# Warren J. Baker Endowment
*for Excellence in Project-Based Learning*
# Robert D. Koob Endowment *for Student Success*

## Proposal Cover Page

**Title of Project:**
Insulated Solar Electric Cooking: Introduction to Ghana

**Proposal Author:** Matthew Walker **Cal Poly Email:** mwalke23

**Student ID:** 011155179 **Dept.:** GENE

**Signature (Optional):** _____
*Signature provides permission to check financial aid eligibility.*

**Previous Baker/Koob Endowment funding? (circle one):** Yes No

**Is this request to support a Senior Project or thesis? (circle one):** Yes (No)

| Team Member(s) | Signature | Cal Poly Email | Department |
|---|---|---|---|
| Grace Gius | | ggius | ME |
| Emma Stine | | estine | ME |
| Matthew Walker | | mwalke23 | GENE |
| | | | |

**Anticipated Start Date:** Sept 1, 2019 **Anticipated End Date:** Sept 15, 2019

**Total Funds Requested:** $ 5000

**Faculty Advisor:** Pete Schwartz **Department:** Physics

**Faculty Advisor email:** pschwart@calpoly.edu **Telephone:** 805-756-1220

**Signature of Faculty Advisor:** _____ **Date:** 11-5-2018

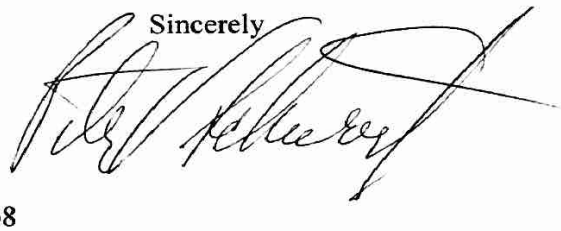
CAL POLY

Physics Department
San Luis Obispo, CA 93401

Dear project selection committee:

As the advisor for the students working on the Photovoltaic-Electric Cooking Project, I fully support their trip to Ghana in the coming summer. We are taking the trip together with several other faculty including Nate Heston and Lonny Simonian, and many engineering students. The subject of cooking in the developing world is likely the World Health Organization's greatest concern as the related indoor air pollution represents 4 million deaths a year (greater than malaria and AIDS together); and collecting fuel for fires costs considerable time and money investment, exposure to violence, and deforestation. By next summer, the students proposing the trip will have spent 1-2 years researching these cooking technologies and studying challenges of implementation in developing countries. They have already proven themselves to be professional and committed; and are well suited and committed to achieve the objectives expressed in their proposal. All trip leaders are committed to these projects for the duration of the student involvement and thereafter. We have full access to all the physical resources necessary to support our projects in Bonderson Mustang '60 and in our laboratory, 520D13. Additionally, we will be implementing projects at the Student Experimental Farm where I am a facilitator.

Sincerely



Nov 5, 2018

Pete Schwartz, (he, him, his)
Cal Poly Physics, Sustainability
the new science building, 180-608
805-756-1220
pschwart@calpoly.edu

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## I. Project Title

Insulated Solar Electric Cooking: Introduction to Ghana

## II. Abstract

According to the World Health Organization, 3 billion people cook with biomass and coal, and 4 million people die from associated emissions. In many communities, biomass cooking has led to deforestation, pollution, early onset respiratory issues in children, and violence against women and children and the soot and CO2 emissions represent significant greenhouse gasses. The purpose of our research is to minimize the negative environmental and health impact from biomass cooking by introduction of a solar cooking method that is both affordable and desirable to our target communities.

In 2016, we introduced our stove in Uganda and published the results.[1] Since then, we have improved the technology, improving efficiency and adding capacity to charge cell phones and lighting systems. We are looking for opportunities to disseminate the cooker and redesign the technology collaboratively with the target users. We intend to travel to Ghana and implement these insulated solar cookers in communities there.

## III. Objective(s)

Our primary objectives for the scope of this trip are:

1. Learn about the way people live in partnering communities.
2. Implement stoves by installing systems in communities.
3. Testing implemented stoves' value.
4. Documenting user response and criticisms to the current design.
5. Gather user feedback, and conduct market research after installation.
6. Understand the end users' needs and current methods.

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- [1] Insulated Solar Electric Cooking – Tomorrow's Healthy Affordable Stoves?, T. Watkins*, P. Arroyo*, R. Perry*, R. Wang*, O. Arriaga*, M. Fleming*, C. O'Day*, I. Stone*, J. Sekerak*, D. Mast*, N. Hayes*, P. Keller, P. Schwartz, Development Engineering 2 (2017) 47–52.

Global objectives for the scope of this entire project include:

1. Reduce GHG emissions, health hazards, and deforestation associated with burning biomass
2. Provide access to clean and cheap electricity to power home appliances for the global south.

The cost of producing solar panels has been steadily decreasing and is now the cheapest way to generate electricity. Consequently, inexpensive solar technology is now a viable solution in low income places that have not yet become accustomed to electricity distributed by a grid. Our cooker optimizes the power derived from a solar panel and acts as a voltage controller, eliminating expenses such as charge controllers and batteries.

## IV. Methodology

We chose the region of Agbokpa, Ghana, a low-income community well-known to trip leader Nathan Heston, Cal Poly Physics faculty (2010-2014 Peace Corps with ongoing familial and professional connection). Dr. Heston and Dr. Lonny Simonian (Cal Poly Construction Management) are leading a larger trip of engineers toward the development of community scale refrigeration. We will be working with Dr. Pete Schwartz (Cal Poly Physics) and the other collaborating faculty. These villages currently cook with biomass. PV panels and all the components necessary for product manufacturing are available in near-by towns.. We will be working under the guidance of these Cal Poly faculty to purchase PV panels from the local market, and connect them to our DC appliances (stoves, batteries, lights, cell phone chargers) in the end user's home. We will also leverage connections in Ashesi University[2] to build ongoing university collaboration. Installation also includes securing the panel in the optimal location, insulating the cooking devices, and testing everything to ensure it is safe. Finally, if time permits, we will be teaching locals how to build these appliances from scratch in hopes that local businesses can continue our work. In the interest of time, we plan to build several appliances before arriving.

A trip to Uganda in 2016 by previous members of our research learned about the culture around cooking and used that information to advance the design appropriately.[1]

[2] http://www.ashesi.edu.gh/

## V. Timeline

For our trip in the summer of 2019, we will be arriving in Ghana early in September and leaving after about two weeks, taking into account flight prices in order to plan the cheapest trip as flight prices can vary by up to $300 by day. We plan to bring several appliances to Ghana with us already built. Purchasing equipment will occur during the first 2 days, installing systems will occur during the next 6 days leaving the last 6 days for gathering user feedback and adjusting the systems to meet the users' specific needs.

## VI. Final Products and Dissemination

Our final product will be an insulated solar electric cooker that is appropriate to our target community's culture and practices. We hope to obtain first-hand experience in the process of implementing solar electrical systems in places not electrically connected as well as form a deeper and more personal understanding of our targeted users' needs as well as with university partners in Ghana. Exploring the possibility of implementing this technology could make way to the widespread development of radically inexpensive solar technology for the global poor.

## VII. Budget Justification

A flight to Ghana alone can cost upwards of $1500 and is the main cost of the trip. Food, housing, and in country transportation is about $500 for the two weeks. This proposal will fund the majority of necessary expenses for three or four students. Traveling to the region of interest is the only way for us to gain hands on experience and an appropriate perspective in the fields of implementation and gathering market data.

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# PROPOSAL BUDGET

| | |
|---|---|
| **Student Applicant(s):** | Matthew Walker<br>Grace Gius<br>Emma Stine<br>Natalie Ryan |
| **Faculty Advisor:** | Pete Schwartz |
| **Project Title:** | **Requested Endowment Funding** |
| **Travel** *subtotal* | $ 5000 |
| Travel: In-state | $ |
| Travel: Out-of-state | $ |
| Travel: International | $ 1667/student |
| | |
| **Operating Expenses** *subtotal* | $ |
| Non-computer Supplies & Materials | $ |
| Computer Supplies & Materials | $ |
| Software/Software Licenses | $ |
| Printing/Duplication | $ |
| Postage/Shipping | $ |
| Registration | $ |
| Membership Dues & Subscriptions | $ |
| Multimedia Services | $ |
| Advertising | $ |
| Journal Publication Costs | $ |
| | |
| **Contractual Services** *subtotal* | $ |
| Contracted Services | $ |
| Equipment Rental/Lease Agreements | $ |
| Service/Maintenance Agreements | $ |
| | |
| **TOTAL** | $ 5000 |