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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 or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request **Beng Guat Ooi**	
Department/Office **Chemistry/DSB223**	Phone # (Office) **898-2076**
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E-mail **bgooi@mtsu.edu**	Submittal Date **9/30/2013**

2. Project Categories (Select One)			
Select the category that best describes the project.			
	Energy Conservation/Efficiency	**X**	Sustainable Design
	Alternative Fuels		Other
	Renewable Energy		

3. Project Information

a. Please provide a brief descriptive title for the project.
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. **Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.**
c. List the source of project cost estimates.
d. Provide a brief explanation in response to question regarding previous funding.

3a. Project Title **Replacing Traditional Nitrogen Gas Cylinders and Liquid Nitrogen Tanks with Sustainable Nitrogen Generation Methods to Reduce Greenhouse Gases**

3b. Project Cost Estimate **Total Amount Requested $ 11,099.00**

1. Parker Balston Nitrogen Generator Model UHPN2 — $10,655.00
2. Dessicant Cartridge for Nitrogen Gas Generator — $ 444.00

3c. Source of Estimate

Restek catalog in MTSU Chemistry Department and website list price (http://www.restek.com/)

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

The current request is under the category of "Sustainable Design". It describes the use of a nitrogen gas generator to meet the needs of chemistry instrumentation laboratory without relying on inefficient nitrogen gas cylinders and liquid nitrogen tanks. This reduces the undesirable environmental impact of greenhouse gases and improves cost efficiency. Previous funding was obtained for developing the technology for the production of biodiesel from used cooking oils.

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 Chemistry Department currently uses nitrogen gas to operate gas chromatography (GC) and infrared spectrometry (IR) instrumentation in the laboratory in Davis Science Building. Every week, bulky nitrogen gas cylinders and liquid nitrogen tanks are brought in to supply ultrahigh purity (UHP) nitrogen to lab equipment and the old or empty tanks or cylinders are hauled off. This routine of transporting nitrogen from the gas generation site to MTSU is very inefficient and

produces the greenhouse gas of carbon dioxide from the combustion of transportation fuels. Furthermore, nitrogen gas delivered in the cylinders or liquid nitrogen tanks are produced by the energy-intensive method of fractional distillation. This proposal aims to implement the sustainable process of using a nitrogen gas generator to meet all our GC and IR gas needs at MTSU while reducing greenhouse gases and achieving operational cost savings.

4b. Scope: Benefit Statement

The two primary benefits of this project are to (i)reduce recurring expenses for nitrogen gas used in MTSU Chemistry Department and (ii) achieve environmental sustainability by reducing the emission of CO_2 greenhouse gas. Other benefits include operational simplicity since it is no longer necessary to order, move, and change nitrogen cylinders every 1-2 weeks, improvement of lab safety by eliminating the need to store and transport pressurized nitrogen cylinders. The nitrogen generator also provides a quieter faculty work environment by eliminating sudden noises associated with the relief valve of the nitrogen generator.

4. Project Description (continued)

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

MTSU Department of Chemistry (Davis Science Building Room 236 or Instrumentation Laboratory)

4d. Participants and Roles

Beng Guat Ooi – Estimating the nitrogen usage requirement of GC and IR in Instrumentation Laboratory and deciding the model of nitrorogen gas generator to buy as well as the time for the replacement of the dessicant cartridge needed; evaluating cost efficiency by switching from helium to hydrogen.

Jessie Weatherly – Installation and maintenance of the new nitrogen gas generator.

Other Chemistry Faculty and Students – Use the generators and report usage duration to track the volume of nitrogen gas used in order to estimate the amount of savings achieved via the use of a nitrogen generator.

4e. Student participation and/or student benefit

The continuous supply of nitrogen by the generator would allow uninterrupted use of the GC and IR, thereby facilitating instructional and research use of the lab instrumentation. It also reduce the need to have faculty or students move heavy pressurized nitrogen cylinders to the GC and to improve safety by eliminating the need to strap down the nitrogen cylinders. Over the long run, this may also help keep the student lab fees at a constant level. The use of a nitrogen generator will also allow the noise level of liquid nitrogen tanks to be eliminated and therefore provide a more suitable lab environment for

learning and research. The noise produced by the relief valve on the liquid nitrogen tank is so loud that it is unpleasant or unbearale for most faculty and students working in the lab with such tanks.

4f. Future Operating and/or Maintenance Requirements

Jessie Weatherly in the Department of Chemistry is in charge of maintenance for all lab equipment including the GC and the proposed hydrogen generator. The replacement of the dessicant cartridge is typically once every 0.5-1 year and the cartridge cost of $444 is minimal and can be paid through the savings in gas expenditure. The generator can also be moved to the new science building without the need to hire the vendor engineers.

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

1. **Gas Supply for Gas Chromatography: How to Compare the Costs of Cylinders and Generator**
   http://www.sigmaaldrich.com/etc/medialib/docs/Supelco/Bulletin/4545.Par.0001.File.tmp/4545.pdf

2. **A Sustainable Approach to the Supply of Nitrogen**
   http://www.parker.com/Literature/Balston%20Filter/IND/IND%20Technical%20Articles/PDFs/Sustainable%20Approach%20to%20N2%20Supply.pdf

5. Project Performance Information

Provide information if applicable.

a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
b. Provide information on estimated annual energy cost savings in monetary terms.
c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
d. 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.)

According to the European Industrial Gas Association, an air separation plant uses 1976 kJ of electricity per kilogram of nitrogen gas produced for nitrogen cylinders . In contrast, the energy usage of the nitrogen generator is considerably less at 1420 kJ of electricity per kilogram of nitrogen gas. This represents a drop of 28% in energy savings.

5b. Annual Energy COST Savings ($)

It is not possible to determine energy cost savings due to the different per unit energy costs at the industrial facility involved in fractional distillation compared to the energy cost of a reactor at MTSU.

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

The annual savings in nitrogen gas expense can be estimated by:

($174.49/cylinder)*52cylinders= $9,073.48

The payback period for buying the nitrogen generator with the cartridge ($11,099) is about 15 months. Since most generators have a useful lifetime of 6-8 years, the overall savings over the lifetime of the generator is about $42,000-$60,000.

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

Department of Chemistry will pay for the consumable cost of the dessicant cartridges needed for the nitrogen generatorafter the first year. The recovered funds (~$1500) from the indirect cost charged to an EPA project may be used to offset the cost of purchasing or maintaining the nitrogen gas generator.