Electric Cooking Devices for Developing World Households: Product Enhancement or Adjustment Opportunities

Authors: S Batchelor, N Rousseau

Gamos

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Loughborough University

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1 Introduction

Companies that sell electric cooking devices could find substantial and growing markets for them across the developing world. In reality, there are very many different scenarios in terms of affluence and the quality of the electricity available – and the ideal characteristics of the devices needed will vary accordingly.

This document summarises our findings regarding cooking requirements to enable you to identify suitable devices or modifications/new devices that would fit well in different contexts. It also suggests which will be the more effective routes to market for the different market segments – from conventional retail via distributors to partnerships with energy providers and/or finance schemes and subsidies.

We will continue to carry out and publish research to deepen our understanding.

All our reports can be found at:

https://mecs.org.uk/publications-categories/

2 Market segments

In Low and Middle Income countries (Africa and Asia) we identify five broad categories of market segments. Our document 'Exploring MECS User Personas' provides a baseline insight into those market segments, and we recognize that within each segment there will be early and late adopters. We suggest the market is best conceived as shown in Table 1 (next pages).

The analysis suggests that while existing EPCS can address a significant portion of the market, many market segments would be receptive to a 'modified' EPC. This document focuses on the technical modifications that could open up these markets.

Please note that some of these markets need credit facilities in place for the consumer to spread out the upfront payment. We are currently working with a number of mechanisms to do that including – 'regular' credit finance, community credit mechanism, on-bill financing through the utility, and Pay-As-You-Go (as used in the solar industry). For each of these solutions there are also various mitigations of risk for the distributors, including results-based financing and carbon credits. This is alluded to in the Routes to Market column.

When looking at the distribution of cases from each country (Table 2), differences in the communities sampled are evident. For example, households with no connection were mostly found in Tanzania and Zambia. Household connected to mini-grids were almost exclusively found in Myanmar. National grids in Kenya and Uganda were strong (few people were categorised as having a weak connection).

Table 2 Persona by Country

	Country						Total
	Myanmar	Ghana	Kenya	Tanzania	Uganda	Zambia	
Isolated (no electricity)	2	4	1	36	22	45	110
Communal (island grid)	24	0	1	16	1	0	42
Weak national grid	50	119	17	76	14	45	321
Strong national grid - small family	10	49	115	5	95	26	300
Strong national grid - large family	23	78	72	27	165	71	436
Total	109	250	206	160	297	187	1209

Table 1 Market Segments

The market segment	Description	Attitude to electric cooking	Suitable device	Route to market
1) Connected and busy 	Reasonable connection to the grid and disposable income that is spent on household items.	Likely to purchase an EPC from a retail outlet if they are made aware of the value proposition.	A standard EPC, running on AC, would be useable.	Conventional route via distributer and retailers.
2) Connected but skeptical (strong grid) 	Reasonable connection to the grid but less disposable income that is spent on household items – but are more conservative about change.	Need to be persuaded about the value proposition, and would likely need some of the risk to be mitigated through a loan or hire purchase.	A standard EPC, running on AC, would be useable.	Conventional route via distributer and retailers. Also through Grid energy supplier who can spread the cost. Partnership with consumer finance institution.
2a) Connected but skeptical (weak grid)	Connection to the grid that may not be up to code, and as above with low disposable income Also they are conservative about change.	Need to be persuaded about the value proposition, and would likely need some of the risk to be mitigated through a loan or hire purchase. Poor standards of wiring/fuses necessitate a device that does not draw high current.	A lower power EPC, running on AC would be preferable. The alternative would be a lower power EPC running on DC powered by a battery charged when power was available.	Through Grid energy supplier who can spread the cost. Partnership with consumer finance institution. Access Results Based Financing, Government bulk purchase, NGO.

The market segment	Description	Attitude to electric cooking	Suitable device	Route to market
3) Weakly connected pioneer 	Connected to a weak grid and does not have much disposable income. They are willing to change but lack resources.	Likely need some of the risk to be mitigated through a loan or hire purchase. They also need a device that does not draw high current through bad wiring and fuses.	A lower power EPC, running on AC would be preferable. The alternative would be a lower power EPC running on DC powered by a battery charged when power was available.	Through Grid energy supplier who can spread the cost. Access Results Based Financing, Government bulk purchase, NGO.
4) Communal energy pioneer 	Connected to a weak grid (possibly mini grid) and does not have much disposable income. They are willing to change but lack resources.	Likely need some of the risk to be mitigated through a loan or hire purchase. They also need a device that does not draw high current through bad wiring and fuses.	A lower power EPC, running on AC would be preferable. The alternative would be a lower power EPC running on DC powered by a battery charged when power was available.	Through mini grid company or Grid energy supplier who can spread the cost. Access Results Based Financing, Government bulk purchase, NGO.
5) Isolated pioneer 	Not connected to grid and has been using Solar Home Systems. They do not have much disposable income. They are willing to change but lack resources.	Likely need some of the risk to be mitigated through a loan or hire purchase.	A lower power EPC running on DC powered by a battery charged by the solar PV.	Through Solar Home Systems supplier who can spread the cost. Access Results Based Financing, Government bulk purchase, NGO.

3 EPC Modifications

3.1 Low power AC EPC

Personas' 2a, 3 and 4 would benefit from the option of a (6litre) lower power AC EPC

- Currently available products are designed for users connected to strong grids and at 1kw or more draw relatively high current.
- 'Weak-grids' and off-grid AC systems can be overloaded by high power appliances.
- There are three main mechanisms of failure within 'weaker grids'
    - An infrastructure that cannot cope with too high a current. Transformers that cannot sustain high current draws. (Ultimately this is the responsibility of the utility to upgrade, but for the interim, lower power EPCs would mitigate this problem.)
    - Household connections and internal wiring not up to code. In the target countries builders and landlords don't always adhere to the regulations. Some households have lower quality fuses and wiring, which can brown out if the current draw is too much. A lower power would mitigate this (although also investment in better quality wiring would also solve this problem)
    - Too much peak load – mini grids in particular are designed to deliver a maximum peak load, and to add too many high power devices all coming on at once could cause problems. This can e mitigated by a lower power device (but also can be mitigated by ensuring not all devices are used at once – particular with EPCs maintain pressure by intermittent heating there is research on smart switching connected to smart metering.
- A low power AC EPC could be identical to the standard EPC, but simply has a heating element rated at around 600W instead of 1kW, with the same 6 litre cooking pot.
- Factories that are making standard AC EPCs could potentially modify their product simply by replacing the 1kW heating plate with a 600W heating element.
- 600W **AC** heating element (500W to 700W)

3.2 Medium or low power DC EPC

Personas' 2a, 3, 4 and 5 would benefit from the option of a (6 litre) lower power Direct Current (DC) EPC

One way of mitigating all the problems of weak grids is to charge a household level battery, and for the cooking to be done from the battery. This has been proven to be possible and cost effective (and will be increasingly cost effective as battery prices continue to drop).

Running an EPC from a battery could either be undertaken via an inverter, in which case the existing and lower power AC EPC could fit the market, or directly. The advantage of the direct connection from battery to appliance is a lack of loss of energy through the inverting.

- A Direct Current (DC) appliance could eliminate the need for an inverter on off grid situations, and enable use in weak grid locations.
- There is only one known DC EPC and this has some quality and safety issues such that formal institutions are not willing to use it.
- The one existing DC EPC is a very low power (250-400W), which making frying, in particular, difficult, and can cause temperature differentials in the pot which can make the cooking experience unsatisfactory (to the sophisticated household).

- The lower power DC EPC we are looking for is has all the feature of EPCS, but runs on DC, as opposed to AC.
- This could be either 24V, 32V or 48V?
- We feel that 12V is not possible due to the very high current.
- 24V is a sweet spot in terms of existing solar home systems, but boosting it to 48V is not difficult nor expensive.
- 600W (500W to 700W) **DC** heating element (with a 6 litre pot)
- Internal wiring, connectors and sensors upgraded for higher current and DC power
- These appliances might be applicable to Solar Home Systems, DC mini grids and mitigation of weak AC grids by cooking from the battery – the appliance would be placed near the batteries and/or thicker wires might be needed from battery to appliance.

3.3 Other features that have arisen in user surveys

EPC that can cook open with a lock to stop the pot spinning

- Many EPCs do not have handles on the pot, and this makes holding it to stir hot food difficult. Some of the newer brands have now addressed this but tend to be the more expensive end of the range. Some recipes require the user to stir the food during the cooking process. EPCs are predicated on not having to stir the food. Are there modifications or adaptations that could be introduced that enabled the user to stir the food during the cooking process (in an EPC or in a pan with a lid). Are there more local solutions as additions to cheaper EPCs.
- More versatile rice cooker. Rice cookers can be used for much more than just rice. However, many are set up to switch off when the rice is cooked, and to use them for other recipes requires some adaptation of the device. Could there be an option to go to higher heat so it can fry.
- Enhanced insulation: The air gap in most rice cookers and EPCs is quite effective. However, the weakness of many devices is the lid and the insulation built into the lid. What could be done to enhance the overall heat retention of cooking appliances while still maintaining an acceptable cooking experience for the user (and not overheating the electronics).
- Robustness: The cooking environment in Africa can be quite harsh with higher environment temperatures, dust and rough handling by users. How can appliances be made more robust.
- Accessories:- Many people ask about a second pot. If a second pot can be supplied with a simple insulated holder, then after cooking one portion of the meal, the food can stay hot (or even carry on cooking) while a stew of something quicker is cooked in the EPC. Multiple pots can be useful for EPC – so can cook one dish and keep hot while cook another.
- Breadth of the weekly menu: A key challenge if your only cooking appliance is an EPC is to cook chapati or shallow fry an egg. Many EPCs have a sauté mode which keeps the heating element on when the lid is open - the problem then is not so much the heating element as the depth of the pan, that prevents lifting the final product without breaking it up. The introduction of the air fryer lid does address some of this but the depth of pan remains a challenge. Is there a shallow pan combined with the air fryer, or are there modifications that could address this?

4 One consideration that would help open up these markets

4.1 Enabling monitoring of usage

There are a number of reasons why it would be beneficial to be able to capture data about the usage of electric cooking devices. As said above, mitigation of the upfront cost of these systems will likely be done through pay-as-you-go schemes where people lease hire the appliance and own it at the end. In some cases,

mini grid and solar home system developers may want to charge a differential tariff and loan recovery depending on how the devices are used. They may also want to report to other bodies that have subsidized the roll out of the scheme – such as results based financing and carbon trading. While smart metering may catch the energy use of the household, it may be that a scheme such as RBF needs to know the carbon saved by a particular appliance which is substituting for more polluting fuels. To have an energy monitor built in to the appliance could be useful (but we also acknowledge its extra expense which not everyone would want – so perhaps it needs to be an optional add on?) There would need to be a set of protocols and data collection standards that agreed with relevant stakeholders and that could be shared with cooking device manufacturers so that they can incorporate these into data capture capabilities within their devices.