



## LEIA – Challenge Fund Summary

2022

EarthSpark, BURN, M-KOPA, SCODE

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## Executive Summary

This report sets out to review the learning from the Modern Energy Cooking Service's LEIA (Low Energy Inclusive Appliances) Challenge Fund Programme. Four projects were carried out, three in Kenya (BURN, M-KOPA and SCODE), and one in Haiti (EarthSpark) to devise and test clean and electric cooking devices and systems undertaken between 2019 and 2020.

The EarthSpark project sought to investigate the potential of electric cooking in rural communities in Haiti by deploying electric pressure cookers (EPCs) and induction stoves to off- and micro-grid participants. They monitored use, cooking habits and feedback during the duration of the study.

BURN's project aimed to produce an EPC tailored to Kenyan needs. This was achieved through several rounds of prototyping and through piloting the EPCs in the field.

M-KOPA sought to find a clean cooking solution that is technically feasible, scalable, and aspirational as well as integrative with a DC-powered, off-grid solar home. Although this was found to be not yet possible, they also focused upon market profiling to determine how future technologies can be successful.

SCODE's project aim was to develop and evaluate a DC Solar EPC unit suitable for off-grid households and households connected to unreliable or weak grid in Mogotio and Mbaruk locations in Kenya. This was achieved through lab testing, where a technical fault was discovered. The field testing phase was therefore carried out using an AC EPC.

All the field-tested products had a positive response, with greater energy efficiency leading to lower fuel costs and faster cooking times, as well as a reduction of indoor air pollution. This is significantly beneficial to women and girls, who often are the primary cooks in households and therefore most impacted by the time and health burden of traditional fuels.

Barriers to clean cooking technology included the upfront cost and lack of financing options which may hinder the access of low-income households. Capacity of cooking devices was also a concern, with the EarthSpark and BURN participants finding that some meals or foods were too large to cook in one pan.

### Updated 2022

These projects were carried out between 2019 and 2020. A lot of research has confirmed or challenged some of their findings. In these text boxes we offer some updated insights

### Updated 2022

Since the M-KOPA LEIA 1 project, DC Solar Home Systems inclusive of cooking are being piloted by other partners

### Updated 2022

The positive responses have been replicated by many projects, and new mechanisms for overcoming the barrier of upfront cost are emerging

Overall, consumer satisfaction was seen to be high, with majority of participants adapting easily and rapidly to clean cooking, suggesting this market has a promising future. The convenience of ecook due to both cost and time burdens being shed, has been shown to make this technology both attractive and transformative.

## LEIA Challenge Fund Overview

The LEIA (Low Energy Inclusive Appliances) Programme is a research and innovation programme that seeks to double the efficiency and half the cost of a range of electrical appliances suited for off- and weak-grid households, small business, and industrial consumers.<sup>1</sup> Supported by FCDO (the UK's "Foreign, Commonwealth and Development Office") and the IKEA Foundation, the programme aims to address market barriers for efficient end-use electrical appliances to improve energy access, increase incomes, reduce greenhouse gas emissions, increase reliability of access to health services, and improve agricultural efficiency and food security. This programme has supported a range of projects with five principal components:

- Market stimulation and incentives – rewards given to innovative early movers and best actors, as well as catalysing innovation in the early stages of a market's development.
- Testing and quality assurance – LEIA collects, generates, and publishes a wide range of appliance performance and market data.
- Marketplace education, communications and coordination – improving the flow of information about efficient and high-quality appliances suited for off- and weak-grid scenarios.
- Market intelligence and technology roadmapping – LEIA addresses gaps in market intelligence through researching about market, consumer, impacts and technology. Research is also focused on developing technology roadmaps to identify and prioritise research and development (R&D) initiatives.
- R&D co-investments – LEIA guides and supports R&D to build partnerships between the private and research sector.

MECS (Modern Energy Cooking Services) funded four programmes through a Challenge Fund, which worked on a range of innovations including electric pressure cookers (EPCs), solar EPCs and business models to improve affordability, efficiency, and applicability of clean cooking appliances to developing country markets. The projects have worked to promote social inclusion and achievement of Sustainable Development Goal 7: "ensure access to affordable, reliable, sustainable and modern energy for all".

## LEIA Project Overviews

### EarthSpark

*Title of Report:* [On- and Off-\(Micro\)Grid PV Electric Cooking: Field Data for Integrated Energy Access in Haiti](#)

*Area of Study:* *The rural community of Les Anglais, Southwestern Haiti*

This study explored the potential of electric cooking in rural communities in Haiti by deploying EPCs and induction stoves with integrated smart meters in 20 households connected to a community-scale solar PV microgrid (using a "SparkStove" system), as well as cookers and stoves supported by stand-alone solar+battery systems in 8 off-grid households (using a SUNSPOT™ solar electric cooking

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<sup>1</sup> <https://efficiencyforaccess.org/leia>



Figure 1: A user of an EPC in her home (L); a training session and cooking demo for the participants (R)

system). Each of the systems were designed to support a “Simpot” EPC and an induction stove. Each device was interconnected to a smart meter that provided 15-minute interval data for customer electricity consumption.

The report discusses the electric cooking data for a minimum of 42 days of observation for each participant, as well as the daily energy diaries submitted by the participants outlining number and type of meal cooked including a baseline pre-electric cooking menu, fuel source, number of people cooked for, and if there were any challenges for that meal.

## BURN

Title of Report: [Electric Pressure Cooker Development for Kenyan and SSA Market](#)  
 Area of Study: [Urban \(60%\) and peri-urban \(40%\) areas of Nairobi and Kiambu, Kenya](#)

BURN’s project aimed to produce an EPC tailored to Kenyan needs. They used three rounds of prototype testing to validate assumptions around users’ needs from a behavioural change perspective, a costing and financing perspective and for durability and safety. The team developed the EPCs using feedback given from potential customers and users, engineers and researchers on the project. The pilot included 50 customers using the EPC for a period of 3 months, 44 of whom have responded to a survey which provided results about the potential for EPCs in Kenya. BURN’s pilots were intended to test out user’s ability to understand cook programs, interfaces on the EPCs and how easily Kenyan customers were able to adjust to the new form of cooking.

## M-KOPA

Title of Report: [Pay As You Cook \(Making Electronic Cooking Assets Affordable\)](#)  
 Area of Study: [Kenya](#)

M-KOPA Labs sought to find a clean cooking solution that is technically feasible, scalable, and aspirational as well as integrative with a DC-powered, off-grid solar home.

Desk research was undertaken on the availability of electric cooking appliances and the market, before assessing product-market fit through a series of human-centred design approaches. Primary research was undertaken in Kenya to understand the cooking practices and preferences of predominantly biomass cooks, and technical in-market assessments were completed to measure power requirements and ideal power sources of various cooking devices. 328 M-KOPA customers were surveyed through a telephone survey, with data being collected on demography, foods cooked, duration of cooking, where cooking occurs and cooking fuel. A “Cooking Day” event was designed principally to map user requirements when buying a cook stove, and to understand what features a suitable ecooker (electric cooker) device would need.

### SCODE

Title of Report: [Development and Evaluation of a Direct Current Solar Pressure Cooker Unit](#)  
Area of Study: [Mogotio and Mbaruk locations in Nakuru County, Kenya](#)



Figure 3: SCODE staff testing the DC solar EPC in the workshop (L); A happy family at Echariria poses for a photo with their new cooking kits

The aim of the project was to develop and evaluate a DC Solar Electric Pressure Cooker (SEPCs) unit suitable for off-grid households and households connected to unreliable or weak grid in Mogotio and Mbaruk locations. In March 2019, a baseline study was conducted, which was used alongside desktop and market reviews to develop a 24-volt, 400-Watt DC SEPC system which was then tested using the standard water boiling test and controlled cooking test protocols.



Figure 2: M-KOPA staff members examining and discussing

However, field testing was carried out with an AC EPC rather than the DC version as at the point when SCODE was installing the DC SEPC for the household field testing, MECS identified technical problems with the DC EPC and advised for work with the DC EPC to halt until it is certified safe to use. In this field testing of AC EPCs, 6 households used the grid power connection directly without storage, while 29 households used batteries charged exclusively from solar systems with inverters. All 35 households were also issued with a two-burner LPG cooker connected to a 6kg LPG cylinder to compliment the pressure cooker.

## Energy, Fuel and Cost

### Fuel Type Used

The use of electricity for cooking is unusual in the cooking contexts of the studied countries. Typically, in Kenya – according to the 2019 Kenya Population and Housing Census – 55.1% of Kenyan households use firewood as their primary fuel for cooking, followed by 23.9% that use LPG. However, the results of the baseline survey completed by SCODE in March 2019 indicated that the majority of households in Mogotio and Mbaruk used firewood as their primary and charcoal as their secondary fuel. This is similar to M-KOPA customers, of whom 60% use firewood as the primary cooking fuel, with charcoal also being popular with 40% of customers noting its use.

Similarly, in rural Haiti, there is a reliance upon solid fuels, with 97.3% of households using solid fuels for cooking: 74.7% use wood, 22.5% use charcoal. Inefficient traditional unvented and unimproved cook stoves or open flames are often used to cook food.

All four projects promoted or developed ecook devices in their work, with all choosing to focus on EPCs. M-KOPA and SCODE chose to use both AC and DC EPCs in their project, although SCODE had to use the AC EPC to roll out user field testing when the DC EPC was discovered to be faulty. Other ecook devices were used, such as the induction stove in EarthSpark’s project which was supplied to field testing participants alongside their EPC and the eco-kettle and hotplate which were lab-tested in M-KOPA’s report.

Although not an ecook device, LPG was also used by SCODE during field testing, stacking with the EPC.

### Fuel Stacking

Fuel stacking is common practice with traditional fuels as well as clean cooking appliances. According to SCODE, some households still used their traditional fuels for some of their meals, despite being supplied with an AC EPC and an LPG stove. However, the usage rate of this was low and only certain items were produced using traditional methods, most often chapati, porridge and warm water. SCODE’s field test also promoted modern fuel stacking through providing two types of clean cooking appliance. Both were used together, with the LPG double burner being used on average 2.59 times per day, and the EPC an average of 1.18 times per day.

Likewise, in the M-KOPA focus groups, it was found that participants were also willing to stack modern cooking appliances, with 64% of participants stating they would adopt the hotplate, 90% would adopt an EPC and 100% would adopt the kettle.

The BURN field test found that users were less likely to fuel stack as they became accustomed to EPC usage, as after 3 months of using the EPC, customers effectively replaced the use of other primary

Updated 2022

Wood and charcoal prices continue to rise due to significant deforestation in the countries studied

cooking methods. The EPC was not used for all cooking tasks though, with quickly reheating and deep frying being preferably done with LPG.

In Haiti, multiple types of fuel were used, with 20/20 on-grid cooking pilot participants and 8/9 off-grid participants being regular charcoal users, and a few participants also using propane and wood. EarthSpark also encouraged modern energy stacking through giving participants both an induction hob and EPC.

### Energy Consumption

The EarthSpark project found that individual customers averaged 1.92 kWh of electricity use per day (off-grid at 1.18 kWh per day and microgrid consumers used an average 2.4 kWh per day). This was split between EPC (0.79 kWh) and induction stove (1.58 kWh). Most of the consumption (61%) occurred between 9 AM and 4 PM. It should be noted that all participants received free electricity for their electric cooking loads to incentivize usage and prioritise actionable data for planning ecook.

This added significant load to the existing microgrid operations: monthly generator use increased 33% from the start of the cooking pilot in July 2020 to the end of October 2020. On normal sunny days, the solar and capacity storage had capacity to keep up with demand, however on cloudy and rainy days, the micro-grid saw increased diesel generator use and on a few occasions blackouts due to overdraw of the generator.

The solar EPCs in SCODE's study were found to have the highest thermal efficiencies (above 60% which means it is a tier 5 device according to the Clean Cooking Alliance) compared to other traditional, improved and LPG stoves tested during the water boiling test. The efficiency of EPCs was also seen in their field studies where households that used the AC EPC complemented by LPG were able to reduce their energy consumption by 78%.

M-KOPA's aim to develop a DC EPC which was compatible with Solar Home Systems (SHS) met with significant challenges because AC off-the-shelf electric cookers are incompatible with DC-powered off-grid systems, meaning that DC devices are needed. However existing DC off-the-shelf cookers were too energy intensive for existing and pipeline ranges of SHS. The project therefore pivoted to focus on customer requirements so that, in the future, collaboration and design of a new and relevant device can happen.

### Cost of Fuel

The projects generally saw the ability for participants to save fuel costs through transitioning to ecook. Although Kenyan participants in the BURN and M-KOPA projects believed that electricity was expensive to cook with 80% of respondents in the BURN trial said they did not notice an increase in electricity expenses, with 64% of respondents self-reporting that they saved more than KES 100 per

#### Updated 2022

It seems important to note that the Haitian cooks received free electricity. Other studies show people use less energy for similar foods when they are mindful of the cost of energy

#### Updated 2022

DC EPCs are now available. During 2019, a low-quality supplier was available, but M-KOPA rightly noted those appliances did not have all the safety features of an AC EPC. There are now high-quality DC appliances with all the safety features.

When M-KOPA note that existing DC appliances were too energy intensive, they were referring to hotplates and induction hobs



week. 20% saw that their monthly bill increased between KES 50 and KES 300, however, after 3 months of using the EPC, 93% of respondents agreed they had been able to save some money due to the better fuel efficiency of the device. Without specific savings data, BURN estimated that average weekly savings were KES 194 after beginning to use the EPC.

The SCODE project also demonstrated fuel cost savings in the Kenyan context, as the total daily average cost of cooking fuel (predominantly biomass and kerosene) before intervention was Ksh 353, while after the introduction of the EPC and LPG double burner system, the cost was Ksh 196, showing that the communities studied were able to save 44% of their cooking cost.

In EarthSpark's Haitian study, 13 participants saved between 80% and 100% on monthly charcoal expenditures after the intervention, with charcoal costs before being between 525 htg (US\$8.28) and 9,300 htg (US\$147). After electric cooking was introduced, charcoal expenditure was between 0 htg and 6,200 htg.

### Upfront Costs

All projects found that the upfront capital costs of the systems and devices used were likely too expensive for most low-income families due to a variety of factors. EarthSpark found that ecook supply chains were undeveloped, as there were less than 10 units of EPCs and induction stoves in all the stores in the country, making it necessary to import devices, adding to cost.

Similarly, in Kenya, EPCs are difficult to source and expensive with the market price at £80 - £120. SCODE found that there was a 16% value added tax on the solar EPCs. Other parts of the system needed, such as solar panels and batteries would further increase price, as importing more robust lithium-ion batteries would attract a 42% tax of factory price in addition to shipping and clearing charges. SCODE's report calls for changes to the tax and policy regime to lower this tax making ecook more affordable.

### Financial Arrangements

According to EarthSpark's report, overcoming the initial capital cost of the devices is the largest challenge. Although their field study gave the devices to participants free of charge, they suggest that leveraging micro-grid models to utilise blended financing, particularly results-based financing for health, development and the environment may help to finance scaling up of ecook in Haiti. They also suggest pay-as-you-save models if the saving margins are high enough with the rising cost of charcoal.

SCODE's baseline survey found that there was no lender in the Mogotio and Mbaruk locations in Nakuru County running a financing plan suitable for solar EPCs. The financing plan developed by the project required long repayment periods (4.5 – 9 year) which was unattractive to

#### Updated 2022

Upfront capital costs are now being mitigated by credit systems or pay-as-you-go.

Supply chains though remain a challenge. Harmonising import duties and tax continues to be an important part of taking these ideas to scale.

Results based funding and the use of carbon credits offers two promising mechanisms by which upfront and total lifetime costs can be reduced for the consumer.

#### Updated 2022

Making lenders and savings and credit cooperatives (SACCOs) aware of the savings that can be achieved by obtaining an energy efficient appliance has begun

financers in the market – according to M-KOPA, customers don't like to be tied into a pay-as-you-go contract for more than 18 months suggesting cultural incompatibility with long repayment times. Full cost recovery was not achieved during SCODE's project period as by the end of the project (December 2020), the participants had paid 21.28% of the total amount they were expected to pay over a 30-month period.

## Frequency, Duration and Cooking Habits

### Cooking Frequency

The BURN project found that 64% of respondents used the EPC unit at least 6 times per week, including 16% of respondents who used the EPC more than 12 times per week. Of the respondents who still used biomass stoves such as charcoal, the frequency per week had also reduced during the intervention period. SCODE also found that unclean fuel use significantly reduced over the course of the study, as outlined in Table 1.

Fuel Type	Number of meals cooked/warmed per day	
	Before intervention	After intervention
Firewood	5	/
Biomass	3	/
Charcoal	2	Less than daily
Kerosene	0.89	/
Electricity	0.23	1
LPG	/	3

*Table 1: The number of meals cooked/warmed by different fuel types before and after SCODE's introduction of EPCs and LPG double burners in Mogotio and Mbaruk locations in Nakuru County, Kenya*

In Haiti, EarthSpark's pilot study led to 79% of customers using electric cooking on observed days, with several customers using ecooking nearly every day of the study. Participants used the induction stove more frequently and intensively than the EPC (there were 1,372 total cooking events with the pressure cooker with a total cooking event time of 1,135 hours, whereas the induction stove had a total cooking event number of 2,282 and a total cooking event time of 2,271 hours), however both devices showed significant daily usage.

### Cooking Time

The EarthSpark cooking diaries, coupled with the electric meter readings showed that, on average, cooking events lasted 58.8 minutes. Ecook significantly reduced cooking time, particularly for staple meal bases like breadfruit (53% time reduction), viv (51%), soup/stew/bullion (51%), wheat/millet (41%), spaghetti/macaroni (39%) and rice (32%). The BURN study also found that bean dish cooking time is significantly reduced, from 3 – 4 hour cooking time, to less than one hour. Moreover, 86% of respondents said they saved time cooking with EPCs. Testimonies included in SCODE's report share about how clean cooking is saving time, with participant Dominic Otieno stating "we take less than half the time to cook".

### Types of Meals Prepared

The urban-based target group for M-KOPA's research tended to eat three meals per day. Breakfast consisted of a hot beverage with chapati/mandazi/pancakes. Lunch and dinner both consist of ugali, vegetables and rice/pilau.

The SCODE controlled cooking lab tests used popular Kenyan dishes including githeri, mukimo, beef meat stew, sweet potatoes and porridge.

BURN did not directly track the frequency of types of meals cooked with the EPC, however the menu option buttons most used were githeri/red beans, minji/dengu, mbaazi/yellow beans, nyama/matumbo, sweet potatoes, and rice.

EarthSpark's cooking diaries revealed that meals mostly consisted of a starch (rice, spaghetti, cornmeal, plantain, viv, breadfruit) and an addition of beans, meat vegetables, eggs and fish. Most food is boiled or fried. Rice was the most common item prepared, followed by hot beverages.

### People Cooked For

According to the SCODE report, the number of people cooked for each day would change. The average rural Kenyan household has 5 members. M-KOPA, which has an urban focus, found that households were typically made up of 6 people: 3 adults and 3 children.

The EarthSpark report had more detail about the number of people cooked for, with the smallest number of people being 2 and the largest 13 which included not only family members but neighbours and friends. This is customary, with food being offered to neighbours and visitors as well as some food being sent to family members living in town. Most participants were serving between 4 and 10 people with household cooking.

## User Experience

### Gender

In both Haiti and Kenya, women tend to bear the majority of responsibility for the cooking. Without clean cooking devices, this can lead to poor health due to indoor air pollution and a time burden which restricts income generating activities, and self- and family care. M-KOPA's report acknowledged that women are often the main purchasers and users of household cooking fuels in Kenya, and BURN used this information to help tailor their EPC product to the female end-user through including women in research, design, testing and feedback.

The Kenyan projects also noted how, although women tend to be the end-users, they often have to discuss ecook purchases with their husband, who decides whether the purchase will go ahead (76% of primary breadwinners were male while 99% of primary cooks were female according to M-KOPA).

Women were also instrumental in creating momentum and interest in SCODE's ecook training sessions as female community influencers were identified who mobilised community members to attend meetings. Interest was not only driven by women, however, as SCODE found attendance at ecook demonstrations was low until three men took an interest in the technology, and became champions of EPCs, buying an EPC for their own households and then bringing both male and female friends to meetings. This resulted in at least three EPCs being purchased every meeting. SCODE also observed that the introduction of EPCs in households had made cooking attractive to men in the house, and they had begun to openly discuss cooking with EPCs in their homes. However, this was to a limited extent.

### Updated 2022

While larger sized EPCs are becoming available, and in Tanzania they are now sold with 2 pots, the average appliance is still too small for the larger families common to the target countries

Similarly, the EarthSpark cooking diaries indicate that there is some participation of male family members in preparation of food, although this is minor. Indeed, only one out of 28 EarthSpark pilot participants was male.

## Age

Only the EarthSpark report discussed the age of the ecook users. Cooking diaries indicate that most of the cooks in the households are between 36 and 55 years old, however children as young as 9 and elderly people as old as 82 did use the electric appliances too.

## Cooking Culture

Much cooking culture is passed down through generations. The EarthSpark report found that most respondents learnt how to cook when they were less than 10 years old, with 81% learning from a maternal figure.

The introduction of ecook, however, may create new cooking cultures. In the EarthSpark study, 45% of participants increased their cooking frequency as a result of the ecook devices. This habit is expected to continue after end of the monitoring period, perhaps indicating a change in cooking culture. Morning food preparation time has also shifted to later in the day due to faster cooking, which allows for a longer night's rest.

Participants also mentioned how the steps in cooking a meal with electricity were different to cooking with charcoal, as the ecook devices were faster to heat up than charcoal devices, meaning the ingredients had to be chopped and prepared ready before heating the ecook device.

## Field Experiences

### Positive Experiences

The greater time efficiency of ecook devices was noted in all three field studies. 83% of respondents using the BURN EPC found that it saved them time (95% of users were satisfied because of how fast the EPC cooked), which they then used to finish other chores, work on business or productive activities, relax and spend time with family. Similarly, the EarthSpark project found that the most mentioned benefit from the EPC/induction stove combination was the amount of time saved. 78% of participants indicated that they use this time for relaxing, 33% for household chores, 15% for focusing on business and income tasks, 7% for self-care and 7% for family care. Time was also saved as fuel did not have to be collected or gathered – SCODE's participants reported that they saved time as they did not have to collect firewood due to the EPC.

In Haiti, participants were concerned with the ever-increasing price of charcoal, which represented a big expenditure for the household. Transitioning to ecook led to 13 participants saving between 80% and 100% on monthly charcoal expenditures. 93% of BURN respondents said that using the EPC had been able to save money due to reduced fuel costs. SCODE likewise found there were significant fuel savings due to ecook, with participants able to save 44% of their cooking cost through using EPC and LPG.

Health and safety were also key pieces of positive feedback: 9% of BURN participants were satisfied with the EPC because of the safety of the device. All the 44 respondents found the EPC to be safe or

Updated 2022

Many studies are showing that people adapt their cooking process to reflect the greater control eCooking devices have over the food. MECS has now published a series of eCookbooks which describe the processes and the energy consumption

very safe to use. SCODE participants also praised the improved air quality, and the ease of use for people with disabilities.

14% of BURN participants stated they were satisfied with the EPC due to the ease of use. Usability features such as local language buttons and a locking mechanism with clear instructions were key successes of the pilot. EarthSpark's participants also appreciated being able to conveniently cook food inside at night, rather than have to use the charcoal stove outside. Moreover, BURN participants like how they could prepare the meal and use the EPC without having to stir it or tend to a flame, allowing them to complete other tasks in the meanwhile.

### Negative Experiences

Both EarthSpark and BURN participants found it challenging to cook the desired amount of food. EarthSpark participants found this because of the small size of the devices (the Simpot is a 6-quart pot and is well sized for a family of 5 – 8 members, yet most households cooked for 4 – 10 people in the EarthSpark study) and BURN found this because of there being only one pot to cook all foods in the EPC. This was found to be challenging for the more voluminous foods in Haitian cuisine such as diri kole (beans and rice). Moreover, the ferromagnetic pots used in EarthSpark's study were difficult to reliably supply and were too thin so would tend to burn foods if the participants were not careful.

Haitian participants were also concerned about how cooking can be disrupted if there is a microgrid outage. BURN participants were not as concerned with this, as although 61% of users reported power cuts 1 – 3 times per month, only 2% of respondents reported them as a challenge for cooking with EPCs. Others were also concerned about electricity, with 16% of BURN participants stating they were concerned with electricity consumption and 23% were concerned by electrical incidents. 47% of participants said they were concerned about misuse of EPC by someone who didn't know how to operate it.

According to SCODE, the high upfront cost of the solar EPC is a significant barrier, and with the lack of fitting financing models present in Kenya, this may continue to be a significant barrier. They also note that the costs of solar and battery systems add further set-up cost.

Almost half of BURN EPC users reported that the proposed cooking time was incorrect, and 16% of users reported that the liquid to food ratios were incorrect. Similarly, 16% of participants were concerned about the taste of the food.

There were also some concerns about the usability of some ecook devices, with SCODE noting that as the AC EPC (110W) had a power rating around 3 times higher than the DC solar EPC (400W), the DC was, therefore, unsuitable for frying.

### Conclusion

The LEIA Challenge Fund projects were innovative, developing efficient new ecook devices, services and grid set-ups which are suited to the cuisine and context of Haiti and Kenya. Although giving valuable insights, the geographical scope of the four studies was not broad, with only Kenya (rural and urban) and Haiti being explored (only rural). However, the studies all demonstrated the compatibility of ecook within the sample communities, and illustrated the significant benefits of clean cook, such as increased time, money and health saved. All projects sought experimental and

field testing in their comparison and exploration of clean cook technologies, providing a user-centric review of technologies and systems.

These projects supported the LEIA principal components about testing devices, marketplace education, market intelligence and technology roadmapping as well as R&D co-investments through: the design of the BURN EPC; the valuable learning about off-the-shelf EPC compatibility with SHS by M-KOPA; EarthSpark's experimental use of micro-grids and off-grid energy to facilitate ecook and SCODE's investigation in DC and AC EPCs in both labs and field studies. In the future, the first principal component should receive more attention: although the high upfront cost of equipment and systems was a key theme, few financing options were found to be available. In order to have a viable market, consumers must be able to access it.

Overall, consumer satisfaction was seen to be high, with the vast majority of participants adapting easily and rapidly to clean cooking, suggesting this market has a promising future. The convenience of ecook due to both cost and time burdens being shed has been shown to make this technology both attractive and transformative.

### Update 2022

BURN, SCODE and EarthSpark have gone on to develop these ideas further and offer commercially viable ecooking. M-KOPA has continued to keep a view on ecooking, but its great success in smartphones has kept the company focused on this core business