

COVER PAGE
Faculty Advised Project Proposal

Submitted by: Georgia Tech chapter of ESW

Project Title: Solar Café

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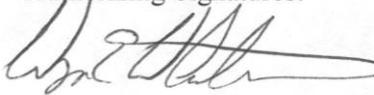
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Total Funding Requested: \$ 4440

Authorizing Signatures:

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12/9/11

12/09/2011

Date

Date

Introduction: Solar Café

Boiling is not a perfect method for purification of drinking water, but it is still today the most accessible and widely used practice to treat water for fecal contamination. Burning wood to boil water, however, is not a sustainable practice: it is neither economically nor environmentally sustainable. What if rural communities could boil water as we do in the developed world, simply by switching on an appliance? And what if that appliance were powered by a fully renewable and sustainable energy source? This is what the Georgia Tech Chapter of Engineers for a Sustainable World proposes to find out, given the opportunity to build a prototype solar kiosk.

Cart Description

The goal of this project is to use photovoltaic energy to make hot beverages to sell to the Georgia Tech community. We will design and build a mobile kiosk and use the energy from a single solar panel to boil water using an electric water kettle. The dimensions of the main body, excluding the single solar panel itself, will be roughly 1.5 meters long, 0.75 meters wide, and 1 meter high (see diagram in Appendix). The cart will have a steel frame for structural rigidity, with a sturdy and lightweight aluminum shell for storage and protection against weather conditions. This will be constructed on a 30" x 60" flatbed cart with two swiveling wheels and two rigid wheels with brakes. Using a flatbed cart instead of casters will significantly improve the mobility and durability of the cart.

A large compartment at the bottom of the cart will comprise the storage area for the battery and inverter. Above the battery compartment will be a dedicated shelf area for cups, cocoa mix, tea, water jugs, and any other sales material to be stored. The solar panel will be mounted at a fixed angle of approximately 30°, which is ideal considering the geographical location (Atlanta, GA) and the anticipated dates of operation for our kiosk (see Market Strategy below). The orientation for optimal insolation during the spring is estimated by subtracting 2.5° from the latitude, but the angle can be recalculated modified later for changing seasons. The panel will be supported by four metal posts which extend to the bottom of the cart for stability. The four supports will be attached to a smaller rectangular frame on the solar panel, and wires from the panel will extend down along one of the metal supports into the battery compartment.

Campus Fundraising Regulations

Because our solar-powered kiosk will be set up on campus, we must obtain permission through Capital Planning and Space Management at Georgia Tech. Capital Planning and Space Management handles all of the scheduling for use of campus space and assists with organization of events through its Event Logistics Committee. The Event Logistics Committee is composed of members of various service departments on campus, such as GT Police Department, Recycling, Student Involvement Office, etc. Our chapter plans to meet with the Event Logistics Committee early next semester to further discuss the details of this project. The committee will help us gain a better understanding of regulations as well as ways to make our event a success.

Selling tea and hot chocolate falls within the scope of allowable fundraisers, so no food-related permit will be required. Based on guidelines set by Capital Planning and Space Management, our kiosk may only be set up outside between the hours of 7:00 a.m. and 5:00 p.m. This limits our hours of sale and also means we must set up the kiosk a day in advance of each fundraising event to charge the battery from solar energy, and we must find storage for the cart

during all other times. One likely location will be the Student Involvement Center, where many student organizations have storage and office space. A storage location will be further discussed upon meeting with the Event Logistics Committee. Use of outdoor facilities requires cleanup and recycling. Trash bins can be obtained from the Facilities Department, and recycling bins can be obtained from the GT Recycling Office.

Market Analysis

Our market strategy on campus is to sell hot beverages, such as tea and hot chocolate, from our Solar Café in the heart of campus on what is known as Skiles Walkway. ESW members will serve passing students during late winter and early spring, when colder weather should automatically generate demand for our products. These drinks can easily be prepared on-site, and hot water from the kettle will be stored in a large thermos to account for inconsistent traffic, i.e., sales may be slow during class hours but pick up during the intervals between classes. Stretching between the library and Student Center, Skiles Walkway is a prime location with heavy student foot traffic, and our cart is sure to attract attention there. As part of our campaign, we will hang a weatherproof vinyl sign across the front of the kiosk to promote our ESW chapter and raise awareness of the applications of renewable energy. Flyers will be distributed from the kiosk along with the beverages, to give our customers a bit more detail to read and think about as they walk to class. We hope that this will also become an opportunity to recruit like-minded students to ESW.

Our fundraisers will be held once weekly between the end of February and Earth Day on April 22nd, when we hope to present excellent results at the Georgia Tech Earth Day celebration. During those 9 weeks, we will sell beverages during the peak hours of campus activity, from 8:00 a.m. to 3:00 p.m. All material costs can be calculated on a per unit basis: hot chocolate and tea are around \$0.25 per packet, and environmentally-friendly paper cups are approximately \$0.10 each. A gallon of water contains 128 ounces, which produces 16 8-ounce servings, and at a price of \$0.70 per gallon, the water cost is \$0.04 per cup. This equals a total raw material cost of \$0.39 per cup, and if it is sold for the reasonable market price of \$0.75, then we are profiting \$0.36 per cup, or almost 50% gross profit margin. At a very conservative sales estimate of 10 cups per hour or 50 cups per day, we can generate \$17.81 net profit per day and \$160.31 total during our 9-week fundraising period.

Budget Analysis

The budget table in the Appendix decomposes our costs into several major categories. Advertising is an important function of our solar kiosk, as we plan to use it as a tool both for recruiting and raising awareness of sustainable practices and technologies. Printing and miscellaneous hardware estimates are approximate, but the flatbed, kettle, vinyl banner, and post card expenses reflect actual, current prices. Airfare and lodging are also approximations, since the location of the 2012 conference has yet to be announced. Our total requested funding is \$4440.

Application Development

Although boiled water is not always free of fecal contamination, boiling has been proven to significantly reduce fecal coliforms and improve the microbiological quality of drinking water. Unlike purification tablets and filters, whose effectiveness can be limited by the presence

of other types of contaminants such as turbidity and dissolved minerals, boiling is a reliable means of decontaminating water across a wide range of conditions. Of course, the most readily available energy source for boiling water in developing communities is wood and other biomass. While it is true that biomass is a renewable energy source, it is a common misconception that it is a relatively harmless one simply because it is “natural”.

Burning wood is actually one of the major contributors to air pollution in rural and urban environments. Wood smoke contains high concentrations of greenhouse gases such as carbon dioxide, carbon monoxide, nitrous oxide, and Volatile Organic Compounds (VOCs); as well as toxic particulate matter which can pose health concerns. The use of biomass as an energy source also has economic and social implications for developing communities, where scarcity of material can make it too expensive for most families to afford boiling water, or women and children may be expected to devote substantial time to obtain such materials for burning. Our project proposes to replace the wood-burning method with a small structure that can harness solar energy to power an electric kettle. The low-cost, portable structure which we have designed should be easily implementable in rural areas with little to no infrastructure for either clean drinking water or electricity. In conclusion, this project will be an exciting vehicle to promote the ESW mission and values, not only by raising campus awareness and involvement in sustainability practices, but also through eventual implementation in developing communities.

References

"Energy Savers: Wood and Pellet Heating." *EERE: Energy Savers Home Page*.

Web.<http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12570>.

Ghislaine, Rosa, Laura Miller, and Thomas Clausen. "Microbiological Effectiveness of

Disinfecting Water by Boiling in Rural Guatemala." *The American Journal of Tropical Medicine and Hygiene* (2010). Web.

<<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2829912/>>.

Appendix

Figure 1. Cart Design Drawing and Specifications

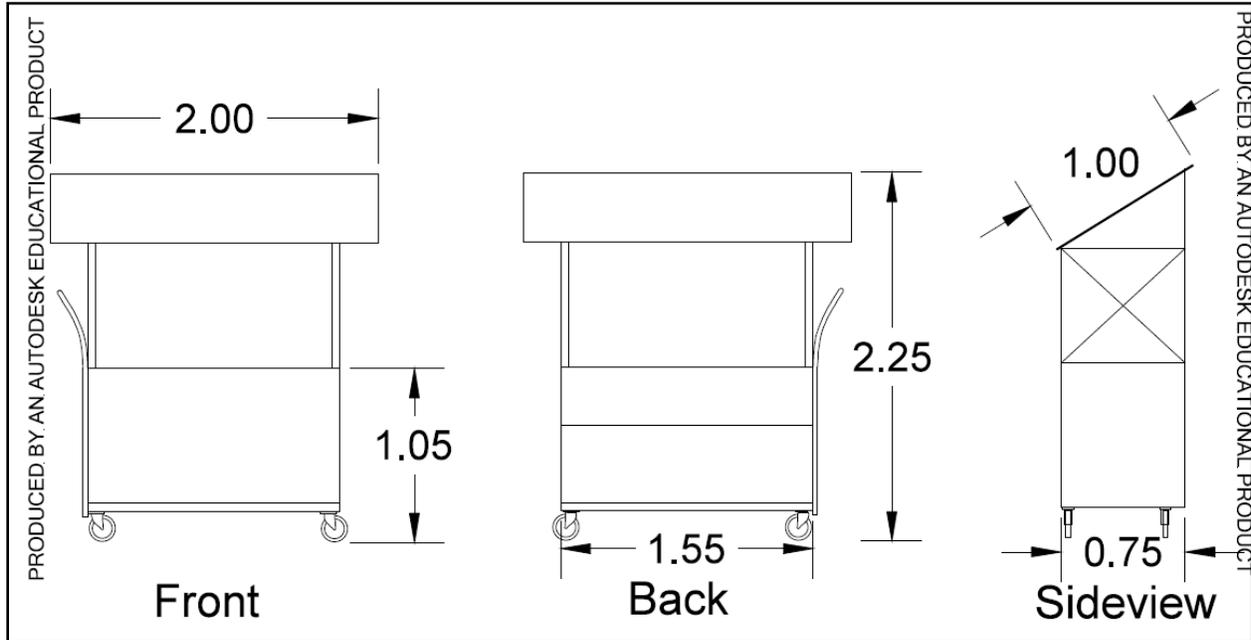


Figure 2. Budget Table

Item	Quantity	Estimated Cost
Startup capital		Total=\$80
<ul style="list-style-type: none"> Materials (water, cocoa mix, tea) Water kettle Thermos 		\$20 \$30 \$30
Cart Hardware		Total = \$430
<ul style="list-style-type: none"> 30x60 Flatbed cart, shipped Steel framing and aluminum sheets Miscellaneous tools and fasteners 	1	\$230 \$150 \$50
ESW National Conference expenses		Total = \$3550
<ul style="list-style-type: none"> Airfare, roundtrip Conference Registration Lodging 	5 members 3 nights' stay	\$500 x 5 = \$2500 \$50 x 5 = \$250 \$100 x 3 x 5 = \$800
Advertising Supplies		Total = \$380
<ul style="list-style-type: none"> Printing fliers for cart Outdoor banner for cart Post Card ad, delivered directly to all on-campus residences 	1 reaches approx. 8000 students	\$50 \$80 \$250
Total Requested Funding		\$4440

Dear Sir or Madam,

I am writing to recommend the solar kiosk project of the Georgia Tech chapter of Engineers for a Sustainable World (ESW). Our ESW chapter is energetic, creative, and carries through with their projects. Their proposal for a hot chocolate solar kiosk will go over very well on our campus. It will help our ESW chapter support itself, and will provide the entire campus community an up-close experience with photovoltaics.

The chapter's plan to sell hot chocolate on Skiles walkway fits well with campus culture and function: Skiles is a main walkway across campus; student groups regularly set up tables and booths along the walkway, and once a week we have a farmer's market there as well. And, critically, a substantial portion of the walkway is unshaded.

The belief has somehow taken hold in Georgia that solar power won't work here. The solar kiosk would be a great way to show that solar power can, and does, work in Georgia.

I strongly recommend the Georgia Tech ESW proposal.

Sincerely,



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