Key Activities

We have established 7 collaborators in India, Ghana, Togo, Sierra Leone, Jamaica, and South Africa who have gone through an application and vetting process and are currently in Stage 1 ($1000 to build and disseminate 8 cookers). Collaborators in India, Ghana, and Togo are in the process of building and testing cookers.

Four different weekly meetings coordinate different foci of our coordinated efforts. Super Group meetings consist of student researchers, advisors, and collaborators where we discuss ISEC development and dissemination. These meetings are helpful for collaborators to expresses their new developments with the technology and dissemination strategies. Weekly laboratory research and senior project meetings are held by Pete to check in with student researchers at Cal Poly. The dissemination team meetings is where student researchers and advisors talk about logistics, collaborator support, and dissemination strategy.

Some Technical updates have been submitted for publication in the accompanying manuscript including:

- ISEC in a double-walled vacuum thermos
- Control of super cooling by forcing crystallization
- Recognition of thermal degradation of erythritol.

Value added to MECS support comes from university funding, classes, and academic research:

- Received 5 paid Frost summer positions ($3500 per position).
- 2 quarters of Frost-supported research students ($850 per quarter)
- Frost funding for hardware ($1000)
- IRA (Instructionally-Related Activities) Received in Sept., 2020 ~ $3567 for materials.
- 2 senior project physics students and 5 quarters of independent study (research)
- 2 engineering senior project groups (8 students total)

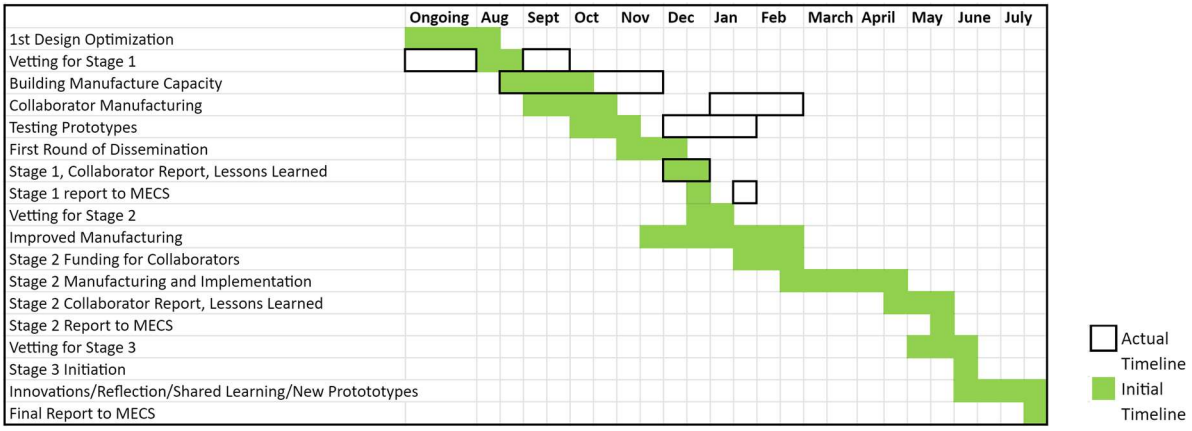
Changes in Planned Activities

Due to multiple barriers, building the ISECs has taken longer than expected in all of our collaborating countries. One of our collaborators has noted building time as, “20 days (working for ~1-2 hours per day = ~ 20-30 hours)”.

Longer than expected time in stage 1 can also be attributed to collaborators tailoring the ISECs to their own community’s needs. We have frequent technical updates that have changed the course of building ISECs as well. Sourcing materials that are essential to building ISECs has also kept collaborators in stage 1. We talk more about this in the lessons learned segment. Our current solution is to send materials over to Sierra Leone from the United States then distribute the supplies to collaborators in Ghana and Togo.

With building times taking much longer than expected, we predict that collaborators will not be entering stage 2 at the time we predicted.

Revised Gantt Chart



Gender and Social Inclusion

In this project, social inclusion is at the forefront of our work and women are involved in design, construction and creation, dissemination, logistical oversight, and education. One of the primary goals in our dissemination plan is to introduce cookers into communities culturally-appropriately through a female liaison. As women are typically the ones responsible for preparing meals in these communities, it is of the greatest importance that their voices and perspectives be included in the process. Bougoune Salma, our collaborator in Togo has incorporated women into his dissemination process. Here is an outline of his process from a recent report:

"Very earlier, I have started working on ISEC dissemination in our local communities. I have contacted some local women leaders during a sustainable agriculture workshop organized by Togo government. On September 13th 2020, I Whatsapp group was created and the ISEC business opportunity was introduced to them. During one month, I have exposed why ISEC dissemination is a solution to stop deforestation, reverse the curve of climate change, and preserve health of women from respiratory illnesses due to traditional cookstoves fumes inhalation. I have trained these women direct selling tactics to disseminate ISEC in their communities. 17 women have participated on the whatsapp workshop and finally 5 women have shown interest on our program."

One of our collaborators from India, Hawazin Khaleel, started a group titled "Spring of 2020". Her webpage https://contactspringof20.wixsite.com/springof20 is another source of information for how to obtain the necessary materials to make an ISEC. Herself and members of her community are in the process of building ISECs to disseminate and have given us valuable feedback.

Grace Gius, an undergraduate Industrial Engineer, and Olivia Hansel, an undergraduate Anthropology and Geography major, are part of the logistical oversight of the project. Grace and Olivia are the primary contacts for communication between collaborators and fellow researchers. They also review proposals for funds, provide recommendations for improvements to the applications, organize information related to data collection, present research and network with people at conferences, and oversee the organization of the project. Grace and Olivia have also decided to use ISEC as the focus of their senior projects. Grace is working with

a team of industrial engineers to make our user manual more effective and culturally literate and Olivia is studying potential adoption barriers. The manual is a “living document” that is continuously updated with new information, accessible from our research website[1].

Dr. Nichole Hugo is working with Martin Osei, a graduate student at EIU, to develop and test ISEC to determine its ability to cook food consistently. They created 5 ISECs at EIU in January 2021 and will soon begin research on the texture and consistency of the food.

Lessons Learned

One of our key lessons learned is that sourcing parts is a challenge in Africa. After talking to fellow collaborators we have decided there is a short-term and long-term solution to this problem. The short-term solution is we have a collaborator bringing these parts to Africa on Feb 2nd from the US and ship them to their needed locations. In the long term, we would like to set up a supply chain where one collaborator has them delivered to their country, tests these parts to see if they work, and then ship them to the areas where they are needed. We have a student working under the FROST research grant investigating which companies ship these materials to their needed locations.

Sourcing	Name	Notes	Price	Contacted?	Link
JB Weld Min “max T” = 200 C	Metal repair adhesive super glue…	Rated from -60C to 160C			#1
	Metal Epoxy Resin AB Glue Steel adhesive…	* Cannot read max temperature, sent email – rated for 180 C * asked them if they have 200 C and they have 220 C max temperature **which is not published on the website**	$0.02/gram $1.3/56 gram = 1 order min order 5000	Y	#2
Silicone Sealant	...Glue Neutral Silicone Sealant	* Weatherproof * no priming needed * -40 to 280 C * $0.32 – $0.65 / piece * 280 / 300 ml per piece			#3
Silicone Tube	High temperature heat resistant food grade silicone tube	* -60 to 300 C * customizations available * $ 0.29 - $ 2.60			#4
Heating Element	Round High Temperature Electric Heater Heating Element for Cooking	* customization * comes in different coating materials			#5

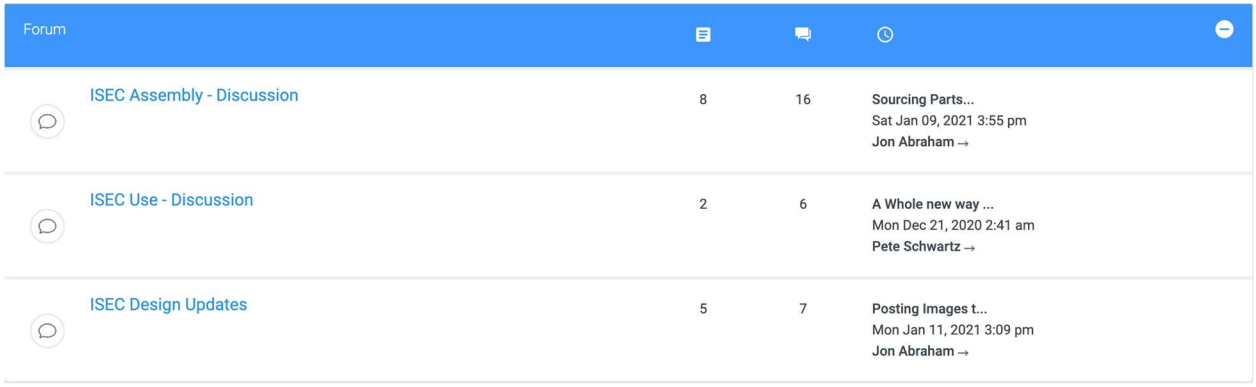
Excerpt from in-progress table made by student researching materials sourcing

We have also learned that the manual we have created to build ISECs is not enough to thoroughly teach people about the technology. Based on questions from collaborators and based off of the information in the manual, a video is in the development process to illustrate more clearly how to make ISEC. The tools and parts for each stage of the development process are highlighted, with a demonstration of how to complete each step. This video is in the final editing stage.

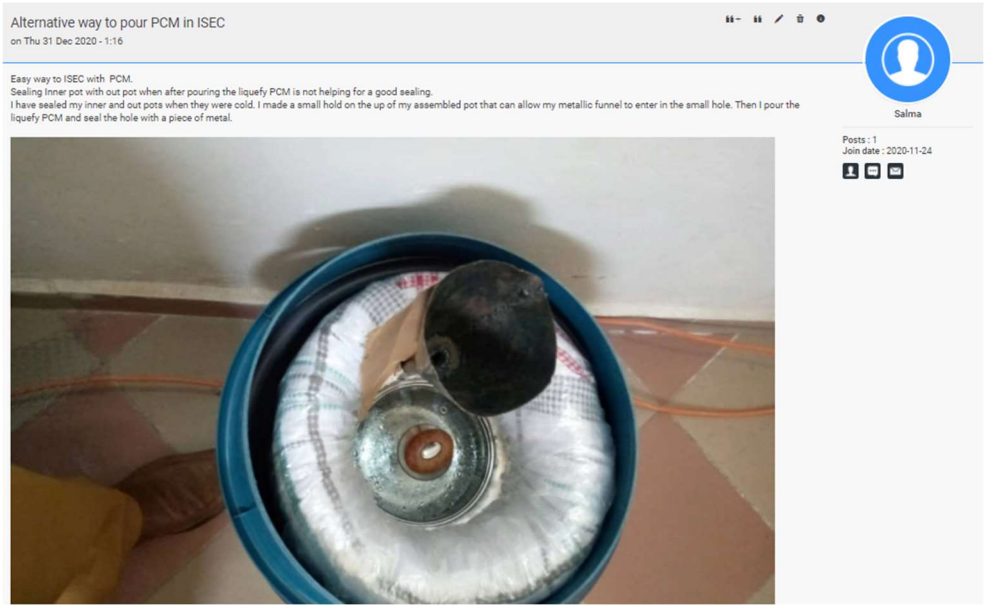
In order to further answer questions collaborators have of ISEC and share information regarding the development of ISEC technology, a forum was created to communicate this

[1] http://sharedcurriculum.peteschwartz.net/solar-electric-cooking/?fbclid=IwAR1sDg2L1wS9bh4wEML0sz3swWEw69rO9OQ4NQOkuYB2PdWZ83AwwmRFEEE

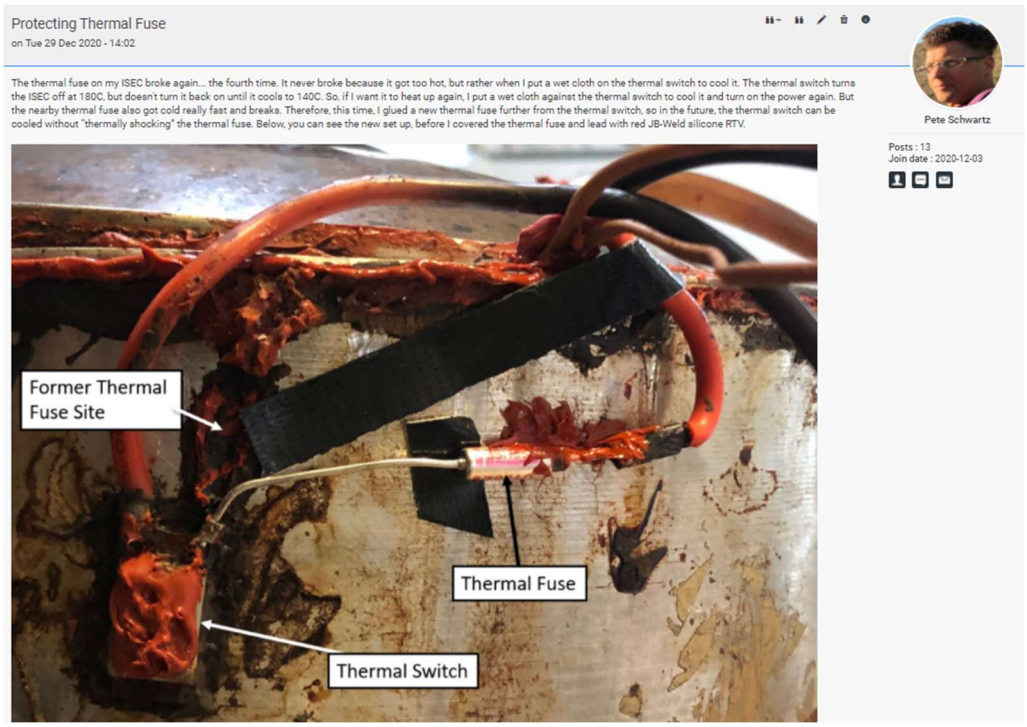
information. Not only does this give collaborators a chance to gain a better understanding of developing ISEC, but individuals and organizations not familiar with the device can become aware and learn about the creation process. This forum contains three subforums (shown below), distinguishing standard ISEC assembly and construction, use, and design updates.



Sub-categories on the [forum website]



A post made by collaborator, Salma in Togo, about ISEC Construction



A post made by Pete Schwartz about Design Updates

Outputs and Dissemination

In an effort to prioritize end users' needs and desires when improving ISEC's design, we require our collaborators to collect user feedback in the various stages of dissemination. Our collaborator in Ghana recently collected feedback from 8 ISEC users, and they reported that they mainly used the ISEC for boiling water because traditional meals take longer to cook in it. While they save money on fuel when cooking with ISEC, since they only use it to heat water, they are not experiencing fuel savings or minimized indoor air pollution since owning ISECs.

One of our collaborators in India, Hawazin Khaleel, has completed 8 preliminary cooking methods surveys. Olivia Hansel will be focusing her senior project on analyzing these 8 preliminary surveys for potential adoption barriers. Preliminary results show most participants use wood (5) and LPG (7) in order to cook their foods. These methods suffer from fuel shortages and price hikes. All respondents identified rice as a staple food in their diets. This is promising since our ISEC trials have shown that the ISEC successfully cook rice. Other foods are still being tested to determine best techniques for using ISEC, as some foods do not cook evenly.

Rice made from the ISEC in India

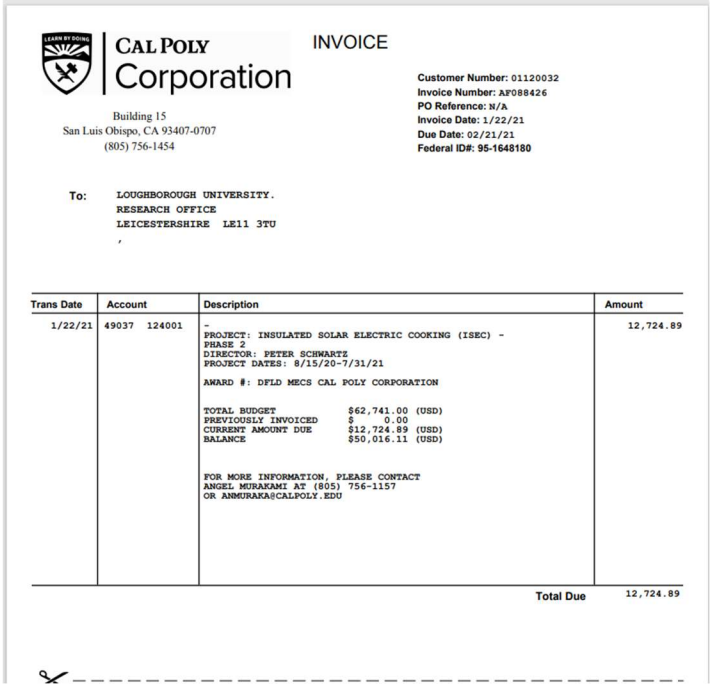
On top of collecting feedback on ISEC users, we also ask our collaborators to use the ISEC themselves so that they can better serve their customers and have a deeper understanding of their target users. In their recent progress report, our collaborators reported that in their initial stage of developing production of ISECs, it takes them an average of 20-30 hours to build each cooker. Lessons they have noted during construction and use are listed in the tables below.

Construction Related Issues	
Lesson	**Collaborator Reporting**
Pot Insulation	Salma
Avoid opening when curing	Salma
Poor wire connection to heating element	Hawazin
MC4 crimping was difficult to maneuver	Hawazin
Broken heat shield	Hawazin

ISEC Use Related Issues	
Lesson	**Collaborator Reporting**
Pot Insulation	Salma
Cloudy Days	Salma
Poor wire connection to heating element	Hawazin

Expense Report

Below is an invoice from Cal Poly Corporations of how much we have spent thus far.



CAL POLY Corporation

INVOICE

Building 15
San Luis Obispo, CA 93407-0707
(805) 756-1454

Customer Number: 01120032
Invoice Number: AF088426
PO Reference: N/A
Invoice Date: 1/22/21
Due Date: 02/21/21
Federal ID#: 95-1648180

To: LOUGHBOROUGH UNIVERSITY.
RESEARCH OFFICE
LEICESTERSHIRE LE11 3TU
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Trans Date	Account	Description	Amount
1/22/21	49037 124001	- PROJECT: INSULATED SOLAR ELECTRIC COOKING (ISEC) - PHASE 2 DIRECTOR: PETER SCHWARTZ PROJECT DATES: 8/15/20-7/31/21 AWARD #: DFLD MECS CAL POLY CORPORATION TOTAL BUDGET $62,741.00 (USD) PREVIOUSLY INVOICED $ 0.00 CURRENT AMOUNT DUE $12,724.89 (USD) BALANCE $50,016.11 (USD) FOR MORE INFORMATION, PLEASE CONTACT ANGEL MURAKAMI AT (805) 756-1157 OR ANMURAKA@CALPOLY.EDU	12,724.89
		Total Due	12,724.89