EXECUTIVE SUMMARY

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SECTION 1: Introduction

The Problem

- Current energy demands and policy place a great strain on the already declining U. S. agricultural industry.
- **Demand for energy in U.S. will only increase.** The priority will always be on the city (more people and more money), and although plans are in place, they are inadequate for the nation, much less the landowner.

What Needs to Happen

- The U.S. agricultural industry must be able to supplement and ultimately produce its own power.
  - The landowner understands his business, but he needs to have some control over the variables and uncertainty of future energy costs.
  - Vertical integration of the landowner's agri business should include crop science and technology that would ultimately generate clean and sustainable energy.
- A new energy technology must be implemented that will **manage** the changing economics of energy.
  - A change in the way farming is conducted is not only required, but mandatory for survival.
  - Emerging technology holds the key to producing clean and sustainable energy as well as managing variable costs.

What Is Already Happening

- Alders Farms (AF) has already implemented wind monitoring programs for the last 5 years. The results of these programs led to the development of the generating side of the proposed technology. The installation of the first 50 kW wind turbine in nearing completion.
- The market is ripe for this kind of technology: ADM, Cargill, and even President Bush are pushing for this kind of technology.
  - "…Agriculture is the key to sustainable global growth." From ADMWorld.com
  - "…enriching the neighboring communities' quality of life through appropriate programs and projects." From Cargill.com
  - "…it makes sense to have our farmers growing energy, so that we don't have to import it from parts of the world where they may not like us too much. And it's good for our environment, as well." President George W. Bush, President Bush Discusses United States International Development Agenda, Ronald Reagan Building and

International Trade Center, Washington, D.C.,
http://www.whitehouse.gov/news/releases/2007/05/20070531-9.html

Alders Farms Proposes a Segment of the Needed Energy Solution

AF has a patentable modular bio-hybrid energy component that decreases landowner production costs and works with the natural bio processes.

- The system repurposes existing organic residue from the normal growth cycle. Energy crops are grown and then fermented and digested, producing usable bio-methane (used for fuel), along with digestate and nutrient-rich water (used for fertilizer).
- Farmers can create energy onsite as well as enhance their growing process, thereby decreasing the overall cost of production due to control over certain variables.
- The combined technologies utilized within the proposed project will deliver fuel gas that is clean, renewable and efficient. This fuel can be used for the generation of heat and electrical energy on a commercial and utility scale.

Alders Farms Request

AF wants to take a proven, successful process and make it useful and profitable on the commercial level through additional funding. This funding will:

- Accelerate technology by building a proto-type of the modular conversion concept so that the mechanism and related infrastructure can be more quickly developed.
- Provide access to funds for services normally unavailable (such as agricultural economists, pathologists, physiologists, etc.).
- Develop, evaluate, and document a system of guidelines for the commercial practice.
- Through continuing education, inform the public.
- Promote sustainable and economically viable agricultural technologies.

SECTION 2: Economic Considerations

With this new technology, farmers can produce their own energy (both heat and electrical). Through cooperative exchange, at times during excess farmers can sell that power, or conversely purchase it as well.

Variables include:

- Immediate cost savings (reduction of electricity, fertilizer, diesel, etc. costs)
- Profit can be obtained from sales
- Cost savings of purchasing the electricity when needed
- Overall reduction in energy unit cost, given that others will enter this market space as well
- Decrease in cost of equipment, given that others will enter this market space as well
- Value in helping the environment (reduced CO_2 expense, cap-and-trade, offsets, energy balance, etc.)
- Future value, return on investment, ad valorum, replacement costs, etc.
- To what extent does implementing bio hybrid energy cycle affect the landowner's primary business

How do we incorporate environmental stewardship into the lowest cost?

- If the technology is to be viable, then it needs to break some of the conventional norms. **This technology shifts the purveyor of energy from the utility company to the farmer.**
- If a paradigm shift in energy is to be invoked, it must show value. We are advocating simply using an agricultural cycle or an extension of it. The true cost of operation must be calculated.

We will seek guidance from Dr. Michael H. Lou, professor of agricultural sciences at Sam Houston State University, an expert in the field of agricultural economics of anaerobic digestion, for the development of the business plan. The true cost and risk assessment of this proposed agricultural cycle will be an integral part of the business plan.

We will include multiple technical resources from the Texas AgriLIFE Research and Extension Center at Beaumont for the development, life cycle planning and the economic evaluation of the proposed project.

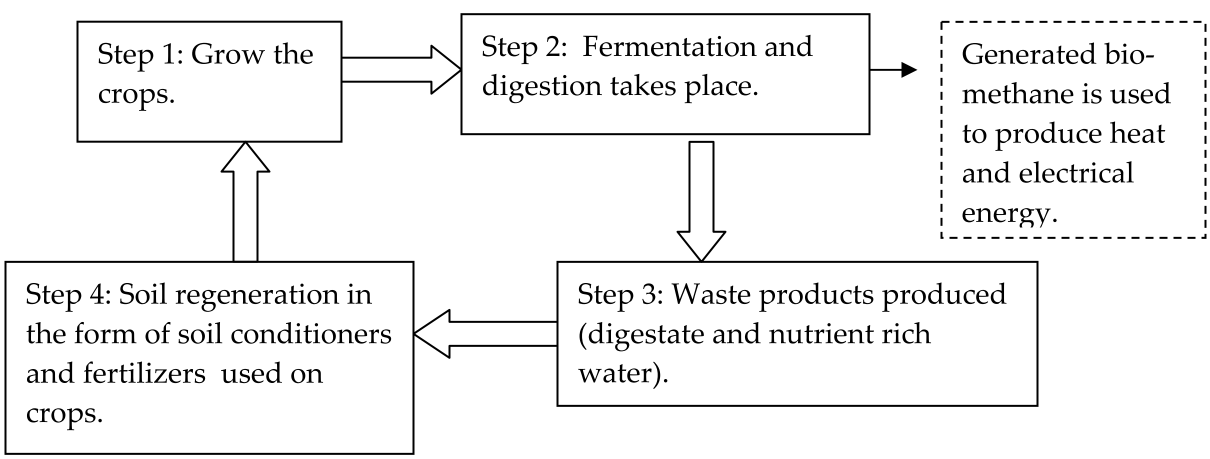
SECTION 3: Environmental Considerations

- The hydrocarbon footprint is reduced.
  - Anaerobic digestion is carbon neutral.
  - Growing plants absorb CO2.
- The process is a closed cycle with a biodegradable waste stream.
  - Waste water/digestate becomes fertilizer and goes back into the growing cycle in the form of soil regeneration.
  - Waste heat is used to sustain the bacteria.
- The process uses a hybrid stream of Green energy.
  - Wind energy (electricity)
  - Bio mass energy (bio-methane)
- The biological cycle will not be changed, only enhanced.
- Local use reduces conventional energy transportation costs.

SECTION 4: Bio-Hybrid Energy Cycle (BHEC) Process and Technology Overview

Cycle Process

The following graphic provides an overview of BHEC.



The cycle will make up a biological flywheel containing the BHEC process, patent application disclosed, patent pending.

The process begins with (step 1) growing genetically modified plants for enhanced cellulose production; (step 2) using fermentation and anaerobic digestion to produce bio-methane; (step 3) remediating the residue into biologically stable soil conditioners; and (step 4) the application of the residue as soil conditioners.

Additionally, the bio-methane can be used as a fuel in place of propane or other hydrocarbons for the generation of heat or electrical energy.
As a added benefit, the growing plants absorb more greenhouse gases (CO2) than the combustion of the bio-methane. Producing fuel, fertilizer, and energy locally lessens the environmental impact of importing those products. The use of bio-methane ultimately produces fuel, fertilizer and promotes local energy efficiency by eliminating grid loss.

Technical Explanation

1. **The Growth Cycle** is the germination, planting, harvesting and conversion of genetically modified, plant structures that contain high levels of carbohydrates specifically grown for the production of biogas through cellulolysis derived from symbiotic anaerobic bacteria.
   - Cellulose is the most common organic compound on Earth. Approximately 33 percent of all plant matter is cellulose.
   - This abundant supply of renewable organic mater could be transformed into clean heat and electrical energy.

2. **The Conversion Cycle** has two steps: (1) the production of silage and the associated fermentation. **Fermented silage is "banked fuel storage"** and (2) the deployment of an anaerobic digester to convert the mix stream of organic material to biogas.

   Silage Production
   During step 1, the ensiled organic mass retains a larger percentage of its nutrients through preservation by anaerobic fermentation. This fermentation process allows for the long term storage of organic material with maintained moisture content of 50 to 70%. This storage function allows the feed stock for future bio fuel production to be "banked" according to annual use rates. This is a unique and patentable feature of the (B-HEC) system.

   Conversion of Organic Materials to Bio Gas
   During step 2, an anaerobic digester converts the mix stream of organic material to bio gas. Anaerobic digestion is defined as a renewable energy source subsequent to the bacterial hydrolysis of organic polymers such as carbohydrates.

   The corresponding biological degradation produces acidogenic, acetogenic and methanogenic bacteria. Methanogenic bacteria are capable of converting acetic acids into bio-methane and carbon dioxide. This organic stream of produced bio-methane is suitable for heat and electrical energy production. This renewable energy source can supplement and eventually replace fossil fuels used in most rural electrical generation systems.

   The utilization of anaerobic digestion will reduce the production of green house gases by:
   a. Current supplement and future replacement of fossil fuels
   b. Reduction of bio-methane emissions
   c. Displacing industrial produced chemical fertilizers
   d. Reducing electrical grid transportation losses
   e. Provide carbon neutral power production.

3. **The Cogeneration Cycle** The three principle products produced by the conversion cycle; biogas, digestate and water will be combined and used in selective energy generation and soil regeneration processes. The biogas will be used to supplement the fuel

requirements of a new system of energy generation and heat distribution. The Wind-Gen-Hybrid™ system will use the biogas to supplement and eventually replace the propane that is currently used to fuel a 50 kW generator that is powered by a wind turbine and an internal combustion (IC) gas engine. The wind turbine and gas engine are coupled to the same generator by a torque management system. This torque management system allows wind energy to be used as the base energy input. The IC gas engine can provide the required torque in low or no wind conditions. This provides a level of reliability that is missing from small wind generation systems. The heat produced by the IC gas engine's jacket water cooling system is used to maintain the required temperature of the digester. Unlike hydrocarbons biogas does not contribute to increasing atmospheric carbon dioxide concentrations when used as fuel for energy generation. This feature is related to the carbon dioxide uptake that growing plant provide. In this application the production of energy from burning biogas would be carbon natural.

4. **Soil Regeneration Cycle** The second and third of the principle products produced by the conversion cycle, digestate and nutriment rich waste-water, will be used in composting and oxidation systems that will be designed to promote soil regeneration and bacterial enhancement respectively by the production of peat. The introduction of peat in to the new land use plan will reduce soil acidification accelerated by the use of acid-forming nitrogenous fertilizers. Energy crops, when combined with planned crop rotations and structured land-use programs will promote the regeneration of regional soil conditions.

SECTION 5: Plan

The two-segment grant of $780,000 will cover (1) feasibility and risk analysis and (2) production simulation and crop cycle evaluation as well as (3) overall process evaluation.

Implementation

- This proposed project will aggregate a bioenergy recovery plan with a current land use plan over a three year time span.
  - The plan includes a functional 10,000 acre agricultural unit with 5,000 acres of grazing land and 5,000 acres of cultivated crop production.
  - The current agricultural unit supports a livestock feeding program that produces 1,500 head of prime feeder beef cattle annually, with an expected growth rate of 18-22% per year.
- The planned process will integrate the existing land-use plan into the design, planning, construction, operation and the economic evaluation of four distinct bio energy cycles.

Deliverables

- Development, design, construction, operation and economic evaluation of a multi stage mesophilic- low temperature digester that is commercially suited for the organic stream produced by the region supporting the bio-gas production.
- Continuing education is a fundamental portion of the deliverable of this project.

Expectation of the New Technology

- As previously stated, paradigm shift in energy production and distribution must take place. We believe this technology will be a vital portion of the required change.
- This technology will generate clean heat and electrical energy through the proposed modifications to conventional agricultural practice.