 1998 as part of his graduate research (for 6 years), and also worked for industry for 12 years. His recent work is focused on investigating the feasibility of several non-woody (cotton burr stem, Guayule bagasse and corn and soy stover) and woody biomass feedstock's for industrial products including densified fire logs, pellets and composite products. He has had extensive experience in the research and development and certification of densified energy products while working in the industry. Currently he is leading several industrial and publically funded projects.

MANAGEMENT

*A description of **how** the applicant will manage and oversee the project to ensure it is being carried out on schedule and in a manner that best ensures its objectives will be met, **and a description of the evaluation points to be used** during the course of the project.*

David Fiebelkorn will be responsible for the overall management of the project. He has a time line developed for each of the tasks to perform. He will also conduct periodic meeting with the other investigators, students working on the project and the industrial collaborator. The two PIs from NDSU will meet with David on a monthly basis to discuss the progress of their research component. Once this project is funded, it will be included in the weekly operations meeting via conference calls. There will be major project group meetings at least twice a year with the NDSU collaborators to assess the progress of the project, and more often on as-needed basis. Twice a year, the PIs will prepare a progress report that will be submitted to David Fiebelkorn who will prepare a final progress report and submit to ND Industrial Commission. Representatives from the NDIC will be given opportunity to visit the Woodshed Renewable plant and NDSU labs and see the progress made on research, if it is so desired.

TIMETABLE

Please provide a project schedule setting forth the starting and completion dates, dates for completing major project activities, and proposed dates upon which the interim reports will be submitted.

Tasks	Aug-Dec 2014	Jan-June. 2015	July-Dec 2015	Jan-June 2016	July-Dec 2016
1. Hiring Postdoc and Graduate Student	X				

2. Data collection on relevant byproducts	X	X	X	X	
3. Economic analysis	X	X	X	X	
4. Material Characterization		X	X	X	
5. Lab experiments for process optimization and identify high energy value formulations		X	X	X	
6. Products Testing and Certification				X	X
7. Commercial trial				X	X
8. Optimization of process at commercial site				X	X
9. Report	X	X	X	X	X

BUDGET (For Detailed Budget Justification, See Appendix E)

*Please use the table below to provide an **itemized list** of the project's capital costs; direct operating costs, including salaries; and indirect costs; and an explanation of which of these costs will be supported by the grant and in what amount. The budget should identify all other committed and prospective funding sources and the amount of funding from each source.* ***Please feel free to add columns and rows as needed.*** *Higher priority will be given to those projects have matching private industry investment equal to at least 50% or more of total cost.*

Project Associated Expense	NDIC's Share	Applicant's Share Woodshed Renewables LLC. (Cash)	Applicant's Share (In-Kind)	Other Project Sponsor's Share
$638,232	**$237,093**	**$172,400**	**$228,739**	
Project Investigators	9,392		$184,739	
Graduate Assistant	38,677			
Postdoc	72,900			
Student Help	2,750			
Repairs	500			
Equipment	5,500	$152,600		
Materials & Supplies	22,000	$19,800		
Third Party Testing	8,000			
Printing	3,000			
Travel	2,500			
Other direct cost			$44,000	
Indirect Cost	71,874			

Note – The funding request is for **two years and six months** project duration

Please use the space below to justify project associated expenses, and discuss if less funding is available than that requested, whether the project's objectives will be unattainable or delayed.

CONFIDENTIAL INFORMATION

Any information in the application that is entitled to confidentiality and which the applicant wants to be kept confidential should, if possible, be placed in an appendix to allow for administrative ease in protecting the information from public disclosure while allowing public access to the rest of the application. Such information must be clearly labeled as confidential and the applicant must provide all required information set forth in NDCC 54-63-02. If there is no confidential information please note that below.

- The proposal does not contain any confidential information.

PATENTS/RIGHTS TO TECHNICAL DATA

Any patents or rights that the applicant wishes to reserve must be identified in the application. If this does not apply to your proposal, please note that below.

- At this point of time the investigators don't anticipate any patent or rights from this technology.

ATTACHMENTS:

Appendix A. References
Appendix B. Company Profile and Products - Woodshed Renewables
Appendix C. Wood Renewables Market Research Analysis
Appendix D Pellet Fuel Characteristics
Appendix E. Biographic Sketch of Investigators
Appendix F. Letter of Support from NDSU
Appendix G. Budget Justification

Appendix A. - References

[1]. International Renewable Energy Agency. 2012. A Report -Renewable energy technologies: cost analysis series – Biomass for Power Generation, Vol 1. Power Sector, Issue 1/5.

[2]. Portz, T. 2014. A Giant Step. Biomass Magazine, March 2014. BBI International, Grand Forks, ND.

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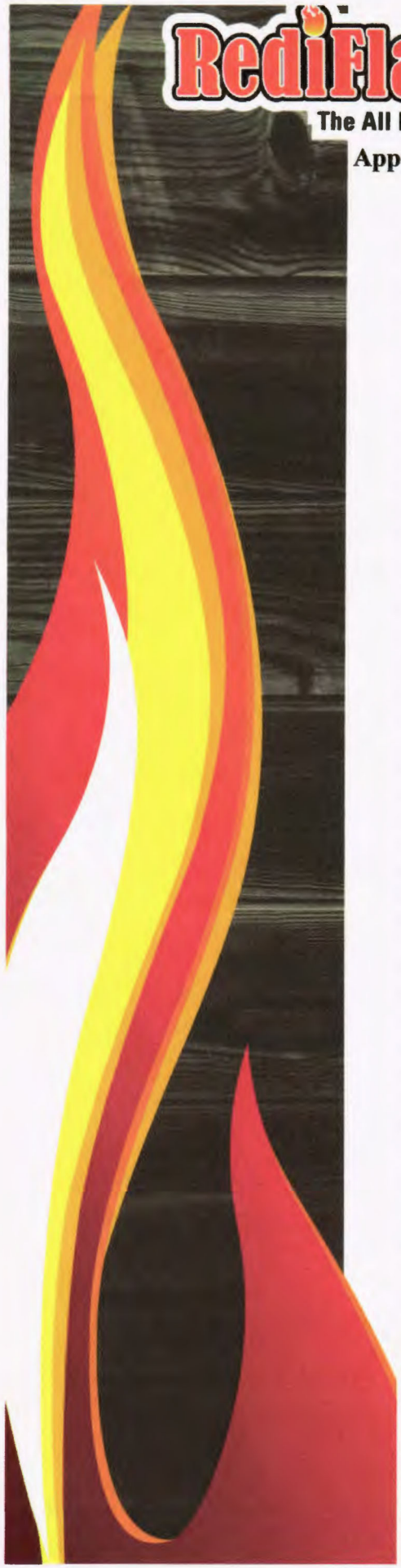


Appendix B. - Company Profile and Products - Woodshed Renewables

Company Overview and Products

Woodshed Renwables, LLC was organized in January, 2013 and is registered and located in Finley, North Dakota. Woodshed Renewables purchased the assets of Green Tree, LLC acquiring the RediFlame, RediLight and Skeeterlog trademarks, intellectual property, patents, products and technology at that time.

Woodshed Renewables intends to continue production in Finley, North Dakota and will focus on manufacturing all-natural compressed fireplace logs, the Skeeterlog, a hickory flavored barbeque griller, and fire starters. The RediFlame fireplace log is an eco-friendly alternative to wax and petroleum-based fire logs. Plus, unlike competitive products RediFlame logs emit no harmful chemicals when burning, making them safe for use in cooking food, indoor or closed fireplaces and stoves.

RediFlame introduced the environmentally friendly Hickory Flavored Wood Griller, a charcoal substitute perfect for grilling at home, at tailgate parties, camping, or anywhere.

RediFlame launched a revolutionary 100% all natural insect repellant called the Skeeterlog, in 2012. It is a registered trademark, effective in repelling flying insects when placed on the perimeter of a campfire, fire ring and allowed to smolder or in the new Chiminea Kit. The Skeeterlog is an ecological, biological safe product made from all-natural wood and eight natural essential oils proven to repel flying insects.

RediFlame launched fuel pellets and animal bedding pellets late in 2013 and has positioned its products for year-round sales, not just a seasonal heat source which level loads the factory production. By adding a new heating pellet of agricultural crop residue blended with wood, RediFlame products will produce 40,000 tons of finished products by 2017. Hardware, Farm and Fleet, Lawn and Garden Retailers will be offered a broader range of products to be ordered from a single source enhancing the service position delivered by RediFlame while maximizing freight to the end customer.

Get-to-market Strategy

RediFlame reaches consumers or buyers through a broker, Heartland Energy Systems (HES), who in turn contracts the products to grocery stores, convenience stores, home improvement and hearth stores, hardware, farm and fleet and camping and outdoor stores. To reach consumers, RediFlame will use in-store displays, seasonal promotions, Internet advertising, and referral marketing to expand its market penetration. To reach new business contacts and potential retailers the HES will attend national trade shows, continuing to build the broker network, and expand the use of social media. For larger commercial or ag accounts, RediFlame will market pellets on a business to business direct sale model.

Company Management

Woodshed Renewables, LLC is led by David Fiebelkorn, Chairman, CEO and President. Fiebelkorn is a proven leader in successful turn-arounds acquisitions that focus on growth, restructuring and repurposing of manufacturing facilities in particular plants that focus on compressed fiber technology. He has spent the past ten years in the renewable fuels production, sales and marketing of compressed fuel and heating appliances. He has experience with producing and selling blended fiber products. Woodshed Renewables, LLC. has been instrumental in previous plant reorganization and production start-ups in three other pellet plants and will shorten the production cycle to market, focus on cost containment and customer service at the Finley site.

Company Ownership

Woodshed Renewables, LLC is owned by Somewhat Relatives, LLC of North Dakota (50%) and Duke Equity Partners, LLC of Minnesota. (50%).

Appendix C. - Wood Renewables Market Research Analysis

(CONFIDENTIAL AND PROPRIETARY INFORMATION)

HEARTLAND ENERGY SYSTEMS – Business Plan

FINLEY, NORTH DAKOTA

I. Executive Summary

Heartland Energy Systems, Inc. (HES) was created by David Fiebelkorn and Allan Beyer to fulfill a market need in the Midwestern United States for biomass energy solutions in the agriculture sector. The poultry industry will be the initial market entry point because the greatest demand for alternative fuel exists in this channel. HES' experience in the poultry industry will develop and allow HES to expand into the commercial, government and greenhouse market channels.

HES has developed a business plan for distributing renewable biomass pellet fuel to the Midwestern region's poultry, commercial and agriculture market base. The business plan recaps extensive market research, showcases HES's market entry plan (including the SPI Projections by month), and details HES value added service, install, and logistics approach as an HHT Distributor.

Allan Beyer is an experienced financial officer with experience in numerous product markets. Allan's successful track record, in businesses ranging from small, family owned entrepreneurial companies up to publicly held, middle market, multi-line manufacturing companies is a huge asset to HES. His ability to develop accurate financial projections and his discipline to control performance to those projections will be integral to the success of HES.

In conducting market research, HES utilized a variety of methods and sources to determine market potential, demand, and sustainability. USDA government and trade group data, university research, and individual grower interviews were used to estimate the size of the poultry market. The largest density of barns is located in Central Minnesota and Western Wisconsin. The region boasts the leading turkey and egg producing states in the country, Minnesota and Iowa, respectively. After reviewing farm, energy, and production reports, HES estimates that there are approximately 4,100 poultry barns in the Midwestern United States. The average poultry barn has the potential to install two furnaces resulting in a potential poultry furnace market of approximately 8,200 furnaces.

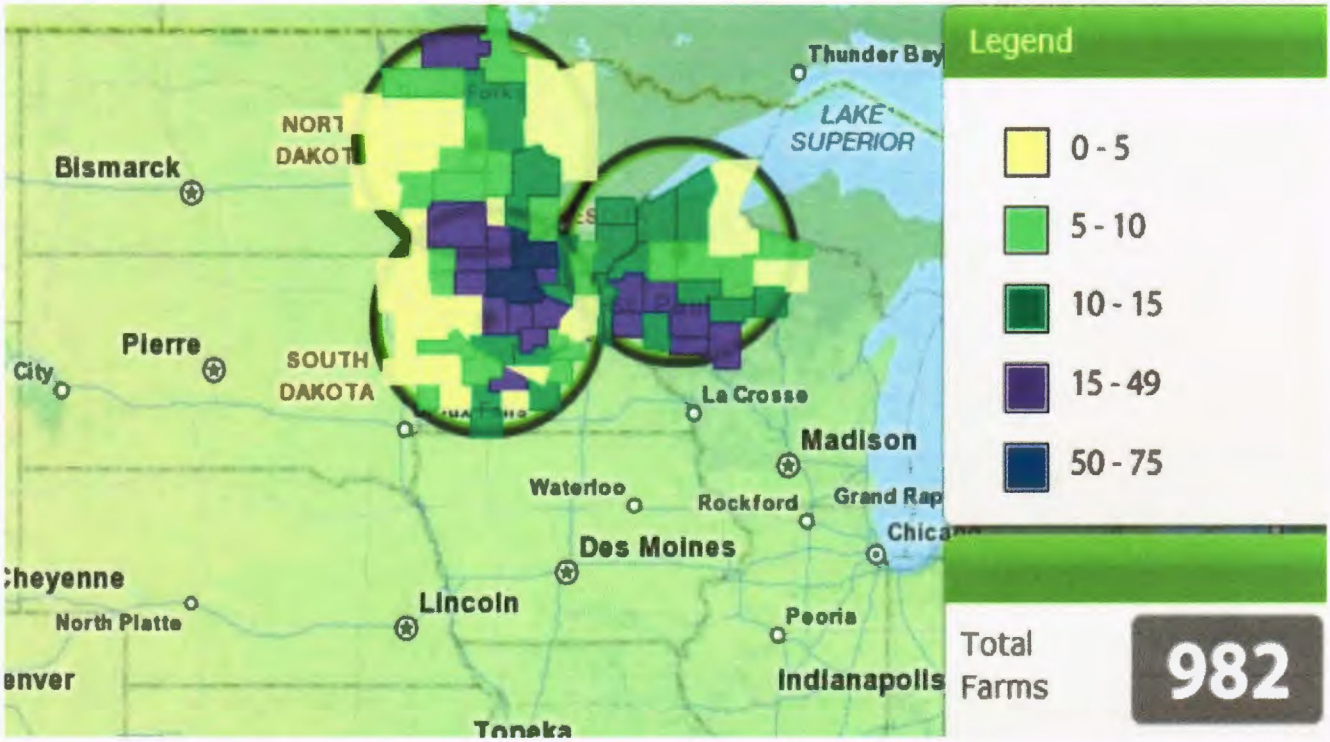
HES's market entry plan is focused on an initial 5.5% adoption rate in the Minnesota, North Dakota and Western Wisconsin region. Outside this region, HES is estimating an initial 2.5% adoption rate. The HES marketing plan has identified two potential segments of the poultry industry: the large corporate farms (J-OTS, Gold'n Plump, Turkey Valley Farms, Northern Pride, Dakota Provisions) and contract growers for the previously mentioned processors. The sales approach at HES will be to market the fuel pellets through existing furnace channels through direct sales contact. The appliance Lake Falls, MN) and Central Boiler (Greenbush, MN) are anxious to provide sales leads as the lack ofr fuel hampers their sales efforts for the appliances.

Heartland Energy Logistics (HEL) will ensure a reliable supply of fuel pellets for all appliance customers. HEL will focus on providing a low-cost pellet with timely deliveries, driving payback for appliance customers.

II. Market Entry Plan

HES will market the ag blended pellet directly to the agricultural producer. HES will go to market with a one step distribution model for the sale, delivery and service of the supply of pellet fuel. HES's market entry plan for the Midwest distribution region will be a two-pronged approach. The poultry industry in the upper Midwest is largely consolidated to major integrated processors and smaller contract growers for those larger processors.

Developing demonstration sites will be essential in solidifying early adoption with corporate farms. Early adoption at corporate farms should lead to additional interest with farmers in the industry. Locations identified as targeted demonstration sites are: Gold-n-Plump Corporate, Jennie-O Turkey Store (MN & WI divisions), and Gorans Brothers Farms in Svea, Minnesota.



In addition to the primary efforts focused around the identified pellet supplier channel partners, HES will coordinate efforts to drive sales in Iowa with the support of the Ag Ventures Alliance group who has significant inroads with the Iowa egg layer market. Additional sales could originate in South Dakota, where production is limited primarily to the Dakota Provisions group of Hutterite turkey growers. Another map showing the three primary channel partners and a fourth secondary channel partner would provide adequate coverage for the South Dakota

producers and western portions of Iowa.

The areas outside of the primary market area offer opportunity at a lower adoption rate. It is estimated that an additional 2,900 potential furnace sales exist in the Dakota's and Iowa. A reduced ROI for the Iowa egg layer barns results in a 2.5% initial adoption rate outside the primary market area. This translates into 85 furnace installs to this market area in the first 16 months.

III. Sales, Production, Inventory (SPI) Projection

The SPI projection is based upon sales of appliances over the next three years with the commitment of fuel availability.

Pellet demand is based upon anticipated heating needs in the Midwest market. The highest ROI projects are brooder barns where temperatures need to be maintained at 90+ degrees Fahrenheit year-round. The Eco BIO-500F pellet-burning furnace can consume 40-80 pounds of pellets per hour. Utilizing 24 hour operation, this is 0.475 to 0.95 tons per day per furnace. The following chart shows the anticipated pellet demand per day per furnace for each month of the year.

Month	Jan 12	Feb 12	Mar 12	Apr 12	May 12	June 12	July 12	Aug 12	Sept 12	Oct 12	Nov 12	Dec 12
Pellets/day	.85	.85	.70	.50	.30	.20	.15	.20	.30	.50	.70	.85

Pellets are anticipated to be supplied by three primary channel partners and additional secondary channel partners as opportunity dictates. The projection anticipates providing pellets based on the following percentages from the three primary channel partners:

Facility	Percentage	Purchase Price	Freight	Sales Price
Finley, ND	76%	$115.90	$45.00	$160.90
Hayward, WI	5%	$118.75	$15.00	$140.00

The gross margin on pellet sales was estimated at a conservative 5%. The addition of an ag blended pellet should increase the availability of feedstocks, lower production costs and increase the margins. Logistics efficiencies and bulk purchasing leverage should increase over time, the initial goal is to drive payback to the grower and thereby increase pellet sales. HEL's supply chain system will strive to remove non-value added costs, thereby accelerating the appliance payback driving additional sales.

Appendix D. - Pellet Fuel Characteristics for Residential/Commercial Market

	Residential/Commercial Densified Fuel Standards See Notes 1 - 3		
Fuel Property	PFI Premium	PFI Standard	PFI Utility
Normative Information - Mandatory			
Bulk Density, lb./cubic foot	40.0 - 46.0	38.0 - 46.0	38.0 - 46.0
Diameter, inches	0.230 - 0.285	0.230 - 0.285	0.230 - 0.285
Diameter, mm	5.84 - 7.25	5.84 - 7.25	5.84 - 7.25
Pellet Durability Index	≥ 96.5	≥ 95.0	≥ 95.0
Fines, % (at the mill gate)	≤ 0.50	≤ 1.0	≤ 1.0
Inorganic Ash, %	≤ 1.0	≤ 2.0	≤ 6.0
Length, % greater than 1.50 inches	≤ 1.0	≤ 1.0	≤ 1.0
Moisture, %	≤ 8.0	≤ 10.0	≤ 10.0
Chloride, ppm	≤ 300	≤ 300	≤ 300
Heating Value	NA	NA	NA
Informative Only - Not Mandatory			
Ash Fusion	NA	NA	NA

Reference - PFI Fuel Grade Requirements (June 2011)

Appendix E. *Curriculum Vita*

DILPREET S BAJWA
Associate Professor, 120A CME, Department of Mechanical Engineering
North Dakota State University, Fargo, ND 58108
Tel. (701) 231-7279 Fax. (701) 231-8913 Email: dilpreet.bajwa@ndsu.edu

PROFESSIONAL PREPARATION:

B.S. - Punjab Agricultural University, India - January 1991, Forestry and Natural Resources

M.S. - University of Illinois at Urbana-Champaign, 1996, Wood Science and Technology

Ph.D. - University of Illinois at Urbana-Champaign, 2000, Wood Science and Technology

APPOINTMENTS:

Associate Professor, Department of Mechanical Engineering, North Dakota State University, Fargo, ND. April 2012
Consultant, Greenland Composites Inc., and HCC Brand, Fayetteville AR. February 2012
Adjunct Professor, Department of Biological and Agricultural Engineering, University of Arkansas. December 2010 to February 2012.
Director, Research and Development. Greenland Composite Products Inc., and HCC Brands, Fayetteville AR. July 2005 to February 2012.
Director of Research and Development. Epoch Composite Products Inc., Lamar, MO. December 2003 – May 2005.
Research Scientist. Quality and Process Improvement. Coates Technical Center, Masonite International Corporation, West Chicago, IL. April 2002 – December 2003.
Senior Product Development Engineer. Engineered Wood Products Division. International Paper Company, Loveland, Ohio. July 2000 – December 2002.

RESEARCH INTERESTS

Research interests include characterization and processing of agricultural biomass, densified biomass products, composite materials, bio-waste for energy applications durability engineering.

CURRENT BIOMASS ENERGY PROJECTS

Value Added Use of Cotton Ginning Byproducts – Fire log
Firelog and Fuel Pellets – Value Addition to Cotton Byproducts

PUBLICATIONS (~16 Peer-reviewed papers and 28 conference presentations):

Bajwa, S. G., D. S. Bajwa, and G. Holt. 2011. Commercial application of cotton burr/stem and module wrap in thermoplastic composites: Effect of scaling from laboratory to commercial. *Journal of Thermoplastic Composites.* (Submitted)
Bajwa, S. G., D.S. Bajwa, and G. Holt. 2009. Optimal substitution of cotton burr and linters in thermoplastic composites. *Forest Product Journal* 59(10): 40-46.
Bajwa, S. G., D.S. Bajwa, and G. Holt. 2008. A novel filler for natural fiber polymer composites from cotton gin waste. *Tenth International Conference on Progress in Biofibre Plastic Composites.* May 12-13, 2008. Toronto, Canada.
Nakayama, F. S., S. H. Vinyard, P. Chow, D. S. Bajwa, J. A. Youngquist, J. H. Muehl and A.M. Krzysik. 2001. Guayule as a wood preservative. *Industrial Crops and Products* 14(2):105-111.

Authored several chapters in books on the utilization of natural fibers for composite materials.

David G. Ripplinger

Curriculum Vitae

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614F Barry Hall
North Dakota State University
Fargo, ND 58108

Phone: (701) 231-5265
Fax: (701) 231-7400
Email: david.ripplinger@ndsu.edu

Education

Ph.D.	Transportation and Logistics, North Dakota State University	2012
M.S.	Agricultural Economics, Iowa State University	2003
B.S.	Agricultural Economics, North Dakota State University	2001

Professional Experience

Assistant Professor and *Bioproducts/Bioenergy Economist* Department of Agribusiness and Applied Economics North Dakota State University	November 2012 -
Research Scientist Department of Agribusiness and Applied Economics North Dakota State University	January 2011 - October 2012
Associate Research Fellow Upper Great Plains Transportation Institute North Dakota State University	2004 - 2010

Memberships:

Agricultural & Applied Economics Association

Western Agricultural Economics Association

Transportation Research Board

Transportation Research Forum, Vice President-Programs 2012-2013

Grants and Contracts

Co-PI: Department of Energy, competitive grant, "Development of High-Output, Low-Input Energy Beets", 2013-2015, $1,800,000 ($238,000 to NDSU; NDSU Lead).
Co-PI: Renewable Energy Council, competitive grant, "Bioenergy Trading Educational Program", 2013-2016, $500,000 (Bill Wilson, PI).

Refereed Publications

Maung, T.A., Gustafson, C.R., Saxowsky, D.M., Nowatski, J., Miljkovic, T., and D. Ripplinger. 2013. The Logistics of Supplying Single vs. Multi-crop Cellulosic Feedstocks to a Biorefinery in Southeast North Dakota. *Applied Energy,* Vol 109, 229-238.

Mattson, J., and D. Ripplinger. 2011. Marginal Cost Pricing and Subsidy of Small Urban Transit, *Transportation Research Record: Journal of the Transportation Research Board,* No. 2274, 77-83.

Mattson, J., Peterson, D., Ripplinger, D., Thoms, J., and J. Hough. 2010. Assessment of Demand for Rural Intercity Transportation Services in a Changing Environment. *Transportation Research Record: Journal of the Transportation Research Board,* No. 2145, 108-114.

Ripplinger, D. 2010. Classifying Rural and Small Urban Transit Agencies. *Transportation Research Record: Journal of the Transportation Research Board,* No. 2145, pp. 100-107.

Manuscripts and Research Reports

Maung, T., Ripplinger, D, McKee, G, and D. Saxowsky. 2012. Economics of Using Flared vs. Conventional Natural Gas to Produce Nitrogen Fertilizer: A Feasibility Analysis. Departmental Paper 699. Department of Agribusiness and Applied Economics, North Dakota State University, Fargo, N.D..

Kantor L., Lino M., and D. Ripplinger. 2001. Using USDA's Thrifty Food Plan to Assess Food Availability and Affordability. *Food Review*, Economic Research Service, Vol. 24, No. 2, pp. 45-53.

Book Chapters

Maung, T. A., C. Gustafson, B. McCarl, D. Ripplinger and D. Saxowsky. 2013. "Economics of Biomass Feedstock and Biofuels." *Biofuel Crop Sustainability*. Singh, B.P (editor). (Chapter 13). Wiley-Blackwell publishing, Hoboken, New Jersey, USA.

DAVID FIEBELKORN

Curriculum Vitae

9967 380th St; St. Joseph, MN 56374 (320) 267-2152 davef@rediflame.com

M&A / Cost Reduction / Outsourcing / International Supply Chain / Organizational Improvements

P&L / Turnarounds / Strategic Planning / Operations / Labor Relations / Negotiations / Startups

Rapid growth, startup and turnaround specialist with extensive experience and accomplishments in maximizing return to shareholders through the continued growth of sales and gross margins. Seasoned strategist with a proven ability to find unique solutions and new markets in troubled times and non-executing organizations. Demonstrated change agent and problem solver. Extensive international experience.

- **Currently leading factory start-up for biomass fuel plant in North Dakota.**
- **Forged strategic supply chain alliances with manufacturers in China for pellet fuel industry.**
- **Led Minnesota Valley Alfalfa Producers to successful profit growth through lean principles.**
- **Led planning and design process flow to co-produce feed pellets and biomass pellets.**
- **Completed research on producing ag-blended fuel pellets through an XCEL energy grant**

Key Skills: Proven record of execution. Successful and prudent risk taker. Seasoned competitor. Results oriented. Exceptional people skills. High achiever. Articulate coach and leader. Strong oral and written communication skills. Outstanding team player. Self-motivated. Energetic. Action oriented. Lead by example.

BS, Saint Cloud University.

SELECTED ACCOMPLISHMENTS

Currently Chairman/CEO of Woodshed Renewables, LLC leading plant redesign and start-up and the market development to manufacture biomass fuel pellets. Developing business plan, securing capital, creating new sales channels, contracting raw material supplies, organizing supply chain logistics, selecting and hiring key operations personnel, laying out and organizing manufacturing mill/s according to Lean manufacturing principles. Joined firm as partner. Challenged to startup and grow biomass business. To find acquisitions or build new facilities. Lead SWOT exercise at the Partner level. Create three year strategic plan targeting growth, EBITA and return on equity for investors. Drive senior executive accountability.

Forged strategic alliances with manufacturers in China for HHT. Company wanted to establish global sourcing strategy with Asia. Relocated to China. Collaborated with local sourcing and QA teams to evaluate suppliers and establish quality control plans. Requested RFP's. Completed design reviews and first article submittals. Wrapped up negotiations. Achieved cost savings of $8.6M in 13 months, identified additional $14M for 2007.

Led R.A. Morton & Associates to a 16% profit increase through lean principles. Joined firm as partner. Challenged to grow business 22% to fund acquisition. Led SWOT exercise. Created three year strategic plan to grow market penetration using the Construction Manager delivery system, improved EBITA and reduced turnover.

Turned around and sold KOMO at substantial return. Company needed a change agent in their $1.6M Automation Business Unit to implement LEAN and Rapid Continuous Improvement practices. Promoted to President / CEO. Took aggressive action to complete the implementation of RCI practices. Identified areas responsible for unacceptable financial performance. Created team to take organization through successful sale.

Grew door sales 19% in 18 months for AJ Manufacturing. Company was in financial trouble. Led strengths, weaknesses, opportunities and threats (SWOT) exercise to determine positioning. Obtained grant from state of Wisconsin to fund hiring. Implemented Rapid Continuous Improvement (RCI) principles with focus on value stream mapping, reducing waste and root cause analysis of warranty customer calls. Raised production from 72 doors per day to 532 doors per day. Cut raw material costs by 28%.

CAREER SUMMARY

Owner & CEO, 3D Business Systems. Independent consulting firms focused on the renewable biomass fuel market for the past ten years. Acquired, restarted closed pellet operations in three different states. Provided leadership in design, engineering, research and product development of renewable fuels. Currently developing makets for various forms of pellets.

Asian Product Sourcing Manager / Materials Manager, Hearth & Home Technologies (HHT), 2001 to 2006. Established process control and procedures for International Procurement function. Oversaw entire supply chain for Quadra-fire Division including raw materials, distribution and warehousing, MRO and transportation. Managed budget of $26M and staff of 42 for this $85M Home Patio, Hearth and BBQ organization.

President & Owner, R.A. Morton & Associates, 1998 to 2000. Oversaw all operational functions including P&L, growth and profitability as well as strategic planning for this $1.6M Construction Management firm. Managed budget of $15.5M and 16 employees. Grew strong banking relationships.

President & CEO / Business Unit Leader, KOMO Machine, 1996 to 1997. Responsible for all P&L for this $46M machine tool manufacturing organization. Refinanced operating LOC with lender. Reduced warranty and customer service dollars and grew revenues. Managed $46M budget and staff of 8. Sold company at a profit.

Earlier: General Manager – Partner, AJ Manufacturing Company. **President & CEO,** 3D Business Systems. **Director of Operations,** Frigidaire Freezer Division.

Appendix F. Letter of Support from NDSU

NDSU NORTH DAKOTA STATE UNIVERSITY

GRANT APPLICATION TRANSMITTAL

This page indicates university endorsement of the referenced proposal and is intended to be submitted to the sponsor organization.

Sponsor Organization:	ND Industrial Commission/Woodshed Renewable, LLC
Project Title:	*Application of Agricultural Byproducts for Energy Systems*
Project Director:	David Ripplinger
Department:	Agribusiness and Applied Economics
Project Budget:	
Total Direct Costs	$ 165,219
F&A/In-direct Costs	$ 71,874
F&A/IDC Rate 45%	
Total Requested	$ 237,093
Authorized University Representative:	Amy Scott
Title:	Assistant Director for Sponsored Programs Administration
Address:	North Dakota State University NDSU Dept. 4000, PO Box 6050 Fargo ND 58108-6050
Phone:	(701) 231-8045
Signature:	Amy B. Scott
Date:	5-2-14

Any future notifications regarding this proposal, including award notices, should be directed to the authorized university representative at the address listed above.
Thank you.

SPONSORED PROGRAMS ADMINISTRATION
NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8045 | Fax 701.231.8098 | ndsu.research@ndsu.edu
Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102

Appendix G. Budget Justification

North Dakota Industrial Commission Proposal – Budget Justification

David. Fiebelkorn, Bajwa, D. S., Ripplinger, D

Amount requested from NDIC: $237,093 (For 2 years 6 months)

Salaries

One PI (D. Bajwa) will work for 1 week in year 1 and 2 weeks in year 2 for supervising the graduate and undergraduate student and analyzing all the results and report preparation. The salary will be $7,225.

One graduate student will work on material characterization and formulation development and data analysis in year 1, in year 2. The salary is $18,500 in year 1 with 3% salary adjustment the next two years. $37,550

One postdoc will work 6 months for David Ripplinger per year for two years. The salary including 35% benefits for two years. $54,000

One undergraduate student worker will assist the graduate student with sampling and data entry for 250 hours a year @ $10/hour for2 years. $2,500.

Fringe Benefits

Fringe benefits are computed at 30% for PI, 3% for graduate student, 35% postdoc and 10% for undergraduate student. $22.444

Total Salaries and Fringe Benefits **$123,719**

Equipment

In year 1, one lab scale pelletizer will be purchased **Total equipment** **$5,500**

Materials & Supplies

Durability Test Apparatus: $1,700
Raw Materials: $2,300
Lab Supplies: $1700
Moisture Tester: 2,500
Screens: $300
Chemicals: $1,500
Data Scanner $12,000

Total Materials & Supplies **$ 22,000**

Travel

In state travel consists of six trips in year 1 to collect raw material and visit the industrial plant for identifying the processing equipment and raw material characterization. In the 2nd year 4 trips are planned for running trails at the industrial partner's facility. The cost of 10 trips @ $250 per trip for two

person based on the following estimates: ($100 transportation, $50 meals, hotel stay @ $100 per night per trip).

Total travel	**$2,500**
Third party laboratory testing for air emissions, product certification	**$8,000**
The cost of to conduct two surveys	**$3,000**
Equipment Repair	**$500**
Total operating costs	**$34,000**
Total Direct costs (Salaries, FB, & Operating)	**$157,719**
Facilities and Administrative Costs (45%)	***$71,874***
Total Request (NDSU Part)	**$237,093**

Woodshed Renewable LLC. Matching Funds:

Total Industry Match: $401,139
Total in-kind match from Woodshed Renewable.: $228,739
Total cash match from Woodshed Renewables: $172,400

Salaries and Fringe Benefits

Key Personnel – David Fiebelkorn year 1-2	**$125,099**	
This is calculated at		
620 hours for David Fiebelkorn Year 1 at $67/hour for year 1		**$41,540**
760 hours for David Fiebelkorn Year 2 at $69/hour for year 2		**$52,447**
438 hours for David Fiebelkorn Year 3 (six months) at $71/hour		**$31,112**
Sub-Total		**$125,099**

adjustment assumed for year 2 of 772 hours.

Plant Manager & other production staff years 1-2	**$59,640**

Plant Manager's time is calculated at @ $29/hour for 526 hours in year 1 ($15,254), and 821 hours per year with a 3% inflation adjustment in years 2 ($23,809)

One plant production @ $19/hour for 421 hours ($7999), and 662 hours in year 2 ($12,578)

Total Salaries & Fringe Benefits **$184,739**

Equipment

Existing pellet Mill equipment modifications at Woodshed Renewables plant **$143,600**

Modifications to existing plant related to.....

a.	Purchase of a Commercial Scale Pellet Mill (Andritz Sprout LM-26) -	**$129, 000**
b.	Material Handling Equipment -	**$8,000**
c.	Pellet dies and rollers	**$6,600**
d.	Installation and start-up	
	Sub-Total:	**$143,600**

Equipment-PLC **$4,700**

Plant Safety **$4,300**

$152,600

Materials & Supplies

Materials Purchase by Woodshed Renewables (Agricultural Byproducts) **$19,800**

Year 1: 4 truckloads (18 tons) of byproducts @ $1800/truck. Year 2: 7 truckloads @ $1800/truckload) for materials of wood and agri-byproducts. Supplies will be bought on the basis of availability and need.

Other Direct Costs

Equipment and Plant Time **$44,000**

In kind support from Woodshed Renewables LLC for use of plant and equipment time. The estimated cost of plant & equipment use time together is $350/hour for 40 hours in year 1 ($14,000), and 85.7 hours in year 2 ($30,000).

Total Industry Match **$401,139** **Total Project Cost** **$632,732**

October 13, 2014

Woodshed Renewables, LLC
116 Industrial Drive
Finley, North Dakota 58230

Ms Andrea Holl Pfenning
Program Administrator
Energy Outreach & Special Programs
ND Department of Commerce
1600 East Century Avenue, Suite 2
PO Box 2057
Bismarck, ND 58502-2057

Re: NDIC Grant
ND tax liability affidavit

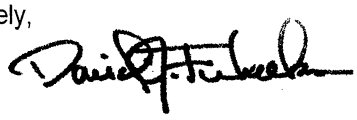
Dear Ms Holl Pfenning:

I, David Fiebelkorn, state that Woodshed Renewable, LLC does not have any tax liability owed to the State of North Dakota or any of its political subdivisions.

If you have any questions or need additional information, please feel free to contact me.

Thank you.

Sincerely,



Dave Fiebelkorn
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Woodshed Renewables, LLC
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Email: davef@rediflame.com