

Overcoming the “Affordability Challenge” associated with the transition to electric cooking

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Final version 2.1

January 2021

This material has been funded by UKAid from the UK government; however the views expressed do not necessarily reflect the UK government’s official policies.’

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1 Executive Summary

The MECS programme is leading a shift across much of the developing world from cooking with biomass to cooking with electricity or gas. Our mission is to enable all sectors of society to cook with electric cooking devices. This presents a challenge as eCooking devices are normally only afforded by the most wealthy. We need to creatively find ways to enable good quality devices to be affordable for as wide a range of households as possible. There are broadly 5 domains where solutions can be found.

Segmenting the potential markets in order to create well targeted market entry strategies: All countries contain a diverse range of households with different living conditions and levels of affluence – and developing countries are no different. Being able to differentiate the market segments that exist in order to target products, prices and marketing most effectively is critical. We have identified the main segments, and are identifying what types of eCooking solutions and strategic approach to reaching those segments will be needed for each. While the most affluent can generally be reached through conventional market engagement approaches and reliance on mainstream retail outlets (online and physical), those with less strong electricity connection and financial resources will inevitably need a different strategic approach. This is where there will need to be more work spent on exploring options and developing partnerships.

Promoting the value proposition effectively: Effectively communicating a compelling value proposition is critical in any market. Developing country markets can be less familiar to many global corporates and this makes it particularly essential to have partners within the country that have a deep understanding of the consumer group, what they value, who makes buying decisions, what media and social media platforms are most effective, etc. The MECS programme is carrying out detailed research into cooking cultures and practices. As a result, we are building a good understanding of the value of eCooking and electric pressure cookers (EPCs) in particular – and how users experience and express that value. The report provides two case studies showing how other technology categories have become successful in developing country markets despite them involving substantial cost - Mobile phones and televisions.

Selecting a business model/payment plan that suits the consumer finance context: There are many payment terms that can be powerful ways to increase their affordability in markets where many households have very limited disposable income or regular income, and few savings. Payment terms that spread the cost can be particularly powerful in the case of eCooking. Our studies have found that households that rely primarily on biomass for cooking may be able to cover their cost directly from savings made by not paying for charcoal, and paying for cooking devices in instalments. Where electricity is relatively expensive, the cost of the device, even up to around \$150, remains a relatively small proportion of the total cost of cooking. There are a range of business models that enable staged payment and many of these are widely used across the developing world.

Understanding and leveraging related financial investments within the markets: In order to offer these payment models, distributors and retailers (or financial institutions offering microfinance to consumers) will require working capital to finance the appliances. Financing instruments—including debt and equity finance, social impact investment, and results-based financing tied to environmental, gender equity, and/or health goals—will need to be combined to close the initial cost–viability gaps. There are substantial institutions within these markets that can provide invaluable financial support. In particular, the business success of utilities companies in countries where the demand for electricity is significantly lower than the generation capacity will often depend critically on raising that demand and, as a result, will be willing partners in promoting electric cooking. In addition, there are considerable sums being invested in efforts to secure a range of “public good” outcomes - from Greenhouse Gas emission reduction, to improved health, to economic growth and gender equality. Given that cooking with electricity can deliver many of these, there are many projects and funds that can be tapped into.

2 Introduction

The MECS programme is leading a shift across much of the developing world from cooking with biomass to cooking with electricity or gas. Partners include World Bank, UN, WHO and national governments along with major financial institutions.

Did you know that:

- 3 billion people cook with biomass and 4 million people die each year from the household air pollution it creates?
- Nearly 2 billion have electricity but do not cook with it.
- \$100 billion was spent on charcoal or other polluting fuels globally in 2012-13¹ (and in 2021 with rising prices, population growth and urbanisation, this has increased significantly) and in many cases cooking with electricity would actually save households money!

The MECS programme provides a wealth of support to help make electric cooking devices available across the developing world.

As well as needing to assess if their products offer a good fit with local cooking requirements, electric cooking device companies will be concerned to ensure they can return a profit from selling their products in these markets. There may be higher costs associated with logistics and import regulations for the different countries that could further erode profit margins unless carefully managed. It is critical, therefore, to understand the different approaches that can be used to sell into developing country markets at a unit price that is profitable.

The margin of profit that is sought by companies coming into these markets will vary and depend on the expected percentage of market penetration/sales that can be achieved. Based on figures such as those quoted above, we believe the potential markets to be extremely large indeed, but recognise that it will take time and concerted effort to unlock the latent demand our research is uncovering.

Within the MECS programme, there is a considerable focus on Electric Pressure Cookers (EPCs) because of the significant benefits they can deliver to a household, particularly in Sub-Saharan Africa². The safety features and additional complexity of these appliances mean they generally command a higher price, making it especially important to address the question of affordability. Many other cooking devices exist that can still meet households' needs, including rice cookers, electric or gas stoves, or LPG burners.

Based on our own research and case studies of related sectors, this report sets out a range of practical measures that can be used by companies considering market entry to meet their potential customers' needs for affordability.

3 Defining the challenge

The determination of what is a realistic price for which a product can be sold is a combination of a number of factors and relates strongly to the overall value proposition for the end consumer, as well as the wider market conditions. According to a recent market study³, vendors in the electric cooking sector compete intensely on price. The raw materials used in products like multicookers (steel, aluminium, and copper) are subject to considerable price volatility and account for over 55% of the production cost, which cannot be always

¹ <https://openknowledge.worldbank.org/bitstream/handle/10986/21878/96499.pdf>

² https://mecs.org.uk/wp-content/uploads/2020/02/eedal_EPC_paper-14-7-19-Final-002.pdf

³ <https://www.marketresearch.com/IMARC-v3797/Multi-Cooker-Global-Trends-Share-12352720/>

transferred to end-users.

The margins added at each stage are reported as:

- Manufacturers: add 15% to 20% to the total production costs.
- Distributors/Exporters: Distributors or exporters procure from the manufacturers and sells it to the retailers adding 18% to 22%.
- Retailers: The retailers add 25% to 30% to the price of the final product and sell it to the end-consumer.

One Small Domestic Appliance brand we have spoken to indicated that their EPCs have to be on the market for at least £100 to cover all their costs with the additional mark-ups.

Our own studies of electric cooking devices available within some of our target markets have identified a wide range of prices.

Table 1 Range of prices for EPCs found in online stores in 3 African countries in USD

	Cheapest models	Mid range models	Most expensive models
Kenya	From 63	78 - 166	Up to 352
Uganda	From 22	50 -143	Up to 223
Zambia	From 39	60 - 94	Up to 108

This demonstrates that there are products in these markets at very different price points, including a number that are definitely in the “premium” category. At this stage, we do not know which products achieve the highest sales, or how consumers factor in price within their buying decisions.

What remains clear is that our mission will not be achieved if only the most affluent are able to obtain and cook with electric cooking devices. We need to creatively find ways to enable good quality devices to be affordable for as wide a range of households as possible. The good news is that there are plenty of examples of technology categories that have become extremely successful, and reached well into the less affluent groups, in these markets despite them involving substantial cost. As part of the preparation for the MECS programme, the STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre at the University of Sussex carried out an analyses of the Lighting Africa programme, which successfully transformed access to solar lighting in Kenya⁴. Their study concluded that a multi-pronged approach is needed that looks at social, political, technical, economic and other drivers and barriers and has been hugely influential in shaping the MECS programme⁵. These all illustrate the assertion that transformational change is possible and new technologies can be successfully introduced to developing markets if a broad enough set of interventions can be delivered, with the right partners. Mobile phones and televisions are also good examples, with very different value propositions and transition pathways (see Case Studies – below). It would be informative to look into how the business models that enabled these to be realised evolved and the key tipping points that substantially opened up the markets. MECS will continue to explore these points as we go forward.

⁴ Ockwell, D., Byrne, R., Chengo, V., Onsongo, E., Fodio Todd, J. and Atela, J. (2019) *Transforming Access to Clean Technology: Learning from Lighting Africa*, STEPS Working Paper 110, Brighton: STEPS Centre

⁵ Batchelor, S.; Brown, E.; Scott, N.; Leary, J. Two Birds, One Stone—Reframing Cooking Energy Policies in Africa and Asia. *Energies* **2019**, *12*, 1591

Case study: Mobile Phones in Africa

The Scandinavians were first to market with mobile phones in the early 1980s, quickly followed by other high income nations. By 2000, mobile phone markets were established in most sub-Saharan countries, albeit at low penetration levels. At that time, mobile phones were regarded as a luxury item largely aimed at the business market and regarded as irrelevant to developing countries. However, early research in Africa found that up to 80% of households made some kind of regular use of mobile phones. Initially they weren't able to afford a phone, but they were able to borrow phone or pay at the growing number of street kiosks. The market was established, and those in the business could see the value that mobile communications offered the masses. In places with no land line infrastructure and low mobility (poor roads, dangerous public transport, seasonal flooding), the advent of mobile communications transformed business and social life. Foreign companies competed for licences and continue to battle for market share.

African companies took the technology and innovated for local markets. The best example is mobile money. This had been tried in Europe and failed since it was competing with other financial instruments such as credit cards. However, Africa provided a different set of consumers, one that had no access to the formal banking sector. MPesa was launched in Kenya in 2007, and a number of other services launched throughout the world. By 2013, over 2 trillion KSH went through the Kenya platform, nearly 50% of the country's GDP, and by 2015 over \$1 Billion a day was passing through all the mobile money systems. Mobile money offerings are available in 90 countries, serving nearly 900m accounts⁶.

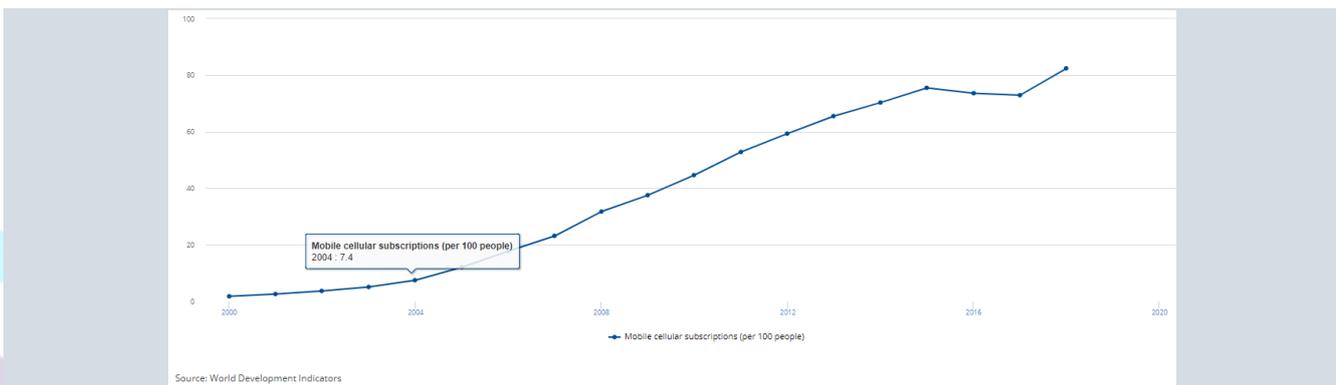


Figure 1 Growth in mobile use in sub-Saharan Africa (subscriptions per 100 people)⁷

Case study: Mobile phone revolution in India

India has emerged as the world's second-largest telecom market by subscribers and remains among the fastest growing in the world. Barring basic commodities, no other product or service has a base of a billion consumers. Distribution and service infrastructure is highly evolved, with instant activation of new connections, neighborhood availability of wide variety of mobiles and mobile connections and tariff plans.

Indians are spending significant sums to purchase and use mobile phones. The price of an average featured phone is 1000 INR (\$13.70), while the latest smartphone can cost up to INR 1-1.30Lakhs (\$1370 - \$1781) in India. India's Telecommunication Service stated that Average Revenue Per User (Mobile) for GSM: Prepaid: All India data was INR 84 (\$ 1.15)/Month in Jun 2020.

⁶ <https://www.gsma.com/r/wp-content/uploads/2019/05/GSMA-State-of-the-Industry-Report-on-Mobile-Money-2018-1.pdf>

⁷ https://databank.worldbank.org/reports.aspx?id=5494af8e&Report_Name=Mobile-penetration

Mobile phones have changed from being seen as a luxury gadget for the rich to become a ‘must-have’ device for all people. The gradual drop in voice calling rates and handset cost have accelerated mobile adoption across most sections of the society. Today, consumers enjoy free phone calls, which used to cost INR18 (\$ 0.25) per minute 25 years ago⁸. **As a result, the number of smartphones owned in India has escalated, with 4G capable devices jumping from 47m in 2015 to 501m by 2019, and in metropolitan areas industry data suggests 84% penetration of 3G capable devices**⁹

For women in developing nations, owning a mobile phone can empower in many ways. In India women in rural areas can use mobile phones to open a mobile phone-based bank account, and even to open a business, without having to trek to a distant city to register that business.

In all of this, the most notable feature is that the government has merely been a facilitator.. In India there is no dearth of entrepreneurial spirit and the willingness to take risks. Private sector has time and again proven its capability to introduce innovative products and business models. What is needed is a supportive environment¹⁰.

Case study: Televisions

The number of households in sub-Saharan Africa with a TV is expected to rise from 42 m in 2010 to 75 m in 2021.¹¹ But these figures only tell half the story. Africans consume their telly over a wide range of devices, notably mobiles phones, so TV sales alone miss the increasing value of the wider television industry. African companies have innovated to provide television, as an entertainment service, using different technology and in different ways that meet African lifestyles. This includes satellite TV, internet TV (IPTV), and cable TV, in addition to terrestrial TV. Companies have innovated with business models and bundles to enable customers to pay for TV. DStv and StartSat, two of the largest pay TV companies on the continent, have 16m and 9m customers across Africa respectively (2019¹²). The sub-Saharan television and video market is estimated to reach 10 bn EUR by 2023¹³; pay TV revenue alone is estimated at 6 bn USD¹⁴.

Given these experiences and the current context, there are five domains where solutions could be found:

- Segmenting the potential markets in order to create well targeted market entry strategies
- Promoting the value proposition effectively
- Selecting a business model/payment plan that suits the consumer finance context
- Understanding and leveraging related financial investments within the markets
- Leveraging bulk purchase to make smaller margins viable

⁸ <https://www.thehindu.com/sci-tech/technology/indias-mobile-revolution-turns-25-tracking-the-high-and-low-points/article32916145.ece>

⁹ https://cdn.coai.com/sites/default/files/Annual%20Report_2019-20_0.pdf

¹⁰ <https://hbr.org/2008/05/indias-mobile-revolution>

¹¹ <https://www.statista.com/statistics/287739/number-of-tv-households-in-sub-saharan-africa/>

¹² <https://medium.com/techloy/the-biggest-pay-tv-operators-in-africa-by-subscribers-75898fb2541e>

¹³ <https://www.eutelsat.com/en/blog/6-TV-viewing-trends-in-sub-saharan-africa.html>

¹⁴ <https://www.ubongo.org/the-future-of-television-in-sub-saharan-africa-in-5-statistics/>

4 Segmenting the markets

All countries contain a diverse range of households with different living conditions and levels of affluence – and developing countries are no different. Being able to differentiate the market segments that exist in order to target products, prices and marketing most effectively is critical.

Our report entitled “Electric Cooking Devices for Developing World Households: Product Enhancement or Adjustment Opportunities”¹⁵ makes a start at this. In summary, this identifies the following segments, and suggests what types of eCooking solutions and strategic approach to reaching those segments will be needed for each.

Table 2 Market Segments

The market segment	Description
1) Connected and busy	Reasonable connection to the grid and disposable income that is spent on household items.
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.
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.
3) Weakly connected pioneer	Connected to a weak grid and does not have much disposable income. They are willing to change but lack resources.
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.
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.

As education and quality of life improves and economies grow within developing countries, there are large numbers of people across the developing world that have a high level of affluence and education (see, for example, Finding the Dynamic African Consumer, Fraym 2018¹⁶). Fraym defines a Consumer Class as the group with highest levels of asset ownership and education. Consumer-facing companies typically view this segment as those who can purchase ‘premium’ products. This would be similar to our Connected and Busy segment, above.

Table 3: The total populations and Consumer Class, where Fraym reports this) in MECS target countries.

	Total population	Size of Consumer Class (%age of total population)
Cameroon	24,6m	4,9m (20%)
Cambodia	16m	
Ethiopia	106m	10,5m (10%)
Gambia, The	2,2m	
Ghana	29m	8,4m (29%)
Kenya	50,2m	8,7m (17%)

¹⁵ <https://mecs.org.uk/wp-content/uploads/2020/10/MECS-report-market-segments.pdf>

¹⁶ https://fraym.io/wp-content/uploads/2019/03/Finding-the-Dynamic-African-Consumer_Fraym.pdf

Malawi	17,6m	
Myanmar	53,3m	
Nepal	27,6m	
Nigeria	190,8m	52m (27%)
Rwanda	12m	
Tanzania	55m	8,3m (15%)
Uganda	41,2m	3,2m (8%)
Zambia	16,9m	3,3m (20%)

These Consumer Class households primarily live in parts of urban centres that have the most robust electricity supply – which can be comparable that of to Western households. As such, they represent potential customers for products currently for sale in North America, Europe, etc.. They will also increasingly be dual income households with parents looking for convenient, efficient, time saving ways to provide meals.

While the Connected and Busy can generally be reached through conventional market engagement approaches and reliance on mainstream retail outlets (online and physical), those with less strong electricity connections and financial resources will inevitably need a different strategic approach. This is where there will need to be more work spent on exploring options and developing partnerships.

We intend to continue to develop these analysis of market segments as this will clearly be of considerable value for companies looking to establish where there are the most promising opportunities and prospects of taking a sizable share of the markets.

5 Promoting the value proposition

5.1 Identifying the value proposition

The MECS programme is carrying out detailed research into cooking cultures and practices. As a result, we are building a good understanding of the value of eCooking and electric pressure cookers (EPCs) in particular – and how users experience and express that value. Much of what we have learnt from studies in Kenya and Tanzania is captured or reflected in our eCookbooks¹⁷.

The cooking diaries studies monitored what and how people cook, both their traditional practice and after they were asked to transition to cooking with electric appliances. The methodology and findings are summarised in Batchelor et al. (2019)¹⁸. Figures 2 and 3 provide some insights relating to consumer preferences that were gained from user interviews.



Figure 2: Responses to the question from 20 trial households in Kenya : “Do you miss the smokey flavour of food? If so, for which dishes in particular?”. Words sized according to the number of responses.

¹⁷ <https://mecs.org.uk/ecookbook/>

¹⁸ <https://mecs.org.uk/download-category/confproc/>

clean (environmentally)
clean (kitchen)
fast/saves time
cheaper
efficient
multi-tasking

Figure 3: Responses to the question from 20 trial households in Kenya: “What were the best/worst things about cooking with electricity?”

In addition, we have carried out Discrete Choice Modelling studies in a number of markets to understand the basis on which consumers make choices relating to cooking¹⁹. This is an econometric approach that enables us to assign value to different characteristics of a product by analysing the hypothetical choices made by respondents. We have published an introduction to this approach and reports on the findings in different countries. The approach explored the relative importance to consumers of different design factors in an imaginary cooking device. Choice models were set up using choice cards, based on the key characteristics identified, each of which has a limited number of ‘levels’. In the MECS surveys, characteristics were divided into three domains, each of which was assigned five or six parameters, each parameter having between 2 and 4 levels (see Table 4). Each design domain also included a cost parameter (not represented in the table).

Table 4: The factors and options explored in the Discrete Choice Modelling studies.

Parameter	No. levels	Level 1	Level 2	Level 3	Level 4
Cooking processes					
Type of cooking	2	Boil only	Boil & fry		
Power (speed of cooking)	3	slow	normal	Fast	
Flavour	2	Smokey flavour	No smokey flavour		
Use of lid	3	No lid	Pot with lid	Sealed pot	
Number of hobs	3	Single hob	2 hobs	4 hobs	
Stove					
Capacity (people)	3	Cooks for 4 people	Cooks for 6 people	Cooks for 8 people	
Capacity (devices)	3	always need to use with another stove	sometimes need to use with another stove	you can do all your cooking on it	
smoke emissions	3	No smoke	gives same smoke as charcoal fire	gives same smoke as wood fire	
Portability	2	cannot be moved (too heavy)	can be carried in/out of the house		
looks	2	Looks plain	Looks good		
Functionality					
Devices	4	2 hobs	2 hobs + 3 LED lights	2 hobs + charge mobile phone	2 hobs + television
Availability	2	only works on sunny days	works on sunny and rainy days		
Financing	3	pay each month (utility)	lease over 6 years	lease over 3 years	
Cleaning	2	awkward to clean	Easy to clean		

¹⁹ <https://meecs.org.uk/download-category/working/page/3/>

The studies found that preferences are country specific, but there are some trends; overall, consumers preferences are for:

- a device that can both boil and fry
- a device with a lid, but not a sealed pot
- multiple hobs, with a slight preference for 2 hobs
- a device that does not make food taste smokey.

This study highlights those product features that will appeal to consumers, and can be emphasised as part of the value proposition.

5.2 Communicating the value proposition

Effectively communicating a compelling value proposition is critical in any market. Developing country markets can be less familiar to many global corporates and this makes it particularly essential to have partners within the country that have a deep understanding of the consumer group, what they value, who makes buying decisions, what media and social media platforms are most effective, etc. A report by CLASP on the off-grid consumer appliance market²⁰ contains some useful insights in this regard.

When considering the market segments referred to previously, the decision about where to start can be key, as how messages flow around the market through word of mouth, etc. can be an extremely powerful additional source of influence. Identifying groups or key individuals that are influential - so that what they buy and/or recommend becomes highly visible - can drive considerable interest and buzz.

The MECS programme is working with a number of partners in our target markets to promote eCooking as a concept and EPCs in particular. This is intended to generate growing interest and awareness of the benefits of cooking with electricity and create demand. We are happy to share our experiences of what approaches seem most effective and the social influencers and others we are partnering with.

The MECS-funded Global LEAP Awards competition for EPCs is also intended to create confidence amongst major players, investors, etc. as well as consumers regarding the energy efficiency and safety of the devices that are successful. The Buyers Guide that results from this should become a key resource within the market.

Western brands have the opportunity to differentiate themselves from existing players in the market through an emphasis on quality, safety, design, brand associations and social status. One area where consumers may have concerns is around post-purchase support, access to spare parts, etc. - it will be important to have an in-country partner who can work closely with you to address those needs.

6 Business models that spread the cost

There are many payment terms that can be powerful ways to increase product affordability in markets where many households have very limited disposable income or regular income, and few savings. Payment terms that spread the cost can be particularly powerful in the case of eCooking, because, in the long run, many households will make substantial savings by reducing/stopping their expenditure on charcoal or other fuels.

We have carried out a major piece of work to look at the scenarios where modern energy cooking is economically viable, based on the cost of charcoal, etc in different contexts. This work has started to set out the conditions that will be optimal for driving the transition to eCooking (ESMAP, 2020²¹). We have built on

²⁰ <https://storage.googleapis.com/e4a-website-assets/CLASP-MarketSurvey-2020-final.pdf>

²¹ <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/920661600750772102/cooking-with-electricity-a-cost-perspective-review-and-roadmap>

the modelling work to explore how differences in cooking device cost impact on the overall economic arguments.

ESMAP (2020) results are mostly expressed as the range of cooking costs that result from the ranges assumed for the possible value of many different parameters in the model. For the present paper, to focus on the significance of appliance costs, central values are used rather than ranges for the other parameters, and so single results are produced for the cost of eCooking or for cooking on traditional fuels, for each context. Key parameter values and assumptions for the present analysis include:

- Electricity tariff of USD 0.17/kWh, reflecting the lifeline tariff for the first 100kWh used per month (within which the assessed level of cooking would comfortably fit)
- Traditional fuel prices in 2020 of 0.52 USD/kg for charcoal, 1.15 USD/kg for LPG and 1.25 USD/litre for Kerosene
- 100% of the daily cooking undertaken using each of the fuel options: charcoal, kerosene, LPG or electric; ie no fuel stacking undertaken
- For electric cooking, 50% of the food is cooked on a hotplate and 50% using an EPC. This results in a total cooking load of 1.92kWh/day
- ESMAP (2020) included a range of business models, reflected in the assumed time horizon over which capital investments are repaid. For the present analysis all costs are spread over 5 years
- Cooking appliances are assumed to have a lifetime of 5 years (conservative)
- Costs are discounted (and levelised) using a real rate of 10% (this excludes inflation, and thus in Kenya where inflation is around 5%, this is equivalent to a nominal discount rate of 15%)

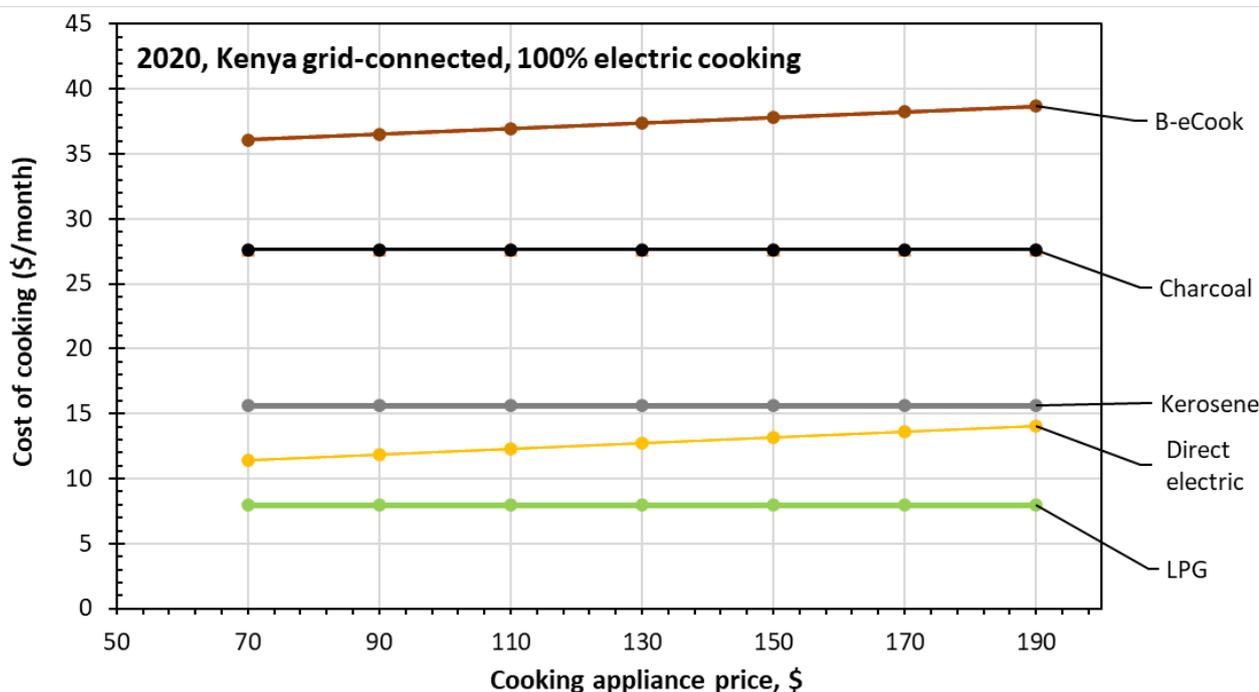


Figure 4. Sensitivity to appliance price (B-eCook is the use of an appliance in an off-grid solar PV system with Battery)

The scenarios used were built on the assumed single price for the cooking device and were not intended to provide a basis for helping eCooking companies to identify what price point might be viable and, from that, test whether they can generate profit from alternative models. For the present report, however, the focus is on the sensitivity of the overall cost of electric cooking to the assumptions made about the cost of the cooking

appliances used. The initial analysis simply varies the total cost of electric cooking appliances (hotplate plus EPC) from USD 70 to USD 190. If the hotplate is assumed to cost USD20, this is equivalent to varying the EPC cost from USD 50 (£40) to USD 170 (£130).

Figure 4 shows the levelised monthly costs of the different options for meeting household cooking requirements, for the range of cooking appliance cost assumptions. The electric cooking options considered are direct connection of the appliances to the grid and cooking with a Lithium ion battery charged from the grid (for situations where the grid is unreliable or the household electricity connection cannot handle the full power draw of the hotplate or EPC). The shallow slope of the lines for the two electric cooking options shows that the results are relatively insensitive to the cost of the electric appliances. Grid-connected electric cooking remains cheaper than either charcoal or kerosene throughout.

Figure 5 shows the composition of the overall monthly cooking costs, highlighting the relatively small share taken by appliances, for the assumption that appliances cost USD 70. Since appliances are assumed to last for 5 years, no costs for their replacement are needed, as the time horizon for financing in the analysis is also 5 years.

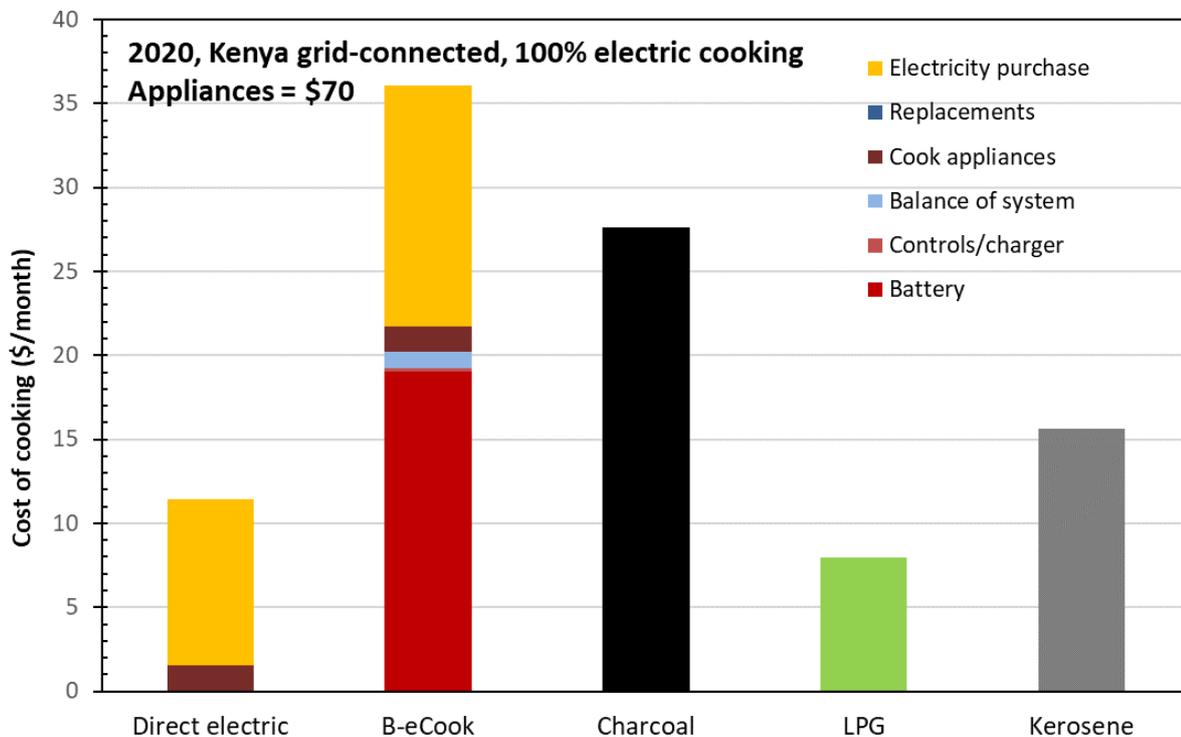


Figure 5. Composition of system costs, for appliance cost of \$70

Figure 6 shows the same results but this time including the full range of appliance cost assumptions. For the direct grid cooking, appliances represent from 13% to 29% of the total monthly cooking cost, and for battery-supported cooking, from 4% to 11%.

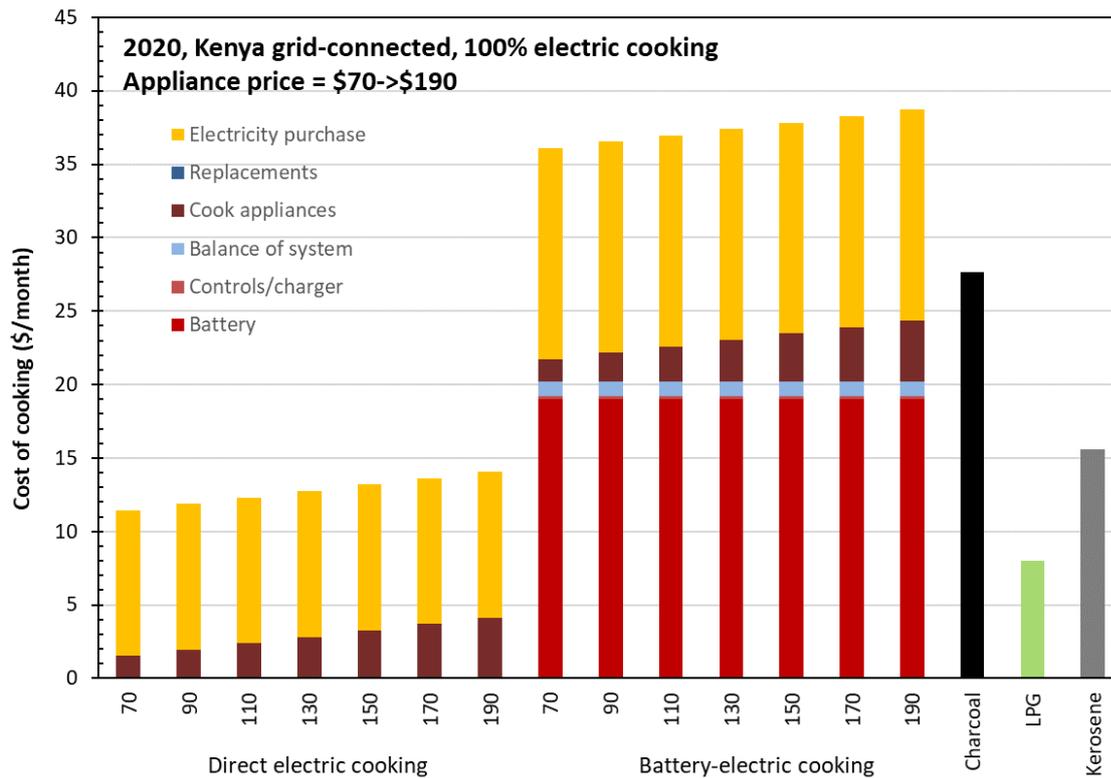


Figure 6. Composition of system costs, for range of appliance costs

It is important to note that these results represent just one set of assumptions, for one context. In other countries LPG may be relatively much more expensive, and/or electricity tariffs much lower. ESMAP(2020) sets out these ranges and identifies where electricity cooking will be most competitive.

In conclusion, it would seem that:

- If households can pay for cooking devices in instalments, they may be able to cover their cost directly from savings made by not paying for charcoal
- Where electricity is relatively expensive, the cost of the device, even up to around \$150, remains a relatively small proportion of the total cost of cooking
- Where electricity is cheap, the overall economic argument is stronger but the device cost makes a larger contribution to the outlay
- Where a battery or other kit is required in addition to the cooking device, the cost of these is a much bigger element and cooking device costs are inconsequential.

There are a range of business models that enable staged payment and many of these are widely used across the developing world. Yet again, local partners will be best placed to help establish the most suitable model to reflect the culture, financial conditions and value proposition.

- Pay-as-you-go for lease- to-own solutions and on-bill financing for energy service models.
- Leasing
- Paying for services rather than a product
- Pay for the product as part of electricity payments (on-bill financing)
- Microfinance loans
- Salary sacrifice schemes for employees (can include paying before tax)

Pay-as-you-go systems rely on a “lock-out” mechanism to prevent the device from functioning if the user does not keep up with regular repayments. This can be done cost-effectively using mobile phone technology.

Microfinance lending has been well established in developing countries as an alternative to bank loans requiring capital assets and have developed innovative risk management. The most famous risk managing model is the ‘group lending’, where members of a group take joint responsibility for repayments.

We have published a number of reports from Challenge Fund projects that explored different business models for opening up access to clean cooking. Appendix 1 has relevant extracts from these. The studies focus on very different aspects of market dynamics that can be critical to successful development of businesses that meet the needs that exist. The overall message from these is that spending time to develop a good understanding of those dynamics and the factors that underpin them is critical – and we hope that our studies shed light on these and can provide some acceleration of the planning of market entry strategies.

Case Study: Microfinance Institutions in India

Microfinance (or microcredit) is a service provided to unemployed or low-income individuals or groups who otherwise would have no other access to financial services²². Microloans can range from as small as \$100 (INR 7,500) to as large as \$25,000 (INR 18.25 Lakhs).

India is the largest microfinance market in the world, with the sector growing at an average rate of over 50 per cent per year. Consequently, it is attracting domestic and foreign investors and new players, who are hoping to practice profitable philanthropy. Close to two decades after its emergence in India, microfinance has matured from being a pure development activity to also being an economic driver at the grassroots level. Thus, even the largest selling mobile phone maker, Nokia, is looking at micro-finance as a major initiative to further increase mobile penetration in India. Increasingly, microfinance is perceived as an effective channel for ensuring financial inclusion of the low-income population and those in the informal sector²³.

Microfinance Institutions (MFIs) first emerged in the late 1990s to raise social and commercial funds for lending to the underprivileged. Today there are over a thousand Indian MFIs, most of which service the rural poor. Several MFIs have also discovered the potential in lending to the urban poor. Banks find it difficult to lend to MFIs in the absence of sufficient collateral. Hence, several MFIs like Biswa, Grameen Kuta in Bangalore and Bandhan in West Bengal have transformed themselves into non-banking finance companies (NBFCs) to widen their capital base.

Microfinance is a unique economic development tool that was introduced with an objective to assist those on low-incomes who aim to work their way out of poverty. India today has a major focus on financial inclusivity and microfinance plays a central role given that it provides a way to extend financial services to the unbanked and underbanked sections of the Indian population. In addition to providing microcredit, MFIs help the poor with allied financial services like savings, insurance, remittance and non-financial services like individual counseling, training, and support to start their own business in accessible ways. What works in favour of borrowers is that all these services can be availed right at their doorstep, and borrowers are at liberty to choose their own repayment schedule²⁴.

²² <https://www.investopedia.com/terms/m/microfinance.asp>

²³ https://www.ibef.org/download/finance_260908.pdf

²⁴ <https://finezza.in/blog/micro-finance-india-how-evolved-over-years/>

7 Leveraging other investments to reduce upfront costs

As the previous section noted, end-users will require options to break down the high upfront cost of eCooking devices into affordable installments or reframe them as eCooking services, where the provider retains ownership of the assets and rents them to the user. Distributors and retailers will require working capital to finance the appliances and roll out supporting services over longer repayment periods. Financing instruments—including debt and equity finance, social impact investment, and results-based financing tied to environmental, gender equity, and/or health goals—will need to be combined to close the initial cost–viability gaps.

While individual consumers/households may have limited financial resources, there are substantial institutions within these markets that can provide invaluable financial support. Understanding these options can provide transformational opportunities to reduce the cost barrier to the user.

A “single investment strategy” that incorporates clean cooking into electrification and renewable energy investments could enable the existing mechanisms for mobilizing finance from the electricity sector to address the problem of cooking with polluting fuels and technologies. These include long-term loans, guarantees, and project bonds, which can offer the clean cooking sector an opportunity to leverage much larger investments. Such a strategy could synergistically position eCooking as an opportunity to improve delivery infrastructure and stimulate demand.

In broad terms, the following specific areas are worth exploring.

7.1 The role of utilities

Utilities (both national grid companies and minigrid operators) that have invested in generation and distribution infrastructure and need to generate income from selling electricity - for them, the potential benefit of their customers cooking with electricity is very substantial, as this redirects expenditure on biomass fuels, for example, to expenditure on electricity, and can increase the utilisation of the generation and distribution assets.

Many countries have invested considerable sums in building the infrastructure to deliver electricity to households and communities, and set up businesses responsible for the generation and distribution of electricity. Where there is only a relatively short history of electricity use, the patterns of consumption that create substantial loads on the grids are not widely adopted and this can jeopardise the viability of these businesses. While we know that consumers are looking for energy efficient cooking devices that will save them money, the total load created by a whole community cooking with electricity can be substantial and this represents a very attractive proposition for the utility companies as well as the Governments that need them to be profitable so as to maintain their economic growth and enable the repayment of loans associated with the original investments.

For this reason, these utility companies can be key allies in promoting the benefits of eCooking (see the blog from Kenya Light and Power Company on how they are promoting electric cooking²⁵), and stimulating demand by developing an on-bill financing mechanism for EPCs. They can further support women entrepreneurs to leverage their social networks to demonstrate new cooking technologies and practices. On-bill financing allows installments to be repaid automatically when topping up electricity units on prepaid meters or adding to the monthly bill on post-paid meters.

²⁵ <https://mecs.org.uk/ecps-in-kenya-a-huge-almost-completely-untapped-opportunity/>

7.2 Harnessing the finance associated with wider benefits eCooking can deliver

There are considerable sums being invested in efforts to secure a range of “public good” outcomes - from Greenhouse Gas emission reduction, to improved health, to economic growth and gender equality. Given that cooking with electricity can deliver many of these, there are many projects and funds that can be tapped into. This is best expanded on with two Case studies – Results Based Financing and the more specific area of Carbon Credits.

Case study: Results Based Financing

Results-Based Financing (RBF) is a mechanism whereby a donor or an agency disburses funds to a recipient contingent upon achieving a pre-agreed set of results²⁶. Three key principles underlying this approach are; 1) payment is tied to achieved results, 2) recipients have free choice on how to attain agreed upon results, and 3) the trigger for fund disbursement is independent verification of results²⁷. In recent years, RBF has begun to gain significance as an innovative market development tool, especially in mitigating market entry and growth barriers that hinder access to clean energy services. However, the results and levels of success vary between implementers, technologies, business models and market dynamics.

Distributors who are uncertain of their go-to-market strategy and the potential for product uptake may be wary of placing bulk orders for new technologies. This leads to low-volume and unsteady purchasing, which results in high overhead and manufacturing cost for suppliers. By helping to mitigate real and perceived financial risk, RBF procurement incentives help catalyze large-scale product procurement. These volumes help distributors in launching and scaling new product lines on a faster timeline than under normal market circumstances. Furthermore, bulk procurement helps suppliers achieve economies of scale and bring down production costs.

Results based approaches in a development context vary in forms and across institutions, agencies and scholars²⁸. If designed and implemented appropriately under the right market conditions, RBF models can be an effective tool for developing sustainable and inclusive energy markets. National RBF programmes are often implemented by governments and/or utilities within a single country. They focus on “downstream” interventions aimed at overcoming the affordability barrier experienced by end-users. Government-run RBF Monitoring and Evaluation processes tend to focus on sales verification and financial disbursements as the measure of impact.

In nascent product markets, these gains are at risk of ineffectiveness if availability and access to quality products is still a problem. CLASP’s Global LEAP Results Based Financing incentive mechanism (Global LEAP+RBF) addresses this by providing an upstream intervention aimed at propelling wholesale markets and large-scale procurement of off- and weak grid²⁹ appliances. It couples the [Global LEAP Awards](#) – an international competition that identifies and promotes the world’s best, most energy efficient off-grid

²⁶ Weber, E. et al. [Results-based Financing for Energy Access](#) How to design and implement projects: Lessons from the field. 2018

²⁷ Weber, E. et al. [Results-based Financing for Energy Access](#) How to design and implement projects: Lessons from the field. 2018

²⁸ Grittner, A.M. [Results-based Financing: Evidence from performance-based financing in the health sector](#). 2013

²⁹ The ‘weak-grid’ market, also sometimes labelled as ‘under-electrified’, refers to households and businesses, which have sporadic, low-quality grid connectivity, typically only a few hours daily with a high degree of intermittency (i.e., frequent and unpredictable power outages).

appliances – with results-based financing (RBF) procurement incentives for manufacturers and solar distributors that partner to distribute large quantities of Global LEAP Awards quality verified products.

CLASP has managed three increasingly successful rounds of Global LEAP+RBF to date. Since its inception in Bangladesh in 2016, this initiative has catalyzed the procurement of over 270,000 best-in-class off-grid TVs, fans, solar water pumps, and refrigerators across Bangladesh, Kenya, Rwanda, Tanzania, Uganda, Senegal, and Zambia. To put this number into context, the 2020 GOGLA Off- Grid Solar Market Trends report³⁰ notes that while there has been growth seen in the sector since 2010, pico products account for around 83% of sales. It further reports that Affiliate³¹ companies sold fewer than 10,000 Refrigerators and similarly for solar water pumps between the first half of 2018 and second half of 2019. For the same period, around 300,000 televisions and over 700,000 fans sales were reported with the lion's share of television sales happening in East Africa and for fans in South Asia.

CLASP is currently administering the fourth round of Global LEAP+RBF, with an expanded product focus to include electric pressure cookers (EPCs). The EPC RBF pilot is taking place in Kenya and will support the procurement of an estimated 5000 EPCs.

From CLASP's model of success, upstream interventions are found to be particularly beneficial in developing nascent product markets as they focus on product development, quality and other factors necessary to build inventory and grow the market³².

Case study: Carbon Credits

Contrary to popular understanding, households in the developing world have non-negligible carbon emissions from domestic energy use for heating and cooking. The reason is that their main fuel source is typically non-renewable biomass and fossil fuels. Greenhouse gases as well as other atmospheric pollutants are emitted due to the inefficient combustion that occurs while cooking over open fires or with basic stoves, and fewer greenhouse gas and black carbon emissions can be achieved when improved and modern stoves reducing fuel use are distributed.

When measurements are taken of fuel use in a traditional scenario and again with a new stove, the resulting emission reductions can be calculated and validated by an independent carbon certification standard. There are a number of different standards under which carbon credits corresponding to such emission reductions may be developed. However, the Clean Development Mechanism (CDM) managed by the United Nations Framework Convention on Climate Change (UNFCCC), as well as Gold Standard for Global Goals and its focus on the impact of projects with respect to the UN Global Goals, are typically preferred by improved cooking solutions project developers. Both require a comprehensive accreditation process, which includes community consultation, data monitoring and third-party review, and the issuance of carbon credits allows projects to generate extra revenue to support project activities such as manufacturing, marketing, lending, etc.

For instance, in areas where there is no mass market for improved stoves due to the low income of most of the population and their customary use of low-cost stoves, carbon revenues are often used to finance aspirational marketing, community demonstrations and sales campaigns. In other cases, funds generated by

³⁰ https://www.lightingglobal.org/wp-content/uploads/2020/02/14005VIV_OFF-GRID-SOLAR-REPORT-V13-Exec-Sum-AW4vis.pdf

³¹ Affiliate products are sold by companies that are connected to any of the partner organizations involved in the semiannual GOGLA sales data reporting process, including GOGLA members, companies selling products that meet Lighting Global Quality Standards, and appliance companies that participated in the Global LEAP Awards or are engaging with the Low Energy Inclusive Appliances (LEIA) program.

³² Weber, E. et al. [Results-based Financing for Energy Access](#) How to design and implement projects: Lessons from the field. 2018

the sales of carbon credits to voluntary buyers for corporate offsetting purposes are being used to expand manufacturing facilities to increase production levels and invest in Research & Development to further improve the quality of the stoves and ensure the needs of the end users are fulfilled.

Owing to local circumstances and the type of improved cooking solution on offer, emission reductions per unit can vary between 1 to 4tCO₂e per annum. Therefore, a carbon market price of \$5/tCO₂e can subsidise a non-negligible portion of the total unit cost. Yet, the current procedures to monitor and issue carbon credits are complex and present a barrier to entry, particularly for smaller project developers. As such, the advent of very detailed and wide-ranging surveys on cooking practices which can be used to determine the baseline, coupled with advances in measurement of fuel used in the project scenario for metered cooking solutions, allow for a much more efficient process for calculating the emissions reductions which should reduce the financial burden on projects seeking carbon finance.

8 Conclusions and next steps

The aim of this report is to help companies considering the feasibility of taking their cooking appliances into developing country markets to understand the range of options open to them that could bridge the “affordability gap”. We hope that you will see that, with the right approach, there are many ways to approach the challenge.

Depending on the market, there will be specific initiatives or potential partnerships that could enable the specific opportunities to be identified and built into your business case and market entry plan. In the first instance, review the other briefing reports on the MECS website³³ to start to build your understanding of the countries we are supporting and the market segments. Figure 7 suggests the iterative nature of the process required.

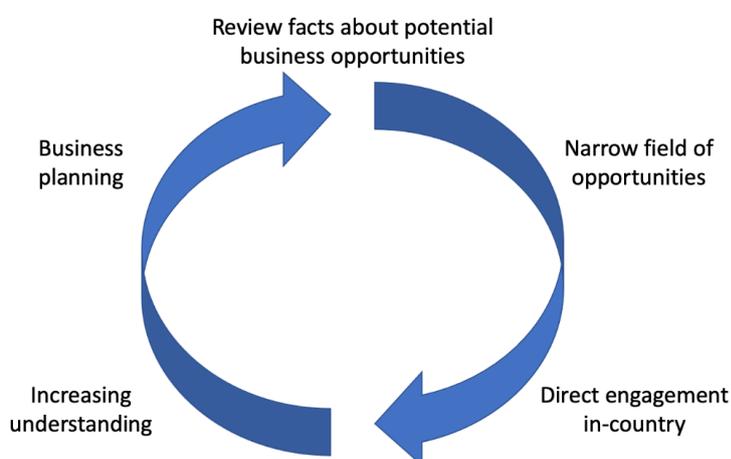


Figure 7: Iterative cycle required to build an effective business plan for a new market.

If you want to discuss any of this, contact Dr Nick Rousseau (n.rousseau@lboro.ac.uk) to discuss and he can introduce you to those leading on engaging with specific countries of interest and to our in-country partners, local distributors, etc.

³³ <https://mecs.org.uk/download-category/device-briefings/>

Appendix 1: Extracts from MECS-funded research into business models for modern energy cooking³⁴

Women-to-women distribution model to increase adoption of clean cooking methods by low income women in rural Kenya

The aim of the project is to develop further and strengthen the role of women leaders, who are clients that represent groups of clients in the Bidhaa Sasa model, to accelerate the adoption of clean cooking devices such as cleaner stoves, LPG, accessories and EPCs by low income rural women in Kenya building on Bidhaa Sasa's existing footprint and resources.

The project has helped to increase Bidhaa Sasa's understanding of leaders' motivations and aspirations through a series of face-to-face interviews with leaders and clients (who are not leaders). In addition, the project has tested three human-centred designed training methods targeting leaders at different stages of their journey as a leader, and lastly the project has also tested the potential demand of EPCs by rural clients of Bidhaa Sasa in two hubs.

With this project we have confirmed that **effective marketing from leaders must involve physical demonstrations of the new goods at people's homes**. We noticed an emergent trend by leaders to **use social media to create interest** in the new technology.

The second learning of this project is the **confirmation that there is demand for new cooking technologies such as electric pressure cookers** which could be added to our product range.

The bottleneck we faced is not the demand from end users (provided there are added value services such as credit, education, post-sale services and parts). **The bottleneck is the lack of reliable importers/wholesalers in the country.**

Another problem which is often ignored is the **access to spare parts**. Although electronic and electrical products usually come with a one-year warranty, the main and most likely reason end users will stop using their new product is their inability to fix it when the breakage is not covered by the warranty. The pot and its coating are the weak points of the EPC that have been already identified by our clients when testing it. In rural areas most cooking accessories are made from aluminium and they are cleaned with abrasive tools and detergents. The realistic business assumption is that the non-stick coating won't last very long even if the end users are educated (by us) and therefore additional inner pots will be fundamental for the continuous use of the device.

³⁴ Full reports can be found [here](#)

Customizing Malawi-made solar electric cooking technology and business models to provide access to very low income villagers

In this project, we explore and evaluate a path for making off-grid solar electric cooking (OGSEC) affordable and accessible for some of the lowest income households in rural Malawi.

We design our approach to low-income solar electric cooking access with the observation that access to OGSEC may be less expensive and more flexible if the OGSEC infrastructure and equipment can be **purchased as an initially small modular system with components that can incrementally increase in capacity over a period of several months or years with new purchases**. By allowing rural subsistence farming households to purchase components of an OGSEC system incrementally after harvest when cash from selling the crop harvest is available, we avoid the financing and monitoring costs of pay-as-you-go business models. Incremental purchases also enable customers to make payments when money is available without the burden or obligation of regular monthly or weekly payments that are the hallmark of the pay-as-you-go business model.

We call our new business model "pay-as-you-grow" or PayGrow for short, because customers make incremental payments as they incrementally grow their solar electric cooking system infrastructure over a period of years.

A key requirement of implementing the PayGrow business model is the ability to introduce an initial, entry-level solar system and service that can contribute to household cooking energy requirements yet be inexpensive enough to be affordable for a very low income subsistence farmer household to purchase up-front. This initial system is an entry-level OGSEC system that can then be expanded over the years with additional purchases of solar panels and larger, higher-power solar cookers over time. In this project, the entry-level system has a solar panel capacity of 150 peak watts (Wp).

In order to create this initial entry-level OGSEC system, Kachione, LLC. designed and began the pilot production of a 150Wp solar home system with insulated solar electric cooker (i.e. SHSw/ISEC) that it began distributing in May/June 2019. Given the findings and experience gained from this project, Kachione, LLC plans on further developing affordable off-grid solar electric cooking access throughout rural Malawi and beyond through the following set of next steps:

- Expanding the PayGrow business model to an "Earn and Grow" model where customers can earn rewards for high cooker utilization efficiency.
- Exploring the introduction of a smaller and cheaper entry-level SHSw/ISEC system that can allow customers to demonstrate their interest in solar electric cooking before upgrading.
- Developing and field testing ISECs with PCM-based thermal batteries that utilize the technologies developed by MECS-supported research and evaluating if these can increase usage efficiencies.
- Designing and developing Malawi-made solar-electric pressure cookers (MM- SEPCs) and testing a distribution and customer training model so villagers can increase the amount of wood they save.
- Continuing the process of converting Kachione, LLC customers from battery- based solar lighting and phone charging systems to super-capacitor-based solar electricity storage for lighting and phone charging systems.
- Developing collaborations with companies and projects interested in deploying SHSw/ISEC technologies in other markets in Malawi or in neighbouring countries (e.g. Tanzania)

SMART COOKING SOLUTIONS Jikoni Magic Limited

The aim of this project was to offer smart cooking solutions to the Kenyan population, specifically those connected to the grid. Knowledge and access to existing modern energy cooking solutions is key because this underpins a sustainable, improved healthy living and reduced environmental degradation.

In the urban areas, the access to electricity was 77.6% in April 2018. This, however, did not translate into them using electricity as their primary cooking fuel and we delved into it to uncover the reasons behind it.

The Electric Pressure Cooker (EPC) is an emerging modern cooking appliance in the Kenyan market that is not widely available or known and yet it is highly compatible with most of Kenyan cooking, especially the long cooking foods that are cooked over charcoal. We were also able to identify the barriers to adoption of EPCs and ways to overcome them in order to have them adopted at scale.

We came up with ways to overcome the barriers to adoption through starting of partnerships with **SACCOS** and cooperatives. We were able to have EPCs stocked with DT Dobie SACCO where the members are able access them as loan and payback in instalments. We've also partnered up with Ministry of Industrialization in order to be able to access cooperatives under their umbrella. They have a very wide network of SACCOS and cooperatives which we can tap into and overcome the initial high cost of investment.

Customers who've purchased the EPCs call us whenever they are stuck so that they can keep using them instead of totally setting them aside from frustration. KPLC stocks some EPCs for us so that customers can buy them from their kitchen because this gives them further assurance that what they are purchasing is of good quality. We started by offering a better rate than supermarkets (after negotiating a good discount rate from supplier) in order to encourage uptake of EPCs. We are currently selling at 59.86 GBP compared to 67.34 GBP.

Challenges faced and their resolution/mitigation:

- Resistance to EPCs because of the lack of safety aspect associated with the stove top pressure cookers they know: Educating them on the safety features embedded in the design of the EPCs. Once they get convinced of these features, they are easily convinced to buy the EPCs.
- There is a general concern about whether it consumes a lot of electricity. We mitigated that by doing live demonstrations in people's houses and offices while using energy meters so we could give them exact numbers when it comes to the amount of money and electricity used.
- Perceived high cost of the EPCs - Worked through Saccos and Women Groups to enable payments through instalments.
- Lack of energy meters in the local market, plus, lack of sufficient quantities of the UK type plug that's compatible with the Kenyan market. We've been buying them in.
- Lack of diversity of suppliers of EPCs in the Kenyan market which means that the prices aren't favourable yet to a vast majority of the population. There are currently only two brands that are widely available; Von and Sayona. We've also been exploring options of importing from either Dubai or China to see how the final price will compare to what is currently in the market.

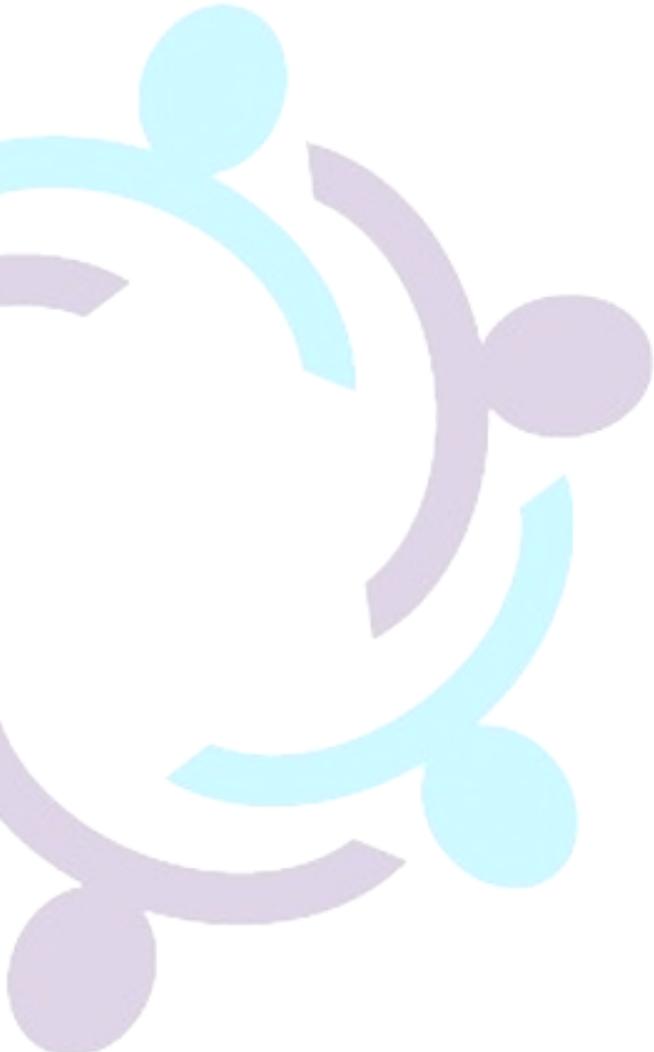
Conclusions

There is a huge potential in the Kenyan market in as far as the EPCs are concerned because it is an emerging theme in the clean cooking sector and ties in with how we cook our foods very well. It does not disrupt cooking as we know it, rather, it comes in to enhance the user experience positively in terms of efficiency, cleanliness and affordability in the long term. We were able to sell over 150 EPCs in six months and counting. A

lot of interest has been generated with KPLC coming on board to work with us. Ministry of Energy has expressed a very keen interest in what we are doing and talks are on-going on how we can work together.

The financing mechanisms in place are very key in helping out majority of the people who aren't able to afford upfront payment of the EPCs. This could either be through the check-off payment system, chamas (investment groups), SACCOS, etc.

There's a difference in the way men and women make decisions to buy the EPCs. The men are more technical and into the idea of saving their money and efficiency- they won't delve too much into how to actually cook the food but will take it home to the wives or partners. Women on the other hand are mostly interested in how their food will turn out and are very keen to learn how to use it. More research still needs to be done to unlock different household dynamics that go into decision making processes in terms of what foods are to be cooked, the appliances to purchase. The information we gathered was sufficient to help in selling the EPCs that we did, but to unlock this at scale is a working in progress.



Assessing electric cooking potential in micro hydropower microgrids in Nepal - People, Energy and Environment Development Association (PEEDA)

The transition to electric cooking in rural Nepali communities with micro hydropower (MHP) mini-grids was explored through cooking practices and MHP behaviour data collection and analysis, laboratory tests of battery powered cooking and modelling of MHP system power flows with and without storage. A cooking diary study was conducted which collected data from 15 households (HHs) in a rural village in Eastern Nepal on the transition from wood and LPG cooking to electric - induction hobs and rice cookers.

Findings included that there was a simplification of cooking (narrower menu and fewer dishes per meal) in the electric cooking phase but that generally HHs accepted and adapted successfully to the new technology. 83% of dishes were cooked on induction hobs and rice cookers, with varying degrees of fuel stacking with firewood and LPG between the HHs. In the eight weeks following the intervention phase, usage of the electric stoves fell for some HHs due to wood stoves providing space heating in the winter months and reduced spare power during dry season.

Mini-grid stability and generated power variability across the seasons presents a challenge for electric cooking.

Batteries could enable unused generated energy in the MHP to be stored and used for cooking, allowing increased uptake of electric cooking. To assess the feasibility of cooking Nepali dishes from lithium batteries, a battery eCook demonstrator was set-up in the PEEDA lab. Rice and dal were cooked successfully from the battery, proving feasibility, but limitations on equipment meant that detailed insights into the effect of high power cooking on battery usable capacity and cycle life were not obtained.

Battery electric cooking requires significant investment for both centralised and household level storage, although a household battery cooking system to cover daily electric cooking, excluding cookers, could be paid for over 20 or 5 years in monthly instalments of \$20.30 and \$30.60 respectively.

Accelerating uptake of electric cooking on AC microgrids through business and delivery model innovations

PowerGen Renewable Energy is a leading developer and operator of microgrid renewable energy systems across sub-Saharan Africa. To date PowerGen has connected over 15,000 homes and businesses to renewable, reliable AC power across Tanzania, Kenya, Sierra Leone, and Nigeria.

With MECS' support, PowerGen has conducted a first-of-its-kind, real-world test of electric cooking in the context of a rural African microgrid. Under the scope of this project, Electric Pressure Cookers (EPCs) were delivered to customers at 2 microgrid sites in central Tanzania. These sites were targeted for the study because they offered significantly lower electricity rates compared to most rural microgrids, thereby making the EPCs cost-competitive with relatively inexpensive and ubiquitous charcoal.

Early indications from these activities have been very positive. Qualitatively, EPCs demonstrate a **strong product-market fit** for AC microgrid customers in Tanzania. Many staple foods are compatible with EPCs without requiring large shift in behaviour. Off-the-shelf EPCs are plug-and-play with 240V AC power provided by the microgrid. Customers love that the EPCs save them time while adding minimal amounts to their electricity bills. Since receiving EPCs, households in the study consumed an additional **2.6 kWh per month** through the end of January. This represents an increase of 19.5% in consumption compared to the prior 3 months, demonstrating a clear appetite for MECS among microgrid customers. Follow-up surveys found that both the loan facility and in-person training were crucial to customer uptake.

PowerGen partnered with a local distributor of EPCs, TATEDO to supply the technology and consumer training. The Nikai Model of EPC was previously tested for quality assurance, product-market fit and mini-grid compatibility and was selected for this project due to its high efficiency and compatibility with the local cooking practices. PowerGen designed a consumer financing product for the EPC that allowed for payment in installments and potentially improved appliance affordability. The payment plan entailed a down payment of TZS 50,000 and monthly instalments of TZS 22,000 for nine months.

Appliance ownership amongst the customers is progressive; generally customers purchase one appliance at a time and complete repayment before making the decision to buy another appliance. High rates of appliance ownership can be partly attributed to PowerGen's business model, which includes provision of appliances on loan, as tested in this study. 19 out of 22 customers interviewed reported they could not have afforded the EPC without the loan facility.

The majority of users cooked entirely on charcoal before purchasing the EPC. Households, on average, use one to two bags (30-50 kg/bag) of charcoal per month while the hotel businesses used between three to eight bags. The average price of a bag is about TZS 8,000 (about \$3 USD) therefore the average expenditure on fuel ranged between \$10-32 USD.

Firewood was preferred for fast cooking, whereas gas was used for light cooking, e.g. evening meals. Two out of the three customers who use charcoal as an alternative to firewood use less than a bag every month. It was noted that changes in seasons affect both availability (decrease) and cost (increase), to about TZS 10,000 (\$5 USD).

Time Savings: All the users confirmed that the EPC created more time for them to spend in their businesses, farms and other activities. The EPC freed up nearly two hours per household. This has been made possible for the following reasons:

- Unlike open fires and jikos which require constant attention, the EPC requires no supervision
- EPC operation is quite straightforward and as a result, consumers can carry out multiple tasks simultaneously.
- EPCs require very little preparation to carry out cooking
- Heavy foods cook much faster.

“The best thing about this [EPC] is having more time. I used to sit inside for two or three hours to prepare each meal (lunch and dinner), but now I can put the food inside the cooker and just leave. I go to my farm and can work there all day. It is especially helpful during the harvest season when we have so much to do. Now I come home and the food is ready.”

One customer said that with this additional time, she is able to spend more time on her farm, finishing tasks such as weeding in time for the planting season. Another recommended it as ‘the go-to appliance for the empowered woman.’

Cost Savings: the customers enjoy using the EPC for precooking/boiling activities; previously, pre cooking foods such as beans would take about three hours and consume a huge amount of wood or charcoal. The EPC had halved this time and by extension cut down on the firewood/charcoal that would have otherwise been bought. A deeper CBA could be done later once the customers have used the EPC for a longer time

No Negative Health Impact: health issues that would arise from the smoke are no longer a problem. Common ailments such as chest and eye problems are no longer a problem as well as accidents such as burns and spills.

“The [EPC] is so easy to use, I even let my children cook in it. Now that they can cook, I have more time and know that they are safe. Coal and fire can be dangerous, but the [EPC] is easy and safe.”

PowerGen has already partnered with Access to Energy Institute ([A2EI](#)) to scale up to 100 EPC customers across different geographic clusters in Tanzania. These EPCs will be metered separately to disaggregate their consumption from the other appliances in the household. Different prices per kWh will be tested to determine willingness-to-pay. PowerGen will be seeking \$100,000-200,000 USD in grant funding to further scale up these activities across Tanzania, and to conduct commercial feasibility studies in West African countries where it operates, such as Sierra Leone and Nigeria. EEP Africa has been identified as a potential channel for this funding.

Developing and Testing Innovative User-friendly LPG financing models to accelerate uptake among rural poor through mobile pay

The aim of the project was to increase access and use of LPG as a cooking fuel among internally displaced low income rural households in Mbaruk and Mogotio areas of Nakuru County.

A baseline survey was conducted in the area to bring about a more detailed understanding of the supply and demand situation of cooking fuels in the project target areas. The survey found out that the households were heavily dependent on traditional biomass fuels and that majority were already purchasing their cooking fuels. An indication that the biomass fuel stocks were on the decline in the study area and that the households were in need of an alternative cooking fuel.

Building on the results from the baseline survey, the project team developed and tested a suitable financing model which was expected to ease the burden of the cost of purchasing of LPG cooking kit and refills among the target households. The a priori argument in this project was that poverty is a major constraint to adoption and use of clean cooking fuel such as LPG.

The model enables registered customers to acquire complete LPG cooking kit on loan and pay for their LPG cylinder refills promptly, in amounts equivalent to or lower than the daily spend on fuels currently purchased by each of the households. Implementation of this project has resulted in increased savings among users initially purchasing biomass fuels and kerosene and who have adopted LPG; other additional benefits are expected to include improved health and wellbeing of end-users, increased environmental conservation, and increased last-mile distribution points / improved access to LPG among the rural poor in the target area.

The results from this project show that majority of target households have been able to make regular payments for their LPG refills, the payments are made promptly, the LPG supply hubs have maintained regular and adequate stocks.

Three financing models; pay to use (PAYGO), Cash payment, and access to LPG through microfinance lending platform were identified, discussed and evaluated using a participatory approach involving target local communities. The PAYGO model was considered most appropriate and therefore selected because of the following advantages: ease of payment in small and affordable amounts, convenience of accessing LPG through a mobile communication money platform (telephony), and time savings.

This model was tested against the following criteria: ease of payment in small and affordable amounts, effectiveness in supply of LPG and discipline instituted among user households for payment of energy consumed.

- In terms of ease of payment, the results show that over 95% of beneficiary households made regular payments of kes1,000/month. This suggests that a significant number of registered users are able to meet their PAYGO commitments on time.
- Effectiveness in supply of LPG – the 2 LPG hubs have adequate stock of LPG cylinders, facilitate timely and reliable delivery of refills whenever required by registered users.
- Discipline instituted among user households for payment of energy consumed - The project instituted a peer pressure payment framework that has ensured that each participating registered user makes prompt payment for LPG used. This is useful for ensuring commercial viability and sustainability of the use and promotion of LPG

Evidence from the project shows that the participating households find the established schedule of payment for the LPG refills affordable and convenient. Majority of participating households have elected to pay for their

LPG requirement in small amounts but there also a few who prefer to make lump sum payments. The mobile application has been used effectively by end-users to order, pay and receive LPG refills whenever required. In addition, the app has been used by project staff in monitoring and tracking payment by individual end-users, monitoring stock levels as well as keeping proper books of accounts. Hub managers have also used the mobile app to monitor stock, release refills to end-users or transporters for delivery. They also receive and respond to issues raised by customers using the app.

The group/cluster peer influence mechanism has so far worked well in ensuring prompt payment by participating households for the LPG energy consumed.

The mechanism has also enabled households that would otherwise have been left due to lack of loan security to be included and benefit from using the LPG cooking kit upfront.



Approach to Designing Delivery Models of Modern Energy Cooking Services in Tanzania (ADD-MECS-Ta)

The MECS TRIID research project aimed at assessing and understanding the entire market systems of modern energy cooking appliances (specifically electric pressure cookers) in order to propose an approach for designing sustainable delivery/business models for scaling up their uptake in Tanzania. The project has been implemented in urban and peri-urban areas of Dar es Salaam Region (Ubungo and Kinondoni districts) and a rural area of Gairo District in Morogoro Region where PowerGen Company is currently operating a Solar PV Mini-Grid power plant.

The research findings from the project indicate that the target markets for EPCs are households and small food business enterprises in both rural and urban areas. The aggregate demand of EPCs is still very low in Tanzania. The factors which were observed and considered to influence the demand of EPCs are awareness of appliance, price of appliance, seasonality of income, availability and quality of the appliance and income level of customers which determines affordability and prices of substitutes/compliments.

Based on the findings of the project, there are six potential chains for marketing EPCs to the end-users. These are market chains from manufacturers through importers to: i) supermarkets to urban end-users, ii) urban end-users iii) distributors to urban end-users iv) distributors to rural end-users v) distributors, retailers to urban end-users, vi) distributors, retailers to rural end-users. Most of retailers are at the moment, mini-grid owners who supply EPCs to rural end-users.

Although, electricity is used for lighting, ironing and phone charging in residential sector, it is exclusively used as energy for cooking by few high income households. According to NBS/REA, of 2016 only 32.8 per cent of households were connected to the national grid in Tanzania but households which are using electricity for cooking is only 0.3 percent. The cost of electricity for this customer category including tax, and other levies is TZS 355 (GBP 0.13) per kWh. If a household will use hotplate, two units of electricity per meal cooked, or six units per day at TZS 2,130 (GBP 0.76), monthly consumption of electricity for cooking would approximate TZS 63,900 (GBP 22.8), currently more expensive than charcoal.

Frequent power cuts also frustrate households that cook with electricity, often requiring a back-up supply of household fuel often charcoal and LPG. Very few Tanzanians think that they will ever have the opportunity to cook using electricity. Access, reliability and affordability seem to be barriers to the promotion of electricity as an alternative to biomass (firewood and charcoal); therefore, it has been difficult for many people to imagine electricity as a realistic alternative energy in the foreseeable future.

The aggregate demand of EPCs is still very low in Tanzania. The factors which were observed and considered to influence the demand of EPCs are price of appliance, awareness, purchasing power of end-users, seasonality of income, prices of substitutes/compliments and quality of the product.

- **Price of the Appliance:** The retail price to end-users of the EPCs ranges from TZS 180,000 (GBP 65) to TZS 250,000 (GBP 90) depending on a point along the chain the appliances are procured by an end-user. The EPCs have high price elasticity of supply; therefore increase in price due to associated market costs may make some low income customers withdraw from buying the product.
- **Awareness:** The EPCs as observed in rural and urban areas is a new product in the market. Several end users in households, government departments, local governments, financial institutions and donors are not aware of benefits of EPCs on energy and budget saving in their households.
- **Ability to Pay by Customers:** The research was conducted in high, medium and low income clusters of different end-users. High income end-users have ability to pay for EPCs easily. The medium income end-

users have shown ability to buy the appliance through credit facilities. The low income end-users will buy the EPC whenever is subsidized through specific market schemes or affordable credit mechanisms.

- **Seasonality of Income:** The factor was observed for rural customers in which there is time in the year, people have relatively high income (boom) and the time when people have low income (recession) in rural areas. This is attributed to seasonality of income from agriculture.
- **Prices of Substitutes and Complements:** The substitutes of EPCs are LPG stoves, normal pressure cookers, charcoal stoves, firewood stoves, etc. The complementary service of EPCs is electricity. If the tariffs of electricity are higher than prices of alternative energy sources, customers may weigh prices from alternative fuels and costs incurred by using electricity for cooking and based on this factor some customers may switch to substitutes.
- **Quality of the Appliance:** There are several types of EPCs. The assessment of quality of the EPCs, showed that some EPCs are not well insulated and some parts are hot when a user is cooking, such that quality varies according to brand and makes in the market. This factor may also make customers demand the high quality electric pressure cookers.

The end users or customers of EPCs who will benefits from saving and reduced costs of modern energy cooking services are categorized into various segments based on their income, availability of electricity and other preferences such as sizes of the appliances. The information was obtained during household surveys, focus group discussions for urban end-users and PRA for rural end users. The category percentage was also determined from the NBS Household Budget Surveys (2017). The customers of EPCs can be splinted in the following categories:

Type 1 – Low Income Customers: About 53% of people fall into this sub-categories:

- Smallholder farmers with average earning of £2-£2.5 per day
- Business persons - earning between £2-£5 per day.
- Individual households with regular monthly incomes (rural medical officer, rural school teachers, etc.) – earning between £4-£7 per day.

Type 2 – Medium Income Customers: About 32% of people belong to the following sub-categories

- Medium scale farmers and enterprises – earning between £8-£10 per day
- Individual households – earning average income of about £10 per day.
- Small enterprises such as food kiosks, food vendors, etc with £8 – £15 per day
- Faith Based organization offices like churches and mosques with £8-£10 per day

Type 3- High Income Customers: About 15% of people with the following sub-categories

- Large farmers earning income of more than £40 per day
- Employed Individual households earning income of more than £35 per day
- People with Business Activities earning income of more than £55 per day

The most important customers for EPCs are types 2 and 3 (high and medium-income customers) and 40% of the type 1(low-income customers), which encompasses business persons and individual households with regular monthly income. The criteria used for selecting who would be a likely and important customer include their income or purchasing power and connection to electricity (solar, mini-grid and national grid). The smallholder farmers are requires special arrangements of flexible payments such as credit financing because their income is seasonal. The supplier who will target this market must access it during crop harvesting when farmers have high income. The end–users in urban areas are households and small SMEs which require modern energy cooking appliances and services for meal preparation. Most of the distributors and retailers are supposed to target these customers. The future efforts will strive to have an active promotion and

marketing strategy to cater for the above categories. Most efforts will be directed towards clients and areas which will have a high demand for EPCs.

- **Awareness Barriers:** The main barrier observed from end-users at all levels was low awareness of using EPCs. Efficient cooking by using EPCs is a new practice to many end-users. The MECS also requires to be introduced in the country education system. The lack of awareness was also observed for development partners, government staff, local leaders and end users in the community. The low awareness if is not resolved will become barrier for demand, support services and commercialization of electric cooking appliances and services. MECS knowledge and skills are also supposed to be introduced in education system of Tanzania.
- **Financial Barriers:** The financial barriers, according to this project can be divided into low affordability by end-users and limited access to capitals for suppliers. The low affordability was observed to be a gap for medium and low-income segments of end-users in both urban and rural communities. This is attributed to seasonality of income for rural end-users and priority put on cooking appliances, lack of adequate income and gender income allocation decisions in the households for urban end-users. The financial barrier for suppliers is limited access to capital for business development (such as credit, loans etc.).
- **Technical Barriers:** The technical barriers identified through this project are size of appliances, quality, knowledge on how to use appliance and after sale services. The size of many appliances promoted and sold through different stores and supermarkets are of six litres. This seems to be inadequate size for a large family of more than eight people. Cooking with efficient electric appliances requires changes in normal practices and behaviours of preparing meals in the households. The qualities of EPCs in the market are different caused by efficiency, operability and limited functions of the appliances. This requires new knowledge on how to use appliance. Any person who will buy EPC will also require assurance of after sale services such as repairs and spare parts. Others will also prefer to have two pots per EPC instead of one.
- **Cultural Barriers:** The cultural barriers assessed from end users especially in rural areas, are related to heating and warming up the house, drying crops and frying some food stuff. The traditional cookstoves are used for cooking and cater for above functions, the electric pressure cooker is only used for cooking. Therefore, the family in cool areas is supposed to find other means of warming up, drying crops and frying food. There are also considerable suspicions surrounding the introduction of EPCs as new products to end-users. Some end- users would prefer for someone else to use and carry the process of appliance familiarity before they buy.
- **Appliance Availability Barriers:** The high efficient electric cooking appliances (especially EPCs) are not easily available in the market at the moment. If awareness creation and promotion is undertaken for EPCs, there are high chances that there will be scarcity of those appliances in the market. There is a need for bulky supply of EPCs in the country in while exploring possibility of establishing factory for EPCs in Tanzania for enhancing supply of EPCs as demand is strengthened

How PAYG mechanisms overcome the challenges of consumer finance for appliances

M-KOPA's recent research on financing options in Kenya uncovered very few loan products that provide low income customers with affordable options to acquire consumer goods on credit. Only a third of the products available have a loan period more than 2 months. For loans of KSH20,000-100,000 (the range that most SHS and appliances fall into), a two-month loan period is too short to be affordable, since each payment would be more than most households would reasonably be able to afford. Of the seven options with loan periods more than two months, two have interest rates of 50 300% APR, making them unaffordable on the basis of financing costs.

Two of the other options are offered by commercial banks, which require collateral against the loan (most low-income people in Kenya don't own property, or any other valuable goods that could act as collateral).

Beyond the interest rate and loan period, traditional loan options generally come with high penalties. For higher value loans, any default or missed payment puts the borrower at risk of repossession without any return of loan payments made. Additionally, almost all of the formal loan companies will report default to the national credit board, and clearing a bad credit report costs KSH2,200 to each of the 3 credit rating agencies in Kenya. Because of the harsh penalties imposed, low income customers reported across the board that they are unwilling to take traditional loans for non-emergency purchases – things like school fees and funeral expenses make the cut, but appliances are considered a luxury purchase.

Compounding this resistance, most loans come with required regular payments on a weekly or monthly basis, and the penalties are triggered with as few as a single missed payment. Low income customers' income is often too irregular to make commitments to service loans on that regular of a basis.

The above factors show unequivocally why pay as you go mechanisms work for extending finance to low income customers. Each of the barriers is addressed through the structure that PAYG provides.

- The repayment period of a PAYG loan tends to be 6 months to 2 years, keeping the loan affordable through lower regular payment amounts.
- In a PAYG scheme, the device becomes its own collateral which means the risk is lower than a traditional unsecured loan. With no need to have someone interface with the customers face to face to collect payments, the operational costs of the loan are lower. Both of these combine to lower the overall cost of finance to the customer.
- PAYG schemes don't have high penalties for missed payments. The device won't work until the next payment is made, but there is no repossession of the product and the customer is not reported to the credit boards unless they stop paying for the product entirely.

Because the implication of missing a payment is relatively low impact, customers can repay with more flexibility, corresponding to when and how they earn their income