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ELECTRIC PRESSURE COOKERS

Solar Appliance Technology Brief

JULY 2021

EFFICIENCY FOR ACCESS COALITION

CONTEXT

This electric pressure cooker technology brief is part of a series of insight briefs developed to synthesise the latest market intelligence and chart the pathway to commercialisation for some of the off- and weak-grid appropriate technologies most relevant to catalysing energy access and achieving the Sustainable Development Goals.

The first LEIA Technology Summaries were published in 2017 to help the newly established Efficiency for Access Coalition navigate a nascent market. There was limited data and reliable research available on market trends and performance of appliances suitable for resource-constrained settings. This technology summary updates and expands on the information presented previously, bringing together the latest insights on market and technology trends, consumer impacts and pathways to scale for electric pressure cookers. You can access briefs on all technologies that are a part of this series here.

This brief was developed by CLASP and Energy Saving Trust as part of the Low Energy Inclusive Appliances programme, a flagship programme of the Efficiency for Access Coalition. Efficiency for Access is a global coalition working to promote high performing appliances that enable access to clean energy for the world's poorest people. It is a catalyst for change, accelerating the growth of off-grid appliance markets to boost incomes, reduce carbon emissions, improve quality of life and support sustainable development.

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SDG INTERLINKAGES

ELECTRIC PRESSURE COOKERS

SDG 1: No Poverty
SDG 2: Zero Hunger
SDG 3: Good Health & Well-Being
SDG 4: Quality Education
SDG 5: Gender Equality
SDG 7: Affordable & Clean Energy
SDG 8: Decent Work & Economic Growth
SDG 11: Sustainable Cities & Communities
SDG 13: Climate Action
SDG 15: Life on Land

Electric Pressure Cookers improve wellbeing, especially for women and children, by significantly reducing exposure to indoor air pollution from biomass cook stoves and enhancing inclusive economic productivity. Instead of spending long hours collecting fuels and tending to cooking, girls have the opportunity to attend schools and women can engage in other leisure and income-earning activities. The environmental benefits include decreased rates of deforestation, forest degradation and biodiversity loss. EPCs also provide climate benefits by decreasing emissions of biomass cookstoves induced by black carbon, an air pollutant with a climate warming impact of 460 to 1,500 times stronger than carbon dioxide.

Introduction

The electric pressure cooker (EPC) is part of a new generation of modern electric cooking (e-cooking) solutions (Figure 1). EPCs are highly energy-efficient appliances and have the potential to expand access to clean cooking for the 2.6 billion people who rely primarily on biomass cooking and other polluting fuels.[1]

EPCs are sometimes referred to as multicookers because they can perform multiple cooking operations, including steaming, boiling, pressure cooking, frying and baking. EPCs cook food faster with less energy than other e-cooking technology methods by using a combination of insulation, high temperature and pressure to accelerate cooking time, while simultaneously reducing heat loss. EPCs use about one-fifth of the energy of a hotplate to cook over 90% of foods.[2]

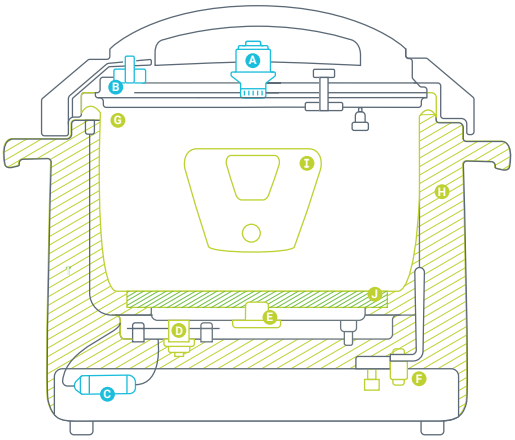
Energy-efficient cooking appliances are particularly valuable when preparing long-simmering dishes and heavy staple meals commonly consumed in Asia and Africa, such as rice, beans and meat stew. EPCs cook a wide variety of dishes through a combination of built-in programmes; some models offer different temperature settings that can be used for frying, etc. prior to cooking under pressure.

The majority of EPCs are used in the household, while some are now also used in restaurants and institutions. EPC capacity ranges from 2 Litres (L) to 20L, while models most commonly used in the household range between 4L to 10L.

Figure 1. Key Safety and Energy Saving Mechanisms of an Electric Pressure Cooker

Safety Features

- **A** Pressure Release Valve: Automatically opens when pressure exceeds normal levels.
- **B** Locking Pin: Prevents lid from being opened when pressurised.
- **C** Thermal Fuse: Cuts power when temperature above expected.
- **D** Secondary Pressure Relief Valve: Automatically opens if pressure sensor & pressure release value both fail.



Energy Saving Mechanisms

- **E** Temperature Sensor: Cuts power when operating temperature is reached.
- **F** Pressure Sensor: Cuts power when operating pressure is reached.
- **G** Pressurizing Seal: Enables food to cook in half the time by raising the boiling point of water.
- **H** Insulation: Insulation around both pot and heating element to prevent heat escaping.
- **I** Interface: Control mechanism to allow user to automatically turn off EPC after cooking time has elapsed. Two types: analogue/dial & digital/button.
- **J** Hot Plate: Standard resistive heating element sized to perfectly fit the pot.

1. SDG 7: Data and Projections, IEA (Paris: 2020), https://www.iea.org/reports/sdg7-data-and-projections.
2. S. Batchelor, E. Brown, N. Scott and J. Leary, Experiences of Electric Pressure Cookers in East Africa? (Jinan, China: 2019), 1, https://mecs.org.uk/wp-content/uploads/2020/12/eedal_EPC_paper-14-7-19-Final-002.pdf.

State of Play

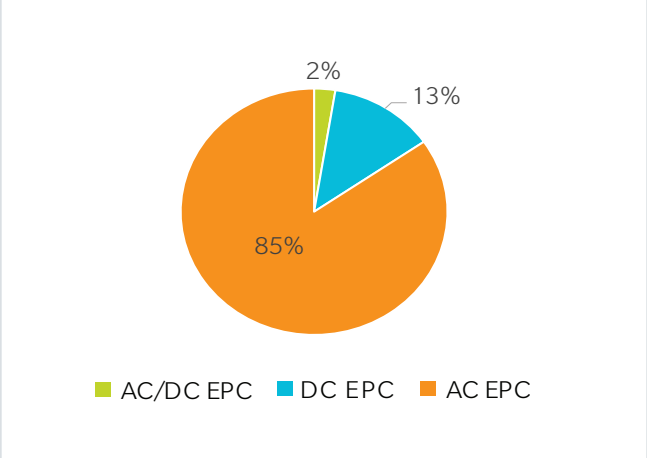
Unlike televisions, fans and other household off-grid appliances, EPCs are at an earlier stage of market maturity. They have a higher upfront cost, typically ranging from USD 22 to USD 352.[3] However, direct current (DC) and alternating current (AC)/DC-powered EPCs sold with a standalone energy supply system cost hundreds of dollars more due to the added costs of the battery, inverters and solar panels. But despite the high upfront cost, EPCs, particularly in East Africa, face the lowest barrier to adoption compared to other e-cooking technologies. They are highly desirable to consumers due to significant time savings and the ability to offer different types of cooking services in a single unit.[4]

In addition to the relatively high product cost, little energy consumption and/or performance data exists for EPCs. As a result, off-and weak-grid energy service providers struggle to determine accurate power system sizing and make informed procurement and distribution decisions, which makes it hard to incorporate EPCs into their product offerings. In 2020, the Global LEAP Awards launched an inaugural competition to help address this gap and identify best-in-class, energy-efficient, durable and affordable EPCs. Manufacturers and distributors nominated 39 products to undergo laboratory-based energy performance, quality and safety tests. The free on board (FOB) unit price observed in the competition ranged from USD 24 to USD 150 with an average of USD 58. The competition showed that AC-powered EPCs dominate the market (Figure 2), highlighting a barrier for technology uptake in off-grid households. DC EPCs constituted only 13% of nominated products. None were recognised as a finalist after failing portions of the product safety and quality tests in the Global LEAP Awards EPC Test Method.

The competition tested and measured EPCs' energy consumption and service delivery across three cooking phases: heating,[5] pressure cooking[6] and sauteing.[7] Total energy consumption of three cooking phases per product ranged from 337 to 1000 Watt-hours for AC EPCs, and 383 to 629 Watt-hours for DC EPCs. As illustrated in Figure 3, total average EPC energy consumption was proportional to pot capacity. The heating phase was shown to be the most energy-intensive, while pressure cooking accounted for the least amount of total energy consumption across different sizes.

Despite the EPCs' consistent energy performance across different cooking phases, some outliers (i.e., 4L to 6L EPCs pressure cooking was relatively higher than 7L to 9L EPCs) can be attributed to differences in product design. For example, the mechanism an EPC uses to control pressure was shown to impact its energy consumption.

Figure 2. Overview of Nominations in 2020 Global LEAP Awards Electric Pressure Cooker Competition



Source: 2020 Global LEAP Awards Electric Pressure Cooker Competition

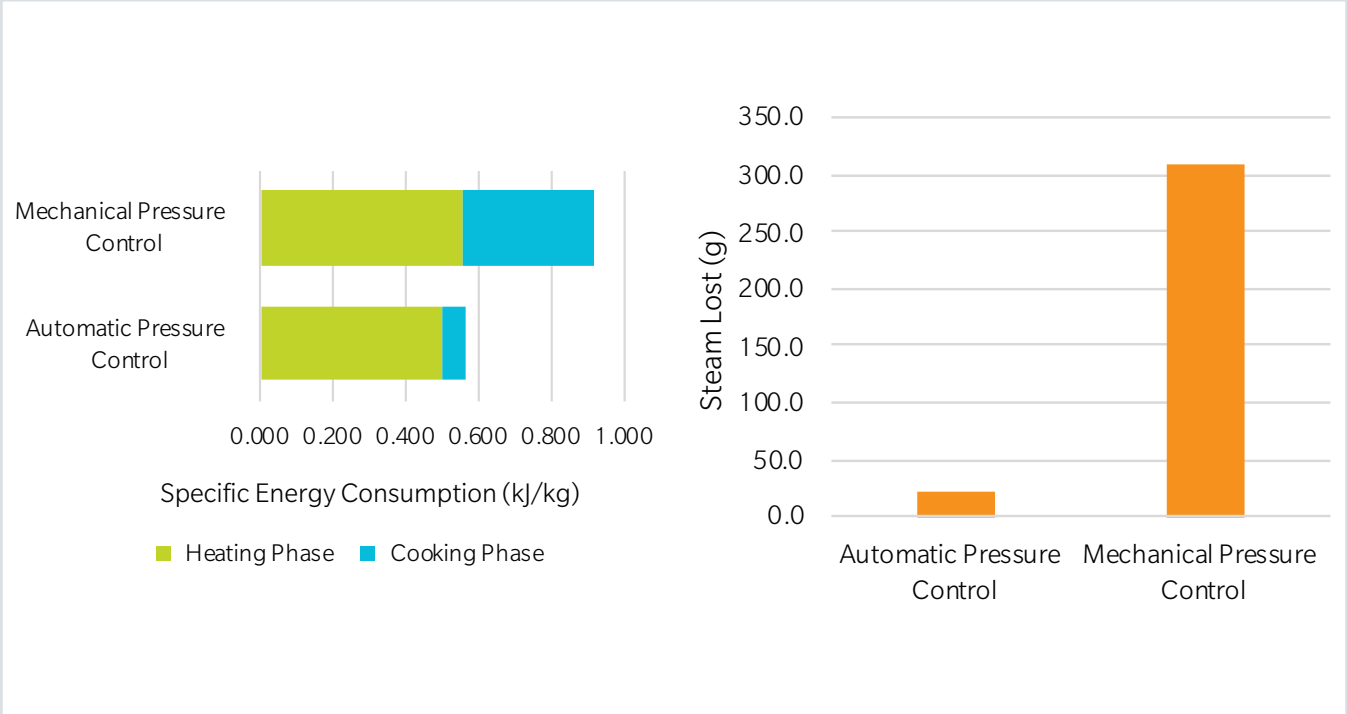
Figure 3. Total Average Energy Consumption Across Cooking Phases by AC Powered EPC Cooking Capacity in Global LEAP Awards EPC Competition—Laboratory Test Results

Capacity [L]	Power Supply	Total Average Energy Consumption [Wh]	Heating Energy [Wh]	Saute [Wh]	Pressure Cooking [Wh]
1 - 3L	AC	370	208	138	23
4 - 6L	AC	603	352	162	89
7 - 9L	AC	868	588	245	36

Source: 2020 Global LEAP Awards Electric Pressure Cooker Competition

3. N. Rousseau, Overcoming the 'Affordability Challenge' associated with the transition to electric cooking, Modern Energy Cooking Services (2021), https://mecs.org.uk/wp-content/uploads/2021/01/MECS-report-affordability-challenge-Final-2.1.pdf.
4. Elliot Avila et al., The Desirability of Clean Cooking in Off-Grid Households, A2EI (2019), https://a2ei.org/resources/uploads/2019/06/A2EI_The_Desirability_of_Clean-Cooking_in_Off_Grid_Households.pdf.
5. The heating phase encompassed turning on pressure cooking mode through heating until pressure cooking phase begins and measuring EPC performance. Each EPC was filled with water to 50% of pot capacity and set to high-pressure cooking mode.
6. The pressure cooking phase measured EPC performance during a 30-minute laboratory test once the device has pressurized. Each EPC was filled with water to 50% of pot capacity and set to high-pressure cooking mode.
7. The saute cooking phase measured EPC performance during a 30-minute laboratory test. Each product was filled with vegetable oil to depth of 2 cm and set to sauté mode (or high-pressure cooking mode if no sauté mode) with the lid off.

Figure 4. Specific Energy Consumption: EPCs with Automatic vs Mechanical Pressure Control (left); Steam Lost During Cooking (right)



Source: 2020 Global LEAP Awards Electric Pressure Cooker Competition

As illustrated in Figure 4, products designed with automatic pressure control devices used much less energy on average than products with mechanical pressure control devices (i.e., weighted valves). Specific energy consumption between EPCs with mechanical vs. automatic pressure control was relatively similar during the heating phase (0.50kJ/kg vs. 0.55kJ/kg) within each size category. However, EPCs designed with a mechanical pressure control device to release steam (intended to maintain pressure) consumed much more energy (0.36kJ/kg vs. 0.06kJ/kg) than those with automatic pressure control devices during the cooking phase. The difference in the energy consumed is likely a result of the steam lost: 309.4g lost by mechanical pressure control devices, compared to only 22.5g lost by automatic pressure control devices.

Customers take safety and quality into consideration when purchasing an EPC. Global LEAP testing also surfaced critical quality and safety concerns in both DC and AC EPC units, including lid lock malfunction, high handle temperatures and poor resistance to voltage fluctuations. Overall, these product design issues, coupled with the variability in energy consumption, suggest room for substantive design improvements.

Market Insights

While EPCs are widely used in on-grid households in North America, Europe and Asia-Pacific, the market is largely untapped in the Global South. In 2018, EPC sales totaled 8 million and retailed for approximately USD 580 million, with 70% sold to household consumers.[8] The vast majority of sales occurred in North America and Europe (Figure 5). The potential EPC market in Sub-Saharan Africa (SSA) is substantial (Figure 6), where approximately 83% of the region's population cook energy-intensive meals with biomass.[9] Despite the rising cost of biomass fuel, it remains the primary cooking fuel across the region.

The opportunity for households in SSA to cook with an EPC has grown over the last decade due to increased grid connections and access to distributed energy solutions (i.e., solar home systems and mini/microgrids). In SSA, the number of people gaining access to electricity doubled from 9 million a year between 2000 and 2013, to 20 million people a year between 2014 and 2019.[10] Recent studies have shown that cooking with electricity is already cost-effective and the cheapest alternative

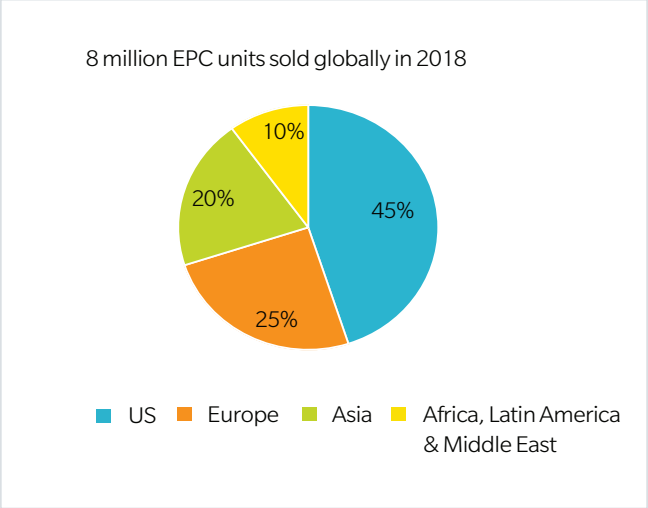
8. Cooking with Electricity: A Cost Perspective, The World Bank Group and Modern Energy Cooking Services (2020), 85, https://documents1.worldbank.org/curated/en/920661600750772102/pdf/Cooking-with-Electricity-A-Cost-Perspective.pdf.
9. International Energy Agency (IEA), Access to clean cooking, https://www.iea.org/reports/sdg7-data-and-projections/access-to-clean-cooking#abstract.
10. International Energy Agency (IEA), Access to electricity, https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity.

in areas with low-cost grid connections (electricity tariffs below USD 0.35/kWh) and high charcoal cost (above USD 0.40/kg).[11] By 2025, expected declines in battery costs, coupled with continued increases in biomass fuel costs, will also make electric cooking cost-effective for populations in off-and weak-grid communities served by solar home systems and mini-grids.[12]

Despite incremental growth and significantly increased interest in EPCs by a variety of commercial actors, the market remains small, and potential demand is largely untapped. A recent multi-criteria decision analysis of factors that either enable or constrain electric cooking (i.e., infrastructure, cooking culture) in different Sub-Saharan African country contexts was conducted. It found that Kenya, Tanzania, Zambia and Uganda have the most favourable local market conditions for rapid EPC uptake, especially in inaccessible off-grid areas.[13] High availability of solar resources, grid expansion efforts, low clean cooking access and a strong cooking culture create a highly viable EPC market. For example, Kenya has a vibrant and mature solar market and a strong track record for innovation. Over the last five years, electricity access has expanded rapidly from 20% to 75% of the population, yet 85% of the population still relies on traditional biomass cooking.

Advances in EPC technology and increased availability of these products in key national markets have the potential to accelerate EPC adoption. The 2020 Global LEAP Awards Competition recognised thirteen EPCs that demonstrate a unique balance of safety, quality and energy performance in the Global LEAP EPC Buyer's Guide. Nine of the thirteen EPCs additionally underwent usability testing by everyday cooks in Kenya to assess potential uptake and products' compatibility with preparing local dishes.

Figure 5. IMARC Total EPC Sales by Region and Percentages in 2018



Source: The World Bank and the Modern Energy Cooking Services (MECS), Cooking with Electricity: A Cost Perspective (2020), p. 85.

The Global LEAP Usability Testing Buyer's Guide details user feedback on cooking experiences and the quality/taste of local food, as well as perception of cost value for each product. Both publications are part of broader market development reports from leading NGOs and institutions (i.e., MECS, Clean Cooking Alliance and ESMAP) that help strengthen the technical infrastructure and facilitate the commercial procurement of best-in-class EPCs by energy service providers.

Figure 6. Share of Population Cooking with Biomas in the Global South, 2018

Region	Countries	Proportion of Population Relying on Traditional Biomass to Cook
Sub-Saharan Africa	East Africa	85%
	West Africa	78%
	Central Africa	88%
	Southern Africa (Not including South Africa)	86%
Developing Asia	India	50%
	Indonesia	21%
	Southeast Asia	42%
	Other Developing Asia	70%

Source: IEA, 2018 Clean Cooking Database analysis of World Health Organization (WHO) Household Energy Database and World Bank Sub Saharan Africa Population Total, 2018.

11. Cooking with Electricity (2020), 22.
12. Id.
13. Batchelor et al., Solar electric cooking in Africa: Where will the transition happen first? (Energy Research & Social Science, Vol. 40: 2018), https://www.sciencedirect.com/science/article/pii/S2214629618301087, 257-272.

BOX 1

E-COOKING AMIDST THE PANDEMIC

The COVID-19 pandemic is anticipated to reverse some of the gains in transitioning households to cleaner cooking fuels, including electricity. For low-income to middle-income households, shocks like COVID-19 have been shown to influence household expenditure decisions, leading a significant number to return to cooking with cheaper polluting fuels. However, this change in cooking behaviour has dramatically increased exposure to IAP as local and national lockdowns force people to spend more time indoors. The result of such sustained indoor exposure increases susceptibility to both detrimental respiratory illness and severe health outcomes of COVID-19.

EPCs are smokeless in design and can play a crucial role in building household health resilience. The COVID pandemic spotlights the need to bridge the EPC product affordability gap by combining financial resources tied to improving health, gender equity and environmental and social impact investments. Donors and strategic partners of these key issues have traditionally operated in silos, but COVID-19 showcases the nexus of access to e-cooking and achieving key sustainable development goals.

Consumer Impacts

Cooking with biomass is a primary source of indoor air pollution (IAP) in the Global South, causing approximately 4 million premature deaths each year.[14] Prolonged exposure to IAP is also associated with adverse health impacts, including acute lower respiratory infections, low birth weight, lung cancer, chronic pneumonia and most recently, increased susceptibility and morbidity to COVID-19.[15] In 2020, Efficiency for Access conducted 400 baseline and 318 follow up interviews with EPC consumers in Kenya from the pilot Global LEAP Awards results-based financing (RBF) EPC programme to better understand impacts on quality of life since accessing the technology. While improved health outcomes are more likely to be observed over time, almost two-thirds of consumers from the forthcoming EPC Consumer Insight Report perceived their health improved over the short term due to reduction of indoor smoke and better nutrition from food cooked with an EPC. In addition, close to 50% of these consumers also reported improved quality of life, and 35% saw a reduction in household fuel expenses.

In countries where EPCs are well suited to the cooking culture, the appliance has the potential to disproportionately improve women's health and socioeconomic standing. Studies show that women are two to four times more likely to be exposed to and suffer adverse health impacts from IAP than men.[16] EPCs can also significantly relieve the time and drudgery associated with biomass cooking. The forthcoming EPC Consumer Insight Report revealed that the average household was able to reduce cooking time by 80 minutes from a baseline of 184 minutes each day. EPC use can eliminate or greatly reduce the need for fuel collection. In some rural areas in the Global South, women spend an average of five hours a day collecting firewood before returning home to spend more hours preparing and tending to food cooked on traditional biomass stoves.[17,18]

The EPC Consumer Insight Report revealed that 90% of EPC users had no prior exposure to EPCs before making their purchase. Additionally, 24% of consumers were also served by solar home systems and mini-grids. The high percentage of first time consumers demonstrates that EPCs are viable replacements for diverse households and have potential for growth in sales among off- and non-grid connected communities.

Consumers are more likely to hear and learn about EPCs from family and friends than through other marketing and sales channels, including direct sales and flyers (Figure 7). Women (56%) are more likely than men (28%) to first hear about EPCs and 59% of them ultimately make the household's product

14. WHO, Household air pollution and health (2018), https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health.
15. Wu, X., Nethery, R. C., Sabath, M. B., Braun, D. and Dominici, F., Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis, (Science Advances.: 2020), https://projects.iq.harvard.edu/covid-pm.
16. ESMAP, State of Access to Modern Energy Cooking Services, (Washington, D.C.: 2020,. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services, 20.
17. Id.
18. Efficiency for Access, The State of the Off-Grid Appliance Market, 2019, https://storage.googleapis.com/e4a-website-assets/Clasp-SOGAM-Report-final.pdf.

purchase decision. However, women (57%) tend to rely on financing from suppliers and savings group (chamas) to purchase EPCs, while men (53%) often use one-off cash payments. The development of flexible and equitable financing mechanisms is critical to increasing uptake of EPCs in high target markets.

"The best thing about this [EPC] is having more time. I used to sit inside [the house] for two or three hours to prepare each meal, but now I can put food inside the cooker and just leave. I go to my farm and work 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."- Female participant in Efficiency for Access and Powergen EPC Pilot

BOX 2

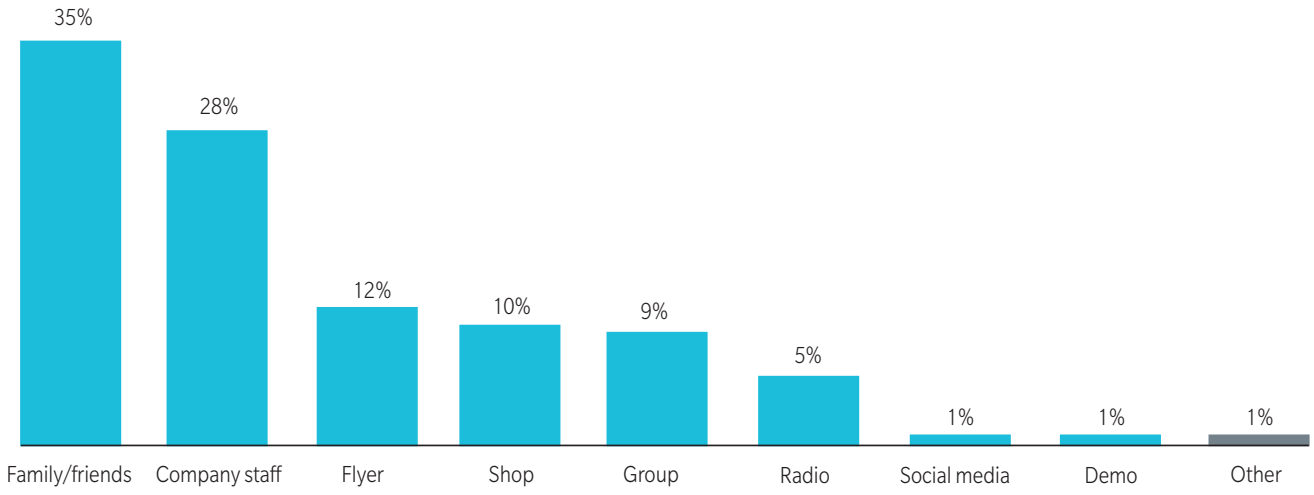
Nairobi, Kenya

COOKING TRADITIONAL MEALS WITH MODERN APPLIANCES

Agnes Kalyonge, a food blogger, focuses on clean cooking, photographing and filming the EPC dishes she creates from her modest apartment in Nairobi, Kenya. Her specialty is Kenyan food with a twist; for example, matumbo (tripe) in the style of Indian butter chicken. In 2021, Agnes was one of the fourteen everyday cooks who participated in the usability testing of the 2020 Global LEAP Awards EPC Competition. The usability testing sought to assess commercially available EPCs' compatibility with preparing local dishes and uncover users' cooking experiences and product feature preferences. From January to March 2021, Agnes cooked local dishes with Global LEAP Awards finalist and winning EPCs and provided daily feedback on her cooking experience with each product, as well as the taste of food prepared and energy consumed per meal (using an energy meter).

"I decided I wanted to participate in the Usability Testing to have products that are up to standard in Kenya," says Agnes. "For women, [EPCs are] a game-changer, in that you don't feel tied to the kitchen." The cost of cooking with an EPC compared to other cooking fuels is what she, along with most of her social media followers, find to be the most compelling. "There is this perception that cooking with electricity is very expensive, but I can actually demonstrate using the energy meters that it's not as expensive. I can configure my energy meter to show me [and them] how much I am spending, so I'm able to say that I am only spending ten shillings (USD 0.09) cooking my beans."

Figure 7. EPC Acquisition Channel of Global LEAP Awards + RBF End Consumers



Q: How did [person] first hear about the company [electric pressure cooker]? (n=400)

Current Success and Remaining Challenges

There have been notable successes over the last five years that demonstrate increasing investments by a diverse set of stakeholders to develop the EPC market and catalyse uptake of the technology.

A growing and supportive EPC commercial ecosystem in Kenya: Over the last three years, a small but significant EPC commercial ecosystem has taken root in Kenya. Approximately 7,100 EPCs were sold nationwide in 2018. In 2020, the Global LEAP Awards+RBF programme facilitated the sales of 3,100 EPCs.[19] A diverse set of local stakeholders, including the national utility Kenya Power and Lighting Company (KPLC), are stimulating household interest in cooking with electricity through innovative initiatives. KPLC, for example, shows cooks preparing local dishes with e-cooking technologies, including EPCs in its Pika na Power (Cook with Electricity) flagship campaign. The utility additionally offers its employees financing support to cover EPC purchases through small monthly payments deducted directly from salaries. KPLC is currently exploring a new on-bill financing service for its entire customer base to support appliance purchases as a way to increase energy consumption, which could significantly accelerate EPC market growth.[20]

Development of a new off- and weak-grid EPC test method: In 2020, the Global LEAP Awards programme developed the first test method to assess the energy performance, quality and safety of EPCs. There are presently very few international EPC testing methods and the majority, if not all, focus exclusively on device safety. The Global LEAP Awards EPC test method provides standardised procedures for test laboratories and manufacturers to measure EPC energy performance and evaluate critical metrics, such appropriateness for use in weak-and off-grid settings (e.g., resistant to voltage fluctuation). The implications of the Global LEAP Awards test method are important; it helps to build the technical foundation of the EPC market in off-and weak-grid areas, while also allowing for consistent and comparable performance data necessary for market stakeholders to make informed procurement and distribution decisions.

Increased EPC pilot projects and R&D: With support from development partners and donors, an increasing number of mini-grid developers are conducting R&D and pilot projects focused on integrating EPCs into business models and experimenting with different consumer financing mechanisms:

- In 2020, the Access to Energy Institute (A2EI) launched an EPC pilot with 100 participants in six Tanzanian villages served by mini-grids. The pilot is ongoing as of the publication of this technology summary, but preliminary insights suggest that tariff levels significantly impact EPC use and load increases on the mini-grids.
- In another R&D pilot, EarthSpark International, in collaboration with Modern Energy Cooking Services (MECS), deployed EPCs to 28 rural off-grid households in Haiti. The pilot, which ran from July to November 2020, tracked consumption levels and usage frequency for mini-

19. State of Access to Modern Energy Cooking Services (2020), 81.
20. Cooking with Electricity (2020), 36.

grid business models. Results revealed that use of EPCs align with mini-grid peak solar generation and can increase – and sometimes overload – system energy capacity.[21] These pilots overall are generating richer qualitative data on business model integration and potential EPC user consumption behaviour.

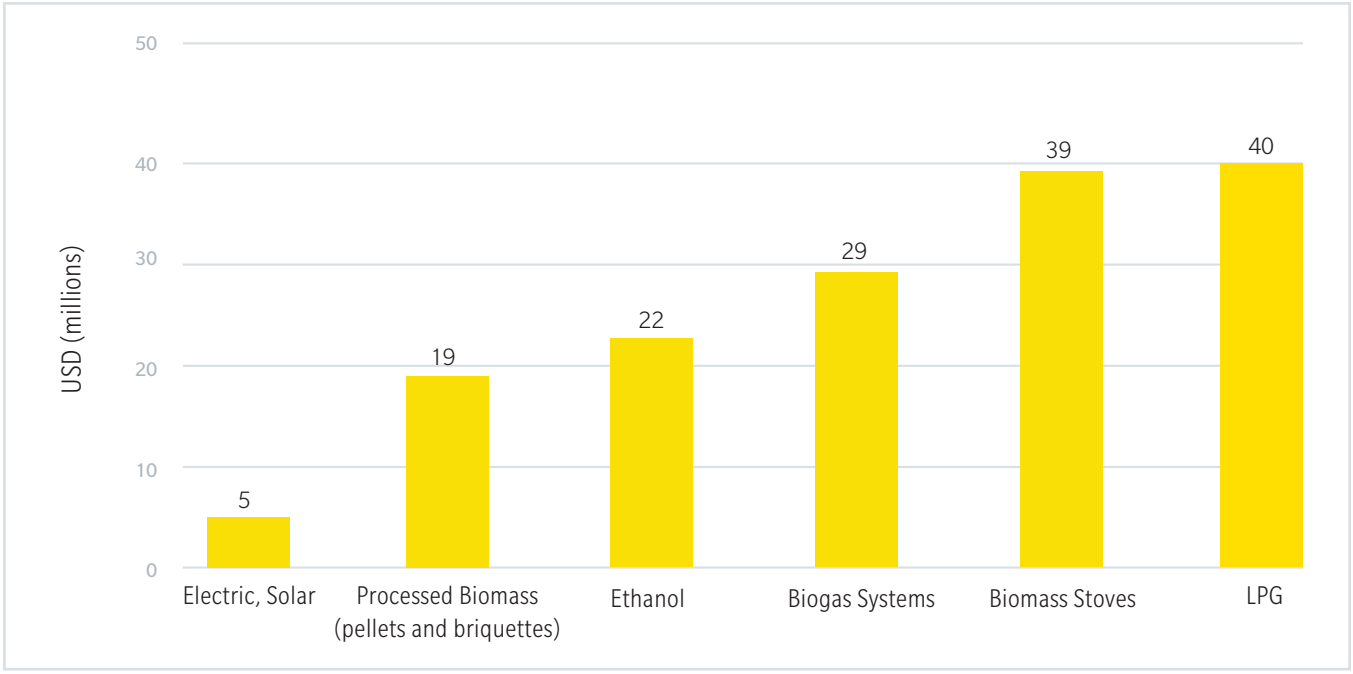
- In 2019, Efficiency for Access conducted a study with PowerGen, a mini-grid developer, to assess business models and delivery mechanisms for EPCs on two mini-grids in the Singada region of central Tanzania. PowerGen partnered with a loan facility to enable customers to pay off the product cost over nine months, with support from the MECS programme. PowerGen also partnered with a local Tanzanian company, TaTEDO, to provide in-person training and live cooking demonstrations. At the end of the six-month pilot, PowerGen saw an average of 19.5%, or 2.6 kWh/month, increase in electricity consumption.

To realise the full potential of the commercial EPC market, the following challenges need to be addressed:

High upfront product cost and lack of consumer financing remain significant barriers to technology uptake: EPCs typically retail for USD 88 in East Africa , while biomass stoves ranges between USD 2 and USD 10. In an Efficiency for Access pilot, a majority (86%) of customers reported that they could not have afforded EPCs without a loan facility.[22] In addition, only 38% of the EPC customers interviewed paid cash based on their household savings, while the rest needed some form of consumer financing.[23] Though the cost of operating an EPC over time is often already cheaper than a biomass cookstove and eventually makes up for the difference in upfront cost, a lack of consumer financing will inhibit uptake in key markets.

Lack of access to working capital among EPC companies: While large multinational e-cooking companies have adequate financing, smaller energy access companies trying to expand into the weak-grid sector, especially in SSA and South East Asia, struggle to secure adequate grant funding and capital compared to other improved cooking solutions companies (Figure 8). Given that EPCs are at an earlier stage in market maturity, many of these companies spend a significant portion of resources on research and development (e.g., field testing pilots, product development). However, early actors encounter many of the same obstacles as other off-grid solar companies when accessing capital, namely the perception among lenders that these businesses are high risk. This perception continues

Figure 8. Capital Raised by Fuel and Technology



Source: 2021 Clean Cooking Industry Snapshot. Clean Cooking Alliances based on tracking data of 51 companies for each year between 2017–19. The data relies on self-reporting by the companies and has been supplemented with publicly available investment data.

21. EarthSpark International, On- and Off-(micro)grid PV Electric Cooking: field data for integrated energy access in Haiti, (2021), 39, https://mecs.org.uk/publications/on-and-off-microgrid-pv-electric-cooking-field-data-for-integrated-energy-access-in-haiti/.

22. Efficiency For Access, Electric Pressure Cooking: Accelerating Micorgrid E-Cooking through Business and Delivery Model Innovations, 2020, https://efficiencyforaccess.org/publications/electric-pressure-cooking-accelerating-microgrid-e-cooking-through-business-delivery-model-innovations.

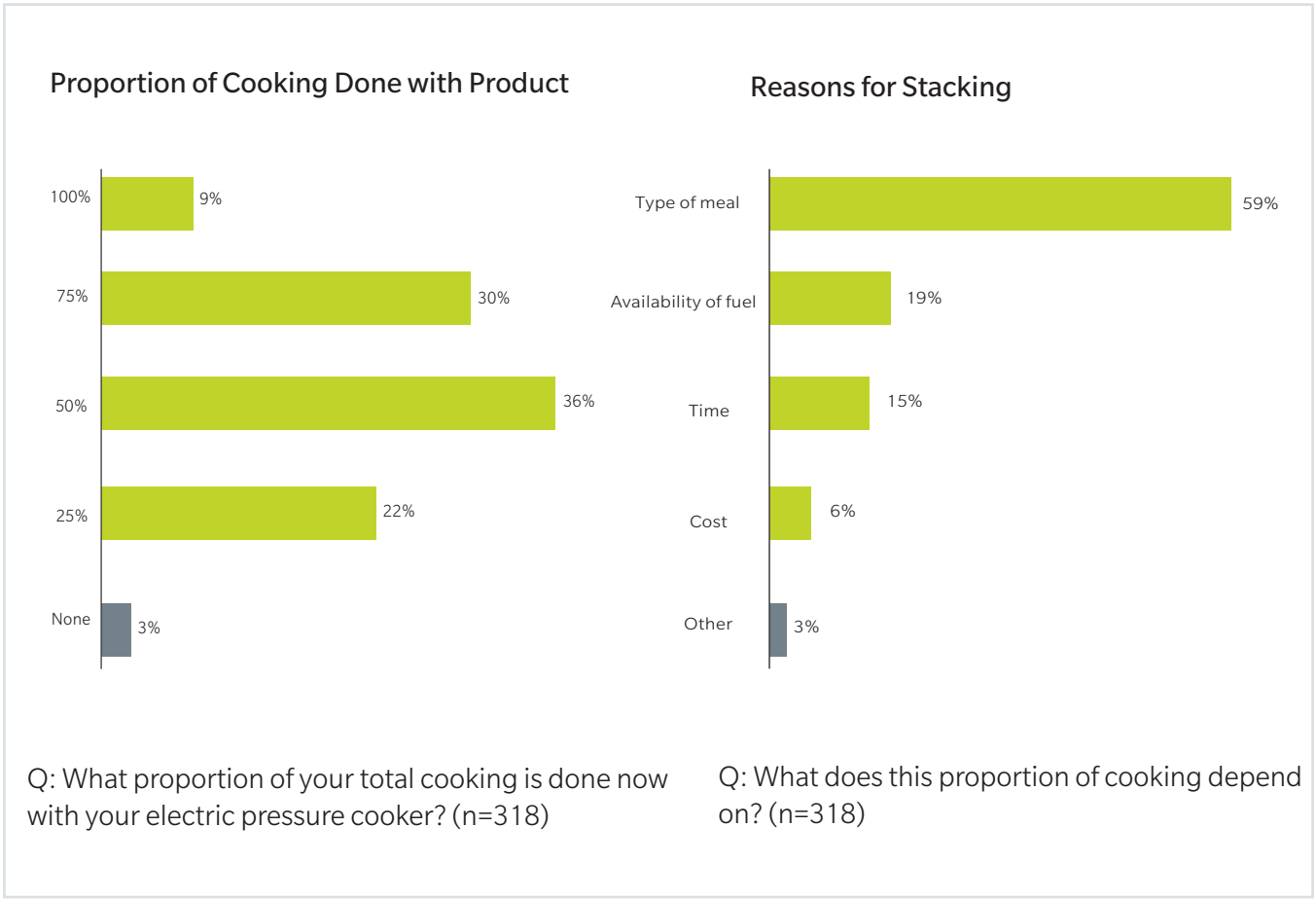
23. 60 Decibels and EPC Baseline Report.

to be driven by the e-cooking sector's quickly evolving business models and uncertainties on the regulations of externalities (i.e., tariffs, import tax), though the broader off-grid solar market has experienced significant risk dilution over the last decade.

Undeveloped EPC supply chain in SSA: Local supply chains, from sales and marketing to product repair services, are nascent and underdeveloped in SSA. In the Efficiency for Access interviews, 14% of customers reported experiencing a challenge using their purchased EPC, and 73% of these issues were unresolved. This can result in negative word of mouth, which can have a significant dampening effect on product sales in off- and weak-grid communities.

Cooking behaviours and fuel preferences: EPCs are relatively new cooking appliances in high potential markets in the Global South. The Efficiency for Access interviews showed that EPC consumers are likely to be early technology adopters. However, 43% of EPC consumers practiced some form of dirty fuel stacking, a complex behaviour in which a household cooks with polluting fuels and stoves in conjunction with cleaner fuels. Dirty fuel stacking is typically driven by a perception that EPCs should not be used to cook certain types of foods (Figure 9). Similarly, a 2019 A2EI study assessing the desirability of EPCs to biomass (wood and charcoal) reported that although EPCs were generally desirable and considered by users to save time and are easy to use, they were only used for certain meals.[24]

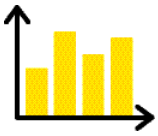
Figure 9. Proportion of Cooking Done with an EPC and Reasons for Fuel Stacking[25]



24. A2EI, The Desirability of Clean Cooking in Off-Grid Households, (2019), https://a2ei.org/resources/uploads/2019/06/A2EI_The_Desirability_of_Clean-Cooking_in_Off_Grid_Households.pdf.
25. Interviews were conducted with Global LEAP Awards + RBF consumers.

Scale-up innovative and equitable consumer financing

Lifetime fuel expenditure is the largest share of total cooking cost. EPCs have a lower lifetime cooking cost than biomass cooking. Cost analysis shows that AC and battery-supported e-cooking is the cheapest option in areas with grid coverage and low electricity tariffs. Though EPCs are highly desirable, lack of consumer financing prevents households from affording the relatively high upfront cost of this appliance. Innovative consumer financing mechanisms, such as pay-as-you-go (PAYGo) and on-bill financing, are essential to break down the high upfront cost of EPCs into smaller, more affordable payments. Financing also needs to be more equitable. Women are the primary users of cooking technologies, but many cannot access financial supports. Surveys in Kenya found only 54% of women could get a loan or financing for an EPC, compared to 74% of men. EPC companies should work with financial institutions to prioritise equity in loan design and roll out.



Increase the availability and quality of DC models

Off-grid solar often requires the use of DC-compatible appliances. The availability of DC EPCs remains limited and some products are either unsafe or poorly built. In addition, DC EPCs tested in the Global LEAP Awards took over an hour to pressurise, while AC EPC models averaged between 19 to 30 minutes, limiting DC EPCs' convenience appeal. DC EPC design and performance need continued improvements. Improving energy efficiency would reduce the size and cost of the energy system needed to run an EPC and open up large market segments.

Increase consumer awareness of EPCs

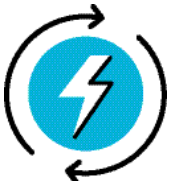
While fuel stacking is a norm in many cultures, doing so with polluting fuels such as biomass diminishes the health benefits and cost savings associated with EPCs. Therefore there is a critical need for consumer awareness initiatives to highlight and help consumers understand the value proposition of cooking with an EPC. These initiatives should center on the health benefits and encourage consumers to switch to cooking primarily with EPCs by demonstrating the range of local dishes the technology can prepare. Collaborative women's groups, hands on demonstrations, early adopter social media bloggers or other diverse channels can disseminate information on local recipes that are compatible with EPCs.

Conduct user-focused EPC research

Understanding how people actually use their EPCs has the potential to result in product design improvements that in turn accelerate market growth. EPCs come with a growing number of pre-programmed dishes that can be overwhelming for users unfamiliar with them. Incorporating user's preferences and product feedback is key to increasing the extent of EPC usage across the cooking menu. User focused EPC research that provides insights into how people cook and what local foods are compatible with EPCs (like MECS' cooking diaries) is needed.

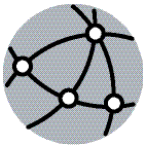
Give a central role to women in EPC programming and interventions

As the primary cooks, women hold many insights into appliance usage. They are also the decision-makers for EPC purchases. Companies, researchers and donors must increase the focus on women's needs and preferences in all EPC market building efforts. This could be particularly effective in the design and implementation of campaigns focused on reduction of fuel stacking.



Invest more in after-sales service

First-time EPC users may need instruction on proper EPC usage. The forthcoming Efficiency for Access EPC Consumer Insight Report reveals that first time users frequently encounter technical issues with performance, but these issues often go unresolved. This has the potential to dampen customer enthusiasm and drive negative word of mouth, inhibiting market growth. At the same time, EPC companies struggle to access the financing required to grow core sales operations, often without taking into account the additional capacity required to provide enhanced after sales service and customer support. While some companies have been able to provide some support by creating social media platforms for sharing recipes and tips, donors and investors must make more funding available for EPC companies to build this critical on-the-ground capacity.



Integrate cooking into electrification planning and renewable energy investments

EPCs have the potential to drive substantial increased household energy usage on the grid, as well as on mini-grids. Cooking accounts for a majority of household energy consumption across the Global South, yet national electrification plans and large-scale donor investments in electrification often omit cooking entirely. This disconnect results in a missed opportunity to increase electricity usage and utility revenues in areas where rapid grid expansion has resulted in heavy financial losses due to lack of uptake.

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Photo Credit: Shell Foundation

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