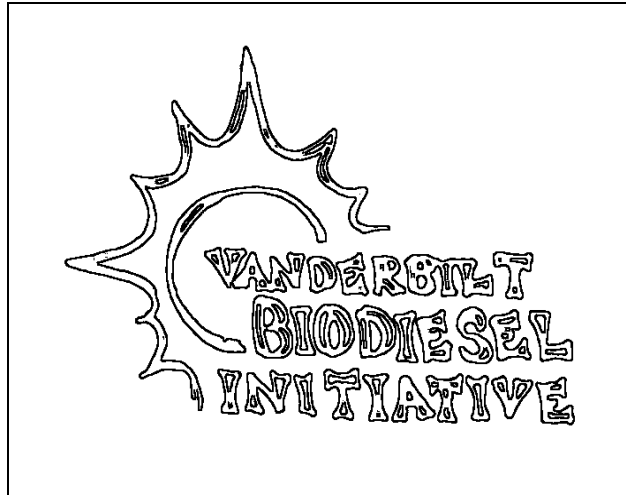


The mtvU GE ecomagination Challenge:
Sustainable Biodiesel Production Application



APPLICATION – PART I

General Information

College/University: Vanderbilt University

Project Name: Sustainable Biodiesel Production

Brief Project Description:

Create a sustainable biodiesel production system on the Vanderbilt University Campus that will fuel both campus vehicles and alternative energy awareness.

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APPLICATION – PART II

Short Essays

1. Provide a detailed project description.

Wilderness Skills (WilSkills) is a student-run organization which has been active and influential on the Vanderbilt campus for over 30 years (www.vanderbilt.edu/wilskills). We introduce fellow undergraduate and graduate students to the outdoors through our semester-long course which integrates the classroom with the Tennessee wilderness. Weekly lectures, films, and discussions on various outdoor and environmental topics are combined with weekend trips to the surrounding areas for canoeing, caving, rock climbing, and winter backpacking. Instructors for the WilSkills course are graduates of the Wilskills course themselves, and each semester, new instructors are trained by the older instructors ensuring the long-term survival and integrity of the program. In addition to teaching our students how to enjoy the natural world, another main goal is to instill environmental stewardship in them. Currently, the weekly trips that we take in our van are adversely affecting the air quality of middle Tennessee, and we want to set an environmental example for our students, our university, and our community.

WilSkills is proposing to create a self-sufficient, sustainable, student-run biodiesel production system at Vanderbilt University. The system will be used to convert dining services waste vegetable oil into environmentally responsible biodiesel fuel that can be used in any university diesel-fueled engines. The fuel will be used by Vanderbilt vehicles such as student activity vans, buses, and landscaping machinery. The ultimate goal will be to curb the consumption of petroleum-based fuel by the Vanderbilt community with a system that is economically and environmentally sustainable. In turn, this program will educate others about the viability of biodiesel as an effective alternative fuel.

Producing biodiesel fuel is a bold new expansion of the WilSkills philosophy – sustainability is simply another form of self reliance. WilSkills has been collecting recyclable paper, plastic, and aluminum products on a weekly basis for the Vanderbilt campus for several years. Recycling vegetable oil the next step in our goal to improve the quality of our campus and the world in which we live. Raising awareness about recycling practices and biodiesel go hand in hand and will help WilSkills uniquely reach a broader audience with the message of conservation and environmental responsibility.

Biodiesel is a fuel that is created by a transesterification process of vegetable oil. Pure vegetable oil or filtered waste vegetable oil are combined with methanol and lye in specific proportions and heated. A chemical reaction occurs and produces biodiesel and glycerol. The glycerol can be turned into a useful soap product, and the biodiesel can be used directly by any diesel engine or can be blended with petroleum-based diesel in any proportion.

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Biodiesel has been extensively studied by many universities including Vanderbilt. It has many advantages over regular diesel and few shortcomings. It burns cleaner, increases engine life, reduces engine noise, cleans the fuel system, eliminates the “diesel smell,” is safer to handle and transport, and transforms a waste product into a useful substance. Biodiesel has not become a viable alternative to petroleum-based diesel on a large scale because the price of vegetable oil has not yet made widespread distribution economically beneficial. However, small scale production and testing using waste vegetable oil has been happening for years.

We will design and construct an initial pilot biodiesel production system on our campus, and it will consist of a standard “apple seed” biodiesel processor which has been used and tested for many years. We will be constructing and testing a pilot system initially to establish the techniques and protocols necessary to eventually scale-up production in a safe manner. The “apple seed” system will be set up in a plant operations facility on campus and will be self-sustainable in energy and financial needs. The energy required to heat the biodiesel ingredients will come strictly from the sun and a small biodiesel-fueled generator (when the solar energy is insufficient). The energy to run the necessary pumps in the system will be collected by a photovoltaic solar cell backup power system. Rain water will be collected in a large cistern to provide the water necessary for cleaning the biodiesel to ensure the highest quality biodiesel possible.

Robin Midgett, an experienced biodiesel producer and electrical technician at Vanderbilt will oversee the design and construction of the pilot and full scale systems. Robin has been producing and using his own biodiesel exclusively for three years and has agreed to help start the pilot system and expand the system as necessary.

Once the pilot system is installed, Robin and Andrea George (sustainability coordinator for Vanderbilt, graduate student in the engineering school, and team member) will help train the Ecomagination Challenge team members on how to safely produce high quality biodiesel fuel from waste vegetable oil. Our preliminary goal is to generate 100 gallons of fuel per week with the pilot system. Trained biodiesel “experts” will lead the biodiesel production while other interested students apprentice. This teaching style distributes the required labor while simultaneously disseminating knowledge and training future experts. We will also be producing and publishing relevant materials on our website to help other universities follow our lead.

We will be initially collecting small amounts of waste vegetable oil from dining services for testing purposes, but once the large-scale system is online, we will be collecting all the dining services oil produced (~250 gallons/week). We will be borrowing a plant operations truck initially to transport the oil, but eventually, we will purchase a transportation vehicle that can be used exclusively for transportation and promotion. The transportation vehicle will have a large graphic applied to its side to advertise the use of biodiesel at Vanderbilt (and the grant that made it possible). We will purchase stickers to be used on all other vehicles running biodiesel to help increase awareness.

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Vanderbilt produces thousands of gallons of waste methanol every year between the many chemistry labs on campus, and currently the methanol is disposed of as a hazardous material. Since methanol is a costly key ingredient necessary to biodiesel production, we will be investigating whether or not the methanol produced on campus can be purified to be used to make our biodiesel.

The labor involved in waste vegetable oil collection and biodiesel production will be lead by the experts from the WilSkills group, but will be a shared effort of many groups on campus. Wilderness Skills, as well as the environmental group SPEAR (Students Promoting Environmental Awareness and Recycling), have a continually replenished student base that will provide the necessary amount of labor to maintain and expand the system.

2. What environmental issue does your project address?

Our project addresses the environmental issue of providing clean, sustainable fuel for transportation while being environmentally conscious of water and energy consumption. Gasoline and traditional diesel-fueled vehicles emit volatile organic compounds (*such as* carbon dioxide, carbon monoxide, sulfur monoxide, and benzene) which contribute to global climate change, acid rain, and smog. Also, the electricity we use on campus is generated by burning coal which further pollutes the air. The emission of these substances on campus by plant operations vehicles creates a less-than-optimal environment for students, faculty, and staff.

The challenge we face is finding a cleaner alternative for powering campus vehicles. Vanderbilt University uses over 6000 gallons of fuel of fuel every month, and substituting biodiesel for a fraction of the fuel used will make a significant difference to the air quality. Biodiesel is a much healthier choice for our environment because its combustion releases less carbon dioxide, particulates, hydrocarbons, and no sulfates into our atmosphere. We hope to produce 1000 gallons of biodiesel per month which could potentially eliminate 20,000 pounds of “lifetime” carbon dioxide emissions every month according to <http://www.coopamerica.org/pubs/realmoney/articles/biodiesel.cfm>. In addition, biodiesel also decomposes four times faster than petrol diesel, reducing the environmental impact of accidental spills, and it is safer to store and transport since its flashpoint is much higher than similar fuels.

3. What impact will your project have on the environment? What do you hope to achieve?

We hope to introduce a new model for sustainable transportation into our community given the reality of air pollution, oil dependency, and climate change that we all are someday going to face. In creating a self-sufficient, safe biodiesel production center, we hope to reduce the emission of volatile organic compounds into the air in middle Tennessee by substituting our biodiesel for a portion of the dirty petroleum-based diesel currently used on campus. We also will be creating and using our own electricity which will eliminate the need for us to be using the coal-produced “dirty” electricity that is used by the rest of campus.

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We hope to eventually encourage the purchase of more diesel vehicles on campus to use biodiesel and replace inefficient gasoline models. Middle Tennessee is currently a non-attainment area for ozone particulate matter with deferred enforcement until the year 2007. Therefore, it is imperative that Vanderbilt, as the largest private employer in Nashville, sets an example to take steps to improve the air quality for our community.

Biodiesel is completely biodegradable, renewable, and nontoxic, and it burns cleanly with no noticeable loss of power. Biodiesel is a very eco-friendly fuel because its production actually adds energy to our environment by taking the sun's energy converted by a soy plant and turning it into a reliable fuel for transportation. Biodiesel actually adds almost 3 times more energy to our ecosystem than ethanol, which is another alternative fuel option.

Methanol is a waste product from many of the labs at Vanderbilt and must be disposed of as a hazardous material, so eliminating the need to dispose of some of the byproduct methanol from chemistry labs and using it to make biodiesel will only improve the sustainable and eco-friendly impacts of this project.

Additionally, we plan to use our project to promote environmental awareness among students, faculty, employees, and community members. We hope to raise awareness about the benefits of biodiesel and the impact of using an off-the-grid system which generates and uses its own power and water. We hope that our efforts will serve as a tool for education and pro-social change as well as a means for improving the environmental impact of campus operations.

We will use this grant to start a program at Vanderbilt which will hopefully lead to biodiesel use in all university vehicles. We also expect that anyone who is involved with the project will better understand the environmental impact of their decisions and embrace alternative, eco-friendly solutions to everyday problems.

4. What is unique and interesting about your project?

We feel that Vanderbilt needs to set an example for middle Tennessee to raise awareness and demand for biodiesel. Since no other individuals or educational institutions in middle Tennessee are pursuing biodiesel production on the scale that we have proposed, we hope to be setting a precedent for other area schools and paving the way for a more sustainable transportation future.

Furthermore, we are not aware of any other biodiesel systems which are designed to function completely off-the-grid without using public electricity, water sources, or possibly even methanol. By collecting, generating, and using our own electricity and water, students will better understand the cause and effect nature of biofuels production. We have not heard of any other research into reclaiming waste methanol from chemistry research labs for biodiesel production either. We hope that these unique aspects to our project will help Vanderbilt students gain an appreciation for the entire environmental impact of biofuels production.

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The biodiesel production system will consist of several tanks, pumps, and plumbing, and it will be located outdoors in a visible location. We will design and build the system in such a way as to make its operation obvious to anyone who looks at it. Most biodiesel systems are complicated and unsightly, so we want to make our system simple and engaging. We will also work with the environmental health and safety office to create simple instructions for using the system to help ensure safe, reliable operation for all users. We want the biodiesel system itself to aid in the publicity and educational aspects of our project to help us increase awareness on campus.

5. What is the implementation timeline of your project?

We will begin renting space for the production center, constructing the safety equipment, and building the core pilot biodiesel processor in April 2007. While the facility is being constructed, our dedicated team will be launching a public relations campaign to raise awareness and invite others to participate. We will begin collecting the waste vegetable oil in April and have an operational biodiesel processor after two weeks of construction. Once we are able to produce biodiesel, the rainwater collection system and radiant solar oil heating system will be added by mid-May 2007. We will begin testing the first batches of biodiesel in several older campus vehicles, and B100 will be used in the transportation vehicle once it is purchased.

As the system is being constructed and tested, we will also begin testing various batches of the methanol produced on campus to determine whether it can be used to reliably produce biodiesel. We may construct a small distillery for methanol for purification purposes depending on the feasibility of that solution.

Several team members will be on campus for the summer taking classes, and we will use the time to formalize all the protocols and procedures with the pilot system. We will expand the capacity of the system and convert all the vegetable oil produced by dining services once school resumes in 2007. Dining services trucks, the WilSkills van, outdoor recreation vans, Vanderbilt's undergraduate shuttle busses, and the medical center shuttle busses eventually could run B20 blend (20% biodiesel 80% petrol diesel) or B100 (100% biodiesel) from our system by Fall 2007.

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6. Please create a budget that explains how you plan to use the \$25,000 grant. Please detail the activities and costs associated with launching and running your project during the span of the project. Types of expenses vary, but may include: research and development; equipment, software, purchasing other materials, etc.

Types of Expenses	Total Cost					Total
	4/1/2007	5/1/2007	6/1/2007	8/1/2007	9/1/2007	
Equipment	3,000		5,000	2,100		10,100
Transport vehicle				10,000		10,000
Public Relations	1,000			1,000	500	2,500
Continuing Costs	220	220				440
Facility Rental	3,500					3,500
TOTAL						\$26,540

Notes:

- We will purchase some equipment in April for the core processor, rent the facility, and make safety modifications to the facility.
- We will start our PR campaign in April as well.
- We will add the rain collection, solar system, and generator in June after school is out.
- We will be testing the system during July, so we will not purchase anything during that month.
- We will expand the system in August before school begins to handle the increase in oil production.
- We will begin to receive revenues from biodiesel during the summer, so they will offset continuing costs after June.
- It will cost about \$.60 per gallon to produce biodiesel (when factoring in the continuing cost of methanol, lye, and titration equipment). Therefore, we will be charging the users of the biodiesel a fee (\$1.50 per gallon of biodiesel) to cover the costs and help fund the future expansion and continual promotion of the system.
- The financial and personnel management of the system will be conducted by WilSkills to ensure the continuing success of the project.

6. Is there a demo or mockup available for your project? If not, how soon can one be available?

Yes, there are two small biodiesel systems in use on campus for research purposes. Robin Midgett has a larger biodiesel processor at his home which he will use as a model for designing Vanderbilt's system.

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7. Please describe each team member's role and their responsibilities with respect to the project.

Every team member will be helping plan, build, and use the biodiesel system. Specific responsibilities are as follows:

- Derek Riley- in charge of the overall design, construction, and maintenance
- Noah Walcutt- in charge of biodiesel group organization and recruitment
- Bryan Reeves- president of WilSkills, in charge of safety
- Sara Williams- in charge of community public relations
- Nate Meltzer- in charge of biodiesel and methanol purification and testing
- Adam Greenhall- in charge of the website maintenance (www.vanderbilt.edu/wilskills/biodiesel.html)
- Chris Gorga- in charge of systems engineering
- Katie Wagman- in charge of Vanderbilt student recruitment
- Jenny Magill- president of S.P.E.A.R., in charge of Vanderbilt public relations
- Erin Feeney- in charge of biodiesel education at Vanderbilt
- Will Deacy- in charge of soap production
- Caroline Cheung- in charge of secretary/treasurer duties
- Chris Miller-McLemore- in charge of Vanderbilt student recruitment
- Sarah Stephens- in charge of graphic design and publicity
- Andrea George- sustainability coordinator for Vanderbilt, in charge of environmental regulation compliance
- Dr. James Clarke- faculty advisor