eCook Zambia Kick Off Meeting Minutes

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Executive Summary

The eCook Zambia Kick-off Workshop brought together key stakeholders from the solar lighting, clean cookstoves and utility sectors to discuss the proposition of battery-supported cooking. The Centre for Energy, Environment and Engineering Zambia (CEEEZ) in partnership with a UK research consortium (Gamos Ltd., University of Surrey and Loughborough University), are collaborating on an initial exploratory study to investigate the opportunity for this potentially transformative technology, which is designed to extend access to electricity access and clean cooking facilities to poorer households (PV-eCook.org).

Prof. Yamba opened the event, highlighting the fact that whilst the rapid spread of solar PV across Africa has already transformed millions of lives, it has yet to have an impact on the main energy need of poor households: cooking. However, in the context of falling global PV prices, recent advancements in battery technology and rising charcoal/fuelwood prices in severely deforested regions, the door is opening for a potentially transformative alternative - solar electric cooking (PV-eCook). eCook also has a role to play in enhancing mini-, micro- and nano- grids, as well as unreliable national grid infrastructure as smart household level energy storage offers grid operators a new demand side management mechanism and households the ability to ride through blackouts.

Dr. Jon Leary of Gamos Ltd. and Loughborough University noted that their recently completed global market assessment highlights Zambia's enormous potential for eCook. Load shedding, relatively cheap grid electricity and an established electric cooking market create an attractive market for Grid-eCook, whilst the vast off-grid population and an emerging SHS industry offer huge potential for PV-eCook.

A prototype eCook device was demonstrated by cooking popcorn on an electric hotplate and beans on an electric pressure cooker. The prototype is capable of charging from both solar PV and ZESCO's grid and was built using off-the-shelf components already available in Zambia. The system is sized for a small family doing most of their cooking on a mixture of efficient appliances and the electric hotplate.

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Small group discussions revealed the key opportunities and challenges that eCook is likely to face in Zambia. Lack of awareness and the high upfront cost were identified as two of the key barriers, whist deforestation and load shedding were two of the main drivers. Micro-financing, pay-as-you-go business models and targeted training and awareness raising were seen as key enablers. The Department of Energy, ZESCO (Zambia Energy Services Company), REA (Rural Electrification Authority), ERB (Energy Regulation Board), the private sector, NGOs, traditional leaders and academia were identified as the key actors in this transition. Peri-urban households were identified as the key target market segment, with pay-as-you-go, Village Banking and cooperatives seen as the best marketing strategies to reach them.

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1 Introduction

This report presents one part of the detailed in country research carried out to explore the market for eCook in Zambia. In particular, this in country work aims to gain much greater insight into culturally distinct cooking practices and explore how compatible they are with battery-supported electric cooking. The report is rich with detail and is intended to provide decision makers, practitioners and researchers with new knowledge and evidence.

This report presents the key learning points from the first stakeholder meeting to inform the future development of eCook within Zambia. It is one component of a broader study designed to assess the opportunities and challenges that lay ahead for eCook in high impact potential markets, such as Zambia, funded through Innovate UK's Energy Catalyst Round 4 by DfID UK Aid and Gamos Ltd. (https://elstove.com/innovate-reports/).

The overall aims of the Innovate project, plus the series of interrelated projects that precede and follow on from it are summarised in in *Appendix A: Problem statement and background to Innovate eCook project*.

1.1 Background

1.1.1 Context of the potential landscape change by eCook

The use of biomass and solid fuels for cooking is the everyday experience of nearly 3 billion people. This pervasive use of solid fuels and traditional cookstoves results in high levels of household air pollution with serious health impacts; extensive daily drudgery required to collect fuels, light and tend fires; and environmental degradation. Where households seek to use 'clean' fuels, they are often hindered by lack of access to affordable and reliable electricity and/or LPG. The enduring problem of biomass cooking is discussed further in *Appendix A: Problem statement and background to Innovate eCook project*, which not only describes the scale of the problem, but also how changes in renewable energy technology and energy storage open up new possibilities for addressing it.

1.1.2 Introducing 'eCook'

eCook is a potentially transformative battery-supported electric cooking concept designed to offer access to clean cooking and electricity to poorer households (HHs) currently cooking on charcoal or other polluting fuels (Batchelor 2013; Batchelor 2015a; Batchelor 2015b). Enabling affordable electric cooking sourced from renewable energy technologies, could also provide households with sustainable, reliable, modern energy for a variety of other purposes.

A series of initial feasibility studies were funded by DfID UK AID under the PEAKS mechanism (available from https://elstove.com/dfid-uk-aid-reports/). Slade (2015) investigated the technical viability of the proposition, highlighting the need for further work defining the performance of various battery chemistries under high discharge and elevated temperature. Leach & Oduro (2015) constructed an economic model, breaking down PV-eCook into its component parts and tracking key price trends, concluding that by 2020, monthly repayments on PV-eCook were likely to be comparable with the cost of cooking on charcoal. Brown & Sumanik-Leary's (2015), review of behavioural change challenges highlighted two distinct opportunities, which open up very different markets for eCook:

- PV-eCook uses a PV array, charge controller and battery in a comparable configuration to the popular Solar Home System (SHS) and is best matched with rural, off-grid contexts.
- Grid-eCook uses a mains-fed AC charger and battery to create distributed HH storage for unreliable or unbalanced grids and is expected to best meet the needs of people living in urban slums or peri-urban areas at the fringes of the grid (or on a mini-grid) where blackouts are common.

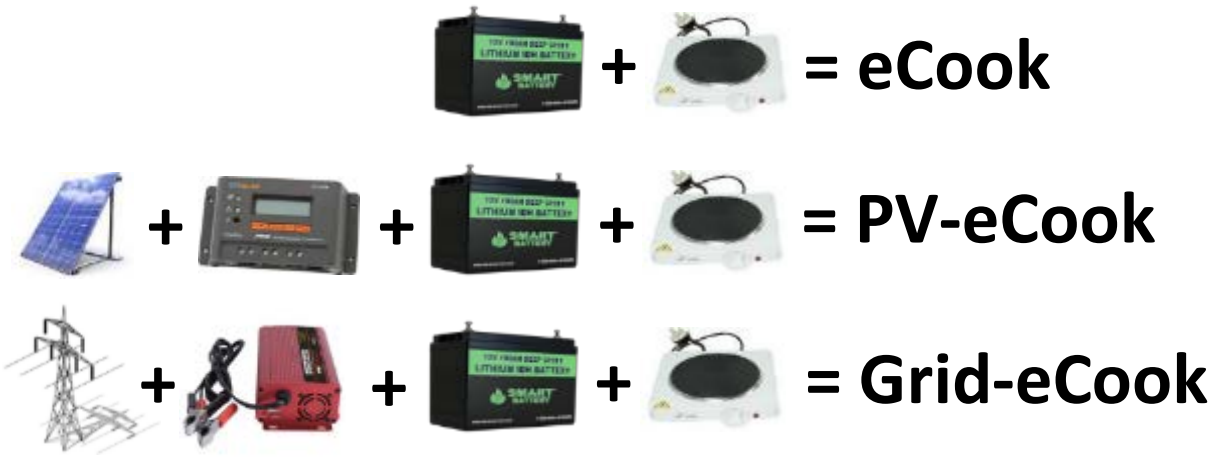

Figure 1: Pictorial definitions of 'eCook' terminology used in this report.

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1.1.3 eCook in Zambia

Given the technical and socio-economic feasibility of the systems in the near future, Gamos, Loughborough University and the University of Surrey have sought to identify where to focus initial marketing for eCook. Each country has unique market dynamics that must be understood in order to determine which market segments to target are and how best to reach them. Leary et al. (2018) carried out a global market assessment, which revealed Zambia as the third most viable context for PV-eCook, as 10% of the population already cook on electricity and recent load shedding caused a significant number of these users to revert back to charcoal, rapidly accelerating deforestation.

The accompanying reports from the other activities carried out in Zambia can be found at: https://elstove.com/innovate-reports/.

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2 Opening Remarks for the eCook Programme in Zambia

Prof F.D Yamba welcomed all the persons present at the meeting. In his opening remarks, he stated that the purpose of the workshop as:

- To explain what eCook is
- What is its potential role in Zambia?
- To build partnerships to support the transition in Zambia.

He further informed the audience that Centre for Energy, Environment and Engineering Zambia (CEEEZ) in partnership with a UK research consortium (Gamos Ltd., University of Surrey and Loughborough University) supported by Innovate UK and DFID.

Together, they are investigating a potentially transformative battery electric cooker combination (eCook), which is designed to extend access to electricity access and clean cooking facilities to poorer households. He also stated that the proposition of Solar Electric Cooking (SEC or PV-eCook) is that by 2020 the cost of using solar photovoltaic panels to charge a battery, and then using the battery for cooking as and when required, will be comparable to the monthly cost of cooking with charcoal and other polluting fuels in many developing regions. This proposition sits at the intersect of two major global challenges; the use of biomass for cooking which is harmful to the household and to the

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environment, and the challenge to extend modern energy access to all peoples (Sustainable Development Goal 7 - SDG7).

Finally, he outlined the 2 month exploratory programme of work which will has the following objectives:

i. Review of national policy areas relevant to the eCook proposition.
ii. Understanding national markets, to include the state of the electricity supply industry (grid and off-grid), including solar PV, and state of cooking markets e.g. supply chains, service networks, skills availability (and deficits), manufacturing facilities.
iii. Understanding cooking practices by collating any existing data on cooking practices e.g. foods cooked, fuels used, fuel stacking strategies, specific energy consumptions, appliances used, factors influencing choice of fuels (and foods).
iv. Dissemination of the eCook concept and supporting information by engaging key stakeholder networks.

He also thanked the participants for taking time to attend the kick-off meeting. Please see *Appendix D - Attendees* for a list of participants.

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3 PRESENTATION: What is eCook and why are we focusing on Zambia?

Please refer to presentation in *Appendix C - eCook presentation by Dr. Jon Leary*.

Gamos and Loughborough University researcher, Dr. Jon Leary stated that:

i. cooking on batteries is possible;
ii. that soon "battery supported electricity" will be cost comparable with charcoal, offering access to both clean cooking and reliable electricity; and
iii. that we are looking to build long-term partnerships to make this transition happen.

Dr. Leary introduced eCook as an opportunity for households in both off-grid and weak grid regions. He shared with the participants a synopsis of the global market assessment, focusing on the opportunity for eCook in Zambia. The analysis showed that 59% of Zambians (10 million) live in rural areas, 96% of whom are off-grid (World Bank 2017). The market for pico-solar products and SHS is expanding rapidly, with 15,000 sales in second half of 2016 (GOGLA et al. 2016) and Zambia has favourable environmental conditions (WorldClim 2017) with good solar resources and a warm climate, meaning that space heating with stoves likely to be minimal and battery lifetime/performance is not likely to suffer from extreme temps.

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Dr. Leary went on to mention the aims of the Zambia case study:

i. To evaluate the compatibility of eCook with the Zambian context.
ii. To assess the potential market and market segments should be target that eCook should target
iii. To explore which marketing strategies that are likely to be most effective
iv. To engage with key stakeholders and build partnerships to facilitate the roll out of eCook across Zambia.

He further elaborated on the programme of work, which will include:

i. Stakeholder engagement to build long-term partnerships to facilitate the transition to eCook, including 2 stakeholder workshops:
    a. this Kick off Meeting; and
    b. a subsequent Design Challenge.
ii. Cooking diaries with 20 households recording what/how they cook and how much energy it uses over 6 weeks.
iii. 4 focus groups with different groups of potential end users to find out how they currently cook and how they aspire to cook.
iv. Choice modelling surveys with 200 individuals to determine which characteristics they value most in a future eCook stove.

3.1 Question and answer segment

QUESTIONS FROM DoE

- Technology: Normally when solar units are been installed, clients are advised not to use heating elements because of charging and discharging of battery. Is an eCook system the same or

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different from the known PV systems, or is the cooker involved very efficient or a type that does not draw a lot of energy and is therefore fit for the known PV system?

- Cost: The current alternatives available- charcoal and LPG.
    - LPG is costly and there is a negative perception about safety to use. If someone used the money they usually spent on charcoal for a month on LPG, it would not last through the month.
    - In order to buy LPG, one has to go to a filling station. Charcoal is easily accessible everywhere. With these two options, people are more likely to choose charcoal.
    - In terms of cost, how do you compare eCook to charcoal and electricity?
- RESPONSE:
    - The main difference between what is been proposed and the standard solar system is the battery chemistry. eCook is proposing use of Lithium ion batteries instead of the conventional Lead acid battery. Lithium ion has much more favourable performance characteristics compared to Lead acid. Lead acid if discharged below 50%, it will reduce its life span, whilst Lithium ion can comfortably go down to just 20%. Lead acid is unlikely to last more than 1,000 cycles, whilst Lithium ion can reach 3,000. Rapid discharge also damages lead acid batteries and reduces the amount of energy they deliver. Lithium ion is much more hardwearing, so they are not affected as much by heavy loads like cooking.
    - In terms of cost, storing the energy in a lithium ion battery is estimated to add 0.25 USD/kWh. As ZESCO's current rates are approximately 0.09 USD/kWh, this would increase the price to 0.34 USD/kWh. Our modelling has shown that with a pay-as-you-go business model, monthly repayments can be comparable to current expenditures on charcoal. However, we came here to Zambia to investigate the relative costs with detailed on the ground research, so we will be able to answer this question much more comprehensively when we have completed this initial scoping study.

QUESTION FROM VITALITE

- What is the durability for eCook system? And how suitable is the system in terms of climate conditions?
- RESPONSE:
    - From our preliminary desk-based research, it seems that Zambia has favourable conditions. It does not get too cold or too hot. Dust maybe. But we could have a prototype that is battery and hot plate on top, in a box that protects the system from dust.
    - Lifetime of Lithium ion battery is around 6 years or 3,000 cycles, but we are also looking at more experimental battery chemistries like sodium ion, which promises 10,000 cycles. Lifetime of the other components is the same as for an ordinary PV system, i.e. solar panel is 20 years, 10 years for inverter, etc.

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QUESTION FROM MUHANYA SOLAR

- How will deployment of eCook be done, as stand- alone or feed in to existing works?
- RESPONSE:
    - We plan to work with as many of the organisations represented here today as possible to build upon your existing product range to offer a solar electric cooking solution to your existing customers within the next 5-10 years.

4 Demonstration of eCook prototype

Dr. Jon Leary demonstrated a prototype eCook device capable of charging from both solar PV and ZESCO's grid. The prototype had 600W PV, 5.5kWh battery storage (2*230Ah 12V batteries), a 24V 1.5kW inverter/charger and a 30A 24V solar charge controller. All components had been sourced within Lusaka. Four electrical cooking appliances were demonstrated – a 1,500W kettle, a 250W slow cooker, a 1,000W electric pressure cooker and a double 1kW hotplate. The system is sized for a small family doing most of their cooking on a mixture of efficient appliances and the electric hotplate.

The demonstration involved cooking popcorn on the hotplate and boiling beans on the electric pressure cooker. The hotplate is the most commonly used across Zambia today, but also the least energy efficient. Some households also own a kettle, but few have an electric pressure cooker or a slow cooker.

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The kettle saves energy by heating water very quickly to avoid heat losses. The slow cooker is very compatible with solar, as it uses a small amount of power throughout the day to slowly cook dishes like meat stew, producing a very tender and flavoursome result. The electric pressure cooker can cook long boiling dishes like offals and beans in approximately half the time and with a fraction of the energy, so is particularly well suited to battery-supported cooking.

5 Break-out group discussions

Four sub-groups were formed to allow participants to discuss questions that would inform the eCook programme of work:

- What are the key barriers and drivers for eCook in Zambia?
- Who are the key actors and what are their roles?
- What market segments should we target in Zambia?
- Which marketing strategies are likely to be most effective?

Professor Yamba chaired the plenary discussion, where participants fed back to the group on the opportunities and challenges awaiting eCook in Zambia.

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5.1 Group 1

Key barriers

- Government policies not attending to ecook
- Availability of traditional stoves- widely available
- Ecook system complicated for a layman
- Initial price is very high
- Awareness on the technology
- Lack of skilled and trained personnel e.g. for installation and maintenance of e cook

Solutions

- Ban traditional cook stoves which will encourage manufactures and users to stick to other improved alternative stoves
- Already assembled unit and few basics written on the unit
- Government to set up a loan scheme of paying slow for the ecook
- Create partnerships between GRZ and producers to educate users on the products
- Skills training

Key Actors

- Government
- Media
- Academia
- NGO's
- Banks
- Manufactures
- Corporate World
- Utilities – Zesco

Key market segment

- Peri urban

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5.2 Group 2

Key Barriers

- Cost of technology – for both production and deployment
- Inadequate awareness on RE solutions, specifically eCook

Key Drivers

- Environmental:
  - High rate of deforestation
  - Climate change
- Reliability and affordability of grid electricity
  - High electricity tariffs
  - Load shedding and power outages
- Health
  - Houses catching fire
  - Breathing smoke

Solutions

- Introduction of cost-effective technologies, like eCook, that are energy efficient
- Micro financing
- Government subsidies on RE technology
- Dedicated investment for financing RE technologies
- Favourable tax incentives on RE technology
- Increase awareness and capacity building, especially community mobilization

Key Actors

- Government (for policy direction)- DoE
- ERB
- ZABS
- Zesco
- Private Sector (inclusive green growth)
- CEEEZ
- REA
- Financial Institutions

Market Segment to target in Zambia

- Off grid areas
- Micro financing institutions. The idea is to come up with friendly financing mechanisms such as saving groups/cooperatives.

Strategies to reach market segment

- Pay as you go,
- Product-loan service such as group loans (chilimba) where money is put up in a group to buy product for one person, and again more is put up to buy for the next until all members have the product.

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5.3 Group 3

Key Barriers

- Social:
  - Acceptance
  - Lack of awareness
- Economical/financial:
  - Cost of purchasing system
  - Cost of electricity

Key Drivers

- Load shedding
- High cost of electricity
- High rate of deforestation
- Increased load shedding

Solutions

- Awareness creation
  - Need for resources to reach and create awareness
- Micro financing with flexible re-payments

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Key Actors

- Community members
- Utilities – Zesco
- Regulator – ERB
- Private sector

Key Market Segment

- Peri- urban

Marketing Strategies

- Pay as you go
- Village bank idea
- Cooperatives

5.4 Group 4

Key Barriers

- Technological:
  - None because technology is known
- Financial:
  - High cost of the system for target group (off-grid in rural areas)
  - Lack of financing mechanisms- i.e. loans
- Social
  - Cultural, e.g. changing the mindset of people that have been using charcoal/firewood to using batteries for cooking
  - Lack of information on the availability of new/improved technologies.
  - People's perception- they would rather have something cooked on charcoal or firewood because it 'tastes better'.
  - Scattered settlements make it difficult to deploy technology. Locations far off make outreach costly.

Solutions

- Micro financing to all target group to access the technology
- Widening the target group- inclusive objective to include middle- and low-income groups. Targeting people in rural areas alone may not work because of high cost of system.
- Widen objectives for eCook: to include energy efficiency as well as poverty reduction
- Capacity building - training more than one person to maintain the system in a given location, such that the migration of one trained person does not affect maintenance in cases of breakdowns.
- Pay as you go or pay to own

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Drivers

- High deforestation
- High cost of charcoal
- High cost of electricity
- Increased load shedding
- Decreasing cost of P.V systems
- Solar electric cooking is a clean and convenient source of energy

Key Actors

- Department of Energy
- Zesco
- REA
- ERB
- Private sector
- NGO and Civil Societies
- Traditional leaders

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6 Closing remarks

Prof. Yamba closed the event by inviting the participants to collaborate with the research team over the next 2 months during this initial exploratory study and to work together to see eCook transform the way we cook across Zambia over the next 5-10 years.

The findings from this stakeholder workshop will be combined with those from the other activities that have been carried under the eCook Zambia Market Assessment. Together they will build a more complete picture of the opportunities and challenges that await this emerging concept. Further outputs will be available from https://elstove.com/innovate-reports/.

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8 Appendix

8.1 Appendix A: Problem statement and background to Innovate eCook project

8.1.1 Beyond business as usual

The use of biomass and solid fuels for cooking is the everyday experience of nearly 3 Billion people. This pervasive use of solid fuels—including wood, coal, straw, and dung—and traditional cookstoves results in high levels of household air pollution, extensive daily drudgery required to collect fuels, and serious health impacts. It is well known that open fires and primitive stoves are inefficient ways of converting energy into heat for cooking. The average amount of biomass cooking fuel used by a typical family can be as high as two tons per year. Indoor biomass cooking smoke also is associated with a number of diseases, including acute respiratory illnesses, cataracts, heart disease and even cancer. Women and children in particular are exposed to indoor cooking smoke in the form of small particulates up to 20 times higher than the maximum recommended levels of the World Health Organization. It is estimated that smoke from cooking fuels accounts for nearly 4 million premature deaths annually worldwide – more than the deaths from malaria and tuberculosis combined.

While there has been considerable investment in improving the use of energy for cooking, the emphasis so far has been on improving the energy conversion efficiency of biomass. Indeed in a recent overview of the state of the art in Improved Cookstoves (ICS), ESMAP & GACC (2015), World Bank (2014), note that the use of biomass for cooking is likely to continue to dominate through to 2030.

> "Consider, for a moment, the simple act of cooking. Imagine if we could change the way nearly five hundred million families cook their food each day. It could slow climate change, drive gender equality, and reduce poverty. The health benefits would be enormous." ESMAP & GACC (2015)

The main report goes on to say that "The "business-as-usual" scenario for the sector is encouraging but will fall far short of potential." (ibid,) It notes that without major new interventions, over 180 million households globally will gain access to, at least, minimally improved[1] cooking solutions by the end of the

[1] A minimally improved stove does not significantly change the health impacts of kitchen emissions. "For biomass cooking, pending further evidence from the field, significant health benefits are possible only with the highest quality fan gasifier stoves; more moderate health impacts may be realized with natural draft gasifiers and vented intermediate ICS" (ibid)

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decade. However, they state that this business-as-usual scenario will still leave over one- half (57%) of the developing world's population without access to clean cooking in 2020, and 38% without even minimally improved cooking solutions. The report also states that 'cleaner' stoves are barely affecting the health issues, and that only those with forced gasification make a significant improvement to health. Against this backdrop, there is a need for a different approach aimed at accelerating the uptake of truly 'clean' cooking.

Even though improved cooking solutions are expected to reach an increasing proportion of the poor, the absolute numbers of people without access to even 'cleaner' energy, let alone 'clean' energy, will increase due to population growth. The new Sustainable Development Goal 7 calls for the world to "ensure access to affordable, reliable, sustainable and modern energy for all". Modern energy (electricity or LPG) would indeed be 'clean' energy for cooking, with virtually no kitchen emissions (other than those from the pot). However, in the past, modern energy has tended to mean access to electricity (mainly light) and cooking was often left off the agenda for sustainable energy for all.

Even in relation to electricity access, key papers emphasise the need for a step change in investment finance, a change from 'business as usual'. IEG World Bank Group (2015) note that 22 countries in the Africa Region have less than 25 percent access, and of those, 7 have less than 10 percent access. Their tone is pessimistic in line with much of the recent literature on access to modern energy, albeit in contrast to the stated SDG7. They discuss how population growth is likely to outstrip new supplies and they argue that "unless there is a big break from recent trends the population without electricity access in Sub-Saharan Africa is projected to increase by 58 percent, from 591 million in 2010 to 935 million in 2030." They lament that about 40% of Sub-Saharan Africa's population is under 14 years old and conclude that if the current level of investment in access continues, yet another generation of children will be denied the benefits of modern service delivery facilitated by the provision of electricity (IEG World Bank Group 2015).

> "Achieving universal access within 15 years for the low-access countries (those with under 50 percent coverage) requires a quantum leap from their present pace of 1.6 million connections per year to 14.6 million per year until 2030." (ibid)

Once again, the language is a call for a something other than business as usual. The World Bank conceives of this as a step change in investment. It estimates that the investment needed to really address global electricity access targets would be about $37 billion per year, including erasing generation deficits and additional electrical infrastructure to meet demand from economic growth. "By

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comparison, in recent years, low-access countries received an average of $3.6 billion per year for their electricity sectors from public and private sources" (ibid). The document calls for the Bank Group's energy practice to adopt a new and transformative strategy to help country clients orchestrate a national, sustained, sector-level engagement for universal access.

In the following paragraphs, we explore how increasing access to electricity could include the use of solar electric cooking systems, meeting the needs of both supplying electricity and clean cooking to a number of households in developing countries with sufficient income.

8.1.2 Building on previous research

Gamos first noted the trends in PV and battery prices in May 2013. We asked ourselves the question, is it now cost effective to cook with solar photovoltaics? The answer in 2013 was 'no', but the trends suggested that by 2020 the answer would be yes. We published a concept note and started to present the idea to industry and government. Considerable interest was shown but uncertainty about the cost model held back significant support. Gamos has since used its own funds to undertake many of the activities, as well as IP protection (a defensive patent application has been made for the battery/cooker combination) with the intention is to make all learning and technology developed in this project open access, and awareness raising amongst the electrification and clean cooking communities (e.g. creation of the infographic shown in Figure 2 to communicate the concept quickly to busy research and policy actors).

Gamos has made a number of strategic alliances, in particular with the University of Surrey (the Centre for Environmental Strategy) and Loughborough University Department of Geography and seat of the Low Carbon Energy for Development Network). In October 2015, DFID commissioned these actors to explore assumptions surrounding solar electric cooking[2] (Batchelor 2015b; Brown & Sumanik-Leary 2015; Leach & Oduro 2015; Slade 2015). The commission arose from discussions between consortium members, DFID, and a number of other entities with an interest in technological options for cleaner cooking e.g. Shell Foundation and the Global Alliance for Clean Cookstoves.

Drawing on evidence from the literature, the papers show that the concept is technically feasible and could increase household access to a clean and reliable modern source of energy. Using a bespoke economic model, the Leach and Oduro paper also confirm that by 2020 a solar based cooking system

[2] The project has been commissioned through the PEAKS framework agreement held by DAI Europe Ltd.

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could be comparable in terms of monthly repayments to the most common alternative fuels, charcoal and LPG. Drawing on published and grey literatures, many variables were considered (e.g. cooking energy needs, technology performance, component costs). There is uncertainty in many of the parameter values, including in the assumptions about future cost reductions for PV and batteries, but the cost ranges for the solar system and for the alternatives overlap considerably. The model includes both a conservative 5% discount rate representing government and donor involvement, and a 25% discount rate representing a private sector led initiative with a viable return. In both cases, the solar system shows cost effectiveness in 2020.

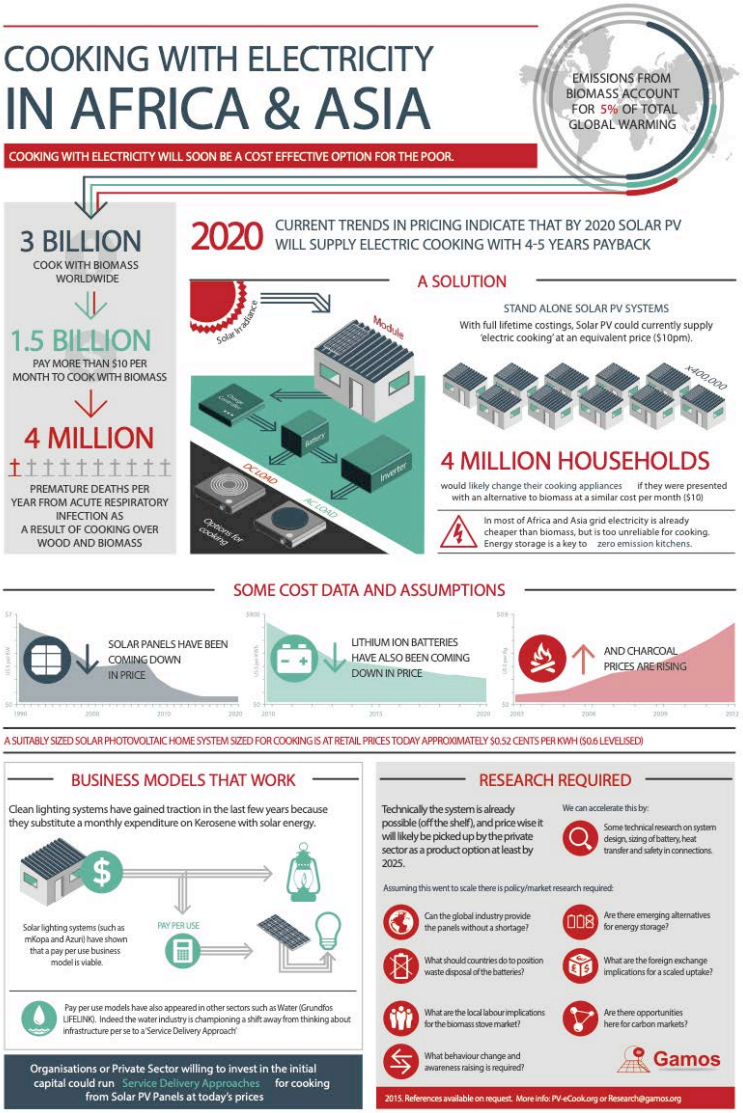

Figure 2 Infographic summarising the concept in order to lobby research and policy actors.

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The Brown and Sumanik-Leary paper in the series examines the lessons learned from four transitions – the uptake of electric cooking in South Africa, the roll out of Improved Cookstoves (ICS), the use of LPG and the uptake of Solar Home Systems (SHS). They present many behavioural concerns, none of which preclude the proposition as such, but all of which suggest that any action to create a scaled use of solar electric cooking would need in depth market analysis; products that are modular and paired with locally appropriate appliances; the creation of new, or upgrading of existing, service networks; consumer awareness raising; and room for participatory development of the products and associated equipment.

A synthesis paper summarising the above concludes by emphasising that the proposition is not a single product – it is a new genre of action and is potentially transformative. Whether solar energy is utilised within household systems or as part of a mini, micro or nano grid, linking descending solar PV and battery costs with the role of cooking in African households (and the Global South more broadly) creates a significant potential contribution to SDG7. Cooking is a major expenditure of 500 million households. It is a major consumer of time and health. Where households pay for their fuelwood and charcoal (approximately 300 Million) this is a significant cash expense. Solar electric cooking holds the potential to turn this (fuelwood and charcoal) cash into investment in modern energy. This "consumer expenditure" is of an order of magnitude more than current investment in modern energy in Africa and to harness it might fulfil the calls for a step change in investment in electrical infrastructure.

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8.1.3 Summary of related projects

A series of inter-related projects have led to and will follow on from the research presented in this report:

- Gamos Ltd.'s early conceptual work on eCook (Batchelor 2013).
  - The key **CONCEPT NOTE** can be found here.
  - An early infographic and a 2018 infographic can be found here.
- Initial technical, economic and behavioural feasibility studies on eCook commissioned by DfID (UK Aid) through the CEIL-PEAKS Evidence on Demand service and implemented by Gamos Ltd., Loughborough University and University of Surrey.
  - The key **FINAL REPORTS** can be found here.
- Conceptual development, stakeholder engagement & prototyping in Kenya & Bangladesh during the "*Low cost energy-efficient products for the bottom of the pyramid*" project from the USES programme funded by DfID (UK Aid), EPSRC & DECC (now part of BEIS) & implemented by University of Sussex, Gamos Ltd., ACTS (Kenya), ITT & UIU (Bangladesh).
  - The key **PRELIMINARY RESULTS** (Q1 2019) can be found here.
- A series of global & local market assessments in Myanmar, Zambia and Tanzania under the "*eCook - a transformational household solar battery-electric cooker for poverty alleviation*" project funded by DfID (UK Aid) & Gamos Ltd. through Innovate UK's Energy Catalyst Round 4, implemented by Loughborough University, University of Surrey, Gamos Ltd., REAM (Myanmar), CEEEZ (Zambia) & TaTEDO (Tanzania).
  - The key **PRELIMINARY RESULTS** (Q1 2019) can be found here.
- At time of publication (Q1 2019), a new DfID (UK Aid) funded research programme '*Modern Energy Cooking Services*' (MECS) lead by Prof. Ed Brown at Loughborough University is just beginning and will take forward these ideas & collaborations.

This data and material have been funded by UK AID from the UK government; however, the views expressed do not necessarily reflect the UK government's official policies.

8.2 Appendix B - eCook Zambia Kick-off Meeting Agenda

Time	Session	Speaker
8.30	Registration	
9.00	Opening	Prof. F. Yamba (CEEEZ)
9.10	What is eCook and why are we focussing on Zambia? • Introduction to eCook • Global market assessment • eCook Zambia preliminary market analysis • Objectives for Zambia case study • Programme of work in Zambia	Dr. J. Leary (Gamos, Loughborough University)
9.40	Feedback session Is our eCook Zambia preliminary market data valid? Will the proposed programme of work achieve the objectives?	
10.00	Tea break	
10.15	Demonstration of eCook prototype	Dr. J. Leary (Gamos, Loughborough University)
11.00	Small group discussions • What are the key barriers & drivers for eCook in Zambia? • Who are the key actors and what are their roles?	
12:00	Plenary session • Summary of group discussions and key learning points • Closing remarks	
13:00	Lunch	

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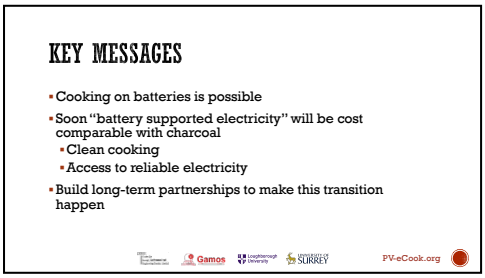
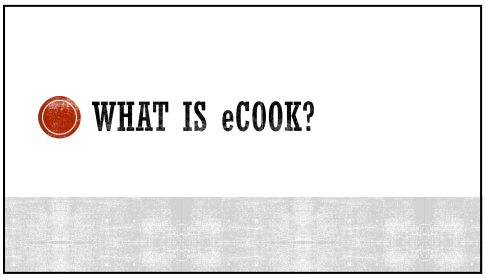
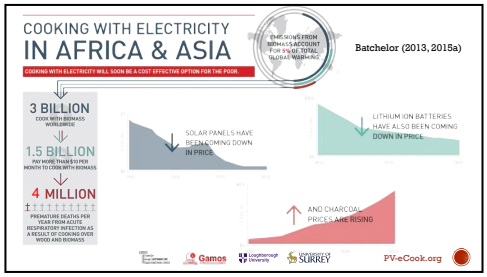
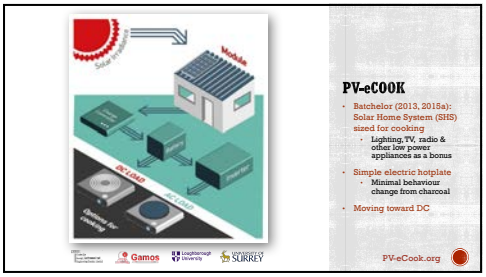
8.3 Appendix C - eCook presentation by Dr. Jon Leary









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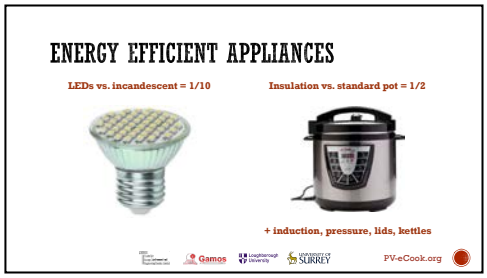

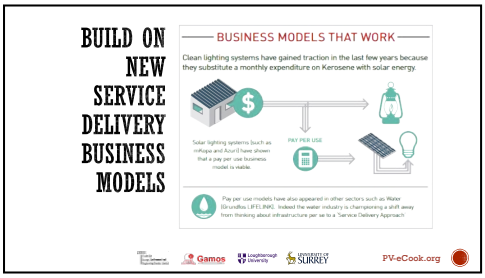

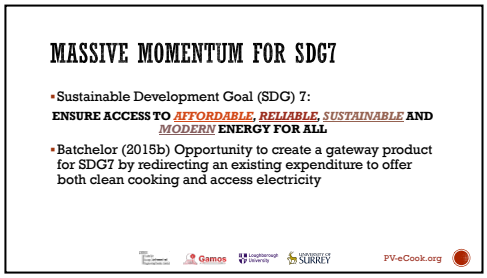

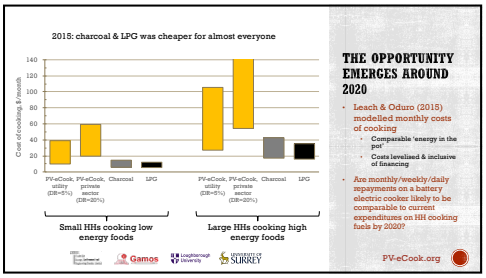

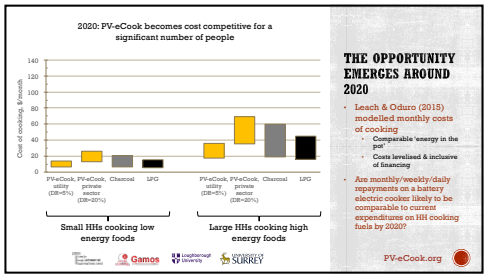

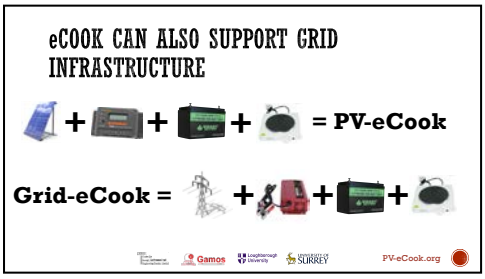

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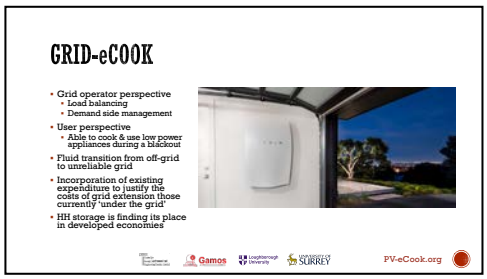

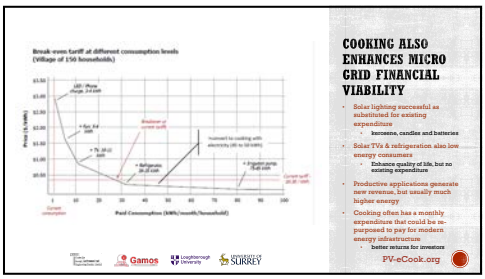

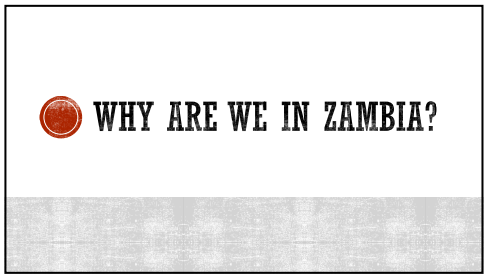

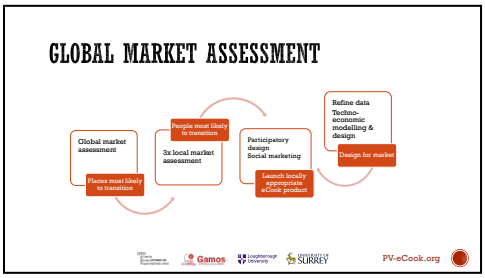

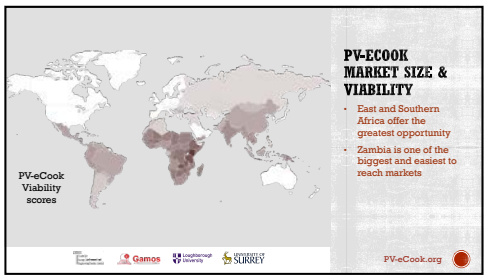

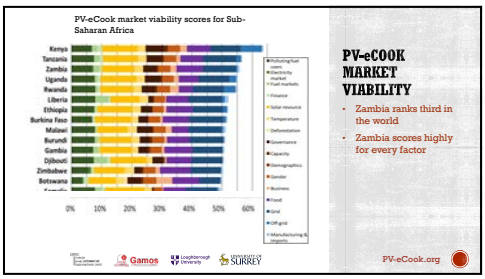

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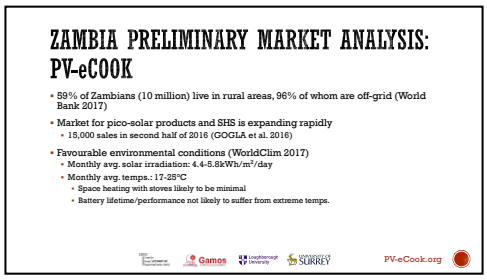

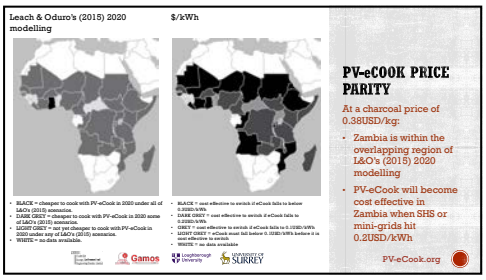

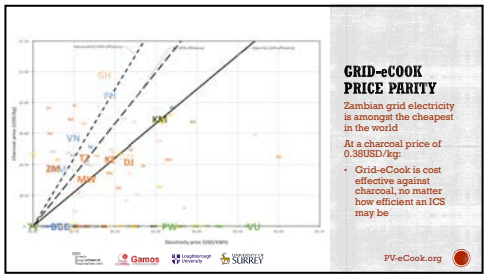

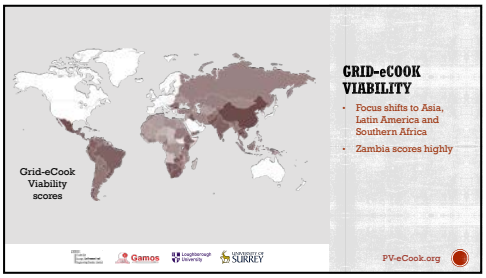

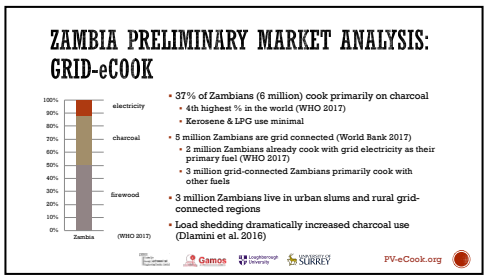

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CEEEZ Centre for Energy, Environment and Engineering Zambia Limited | Loughborough University | University of Surrey | Gamos

WHAT ARE WE PLANNING TO DO IN ZAMBIA?

OBJECTIVES FOR ZAMBIA CASE STUDY

- To evaluate the compatibility of eCook with the Zambian context
  - What is the potential market for eCook in Zambia?
  - Which market segments should be targeted?
  - Which marketing strategies are likely to be most effective?
- To engage with key stakeholders and build partnerships to facilitate the roll out of eCook across Zambia

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PROGRAMME OF WORK IN ZAMBIA

- Workshops
  - Kick off Meeting
  - Bake-off & Entrepreneurs' Workshop
- Cooking diaries
- Focus groups
- Choice modelling surveys
- Interviews
- Building long-term partnerships to facilitate the transition to eCook

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FEEDBACK

DR JON LEARY
JONKLEARY@GMAIL.COM

Is our eCook Zambia preliminary market data valid?
Will the proposed programme of work achieve the objectives?
Who should we be partnering with to make this happen?

SMALL GROUP DISCUSSIONS

- What are the key barriers and drivers for eCook in Zambia?
  - How can we overcome the barriers?
  - How can we leverage the drivers?
- Who are the key actors and what are their roles?
- Which market segments should we target in Zambia?
  - What marketing strategies can we use to reach them?

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8.4 Appendix D - Attendees

NAME	ORGANIZATION	POSITION
GEORGE CHULU	Master Electronics	Technician
SABERA KHAN	GKI/Beyond the Grid Fund Zambia	Facility Admin
MUTANGA MUNKOMBWE	Rural Electrification Authority (REA)	Renewable Energy Solar Expert
STEWARD MAKANSE	Act to Save	Executive Director
DIANA ZULU	Solar Aid (sunny money)	Business Support
TOPUNJI BANDA	Emerging Cooking Solutions	Sales and Marketing
PRAKASH C. GHIMIRE	SNV Zambia	Energy Sector Leader
FERGUSON KAMPOMPO	Zambia Bureau of Standards (ZABS)	Laboratory Analyst
MUYUNDA AKUFUNA	VITALITE	Training Coordinator
MKANDAWIRE JAMES	Green Innfordev	Operations
ELIZABETH MUSONDA	ZENGO	Technical
FLORENCE CHAUNGA	ZENGO	Coordinator
GEOFFREY KAILA	Muhanya Solar	Managing Director
DAISYDARIA MKANDAWIRE	Zesco Ltd	Principal Engineer
RASHID PHIRI	Rasma engineering	Director
FRANCIS MWILA	CEEEZ	Natural Resources
F.D. YAMBA	CEEEZ	Director
CHILOMBO CHILA	Department of Energy (DoE)	Energy Officer
BRIAN SIAKWENDA	Department of Energy (DoE)	Energy Officer

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BRIAN S. MAINZA	Department of Energy (DoE)	Senior Energy Officer
KEDDY MBINDO	Forestry Department (FD)	Senior Research Officer
HARBGUY MWAMBAZI	Times of Zambia	Reporter
BANDA FABIAN	University of Zambia- Technology Development and Advisory Unit (UNZA-TDAU)	Project Engineer
JON LEARY	GAMOS	eCook Lead Researcher
NANCY S. NG'OMA	CEEEZ	Centre Coordinator

8.4.1 Invited Guests Not in Attendance

NAME	ROLE	ORGANIZATION	REASON
CHANDA MONGO	**Independent Consultant**	**Renewable Energy Expert**	**Out of the country at time of meeting**
REPRESENTATIVE	**Solar dealers**	**EML**	**Did not communicate**
ALFRED MUMBI	**ICS Entrepreneur**	**Ecohazmart**	**Did not communicate**
REPRESENTATIVE	**NGO**	**Action Africa Help Zambia**	**Did not communicate**

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