eCook Myanmar Focus Group Discussions

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Executive Summary

This report summarises the findings from **four Focus Group Discussions (FGDs) held in Myanmar**, with the aim of informing the development of a battery-supported electric cooking concept, eCook. It is part of a broader programme of work, designed to identify and investigate the opportunities and challenges that await in high impact markets such as Myanmar. Women and men from rural and peri-urban contexts were asked about their current cooking practices and how they aspire to cook in the future. The participatory sessions involved a **live cooking demonstration of popular local foods with a prototype eCook device**.

The evidence from these FGDs suggests that **electricity is currently the aspirational fuel** for most households in Myanmar, as automated energy-efficient appliances such as the **rice cooker and insulated electric frying pan can make cooking much easier**. Reliability and access are major concerns, which make cooking with battery-supported electricity an attractive proposition, if this can be successfully communicated to potential users. Whilst affordability is less of a challenge than in other contexts due to the very low grid tariff, **battery-supported devices will add significantly to the cost, but will also add significantly to the value proposition be enabling reliable electricity access**.

Rice & curry is the most popular meal in Myanmar, which explains why the most popular electric cooking appliances are **rice cookers & electric frying pans**. Rice is one of the easiest staples to cook with electricity. Although there is some behaviour change from cooking on other fuels, it is a lot easier, so rice cookers are understandably one of the first electric appliances that many people in Myanmar buy. The cheap red electric frying pans that are popular across Myanmar are surprisingly energy-efficient, as the heating element is stuck to the bottom of the pan & there is insulation around it. This creates extremely efficient heat transfer into the pan, just like with an induction stove.

Space heating is often an important dual use for cookstoves, meaning that supposedly more efficient cookstoves are often not adopted as they are less efficient space heaters. However, the climate in much of Myanmar is warm enough that focussing the heat onto the pot rather than the cook is desirable.

Electricity is the aspirational cooking fuel, despite the **incredibly poor quality of electricity** available on Myanmar's national grid. In Nat Mauk, participants were so desperate to use it that they were willing to **get up as early as 2am to begin cooking before the voltage starts to sag** as the grid is loaded up throughout the day. The voltage on the government grid is so unstable that the **manual voltage transformers** used by many households in Myanmar to bring the voltage up to a usable level require constant adjusting as the lights begin to flicker to prevent them from going out completely. It requires **as much attention as tending a fire, so it's certainly not modern or convenient access to energy**. In

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Maw Gyun, **the voltage frequently dipped below 50V** just in the few hours we were there & sometimes reportedly dips as low as 20V.

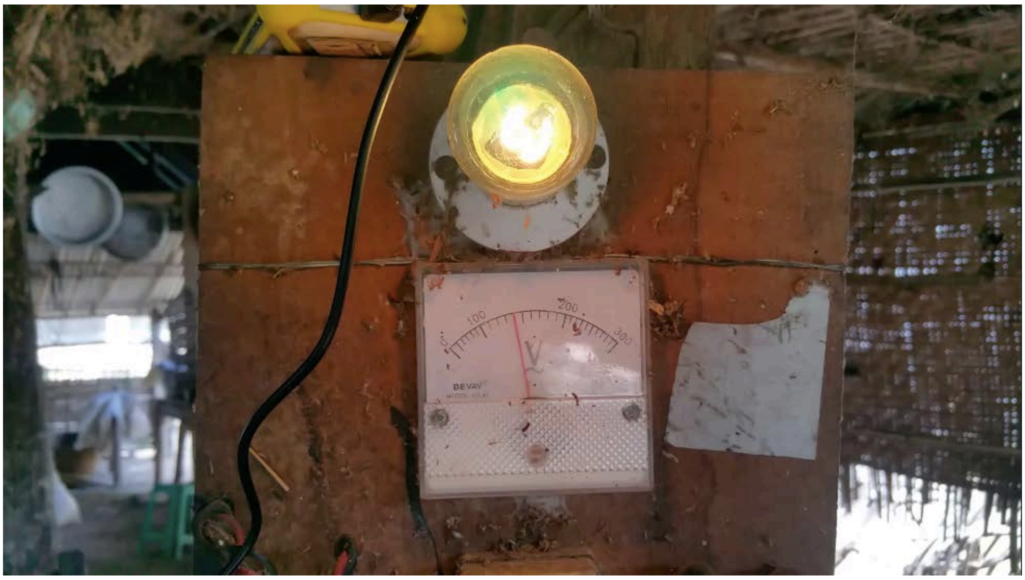

Figure 1: Most households in Myanmar have a voltmeter somewhere visible, as it dictates the daily routine. If the voltage is above 150V, life becomes significantly easier. If it surpasses 200V – make hay whilst the sun shines!

The popularity of **insulated electric cooking appliances** such as rice cookers & red electric frying pans in Myanmar can partly be explained by the fact that they are able to **maintain cooking performance during blackouts and voltage dips simply by preventing heat from leaving the pot**. However, low quality appliances have created the perception that electricity is unsafe to cook with as it is likely to shock the cook.

Cooking is cheap in Myanmar, with participants reporting expenditures around 10,000 MMK (7 USD) for a month of cooking on firewood, charcoal, gas or grid electricity. However, it may be possible for eCook systems with longer financing horizons to be competitive, especially as the cost of battery storage continues to fall. Mini-grids usually have higher tariffs than the government grid and at participants in Hlaine Bone reported paying 30,000 MMK (20 USD) per month to cook with electricity. At this price point, a PV-eCook system with a 5 year financing horizon may even be competitive today.

Unsurprisingly, innovative financing mechanisms will be needed to break down the high upfront cost of battery-supported devices into manageable repayments. **Pay-as-you-go financing mechanisms have not yet taken off in Myanma**r, so there is a need to find creative business models that can break down the high upfront cost of future eCook devices. Interestingly, people were willing to pay considerably more for a reliable power supply than an eCook device, implying that leveraging the additional functionality of eCook devices as enablers of reliable access to electricity for other domestic applications is likely to be a key marketing strategy.

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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 Myanmar. 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 findings from four focus groups designed to inform the future development of eCook within Myanmar. 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 Myanmar, funded through Innovate UK's Energy Catalyst Round 4 by DfID UK Aid and Gamos Ltd. (https://elstove.com/innovate-reports/). A much deeper analysis of the data collected during this project was supported by the Modern Energy Cooking Services (MECS) programme, which included the writing of this report.

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 UK Aid (DfID) 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.

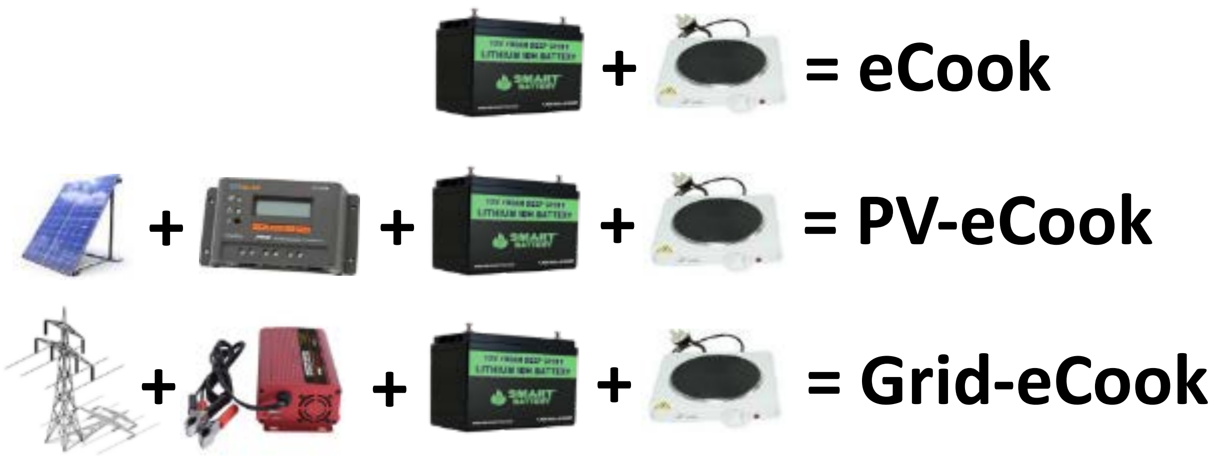

Figure 2: Pictorial definitions of 'eCook' terminology used in this report.

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1.1.3 eCook in Myanmar

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 Tanzania as the second most viable context for PV-eCook, due to its strong SHS industry and the fact that it is one of the world's biggest charcoal markets, creating several global deforestation hotspots.

The accompanying reports from the other activities carried out in Myanmar can be found at: https://elstove.com/innovate-reports/ and www.MECS.org.uk.

1.2 Aim

The aim of this study is to gain a deeper understanding of how people in Myanmar currently cook and how they aspire to cook.

In particular, the objectives of the study are:

- To assess the compatibility of current and aspirational cooking practices with battery-supported electric cooking (eCook).
- To identify design modifications and marketing strategies that can enable the generic eCook concept to evolve around the needs and aspirations of cooks in Myanmar.

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2 Methodology

Four focus groups were carried out to gain further insight into how people in Myanmar currently cook and how they aspire to cook. A series of questions were designed to guide the discussion (see *Appendix B: Focus group design brief)*, however open dialogue was encouraged when unforeseen issues were brought up by the participants. The participatory sessions involved a live cooking demonstration of popular local foods with a prototype eCook device. An range of energy-efficient electric cooking appliances were demonstrated with a prototype battery-supported cooking device during each session. Comments were invited from the audience on how compatible the device might be with the current and aspirational cooking practices.

Figure 3: The battery-supported cooking system and energy-efficient electric cooking appliances demonstrated during the focus groups.

Table 1 shows the four locations selected for the focus group discussions. These contexts were chosen to be able to compare and contrast the issues faced by people in rural and urban areas, of different income levels and who are using different cooking fuels.

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Table 1: Description of the 4 locations chosen for focus group discussions.

Location	Context	Participants	Context	Fuels
Immyauk Village, Natmauk Township, Magway Division 	Off-grid village in dry zone	9 male, 33 female	REAM has a sub-office nearby	Firewood & charcoal
Hlaine Bone, Mawlamyaing Gyun Tsp. Ayeyarwady Division 	Off-grid village in Ayeyarwady delta	16 male, 7 female	REAM rice husk gasifier mini-grid	Firewood, charcoal, LPG, electricity.
Maw Gyun Township, Ayeyarwady Division 	Peri-urban town in Ayeyarwady delta	10 male, 11 female	REAM member's residence	Firewood, charcoal & electricity
Natmauk Township, Magway Division 	Peri-urban town in Ayeyarwady delta	4 male, 8 female	REAM sub-office	Firewood, charcoal & electricity

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3 Results

3.1 Cooking practices

All groups confirmed that a rice and curry combination is the most commonly prepared meal in Myanmar. Other popular foods included fish, vegetables, green tea and vermicelli.

RICE IS ONE OF THE EASIEST STAPLES TO COOK WITH ELECTRICITY. ALTHOUGH THERE IS SOME BEHAVIOUR CHANGE FROM COOKING ON OTHER FUELS, IT IS A LOT EASIER, SO RICE COOKERS ARE UNDERSTANDABLY ONE OF THE FIRST ELECTRIC APLIANCES THAT MANY PEOPLE IN MYANMAR BUY.

Figure 4: Vermicelli – a popular staple in Myanmar that is very simple to cook by boiling for just a few minutes.

Several groups (Immyauk, Hlaine Bone) discussed the traditional practice of cooking rice by tipping out the starchy water part way through the cooking process. This is different to the process that is commonly used when cooking rice in a rice cooker, where no water is thrown out and all the starch soaks back into the rice, unless it is rinsed first. Participants acknowledged that this was different, but generally agreed that they would be happy to adopt the alternative practice, as the convenience of cooking with a rice cooker outweighed the drawbacks.

> *"We are not interested rice liquid throw away cooking way. We will change to electricity if the expenses are low." Hlaine Bone FGD participant*

RICE & CURRY IS THE MOST POPULAR MEAL IN MYANMAR, WHICH EXPLAINS WHY THE MOST POPULAR ELECTRIC COOKING APPLIANCES ARE RICE COOKERS & ELECTRIC FRYING PANS.

When asked about the flavour of food cooked on biomass, several participants noted they preferred the cleaner flavour of food cooked on electricity.

> *"The wood namely 'Tha Man Thar' smells extremely bad. When cook with this, curry smells so bad to eat. Rice cooker were*

applied, no smell comes out. Previously wood-cooked curry smelled horrible." Maw Gyun FGD participant

Rice cookers and insulated frying pans were the most common electric cooking appliances amongst participants, although some also reported owning kettles. Most participants reported using aluminium cookware, which is incompatible with induction stoves. However, the popular red insulated electric frying pans exhibit similar performance to induction stoves, as they have the heating element fixed to the bottom of the frying pan, with insulation all around, making heat transfer into the pan highly efficient. Pressure cookers are difficult to open during the pressure-cooking stage, however, there are also advantages, as water is sealed inside meaning that the main reason to open the lid, to stir, becomes redundant:

THE CHEAP RED ELECTRIC FRYING PANS THAT ARE POPULAR ACROSS MYANMAR ARE SURPRISINGLY ENERGY-EFFICIENT, AS THE HEATING ELEMENT IS STUCK TO THE BOTTOM OF THE PAN & THERE IS INSULATION AROUND IT. THIS CREATES EXTREMELY EFFCIENT HEAT TRANSFER INTO THE PAN, JUST LIKE WITH AN INDUCTION STOVE.

"It is important to be well-cooked and edible fine only. If no need stirs, less work than we have."
Maw Gyun FGD participant

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Figure 5: The classic Myanmar kitchen set up: a rice cooker for rice, red insulated frying pan for curry and kettle for green tea.

Firewood stoves often provide additional benefits such as preserving meat by smoking and space heating, however in the contexts studied, these additional benefits were found to be minimal. In both the Dry Zone and Ayeyarwady Delta regions, participants reported firewood is no longer used for space heating, as the climate is now warmer. Whilst meat used to be smoked using firewood to preserve it, participants in Immyauk stated that it instead sun dried.

In the Delta region, participants flagged up the fact that PV-eCook devices are likely to have limited performance during the monsoon season.

3.2 Fuel choice

In Maw Gyun, electricity is preferred, but during blackouts, firewood is often used as its quick to light. However, smoke is undesirable and it's hard to use in the rainy season. However, charcoal is generally preferred to wood as it can cook many dishes consecutively.

SPACE HEATING IS OFTEN AN IMPORTANT DUAL USE FOR COOKSTOVES, MEANING THAT SUPPOSEDLY MORE EFFICIENT COOKSTOVES ARE OFTEN NOT ADOPTED AS THEY ARE LESS EFFICIENT SPACE HEATERS. HOWEVER, THE CLIMATE IN MUCH OF MYANMAR IS WARM ENOUGH THAT FOCUSSING THE HEAT ONTO THE POT RATEHER THAN THE COOK IS DESIRABLE.

ELECTRICITY IS CLEARLY THE ASPIRATIONAL FUEL IN MYANMAR; HOWEVER, GAS IS BECOMING POPULAR TOO.

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Figure 6: A typical biomass stove in use across Myanmar.

In Immyauk, if firewood, charcoal & electricity were all available for free, electricity would be preferred, then charcoal, then firewood. Electricity can be turned on with the press of a button. Charcoal is hard to light, but once lit, it burns steadily for a long time. Firewood is widely used because it can be collected for free or bought very cheaply. Both charcoal and firewood are available to buy in the village throughout the year.

In Hlaine Bone households with multiple cooking fuels available reported choosing gas and electricity when they were in a hurry.

The Ayeyarwady delta region used to be one of Myanmar's top charcoal producing region. However, extreme deforestation has meant that woodfuels are now much scarcer, so the quality has gone down and the price has gone up. As a result, gas is now used by around 40% of the village as a substitute.

3.3 Cooking with electricity

Myanmar's national grid suffers from severe voltage instability. Standard voltage is supposedly 220V, but even in Yangon it's often below 160V. Customers are forced to buy their own transformer and/or voltage regulator and install it after their meter if they want their appliances to last more than a few months. All delicate equipment like TVs and air-conditioning has to have a safeguard to detach the power supply when spikes or dips come through to stop them blowing up.

THE QUALITY OF THE ELECTRICITY PROVIDED BY MYANMAR'S NATIONAL GRID IS EXTREMELY POOR. BLACKOUTS ARE A FREQUENT OCCURRENCE & THE VOLTAGE FREQUENTLY SAGS BELOW HALF THE EXPECTED LEVEL. USERS ARE FORCED TO PURCHASE AN EXPENSIVE ARRAY OF HARDWARE (VOLTAGE STABILISERS, SAFEGUARDS, ETC.) TO BE ABLE TO USE DOMESTIC

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Figure 7: The incredible array of devices needed to ensure a reliable supply of electricity at the hotel we stayed at in Maw Gyun. A safeguard for each room, several voltage stabilisers, a battery and UPS, as well as a diesel generator!

So, whilst the unit cost of grid electricity in Myanmar is one of the lowest in the whole world, the cost of the additional hardware required to use it properly severely limits its utility. As a result, many grid connected households also have generators, solar panels or parallel connections to other localised mini-grids with higher unit costs, but much greater reliability. Power electronic equipment required to stabilise the voltage is usually quite poor quality and therefore has to be overrated. For example, a 1kW voltage regulator is not usually considered enough to enable cooking, even on a single 1kW appliance. Participants in Nat Mauk report paying 300,000 MMK for 5kW voltage stabilisers and are able to use them to cook rice and curry in a rice cooker and electric frying pan.

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HOUSEHOULDS ARE ALREADY PAYING 300,000 MMK (200 USD) FOR A VOLTAGE STABILISER THAT HAS NO INBUILT STORAGE.

Figure 8: A 1kW transformer tested at Nat Mauk with a 1kW cooking appliance shortly before smoke started pouring out the vents due to overloading.

In the house where the May Gyun focus group took place, there is a national grid connection, however, they had to use both a manually adjustable voltage transformer for the whole house, plus an automatic voltage stabiliser and safeguards for all sensitive equipment. The voltage on the government grid is so unstable that the manual voltage transformer requires constant adjusting as the lights begin to flicker to prevent them from going out completely. It requires as much attention as tending a fire, so it's certainly not modern or convenient access to energy. The voltage frequently dipped below 50V just in the few hours we were there and sometimes reportedly dips as low as 20V.

In the evenings, the national grid is totally abandoned, as peak loading drops the voltage down to unusable levels (<80V). A group of friends and family have clubbed together to create a 'private line' that comes from a small diesel generator and allows people to light their homes when they need it most. They also have their own generator to support their printing business and several small solar systems.

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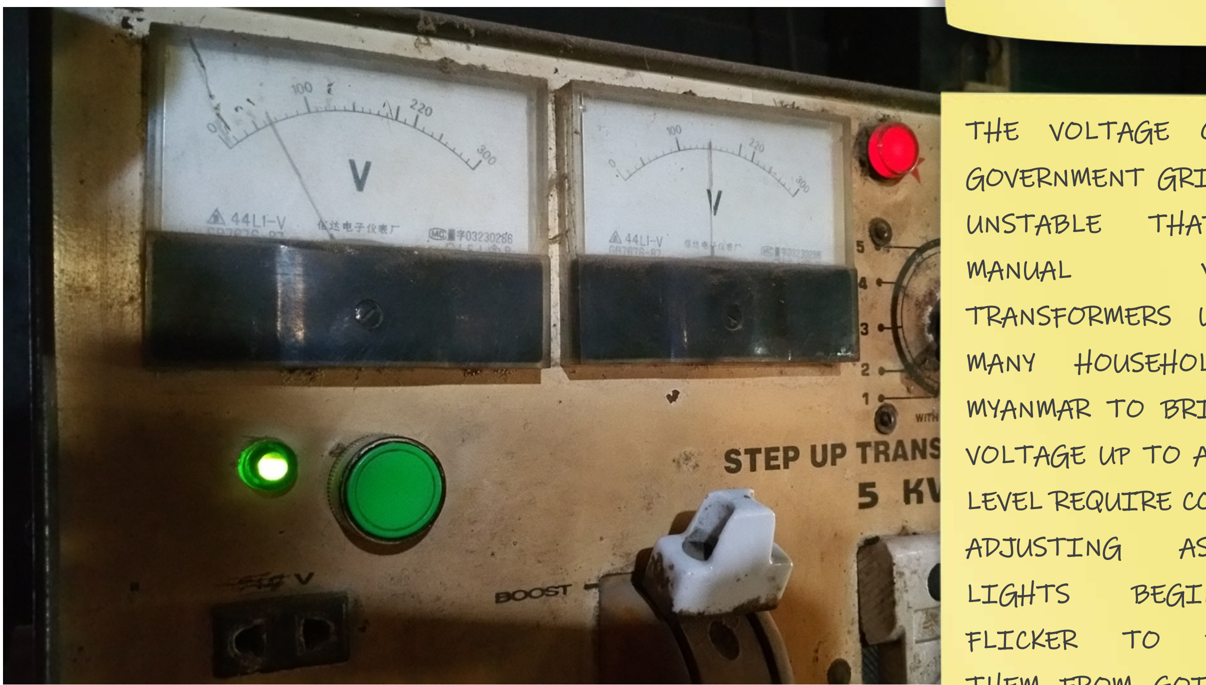
IN MAW GYUN THE VOLTAGE FREQUENTLY DIPPED BELOW 50V JUST IN THE FEW HOURS WE WERE THERE & SOMETIMES REPORTEDLY DIPS AS LOW AS 20V.



THE VOLTAGE ON THE GOVERNMENT GRID IS SO UNSTABLE THAT THE MANUAL VOLTAGE TRANSFORMERS USED BY MANY HOUSEHOLDS IN MYANMAR TO BRING THE VOLTAGE UP TO A USABLE LEVEL REQUIRE CONSTANT ADJUSTING AS THE LIGHTS BEGIN TO FLICKER TO PREVENT THEM FROM GOING OUT COMPLETELY. IT REQUIRES AS MUCH ATTENTION AS TENDING A FIRE, SO IT'S CERTAINLY NOT MODERN OR CONVENIENT ACCESS TO ENERGY.

Figure 9: The manual voltage stabiliser struggling to keep up as the voltage sags to 50V during the focus group in Maw Gyun (bottom), requiring constant intervention from our hosts, as the voltage bounced up and down throughout the session (top).

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Figure 10: The cooking device of choice (below) when the voltage is high enough, plus the alternative (above) when it is not.

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The situation is similar in other locations, with users in Nat Mauk also reporting serious voltage dips throughout the day.

> *"They want to change. If the electricity grid offered a stable voltage when they need to cook, everyone would cook all their meals on electricity."*
> *Nat Mauk FGD transcript*

ELECTRICITY IS THE ASPIRATIONAL COOKING FUEL. IN NAT MAUK PARTICIPATS WERE SO DESPERATE TO USE IT THAT THEY ARE WILLING TO GET UP AS EARLY AS 2AM TO BEGIN COOKING BEFORE THE VOLTAGE STARTS TO SAG AS THE GRID IS LOADED UP THROUGHOUT THE DAY.

Fortunately, there seems to be some predictability to it, with the voltage dipping to unusable levels in the evening and morning peaks, but recovering at certain points. This creates windows of opportunity for cooks to power up their electric cooking appliances:

> *"Mostly used to wake up early 2-3am round, use Rice Cooker to cook Rice, Curry by Charcoal or Fuel wood for safe cook due to irregular current ... At regular Voltage hour supply time 2-3:30 am, we use cook with electricity. Traditionally Rice as named "Soon" used to donate Buddha at Pagodas and House Shrines, also to Monks and even Aged persons at house consume rice at 4am round is habitual custom. So people used to wake up early cook rice at safe and regular Voltage time very early morning. "*
> *Nat Mauk FGD participant*

This may also explain the preference for insulated appliances such as rice cookers and the popular red insulated electric frying pans, as the insulation prevents heat from escaping from the pan, meaning that less power is required from the heating element. What is more, heat can be retained and cooking can continue during short blackouts. in the dry season there are almost no blackouts, but in the rainy season there are heavy storms and then they can occur many times a month, sometimes lasting for up to 2 days.

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THE POPULARITY OF INSULATED ELECTRIC COOKING APPLIANCES SUCH AS RICE COOKERS & RED ELECTRIC FRYING PANS IN MYANMAR CAN PARTLY BE EXPLAINED BY THE FACT THAT THEY ARE ABLE TO MAINTAIN COOKING PERFORMANCE DURING BLACKOUTS AND VOLTAGE DIPS SIMPLY BY PREVENTING HEAT FROM LEAVING THE POT.

Figure 11: Insulating cooking devices is not a new idea, as this insulated box for a tea pot shows, beside the modern equivalent, the thermo-pot, which can also bring to the boil and automatically keep the heat topped up.

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3.4 Relative costs of cooking

In Nat Mauk, participants report paying 10,000 MMK per month to cook with electricity and around the same for wood or charcoal. Gas is considered to be expensive, so is only used by most for warming food or cooking during blackouts. They use a 5 viss cylinder and pay 3,000 MMK per viss. A bullock cart of firewood typically sells for 10,000 MMK and would last a family of 5 for one month.

10,000 MMK (7 USD) FOR A MONTH OF COOKING ON FIREWOOD, CHARCOAL, GAS OR GRID ELECTRICITY IS RELATIVELY CHEAP, HOWEVER IT MAY BE POSSIBLE FOR ECOOK SYSTEMS WITH LONGER FINANCING HORIZONS TO BE COMPETITIVE, ESPECIALLY AS THE COST OF BATTERY STORAGE CONTINUES TO FALL. AT 30,000 MMK (20 USD) PER MONTH, A PV-ECOOK SYSTEM WITH A 5 YEAR FIANCING HORIZON MAY EVEN BE COMPETITIVE TODAY.

Immyauk is not yet connected to the grid, but they hope to be by the end of the year, as they are only 1 mile from Natmauk town. They are saving up and need to raise between 160,000 and 700,000 MMK per household for connection. A bullock cart of dry firewood costs 5,000 MMK.

In Maw Gyun, charcoal sells for 5,000 MMK/viss and 1 bundle of firewood that lasts 3 days costs around 1,200 MMK.

In Hlaine Bone, there are also some gas users, who report paying similar prices 12,000 MMK for a 4 viss cylinder (3,000 MMK/viss), which last for 1.5 months for a 2 person household cooking rice, 2 types of curry and heating hot water with gas.

In Hlaine Bone, there is access to electricity in most households via an experimental rice husk gasification plant installed by REAM and DRI (Department of Research and Innovation). Electricity is only available during set hours (6 - 10 AM and 5:30 - 11:00 PM) and the unit cost is high (600 MMK/kWh). One participant who uses electricity for cooking, lighting and TV pays around 30,000 MMK per month. They used to cook with firewood, but report that in terms of cost, there is not much difference between what they were paying and what they now pay. Another participant reported cooking rice twice a day with a rice cooker for 150MMK, stating that if the unit cost dropped to 1/6-1/3 of its current level, they would definitely use it regularly.

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Figure 12: The experimental rice husk gasification plant at Hlaine Bone installed by REAM and DRI. At 600 MMK/kWh (0.39 USD/kWh), the unit cost is considered very expensive by residents, but by international standards, this is a relatively cheap mini-grid.

It's also possible to cook directly with rice husk. One Hlaine Bone participant reported spending 4,000 MMK/month for their 8 person household. Firewood is also commonly used for cooking, with another household with 4 members paying 15,000 MMK per month. Another participant stated that they share fuel costs amongst 13 families, who fuel stack electricity and charcoal for cooking. They spend 150,000 MMK per month (11,500MMK per household) on electricity and use 12 bags of charcoal per month at 5,000-6,000 MMK per bag. Gas is also available for 3,000 MMK/viss, with the price reportedly dropping a lot recently. One participant reports that his household uses a 4.5 viss cylinder lasts his household 1.5 months (9,000 MMK/month).

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3.5 Safety

Safety is a serious concern, with many FGD participants afraid that electric cooking appliances might shock them or that they might be damaged by the unstable voltage. A participant also told a familiar story of pressure cookers exploding:

"Once I experienced was when I stewed Hilsa Fish in Pressure Cooker, it exploded, and my children burnt." Hlaine Bone FGD participant

LOW QUALITY APPLIANCES HAVE CREATED THE PERCEPTION THAT ELECTRICITY IS UNSAFE TO COOK WITH AS IT IS LIKELY TO SHOCK THE COOK.

3.6 Willingness to pay

There is clearly an important role for innovative financing mechanisms to break down the high upfront cost of battery-supported cooking devices. In Hlaine Bone, those that were interested in acquiring single off-the-shelf appliances such as the induction stove and were generally able and willing to pay the upfront cost of 30,000 MMK. Participants were asked how much they were willing to pay. However, nobody was willing or able to pay the estimated 1,500,000 MMK upfront cost for battery-supported devices, in one go. However, a 10 year financing plan with 150,000 MMK annual repayments was attractive to all.

Interestingly, in Maw Gyun, participants were willing to pay up to 500,000 MMK upfront cost to guarantee a reliable supply of electricity, in addition to their existing monthly bills. However, they were only willing to pay up to 500MMK per day to use a battery-supported cooker (180,000 MMK). This implies that leveraging the additional functionality of eCook devices as enablers of reliable access to electricity for other domestic applications is likely to be a key marketing strategy.

UNSURPRISINGLY, INNOVATIVE FINANCING MECHANISMS WILL BE NEEDED TO BREAK DOWN THE HIGH UPFRONT COST OF BATTERY-SUPPORTED DEVICES INTO MANAGEABLE REPAYMENTS. PAY-AS-YOU-GO FINANCING MECHANISMS HAVE NOT YET TAKEN OFF IN MYANMAR, SO THERE IS A NEED TO FIND CREATIVE BUSINESS MODELS THAT CAN BREAK DOWN THE HIGH UPFRONT COST OF FUTURE ECOOK DEVICES.

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INTERESTINGLY, PEOPLE WERE WILLING TO PAY CONSIDERABLY MORE FOR A RELIABLE POWER SUPPLY THAN AN ECOOK DEVICE, IMPLYING THAT LEVERAGING THE ADDITIONAL FUNCTIONALITY OF ECOOK DEVICES AS ENABLERS OF RELIABLE ACCESS TO ELECTRICITY FOR OTHER DOMESTIC APPLICATIONS IS LIKELY TO BE A KEY MARKETING STRATEGY.

Figure 13: The battery-supported prototype eCook device on display during the participatory cooking session at Hlaine Bone.

This research is funded by DfID/UK Aid and Gamos through the Innovate UK Energy Catalyst and the MECS programme.

4 Conclusion

The FGDs have confirmed that there is a strong market for eCook products and services in Myanmar. The convenience of being able to turn on an electric stove and control the heat output at the press of a button is highly valued by the majority of FGD participants. The evidence from these FGDs suggests that electricity is currently the aspirational fuel for most households in Myanmar. Energy-efficient appliances such as the rice cooker and red insulated electric frying pan make cooking much easier and are already widely adopted. However, safety is also a concern for many, as poor-quality devices have been known to shock users. Reliability and access are major concerns, which make cooking with battery-supported electricity an attractive proposition, if this can be successfully communicated to potential users. Whilst affordability is less of a challenge than in other contexts due to the very low grid tariff, battery-supported devices will add significantly to the cost. Pay-as-you-go financing mechanisms have not yet taken off in Myanmar, so there is a need to find creative business models that can break down the high upfront cost of future eCook devices.

The findings from these FGDs will be combined with those from the other activities that have been carried under the eCook Myanmar 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/ and www.MECS.org.uk.

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5 Appendix

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

5.1.1 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 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

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[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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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 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.

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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.

5.1.2 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 14 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 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

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

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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.

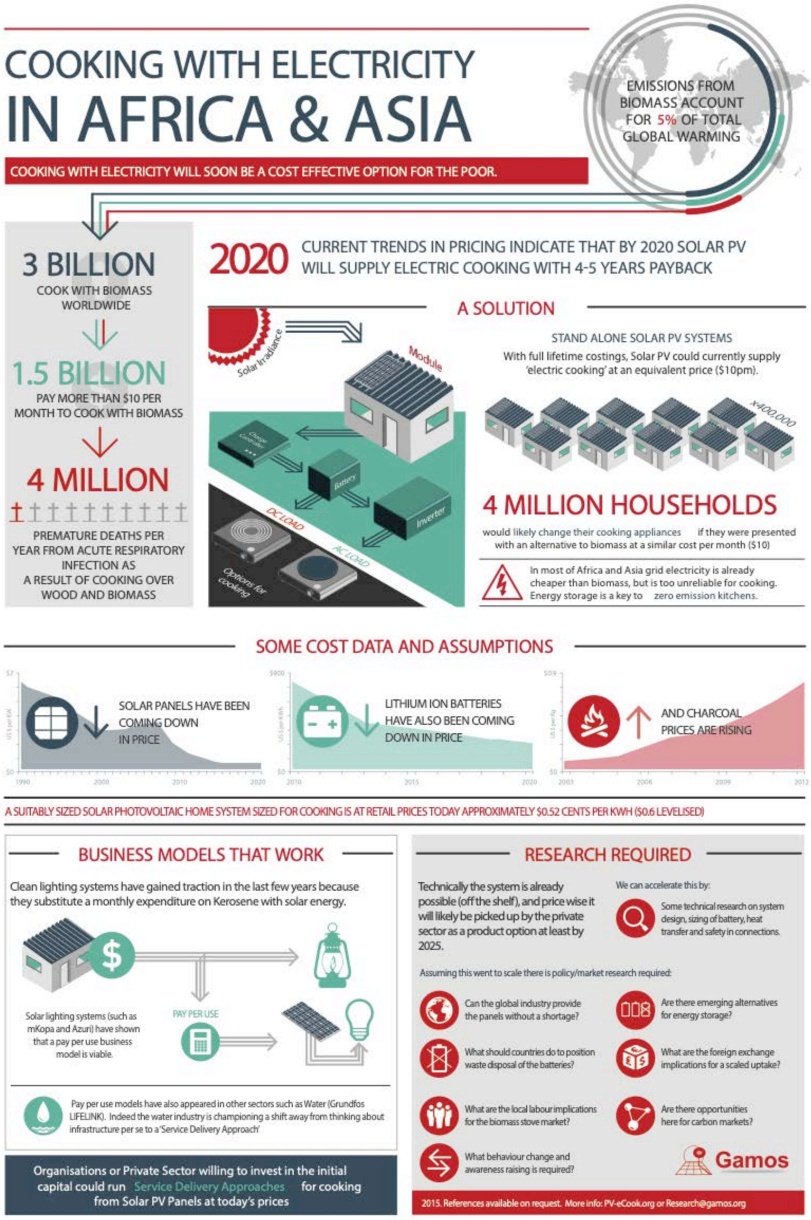

Figure 14 Infographic summarising the concept in order to lobby research and policy actors.

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

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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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5.1.3 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.

5.1.4 About the Modern Energy Cooking Services (MECS) Programme.

Sparking a cooking revolution: catalysing Africa's transition to clean electric/gas cooking.

www.mecs.org.uk | mecs@lboro.ac.uk

Modern Energy Cooking Services (MECS) is a five-year research and innovation programme funded by UK Aid (DFID). MECS hopes to leverage investment in renewable energies (both grid and off-grid) to address the clean cooking challenge by integrating modern energy cooking services into the planning for access to affordable, reliable and sustainable electricity.

Existing strategies are struggling to solve the problem of unsustainable, unhealthy but enduring cooking practices which place a particular burden on women. After decades of investments in improving biomass cooking, focused largely on increasing the efficiency of biomass use in domestic stoves, the technologies developed are said to have had limited impact on development outcomes. The Modern Energy Cooking Services (MECS) programme aims to break out of this "business-as-usual" cycle by investigating how to rapidly accelerate a transition from biomass to genuinely 'clean' cooking (i.e. with electricity or gas).

Worldwide, nearly three billion people rely on traditional solid fuels (such as wood or coal) and technologies for cooking and heating[3]. This has severe implications for health, gender relations, economic livelihoods, environmental quality and global and local climates. According to the World Health Organization (WHO), household air pollution from cooking with traditional solid fuels causes to 3.8 million premature deaths every year – more than HIV, malaria and tuberculosis combined[4]. Women and children are disproportionally affected by health impacts and bear much of the burden of collecting firewood or other traditional fuels.

Greenhouse gas emissions from non-renewable wood fuels alone total a gigaton of CO_2e per year (1.9-2.3% of global emissions)[5]. The short-lived climate pollutant black carbon, which results from incomplete combustion, is estimated to contribute the equivalent of 25 to 50 percent of carbon

[3] http://www.who.int/indoorair/health_impacts/he_database/en/

[4] https://www.who.int/en/news-room/fact-sheets/detail/household-air-pollution-and-health https://www.who.int/gho/hiv/epidemic_status/deaths_text/en/, https://www.who.int/en/news-room/fact-sheets/detail/malaria, https://www.who.int/en/news-room/fact-sheets/detail/tuberculosis

[5] Nature Climate Change 5, 266–272 (2015) doi:10.1038/nclimate2491

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dioxide warming globally – residential solid fuel burning accounts for up to 25 percent of global black carbon emissions[6]. Up to 34% of woodfuel harvested is unsustainable, contributing to climate change and local forest degradation. In addition, approximately 275 million people live in woodfuel depletion 'hotspots' – concentrated in South Asia and East Africa – where most demand is unsustainable[7].

Africa's cities are growing – another Nigeria will be added to the continent's total urban population by 2025[8] which is set to double in size over the next 25 years, reaching 1 billion people by 2040. Within urban and peri-urban locations, much of Sub Saharan Africa continues to use purchased traditional biomass and kerosene for their cooking. Liquid Petroleum Gas (LPG) has achieved some penetration within urban conurbations, however, the supply chain is often weak resulting in strategies of fuel stacking with traditional fuels. Even where electricity is used for lighting and other amenities, it is rarely used for cooking (with the exception of South Africa). The same is true for parts of Asia and Latin America. Global commitments to rapidly increasing access to reliable and quality modern energy need to much more explicitly include cooking services or else household and localized pollution will continue to significantly erode the well-being of communities.

Where traditional biomass fuels are used, either collected in rural areas or purchased in peri urban and urban conurbations, they are a significant economic burden on households either in the form of time or expenditure. The McKinsey Global Institute outlines that much of women's unpaid work hours are spent on fuel collection and cooking[9]. The report shows that if the global gender gap embodied in such activities were to be closed, as much as $28 trillion, or 26 percent, could be added to the global annual GDP in 2025. Access to modern energy services for cooking could redress some of this imbalance by releasing women's time into the labour market.

To address this global issue and increase access to clean cooking services on a large scale, investment needs are estimated to be at least US$4.4 billion annually[10]. Despite some improvements in recent

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[6] http://cleancookstoves.org/impact-areas/environment/

[7] Nature Climate Change 5, 266–272 (2015) doi:10.1038/nclimate2491

[8] https://openknowledge.worldbank.org/handle/10986/25896

[9] McKinsey Global Institute. *The Power of Parity: How Advancing Women's Equality can add $12 Trillion to Global Growth*; McKinsey Global Institute: New York, NY, USA, 2015.

[10] The SE4ALL Global Tracking Report shows that the investment needed for universal access to modern cooking (not including heating) by 2030 is about $4.4 billion annually. In 2012 investment was

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years, this cross-cutting sector continues to struggle to reach scale and remains the least likely SE4All target to be achieved by 2030[11], hindering the achievement of the UN's Sustainable Development Goal (SDG) 7 on access to affordable, reliable, sustainable and modern energy for all.

Against this backdrop, MECS draws on the UK's world-leading universities and innovators with the aim of sparking a revolution in this sector. A key driver is the cost trajectories that show that cooking with (clean, renewable) electricity has the potential to reach a price point of affordability with associated reliability and sustainability within a few years, which will open completely new possibilities and markets. Beyond the technologies, by engaging with the World Bank (ESMAP), MECS will also identify and generate evidence on other drivers for transition including understanding and optimisation of multi-fuel use (fuel stacking); cooking demand and behaviour change; and establishing the evidence base to support policy enabling environments that can underpin a pathway to scale and support well understood markets and enterprises.

The five-year programme combines creating a stronger evidence base for transitions to modern energy cooking services in DFID priority countries with socio-economic technological innovations that will drive the transition forward. It is managed as an integrated whole; however, the programme is contracted via two complementary workstream arrangements as follows:

- An Accountable Grant with Loughborough University (LU) as leader of the UK University Partnership.
- An amendment to the existing Administrative Arrangement underlying DFID's contribution to the ESMAP Trust Fund managed by the World Bank.

The intended outcome of MECS is a market-ready range of innovations (technology and business models) which lead to improved choice of affordable and reliable modern energy cooking services for consumers. Figure 15 shows how the key components of the programme fit together. We will seek to have the MECS principles adopted in the SDG 7.1 global tracking framework and hope that participating countries will incorporate modern energy cooking services in energy policies and planning.

in cooking was just $0.1 billion. Progress toward Sustainable Energy: Global Tracking Report 2015, World Bank.

[11] The 2017 SE4All Global Tracking Framework Report laments that, "Relative to electricity, only a small handful of countries are showing encouraging progress on access to clean cooking, most notably Indonesia, as well as Peru and Vietnam."

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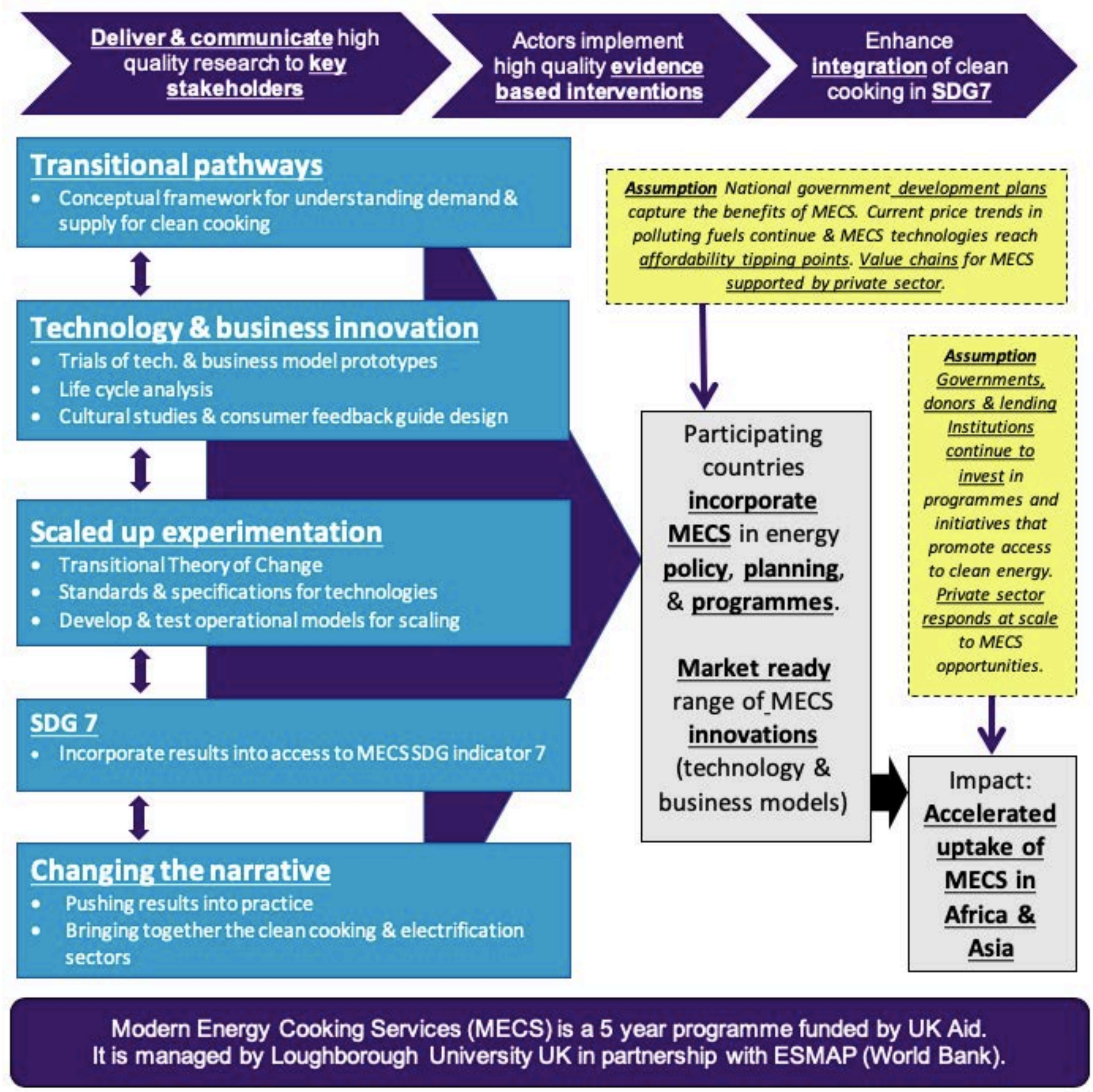

Figure 15: Overview of the MECS programme.

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5.2 Appendix B: Focus group design brief

Topics to explore:

1. Current cooking practices - **what do you currently cook and how?**
   - **1.1. What foods do you cook?**
     - **1.1.1. What processes are required for each (e.g. boiling, frying)?**
     - **1.1.2. What appliances do you use for each (both stoves and pots)?**
   - **1.2. Why do you prefer specific fuels/appliances?**
     - 1.2.1. Where/how do you store each fuel?
     - 1.2.2. Availability?
     - 1.2.3. Seasonal patterns?
     - 1.2.4. Cost?
     - **1.2.5. Has anybody tried cooking on electricity?**
       - 1.2.5.1. If so, what did they like and what did they not like?
       - 1.2.5.2. If you have electricity at home, when do you use it?
     - **1.2.6. Do you cook differently on different fuels/appliances? If so, why?**
     - 1.2.7. Does anybody use task specific appliances (e.g. kettle, rice cooker) or pots (e.g. pressure cooker/kettle without heating element)
   - **1.3. Does everybody tend to cook in more or less the same way? If not, why do people cook differently?**
   - **1.4. Is there any experience of people changing the way they cook?**
     - 1.4.1. How much resistance to change is there?
     - 1.4.2. What would make people change (e.g. fuel shortages, fuel prices, access to electricity….)?
2. Future cooking practices **- what and how would you prefer to cook in the future?**
   - 2.1. **Desirable foods and preparation methods** (e.g. what foods would you like to cook more often if they were easier to prepare)
   - 2.2. Desired fuel/appliance use
     - **2.2.1. What are the desirable features of the ideal cooking appliance?**
       - Portability?
       - Multitasking – can people leave food to cook and get on with something else?
       - Access to pot (do you need to stir it the whole time)?
       - Importance of safety
       - Suitable mode of acquisition - self-build/cash/pay-as-you-go/utility
       - Skills for operation/maintenance
       - Access to fuel/device retailers
     - **2.2.2. What prevents people from using this ideal fuel/device?**
       - 2.2.2.1. If electricity were available in everybody's homes and had no cost, would everybody use it for everything or are there other barriers too?

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