MECS-TRIID April 2019 Competition Reporting Template

Reporting period	**August 19, 2019 – October 25, 2019**
Report author/s	**Pete Schwartz**
Institution/Organisation	**Cal Poly Corporation, San Luis Obispo**
Project code/Project Title	**16-541/Thermal Storage with Phase Change Materials**

1. **Key activities**

Summary of Progress: I spent August 7 – August 27 in Ghana with four research students from Cal Poly. We visited Asheshi University and initiated collaboration with two professors in the business department, who are planning the dissemination strategy and adoption study. We spent most of our time In Agbokpa, a small village without electricity, running water, or sanitation in the Eastern Division on Lake Volta. The first week of the trip, I visited KNUST, a university in Kumasi, Ghana. Three Ghanaian graduate students in mechanical engineering (Martin Osei, Emmanuel, and Bismark) and I constructed an ISEC with PCTS (an Insulated Solar Electric Cooker with Phase Change Thermal Storage). Subsequently, these graduate students came to Agbokpa to work with a Cal Poly student building, cooking, fixing ISECs as illuminated in this video: https://www.youtube.com/watch?v=vK-XyyHJaX4). We installed two cookers and left two more with a professional chef. We formed a company (SolCook LLC) dedicated to the production, dissemination, and support of ISEC with PCTS. Martin will take a year off from graduate school and work full time, where Emmanuel and Bismark will work part time on the project.

Figure 1 Cal Poly students and collaborators in Agbokpa practicing ISEC cooking.


Figure 2 Martin Osei in Agbokpa, with a nested slow cooker (NS)

We visited NGO SNV (http://www.snv.org/country/ghana) in Accra on August 26. They expressed interest in collaborating on pilot studies as soon as we had means of production. Immediately afterwards, we visited Domod Aluminum Company (http://www.domod.com) in Accra. The company agreed to make the specialty parts that we need for the PCTS vessel.

Cal Poly began classes mid-September. The appropriate technology class (http://appropriatetechnology.peteschwartz.net/appropriate-technology-development-fall-2019/) I facilitate is largely composed of service-learning group projects. Many of the groups are dedicated to different aspects of this project, providing a service while learning about real-world projects. Additionally, I have received considerable interest from the outside to help others develop the capacity to build and disseminate ISEC technology, including AidAfrica (AidAfrica.net, Uganda), WAEV Women's Group (http://codycapella.com/cp/391/about.html,

Tanzania), Project Peanutbutter (https://www.projectpeanutbutter.org/, Sierra Leone), and Beacon of Hope Secondary School (https://www.one.org/us/blog/pilgrim-africas-beacon-of-hope-in-uganda/, Uganda). While these organizations are not part of the grant project, they present a means for future dissemination. One of the student groups is dedicated to producing video documentary on how to build ISEC technology.

August 17, we met with Nexleaf (https://nexleaf.org/, an NGO dedicated to studying the adoption of improved cooking technologies). Nexleaf will help guide the dissemination process and data collection using "Treks", their thermometer data loggers. During their visit, they demonstrated the use of the Trek with our newest generation of ISEC with PCTS.

We have decided to initially introduce three different ISECs, each with a USB charging port and LED light source:

a. Nested Heater Slow Cook (NS). The nested heater allows the heater to be separated from the cooking pot. It is a Slow Cook because there is no thermal storage.

b. Nested Heater with Phase Change (NP, see figure 3). A Phase Change Assembly (PCA) is inserted into the nested heater. An additional empty pot is provided with this assembly allowing the device to be used as an NS (above).

c. Directly-Heated with Phase Change (DP). The diode-chain heater is immersed directly in the Phase Change Material (PCM, which is erythritol), so there is no need for a heater nest.

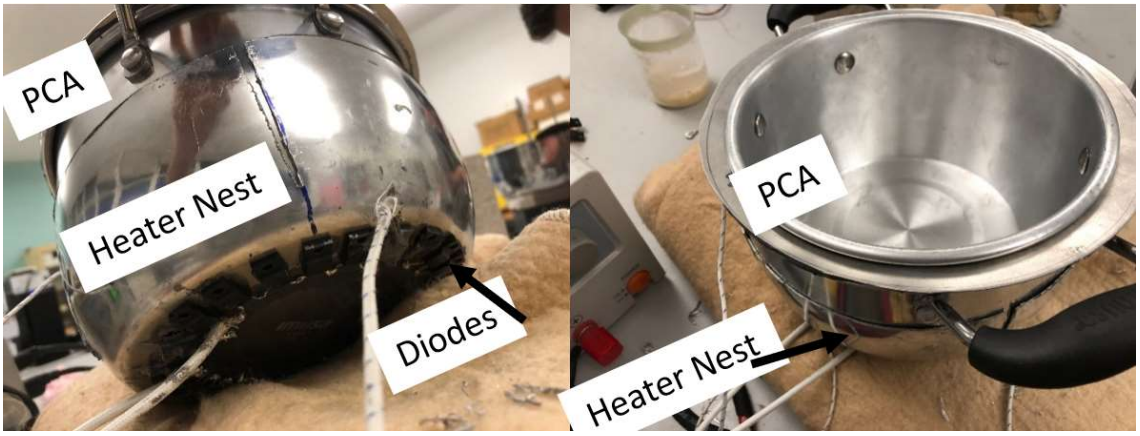


Figure 3 Nested Heater with Phase Change (NP) shows the square diodes glued to the heater nest (left). The pot for the heater nest is cut so that it can expand to accept the Phase Change Assembly (PCA) of the same size pot. At right, the PCA consists of two pots of differing sizes that house the Phase Change Material (PCM).

Our manuscript outlining the advantage of using Direct Drive Solar (DDS) with diode heaters should publish in the coming week in Development Engineering. We are free to circulate the preprint: http://sharedcurriculum.peteschwartz.net/wp-content/uploads/sites/3/2019/10/Gius-Hot-Diodes-Oct-24-2019.pdf

We have not yet begun production of ISECs in Ghana as we first finished the contract and gained access to the grant money on October 22 and wired 2,269.88 to SolCook, Ghana, October 25. The timeline has been pushed back as indicated in the Gantt chart below. The new timeline is also workable and we look forward to starting production in the coming weeks.

Changes in Planned Activities:

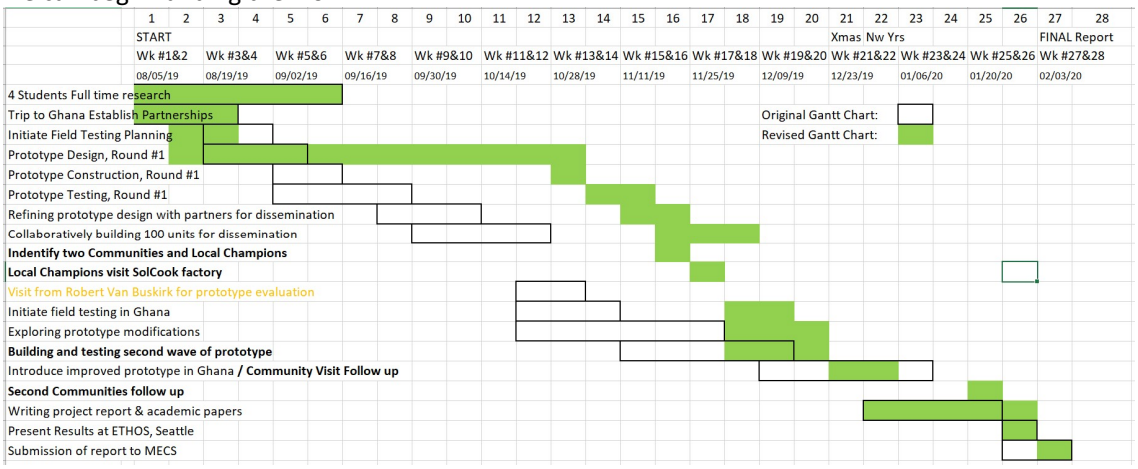
1) We've pushed back the beginning of manufacturing the ISECs by seven weeks. We will compress the amount of time allowed to build them and also reduce the amount of time between the first and second community visit.
2) Robert Van Buskirk will not visit Cal Poly. Our research efforts are no longer correlated.
3) Through our discussions with Nexleaf, we decided to hire a representative, a woman, from each village targeted for dissemination, to spend time with Martin and SolCook for the week before visiting the village. These representatives will remain employed for the duration of the project to provide connectivity to all users in both communities as well as with SolCook.
4) We have replaced "Introduce Improved Prototype" with "Community Visit / Follow up". During this visit, we will inquire with each recipient to see if they would prefer a different ISEC of the three models.

Staff Changes: We have hired Martin Osei to run SolCook

Lessons Learned: The amount of time necessary to negotiate the grant submission, the contract agreement, and the distribution of grant funds has been much greater than anticipated. Likely future efforts will be funded directly to our company. At the same time, Cal Poly is undergoing process changes and has already taken steps to improve this process. Potentially, I learned that if something doesn't make sense or seems to not be working, I should ask questions and solicit assistance more widely. Additionally, it has been challenging to balance expedience and the need to be careful to avoid unrealistic expectations while building a collaboration - especially when the majority of communication takes place on a three-week trip in a new country. Setting up the collaboration between a new company, people in Ghana, and administrators and students at Cal Poly has been an intense learning experience for all of us.

2. **Planned activities for the next two months**

Our revised Gantt Chart is shown below. The original timeline is indicated with a black outline while the revised timeline is in green. Much of the innovation toward the first prototype has taken place at Cal Poly, and we have a design to start production as soon as we can begin funding the work.



3. Outputs and dissemination

1) We will publish next week in Development Engineering, as described above.
2) We've established many websites regarding the project. Many of them are part of student projects in my appropriate technology class, but we have established one in particular for SolCook, our company in Ghana, http://solarelectriccook.com
3) October 7-11, 2019, Martin presented our technology at the Ghana Renewable Energy Fair and National Symposium http://www.ghanarefair.com/en/. See Figure 4
4) Martin is planning to go to Nairobi for the Clean Cooking Forum, https://www.ccacoalition.org/en/event/clean-cooking-forum-2019.

Figure 4 Martin discusses ISEC at Renewable Energy Fair in Accra

4. Financial reporting (add additional boxes if required)

Costings

Use this table to detail your costings for the project. List each person involved, along with their daily rate and number of days worked. Also include other costs, such as equipment, material and contracting.

Name of employee	***Hourly rate (£)**	**Company** (esp. if collaborating)	**Number of hours per employee**	**Total budget (£) (highlight field(s) and press F9 to calculate/ update grey cells)**
Martin Osei	1.79		228	409
Emmanuel	1.79		20	36
Bismark	1.79		18	32
				0
	Consultancy costs (£)			0
	Material costs (£)			0
	Equipment cost (£)			170
	Travel Costs (£)			144
	Ghana Renewable Energy Fair Entry Fee (£)			1146
	Total cost (£)			1937

6a. Deviations

We hadn't anticipated that we would be able to attend a meeting in Ghana that required an additional cost of £ 1146.

5. **Gender**

As stated above, we plan to hire one woman from each community to be a representative in that community for our project.

6. Safeguarding

NB – if the situation changes and new issues/risks are identified that may have serious impact to your project please contact MECS team IMMEDIATELY on mecs@lboro.ac.uk to arrange a skype meeting to discuss the situation. DO NOT wait for the monthly report to report urgent issues. This is to be used for regular reporting.