Appendix 8

Dissemination Report

Contents

Preface

Objective

The work done in this project needs to be conveyed to a wider audience for a number of reasons including:

- *Ensuring that the eCook stoves proposed are required and are acceptable for the intended use*
- *Sharing and exchanging expertise so as not to "reinvent the wheel"*
- *Informing interested parties of the work we are undertaking*
- *Sharing information with our partners so that they can understand the principals of the project*
- *Explaining the concept to local people for them to see how they could use the eCook stove*
- *Teaching and training others to build the eCook stove in country*

The method used for the dissemination will vary with the type of information and the audience.

Initial dissemination of the eCook stove concept to local Malawian people

Objective

The local people who will use the eCook stove need to made aware concept of the solar powered cook stove as a replacement for wood fuel. It needed to be ascertained that it was something that they would want and it would be something that they would use. They also needed to have their input into the design of the cCook stove including what was acceptable and what wasn't.

Methodology

Initial communications were with our potential partners, Aquaid Lifeline, in Malawi. This was by e-mail, Skype and Whatsapp to discuss the concept of the project and to see if it was something that they would be willing to be a partner in. Face to face meetings were also held with the UK trustee of the charity.

There was a field trip to Namisu, Malawi to talk to the local ladies directly about the eCook stove and to get their feedback and input.

Part of the field trip included taking part in a debate with secondary school children on the impact of new technology on the younger generation where the solar powered eCook stove concept was introduced and explained to them.

Results

The feed back from Aquaid Lifeline was that they were very conscious of the deforestation caused by the overuse of wood as a fuel source. They had been looking at ways to reduce their wood usage including the purchase as use of more fuel efficient Rocket stoves and by trying to grow bamboo as a fuel source.

> *All the Aquaid Centres are in a rural setting, in villages and firewood is the only source of cooking fuel. All meals are cooked in the more energy efficient Rocket Stoves, no meals are cooked on open fires.*
> *Aquaid Lifeline has made significant steps in establishing its own woodlots to reduce the demand for locally provided wood fuel and tries to use this wood as efficiently as possible.*
> *However, we believe that we need to take further steps to reduce our dependency on wood as deforestation and the environmental impact throughout Malawi is significant. The declining supply of available firewood is also becoming noticeable and the cost of obtaining firewood is steadily increasing.*
> *We believe that changing habits starts from a young age, and we are in a privileged position where we can influence young minds and the next generation to do things differently.*
>
> *Aquaid Lifeline is very excited about the MECS SOWTech cookstove as we see this as a possible alternative and sustainable solution to what is a huge problem not only in Malawi but many African and less developed countries.*
> Angus Gaisford, General Manager, Aquaid Lifeline

During the first field trip to Malawi there was the opportunity to speak to many local people. The concept of the solar power cook stove was explained. People were aware of the diminishing wood supply which manifests itself most obviously to them with the increase in wood prices.

The ladies in the village. Buy the firewood for their home cooking They walk up to 6km to fetch it and they spend about 500kwacha/day. Last year they were spending 400k/day. This price can go up in the rainy season to 1,000k/day due to a lack of available wood.

Firewood is the fuel of choice in rural areas and charcoal in urban ones. In Malawi it is forbidden for motorised vehicles to bring charcoal into the town. It therefore comes in on bicycles for the charcoal ovens in the hillsides. The men travel 70-80km all through the night to bring in the charcoal. The cost of charcoal is about half as much again but it burns for longer.

The ladies were excited about having a solar eCook stove. They had input into the design of the stove (see Appendix 3: Report of initial user-centred design visit to Malawi).

We were able to take part in a debate on the impact of technology on the new generation with secondary school children at Gormani. Primarily this was about mobile phones and the Internet. After the main debate I was introduced and I explained what I was in Malawi to do. The discussion was then opened up to include solar-powered cooking. They were all very enthusiastic about the possibility of using solar-power to cook with. They were aware of deforestation and the impact of it.

They discussed the pros and cons of using solar energy.

Pros:

- It would save wood
- it would use a sustainable energy source
- there would be less contamination in the food
- it would be more healthy
- it would be cleaner

Cons:

- the cost of the stoves
- food might taste different
- it might take longer to cook the food

Overall they agreed that using solar to cook with was a good thing.

SHARING AND EXCHANGE OF INFORMATION WITH OTHER PROFESSIONALS IN THE FIELD

Objective

It is known that there are other teams looking into solar cook stoves. By sharing information between the teams we can learn from each other and avoid known pitfalls. The information exchange will enable the project to proceed more rapidly.

Methodology

The MECS team put SOWTech in contact with Prof. Peter Schwartz and his team at California Polytechnic State University (Cal Poly). They are working on a similar eCook stove using phase change materials.

There have been many email exchanges between the Cal Poly team, SOWTech and Dr Paul Routley, SOWTech's consultant.

Results

There has been a very fruitful exchange and dissemination of information between the two teams especially regarding the electrical components cumulating in SOWTech supplying Cal Poly with one of the Power Optimisation Devices that we have developed.

Below is an example of the type of correspondence between us.

RE: Introduction from the UK re solar cookers

Peter V. Schwartz pschwart@calpoly.edu via cpslo.onmicrosoft.com

20 Dec 2019, 06:59

to mattwalker175@yahoo.com, Paul, John, me, Grace, Owen, Euan

Thanks Matt!

Here's the flat diode. I bought 2000 of them. I think we sent 700 to Ghana.

Pete

From: matt walker <mattwalker175@yahoo.com>

Sent: Thursday, December 19, 2019 10:52 PM

To: Peter V. Schwartz <pschwart@calpoly.edu>; Paul Routley <prroutley@outlook.com>; John Mullett <johnajmullett@gmail.com>

Cc: Lynn wk McGoff <lynnm4ad@gmail.com>; Grace Isabel Gius <ggius@calpoly.edu>; Owen Hugh Staveland <ostavela@calpoly.edu>; Euan Smith <euan1971@yahoo.co.uk>

Subject: RE: Introduction from the UK re solar cookers

Paul,

Matt Walker here, one of Pete's research students. Hoping to clarify something.

We currently use 1N5408 doides (3A silicon rectifier). The data sheets and pricing can be found online. We have no problem running 6A or more through them if they are properly heat sunk. They cost about 4 cents a piece when you buy 1000-2000.

The flat diodes cost a significant amount more. I'm not familiar with them yet and don't have the part number. We have done only a small fraction of our work using these diodes so far. Any results we have published are from the round 1N5408 diode based heater.

Matt

On Thu, Dec 19, 2019 at 10:22 PM, Peter V. Schwartz <pschwart@calpoly.edu> wrote:

Paul,

Thanks for the explanation.

For 100 W, we would run a chain of 19 or 20 diodes costing $0.80. This would be for a nominally 18 V, 6 A solar panel. Thus each diode would dissipate about 5 W.

Pete

From: Paul Routley <prroutley@outlook.com>

Sent: Thursday, December 19, 2019 1:23 PM

To: Peter V. Schwartz <pschwart@calpoly.edu>; John Mullett <johnajmullett@gmail.com>

Cc: Lynn wk McGoff <lynnm4ad@gmail.com>; Grace Isabel Gius <ggius@calpoly.edu>; Owen Hugh Staveland <ostavela@calpoly.edu>; mattwalker175@yahoo.com; Euan Smith <euan1971@yahoo.co.uk>

Subject: RE: Introduction from the UK re solar cookers

Peter

The circuit does function as a MPPT controller but by maintaining the voltage on the solar panel, the average voltage on the heater is what is varied to extract the maximum current from the panel before the panel voltage starts dropping. The average heater voltage will vary from a maximum, under bight sunshine, of the voltage on the panel (about 30V in our case) to zero as the amount of sunlight falls. Heater resistance is about 3Ohms for 300W, I.e. about 10A heater current. 280C max sounds about right for Silicon diodes. The heater wire should be good to over 1000C.

We had some good experiments today with John's heaters made from two ceramic tiles with heater wire between stuck together with clay.

Just checking your pricing for he diodes; We are looking for a total heater power of about 150W to 300W. The diodes I was looking at dissipate about 1W so 300 diodes would be needed costing $12 for the round ones or $63 for the flat ones, using your prices. Prices proportionally lower for lower powers.

Regards

Paul

From: Peter V. Schwartz <pschwart@calpoly.edu>

Sent: Thursday, December 19, 2019 7:46:48 PM

To: Paul Routley <prroutley@outlook.com>; John Mullett <johnajmullett@gmail.com>

Cc: Lynn wk McGoff <lynnm4ad@gmail.com>; Grace Isabel Gius <ggius@calpoly.edu>; Owen Hugh Staveland <ostavela@calpoly.edu>; mattwalker175@yahoo.com <mattwalker175@yahoo.com>; Euan Smith <euan1971@yahoo.co.uk>

Subject: RE: Introduction from the UK re solar cookers

Paul!

Nice to meet you and thanks for the communication.

I think what you're presenting to me is a device that will maintain 5 V output under all solar intensities by imposing a duty cycle of the output and holding energy in a capacitor or inductor. This will function as a low cost MPPT controller. I think it's a great idea, and have thought about it as well, but never investigated it.

I agree with what you say about the shortcomings of diodes… except the price. We purchase the diodes we use for $ 0.04 per diode for the round ones, and $0.21 for the flat ones. I'm reasonably sure that we can get them for considerably less if we manage a sale directly from China. But it's not important because as is the cost is less than $4 per pot. Additionally, while your device costs about the same, you haven't provided the heater yet.

However it is not my intention to poo poo your direction. I'm FULLY in support of it, and I think it needs to be done! And there's an important concern about diodes you didn't mention: the temperature limitations. 280 C seems to be the maximum temperature the diodes can withstand. And while this is reasonably hot for cooking, it imposes a power limitation because at high power the diodes will be considerably hotter than the food.

I'm curious how this will work. 5 V is a rather low voltage indicating the need for high current. 150 W would require 30 A. So the resistance of the heater would have to be pretty low… well under an Ohm, and the lead wires to the cooker would have to be VERY low resistance… but they could be short if the modulation unti is close to the cooker.

I look forward to our future communication.

Pete

From: Paul Routley <prroutley@outlook.com>

Sent: Wednesday, December 18, 2019 8:24 AM

To: John Mullett <johnajmullett@gmail.com>; Peter V. Schwartz <pschwart@calpoly.edu>

Cc: Lynn wk McGoff <lynnm4ad@gmail.com>; Grace Isabel Gius <ggius@calpoly.edu>; Owen Hugh Staveland <ostavela@calpoly.edu>; mattwalker175@yahoo.com; Euan Smith <euan1971@yahoo.co.uk>

Subject: RE: Introduction from the UK re solar cookers

Hi Peter

I am Paul Routley the electronics engineer working with John.

With regards to the diode heating, the diode string does the right thing, by maintaining a constant voltage on the solar panel (approximately) irrespective of the current being produced. There are a couple of shortcomings though:

Power diodes are not cheap, I think about $20 for 150Watts worth of diodes

The voltage is temperature dependant

Changes to the solar panel optimum working voltage require a change to the heater design

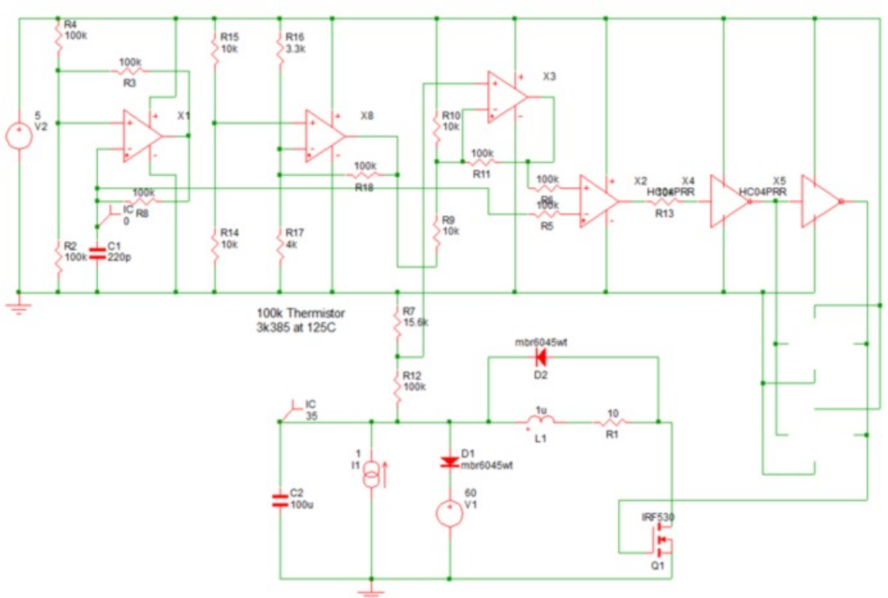
The solution we are working with is a resistive heater fed by a PWM signal to match the resistance to the current generated by the solar panel. The circuit monitors the voltage on the panel and adjusts the PWM ratio to get the right average current. The current is smoothed by a large capacitor (could be inductive, and I had hoped the heater coil self inductance might be enough, but unfortunately not. Capacitors seem to be more cost effective). The circuit consisting of a quad opamp and hex inverter is shown below and the simetrix file attached (you can get a free simulator to run it from https://www.simetrix.co.uk). Only three invertors are on the schematic as there is a component limitation on the free version of simetrix

The circuit consists of:

A triangle wave generator based around X1

A temperature error amplifier based around X8, R17 is a 100k (at 25C) thermistor.

A voltage error amplifier based around X3 which measures the voltage on the solar panel modelled by D1, V1, I1. The working voltage is adjusted by varying R7.



The voltage reference is shifted by the output from the temperature error amplifier so the temperature control is achieved by moving the solar panel working voltage away from the optimum.

The gain around X3 can be adjusted to provide 'super optimum' control of the solar panel voltage. I.e. allowing the voltage on the solar panel to fall slightly as the current drops. We have not done the experiment to optimise the gain yet.

The voltage error signal is compared with the triangle wave by X2 to give the PWM signal which is cleaned up the logic invertors, X5, X5 etc, before switching Q1 which drives the heater modelled by L1, R1. D2 is to prevent damage to the electronics by any inductance in the heater.

C2 is the smoothing capacitor. About 3000uF in real life but 100uF for the simulation so things settle faster.

Cost of components is about $4 + $2 for a 5V smps convertor that generates 5V from the solar panel output. The 5V can also be used to charge a phone. Wire for the heater costs about 50c.

Regards

Paul

From: John Mullett

Sent: 12 December 2019 15:34

To: Peter V. Schwartz

Cc: Lynn wk McGoff; Grace Isabel Gius; Owen Hugh Staveland; mattwalker175@yahoo.com; Paul Routley; Euan Smith

Subject: Re: Introduction from the UK re solar cookers

Hi Peter

Great to have heard more of your experiences.

Re heaters. We are still at early days but resistive wire on bottles has worked so far. We cover the wire with morter in thin layer of heat resistant mortar, as used in fireplaces. This is cured by placing on the top of a wood stove to just warm through. We are also trying a unit made with the wires in clay, but not tried this yet. Having issues with the clay shrinking and then exposing the wire. We are also experimenting with different wire thickness and types of wire.

Re the diodes, I can ask my electron partners if they have any comment, that sort of issue is outside my paygrade...

Re the supply of Erythritol, as far as I know its made by fermentation using a specific micro-organism (I would need to look up the name again). Perhaps subject to another project once we have proved its the right PC material.

Re condensation. would I be right in thinking it is the steam being released from the cooking pot into the insulation. I will review our designs with this in mind. If it is, then we must consider the internal structure of the cooking chamber to ensure its damp resistant and maybe have a drainage /venting arrangement.

Useful to have your input. Hope to be able to share more of our experience as we gain it!

Thanks

John

On Mon, 9 Dec 2019 at 18:08, Peter V. Schwartz <pschwart@calpoly.edu> wrote:

John,

This is great. Already we are helping each other:

Thanks to you, we have more confidence in our past experiments indicating supercooling is not a concern.

We can tell you about our (mis)adventures making resistive heaters… It was a bit of a mess trying to find an electrical insulator that is thermally conductive. We went with the industry standard of MgO, but man, what a mess… and trying to compress it? You can see videos online about how they make standard electrical heaters. It's hard to emulate. It may (… most certainly) be best to contact a factory and have them make the heaters for you, and you can just bend them around the cookers, or put them in the cookers…. Or better yet, design a cooker that can use a conventionally-available heater.

You can import lots of Erythritol rather inexpensively from China. If you buy a lot, it's cheaper. I actually don't know how it's made, but I agree that what we want to do is make loads of it cheaply in Africa with low low low standards of quality because no one's going to eat it. If you can contact a company in China, we could *get them to do it. However, Africa is tomorrow's China for manufactured goods, so we might as well get that started.*

Issues? Condensation! You can run a small vent to the pot as we did in our "baking" video. However, you'll still get some condensate in the insulation and it will accumulate… like after ~ 30 tests in the making of the "Hot Diodes!" paper, I was surprised to find pools of water in the bottom of two of the three buckets. What did I find in the bottom of the third? A crack. So, I drilled a bunch of holes in the bucket I use at home and the difficulty is only acute… meaning after I cook, everything is wet, it might be a little wet, but the moisture is largely driven off by the heat…

Looking forward to our future communications.

Pete

From: John Mullett <johnajmullett@gmail.com>

Sent: Monday, December 9, 2019 2:47 AM

To: Peter V. Schwartz <pschwart@calpoly.edu>

Cc: Lynn wk McGoff <lynnm4ad@gmail.com>; Grace Isabel Gius <ggius@calpoly.edu>; Owen Hugh Staveland <ostavela@calpoly.edu>; mattwalker175@yahoo.com

Subject: Re: Introduction from the UK re solar cookers

Hi Pete

Thanks for getting back to me and so quickly.

We will certainly let you have our feedback on the resistive heating elements. We are undergoing modest testing with them right now.

RE the students in Austin. I have misled you. The mentoring I do is via skype calls to engineering students who are undertaking projects in biological waste treatment for emergency aid. (nothing to do with solar cookers ... yet).

I know the head of sanitation for the International Red Cross in Geneva who happens to be an Austin Uni Alumni. He suggested I could help out the students which is how it has come about. This work is all pro bono, so I just do it by skype as and when Prof Janet Ellzey (of Austin) requests it.

I have read some of stuff on hot diodes, but not sure which if I have read the particular paper you allude to. Happy to do so if you could point me to it. (Also reviewed the videos of making them - very helpful)

I was aware of the supercooking issue from the literature, but like you we have not encountered this problem with our trials to date. Our early trials gave off heat at around 115 degrees C which was pretty much what we expected. Are there other phase change options you would suggest we should consider?

Do you have any knowledge of where it can be purchased at the lowest cost. I am using catering/food grade material as its easy to buy but I feel sure there must be cheaper options. One day I hope we can ferment our own in Africa but that is a way off yet! That does call for biology!

Would love to chat over the issues you are encountering too. Will keep you posted on how we get on.

Thanks again.

John

On Thu, 5 Dec 2019 at 19:27, Peter V. Schwartz <pschwart@calpoly.edu> wrote:

John,

I receive your introduction enthusiastically.

I think it is a great idea that you are pursuing the resistive heater direction. I am interested to know what we can learn from each other.

Have you read the "Hot Diodes!" paper? It outlines the advantages of diode heating… more efficiently extracting heat from the solar panel. However, there are significant disadvantages as well… and all the diode advantages can be realized if you have a "smart" system connecting the solar panel to the heater… Such "intelligence" is ever decreasing in cost… and we really should get on it and develop this… requiring collaboration with electrical engineering.

The other thing is that Erythritol exhibits super cooling… that you don't get the latent heat of fusion back until the temperature drops well below a cooking temperature… I've read about this, but we haven't experienced this problem… I invite you to collect cooling curves and see if things work well for you too.

We are running into other challenges, and slowly chipping away at them. I look forward to our future communication.

As for Skype, etc. I'm open to this, but likely we have more information to share. If you have students in Austin, I think it may be appropriate to visit each others' labs… particularly in summer… For instance, we could host a research student for a month… just a thought.

Pete

From: John Mullett <johnajmullett@gmail.com>

Sent: Thursday, December 5, 2019 9:17 AM

To: Peter V. Schwartz <pschwart@calpoly.edu>

Cc: Lynn wk McGoff <lynnm4ad@gmail.com>

Subject: Introduction from the UK re solar cookers

Hi Pete

We have not been in touch before. My normal territory is biological waste management such as composting and AD. However, we got the opportunity to participate in a solar cooking initiative being hosted by Loughborough University (UK). During our initial discussions with Simon Batchelor the issue of heat batteries came up. I already have heat batteries in my house (27kwh worth) using kit from Sunamp. Simon introduced me to your work which I have read with great interest. I should explain that after a lifetime of building large waste recycling plants for the developed world, I and two other colleagues spun out of our business a social enterprise for working in low income countries with the catchy little name of Sustainable OneWorld Technologies cic. We have been involved with novel digesters and biogas cookers in various African countries but feel that solar and heat storage is good way to stop cutting down trees. So we are looking to build on your expertise and are building a pv powered cooker using Erthritol as the phase change. We are currently building a prototype in the UK and plan to do another in Malawi in the next two months. We have opted for resistive wire rather than diodes as the heating element. The plan is for local manufacture to facilitate acceptability, low cost and "ownership". In fact much as you have been doing.

We would welcome any tips you might care to offer. We will be open source about the project once we have something to say, and look forward to trying to crack this really difficult cooking problem. Being a biologist by training and background, the physics is all a mystery to me. However, organic matter, the soil and the need to conserve trees is my world, and as a PhD in algae and as an ex worm farmer, I have some empathy for permaculture too.

Would be good to connect. I do skype /whatsapp/ viber if appropriate and you might be interested to know I am currently a mentor for some student projects in a Uni of Texas at Austin programme. Any help or tips much appreciated.

Kind regards

John

INFORMING INTERESTED PARTIES OF THE WORK THAT WE ARE DOING

Objective

The work that we have been doing has been disseminated to the wider public who are interested in the fields of sustainable living, deforestation, WASH and health.

Methodology

This has been done through three main channels:

1. Articles in Lynn's Letters, a newsletter that is send out by SOWTech to a wide range of international recipients including senior officers in international Charities and NGO, workers in the health and WASH fields
2. Bulletins on the SOWTech website www.sowtech.com
3. Conversations with interested people

Results

We have had some positive feedback from our communications.

John R <rutahiwajohn12@gmail.com>
Mon, 2 Dec 2019, 13:09
Hello Lynn,
Thanks so much for sharing me this email, am so interesting with this project please if you will need any assist from Tz am Keen to work with you more in this project.
Cheers
John

From: director@grassrootsafrica.org <director@grassrootsafrica.org>
Sent: 26 October 2019 18:47
To: 'Lynn McGoff' <lynnm4ad@gmail.com>
Cc: 'Charlie Knight' <crhknight@hotmail.co.uk>
Subject: RE: Grant to design an ecookstove
Dear both,
Can I put the two of you in touch with one another?
Charlie has been working with an organisation promoting smart stoves in Malawi. You might have common grounds.
Regards,
Benny

David Little <david.i.little@btinternet.com>

Fri, 6 Dec 2019, 14:26

Lynn,

Thanks for the letter from Malawi, sounds like a great idea for the replacement of polluting stoves. The mitigation of deforestation for wood fuel is also essential. In the DRC a few years ago, we saw boys riding their bikes out of town, not into town as you might expect for work. Eventually we worked out, when we once saw the same boy in the evening, that they had spent all day gathering wood and tying it to their bikes to push back into town. I suppose they were lucky to be in the fresh air, unlike the girls and women doing the cooking?

Cheers,

David

Example Lynn's letter

Subject: SOWTech visit to Malawi

Hi

I recently had the privilege of going out to Malawi as part of the ecookstove project. I was the guest of Aquaid Lifeline at their Children's Village at Namisu where I was met and hosted by Josie Charter, one of their trustees from the UK.

The purpose of my visit was to find out first hand how and what the women cook in rural communities and to get their input into the design of our ecookstove. I spoke to a number of ladies both in the villages and in the Children's village. The staple food is nsima, a thick porridge made from maize flour. This is normally eaten with boiled red kidney beans and a vegetable relish. In the villages they cook on three-stone wood fuelled fires that are outside of their houses. The ladies get up at 4am to light the fires and cook a maize porridge for the children before they go to school. The ladies buy in all their wood fuel which is a big expense for them, 30-40% of their income, especially as the cost of the wood can double in the wet season.

Some of the design outcomes from my visit was that solar power stoves would be welcome. The stoves would have to mimic their current stoves as the stirring of the nsima is important so an enclosed oven type stove would not work. A stove that had more than one hotplate would be an advantage as it would allow the nsima and kidney beans to be cooked at the same time cutting down on the actual time spent cooking.

I also visited a number of schools with Josie. At one of these schools the older students held a debate on the impact of new technology. It was initially focused on internet and mobile phones but after they were told why I was there they discussed using solar power for an ecookstove. They were very enthusiastic about especially as they were very aware of the problem of deforestation. The other advantages they highlighted were less contamination in the food, money saved from not buying wood, it would be cleaner and more healthy. Their concerns were the initial cost of the stove, the food might taste different and that it might take longer to cook.

Another highlight of my visit was being taught how to make nsima. My attempts to beat the nsima to make it smooth caused much amusement but, with help, I succeeded. It even tasted alright too. We ate some of it and gave the rest away to a local family.

The information I brought back will now be used as part of the User-Centred Design process as we go forward with the project designing the ecookstove and building a prototype.

Regards

Lynn

PS If you not longer wish to receive Lynn's Letter please drop me an e-mail and I'll take you off the mailing list.

Lynn McGoff

Director
SOWTech

EXPLAINING AND DEMONSTRATING THE CONCEPTS TO OUR PARTNERS AND LOCAL PEOPLE

Objective

One of the most important purposes of information dissemination is informing our partner in Malawi, Aquaid Lifeline what we are trying to do and why so that they will be full onboard with the ideas and be able to turn it into a reality.

Methodology

We spoke with and emailed Aquaid to explain the concepts of the eCook stove and sent the team in Malawi production drawings and reports to keep them up to date with the things we were doing.

When in Malawi the working of the Phase Change Material (PCM) was demonstrated by heating the PCM and showing how it melted and took in heat which it then released when it solidified.

We were able to demonstrate how the eCook stove to some of the local people and they were able to try using it.

Results

By disseminating the information to Aquaid Lifeline in Malawi they were kept fully informed as to where we were in the project.

Sending them the production drawing in advance enabled prototype components to be made in Malawi ready for the field visit to trail the prototype eCook stove.

The local people were interested in what we were doing and were eager to try out the eCook stove.

The results of the PCM demonstration can be found in the section “Demonstration of phase change process to partners”

Illustrations

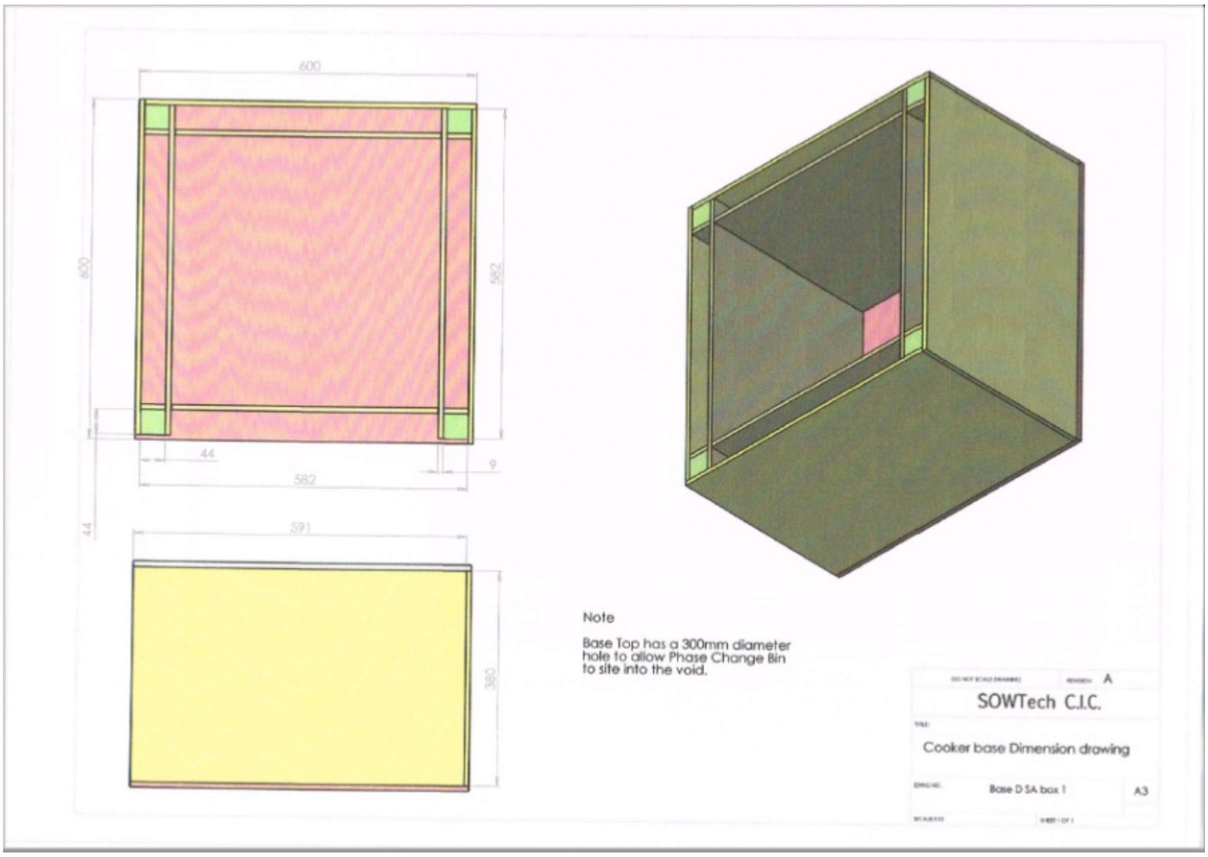


Illustration of one of the design drawings sent to Malawi

Photo illustrations

#1 Local lady cooking nsima in eCook stove

#2 Local lady cooking nsima in eCook stove

#3 Local children taking an interest in eCook stove

#4 Local lady cooking nsima on eCook stove hotplate

DEMONSTRATION OF PHASE CHANGE PROCESS TO PARTNERS

Objective

The objective was to show how the Erythritol Phase Change Material (PCM) material melted and then subsequently became solid again with the continuous release of heat. The explanation of the chemistry for the release of energy during solidification is challenging. This task was used as a "show and tell" exercise.

Methodology

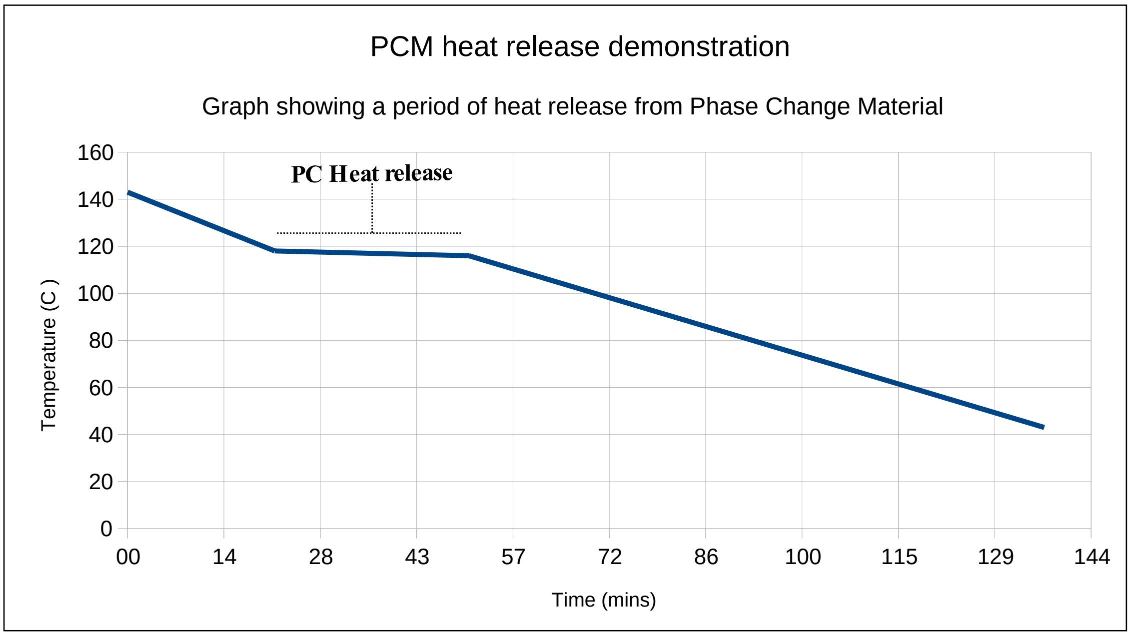
The demonstration was observed by both our partners in Aquaid, (Angus and Josie) and also one of their Malawian staff, Eviness.

Approximately 500g of granular phase change material was placed in a small cooking pan. The LPG cooker in the guest house was used to gently heat and melt the PCM. The change of appearance of the PCM after cooling was also shown to the team.

Results

The melting was observed by the participants, and particular attention was drawn to the fact that part of the PCM could be molten whilst a few centimetres away there was unmelted PCM at a completely different temperature. An oven thermometer was used to demonstrate that the molten material was at a temp of 155°C whilst the unmelted material was only at 75°C.

The following graph contains the temperature decay data/graph.



The demonstration helped our Malawian partners to appreciate the function of the PCM. Considerable surprise of the heat release properties of the PCM were expressed. It is of note that even after 2 hours of cooling the temperature of the PCM was still at 43°C.

The following photos illustrate show Eviness being shown the process.

Demonstration of the melting of the Phase Change Material in Malawi

Discussion of eCook stoves with potential partners for roll out

Objective

For this project to be successful there needs to be a conduit for the roll out of the ecCook stoves within Malawi and beyond.

We are therefore looking at potential partners who would be able to undertake this.

Methodology

When in Malawi John met with Wessie Tenthani and Winfore Ng'ambi who are Senior Regional Managers at Mary's Meals. Mary's Meals is a UK based charity which works in 18 countries across Africa, Asia, Latin America, Eastern Europe, and the Caribbean. They aim to provide a cooked meal to every child in education in some of the most impoverished countries in the world and are now feeding 1,667,067 children every school day worldwide. Malawi is Mary's Meals largest school feeding programme as it is one of the poorest countries in the world and faces huge challenges in education, access to healthcare and widespread child malnutrition. They provide meals to 30% of primary school aged children across the country. Since the start in 2002 1,019,335 children in Malawi have received Mary's Meals. Locally supplied wood is what is used to cook these meals. The fires are lit at 3am so that the porridge is ready before the start of school. This cooking task has is probably the biggest single use of wood fuel on any given day amongst the poorest in the community. The porridge mix and the methods of cooking are standardised throughout the programme. In Malawi this cooking task is around 260,000 litres of porridge a day.

We are also talking to Sandile Mtetwa and Admire Baudi of Bolsan, an entrepreneurial organisation based in Zimbabwe. They are looking for novel sustainable products that they can make using supported local manufacturing in Zimbabwe.

Results

Mary's Meals Malawi operates out of Blantyre in southern Malawi and has around 114 employees who manage, deliver and monitor their school feeding programme. They provide meals of maize and soya porridge locally referred to as likuni phala, fortified with essential vitamins and minerals

During the meeting Mary's Meals expressed concern about the sustainability of future of wood fuel supplies. They have now passed the responsibility of procuring the wood in rural areas to the individual sites rather than supplying it direct. In urban areas they supply briquettes. A proposal by Mary's Meals to explore bamboo as a fuel source had failed to secure funding.

The concept and working of the solar eCook stove was explained and discussed with them. They expressed a desire to be involved in future work to trial the eCook stove and to work with SOWTech on a scale up project.

Sandile and Admire from Bolsan are graduates who are looking for ways to support their local communities in Zimbabwe. They are looking to start to fabricate and install Interseasonal Rainwater Harvesting systems in schools in rural Zimbabwe and on farms. They have expressed an interest in the eCook stove as they are very conscious of the effects of deforestation in their country and are looking at ways that they can mitigate this. Sandile is currently studying at Cambridge University in the UK and we have held face to face meeting with her as well as Skype calls with both her and Admire.

Photo illustrations

#1 Bags of flour used to make meals

#2 Firewood for use in cook stove

#3 Cooking the meals

#4 Children being fed by Mary's Meals

Potential of supporting individuals setting up in business

Objective

Much of the local rural economy in Malawi is built on individuals running small businesses selling goods and produce much of which is home grown or home made. Those that bake to produce goods do so on a small scale on three stone wood burning fires or ovens. There is the potential for such individuals to use an eCook stove as an alternative and the feasibility of the idea was explored.

Methodology

A local women, Beata, was visited by SOWTech when in Malawi. She makes a living by making mandasi, a type of doughnut, which she sells for MK 50 (about 5p). SOWTech had explained and demonstrated the solar powered eCook stove to her when she visited Namisu selling her mandasi.

She also has a bread oven and makes and sells bread during the dry season as the wood is too expensive in the wet season to make a profit. In the dry season she pays MK1000 for firewood to make a batch of 230 Mandasi. In the wet season this rises to MK3,000.

Results

SOWTech were invited to Beata's home to see how she makes mandasi. To make a batch of 230 Mandasi she uses 10kg wheat flour which costs MK5,200, sugar costing MK850 and salt costing MK50. The dough made is fried in 3 litres of oil costing MK2,000. In the wet season she therefore makes virtually no profit.

Cost to produce 230 Mandasi

	Wet season	Dry season
Wood	3,000	1,000
Wheat flour	5,200	5,200
Sugar	850	850
Salt	50	50
Oil	2,000	2,000
Total	**11100**	**9100**

	Wet season	Dry season
Cost to make 1 Mandasi	48.3	39.6
Profit per Mandasi	1.7	10.4
Profit per batch	**400**	**2400**

Discussions were held about the eCook stove and the benefits that could be had from using solar power instead of wood fuel.

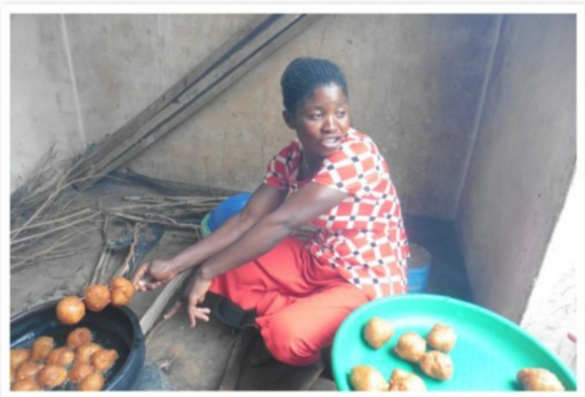
Photo illustrations

#1 Beata using the eCook stove

#2 Preparing the batter for mandasi

#3 Forming the batter into mandasi balls

#4 Frying the mandasi



#5 Finished mandasi

#6 Bread oven

Training of potential fabricators in Malawi

Objective

One of the key rationales of the eCook stove is that it can be manufactured locally in country. To be able to to this the local people need to be given the training and skills to do so.

Methodology

When in Malawi John met with Lupactio Mwandenga, who was the star pupil of the year last year. He was very interested in the eCook stove and especially the electronics as he hopes study medical engineering. John explained the workings of the eCook stoves including the electronics.

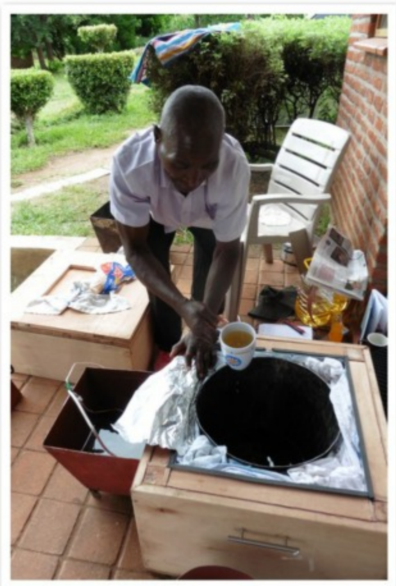
Results

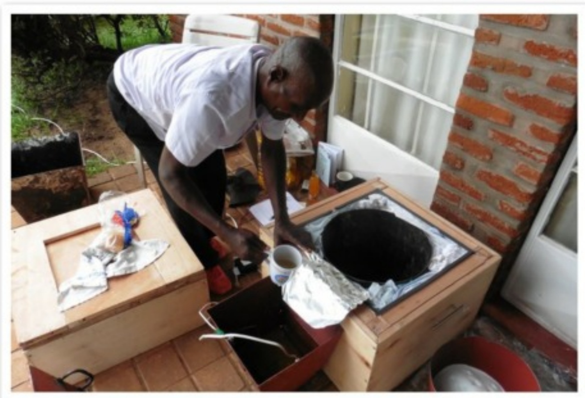
Lupactio was very receptive of the information and learned fast, understanding how and why everything worked. He was then able to explain to other Malawians about the eCook stove and how it worked in their own language.

Lupactio spending time with John Mullett to learn about the eCook stove

Photo illustrations

Lupactio explaining the concept and electronics to locals in their own language





Local man learning about the fabrication of the eCook stove and helping to make adaptations to it

Future dissemination plans

Objective

To enable the eCook stove project to continue and to go into production information about the stove needs to be spread more widely.

Methodology

There needs to be a number of routes of dissemination. These will include:

1. Further articles in Lynn's Letter
2. Bulletins on website
3. Discussions with people who are interested in building and selling the eCook stove
4. Continued collaboration with Cal Poly
5. Publication of reports on SOWTech website and direct sharing of the reports with interested parties