

9/28/12

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## MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See <http://www.mtsu.edu/sga/cleanenergy.shtml> for funding guidelines. Save completed form and email to [cee@mtsu.edu](mailto:cee@mtsu.edu) or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request <b>Beng Guat Ooi &amp; Ngee Sing Chong</b>	
Department/Office <b>Chemistry/DSB231</b>	Phone # (Office) <b>898-2076 &amp; 898-5487</b>
MTSU Box # <b>Box 68, MTSU</b>	Phone # (Cell)
E-mail <b><a href="mailto:bgooi@mtsu.edu">bgooi@mtsu.edu</a> &amp; <a href="mailto:nchong@mtsu.edu">nchong@mtsu.edu</a></b>	Submittal Date <b>September 28, 2012</b>

2. Project Categories (Select One)	
Select the category that best describes the project.	
<input type="checkbox"/> Energy Conservation/Efficiency	<input type="checkbox"/> Sustainable Design
<input checked="" type="checkbox"/> Alternative Fuels	<input type="checkbox"/> Other
<input type="checkbox"/> Renewable Energy	

3. Project Information	
<p>a. Please provide a brief descriptive title for the project.</p> <p>b. The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. <b>Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.</b></p> <p>c. List the source of project cost estimates.</p> <p>d. Provide a brief explanation in response to question regarding previous funding.</p>	
3a. Project Title <b>Increasing the Production Capacity of Biodiesel at MTSU and Enhancing the Fuel Quality through Testing and Process Improvement</b>	
3b. Project Cost Estimate <b>Total Amount Requested \$9,964.45</b>	
1. NaOH - 50 lb Pail	\$79.95
2. Drionex 50 lb package	\$337.50
3. Purolite Resin PD206; 50 lb. Box	\$597.50
4. Power Centrifuge 6000 RPM Motor	\$1547.00
5. 6" Dia. Dry Wash Tower (w. resin, pump, and fittings)	\$1,349.00
6. Mini-Scan Analyzer for Testing Biodiesel	\$5,995.00
7. 1,000 Watt Heater for warming waste cooking oil	\$58.50

## 3c. Source of Estimate

**Vendor catalogs and website price quotes**  
**(<http://www.utahbiodieselsupply.com/>)**

3d. If previous funding from this source was awarded, explain how this request differs?

**Previous funding was obtained for the conversion of the engine so that the MTSU Biobus that can use vegetable oil and biodiesel in addition to petroleum-based diesel.**

#### 4. Project Description

(Completed in as much detail as possible.)

- a. The scope of the work to be accomplished is a detailed description of project activities.
- b. The benefit statement describes the advantages of the project as relates to the selected project category.
- c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
- d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
- e. Provide specific information on anticipated student involvement or benefit.
- f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
- g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

4a. Scope: Work to be accomplished

**MTSU currently has a biodiesel production operation based on conversion of used cooking oil that generated about 120 gallons per month for use in tractors in Tennessee Livestock Center. This proposal will increase the production output by 30% and improve the fuel quality to reduce maintenance needs and improve the durability of MTSU tractors and the Biobus. Additional sources of used cooking oil besides that from Aramark Food Services on-campus will be arranged with**

restaurants in Middle Tennessee area. The biodiesel produced will be analyzed by students at the Department of Chemistry at MTSU to ensure that the fuel meets the quality standards set by National Biodiesel Board. Small-scale production methods will be developed at the MTSU Chemistry Department for implementation at production facility in Tennessee Livestock Center under the supervision of Mr. Matt Wade. The environmental benefits of lower harmful emissions of pollutants in biodiesel fuel will be evaluated and demonstrated by testing in MTSU Biobus and diesel generators. The MTSU biodiesel group (Jack Nowotarski, Duy Nguyen, and Ryan Thomas) will promote the awareness of benefits for the alternative fuel on the Earth Day celebration via poster exhibit.

4b. Scope: Benefit Statement

The primary benefit of this biodiesel project is to take used cooking oil generated by MTSU/Aramark Food Services and convert it to fuel for operating MTSU tractors and Biobus. Instead of having to dispose of the used oil as waste, MTSU will save money via reduced expenditure for buying diesel fuel. This will allow MTSU to set an example to encourage businesses and companies to recycle their used cooking oil and to use domestically produced renewable biodiesel from raw vegetable or canola oil and used cooking oil. The collaboration between Tennessee Livestock Center and Department of Chemistry will provide a beneficial learning environment for students planning to pursue an advanced degree in alternative fuel research or work in biodiesel industry that produced 1.1 billion gallons of biofuel with a workforce of 39,000 persons in 2011. The fuel produced will be improved through biodiesel research carried out in Chemistry Department and the technologies developed for the production of renewable fuel additives will be evaluated

for other energy applications based on combustion.

The long-term plan of this project is to gradually increase the production of biodiesel to a level that it can routinely be used for MTSU buses. This requires space for additional biodiesel reactors, additional volume of used cooking oil, significant numbers of students involved in the production process, and the cooperation of MTSU Transportation Services.



#### **4. Project Description (continued)**

4c. Location of Project (Building, etc.)

**MTSU Department of Chemistry (Davis Science Building Room 206), Tennessee Livestock Center, and Voorhies Building Machine Shop for MTSU Biobus engine maintenance**

4d. Participants and Roles

**Matt Wade, Beng Guat Ooi, & Ngee Sing Chong – Directing student efforts in producing biodiesel and applying research-based production methods and fuel testing procedures.**

**Charles Perry – Coordinating the use of biodiesel in MTSU Biobus and bus engine maintenance.**

**Ngee-Sing Chong – Responsible for emission testing of biodiesel in Biobus, tractor, and diesel-powered generators.**

**Jack Nowotarski, Duy Nguyen, and Ryan Thomas – Assisting in the production and testing of biodiesel and recruiting students for the biodiesel production project.**

4e. Student participation and/or student benefit

**Currently, there are three students involved in the biodiesel project. More will be recruited with the help of Students for Environmental Action. Students will learn the chemistry related to biodiesel production and the economics and industrial practice associated with biodiesel production. Students may seek employment in the biodiesel industry with a workforce of 39,000 persons. Besides, the research aspect of the biodiesel technology developed at MTSU may result in a publication in *Fuel Chemistry* published by the American Chemical Society.**

4f. Future Operating and/or Maintenance Requirements

**All the facilities and personnel needed to continue the production of biodiesel are available at Tennessee Livestock Center, Department of Chemistry, and Department of Engineering Technology. Expansion of the biodiesel production facility will require additional space that may become available in the vacated lab space of Davis Science Building when the Chemistry Department is moved into the new Science Building.**

4g. Additional Comments or Information Pertinent to the Proposed Project

<http://westernfarmpress.com/management/epa-releases-2012-biodiesel-production-numbers>

[http://en.wikipedia.org/wiki/Biodiesel#Production\\_levels](http://en.wikipedia.org/wiki/Biodiesel#Production_levels)

**Montefrinoa, M. J. F.; Obbardb J. P. "The Economics of Biodiesel Derived From Waste Cooking Oil in the Philippines" Energy Sources, Part B: Economics, Planning, and Policy, Volume 5, Issue 4, 2010**

**Canakci, M. The Potential of Restaurant Waste Lipids as Biodiesel Feedstocks. Bioresource Technology 2007, 98, 183–190.**



## 5. Project Performance Information

Provide information if applicable.

- Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
- Provide information on estimated annual energy cost savings in monetary terms.
- Provide information on any annual operating or other cost savings in monetary terms. Be specific.
- Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

**Using the published energy density value of 37.27 MJ/kg for biodiesel and the expected annual MTSU production volume of 1900 gallons or 7912 liters of biodiesel with a density of 0.88 kg/liter, we will have annual energy savings of  $2.23 \times 10^8$  BTU or  $6.55 \times 10^4$  kWh.**

**37.27 megajoule = 35,325 Btu = 10.35 kilowatt hour**

**235,888 megajoule = 223,579,496 Btu = 65,524 kilowatt hour**

5b. Annual Energy COST Savings (\$)

**Assuming that 70% of the biodiesel production cost is due to the vegetable oil feedstock and a petroleum diesel price of \$3.80/gallon, the cost savings is about \$5100 this academic year. When the production is fully scaled up to meet the needs of all MTSU buses and farm equipment, the savings will be about \$20,000 per year.**

5c. Annual Operating or Other Cost Savings. Specify. (\$)

**There are other savings or benefits of operating farm equipment, buses, and power generators using biodiesel. This is due to the better lubricity characteristics of biodiesel that allows reduced usage of lubricant additives and the lower emission of particulate matter (i.e. soot) and harmful pollutants that lead to a longer lifetime of emission control devices.**

5d. Matching or Supplementary Funding (Identify and Explain)

**Department of Chemistry provides ~\$2,500 per year for the purchase of supplies for biodiesel research.**

**Tennessee Department of Environment and Conservation awarded Dr. Chong a grant of \$97,621 in 2007 for biofuel research; the equipment purchased with the grant will be used for emission testing and biodiesel fuel quality analysis for this project.**

**National Science Foundation has sponsored MTSU students involved in biodiesel research for the past 4 years. Last year, Jack Nowotarski and Duy Nguyen each received about \$1500 for travel to Washington DC to present their research.**

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