



# Mozambique

## eCooking Market Assessment

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## The MECS/EnDev eCooking Market Assessments

This study is one of a series of publications produced jointly by Energising Development (EnDev) and the Modern Energy Cooking Services (MECS) Programme. This series of market assessments offer strategic insight on the current state of electricity access and clean cooking in eight countries across sub-Saharan Africa and South Asia. These studies identify the key opportunities and challenges to the scale up of electric cooking in the coming decade and conclude with a series of recommendations for targeted interventions that could support the development of emerging eCooking sectors. The market assessments are structured according to the MECS transition theory of change (TToC), which consists of three interrelated dimensions: the enabling environment, consumer demand and the supply chain.

## Acknowledgements



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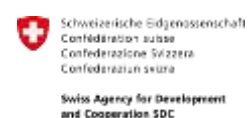


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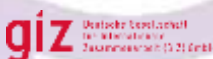
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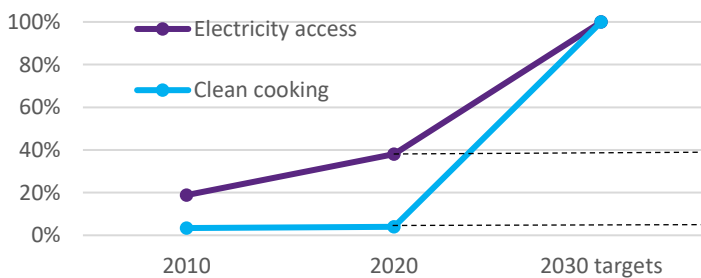
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# Executive Summary

The market potential for eCooking in Mozambique is growing rapidly given the upward rise in the proportion of the population with access to electricity, which has doubled, from 17% in 2009 to 34% in 2020 (ALER, 2021). Mozambique has an emerging eCooking sector, with 1.4% of the total population already cooking primarily with electricity (WHO, 2020). Access to electricity and eCooking is concentrated in urban areas, with 73% of the urban population now connected and UNDP (2020) reporting that 17% of the urban population cook with electricity. Mozambique’s low electricity tariff (\$0.10/kWh) means that eCooking is already the most affordable option, even without considering the generous lifeline tariff (\$0.02/kWh < 100kWh/month). Reliability and access, in particular in rural areas, hinder greater uptake, creating an opportunity to pilot battery-supported and solar-powered cooking. Further study of the existing eCooking market in urban areas involving primary research is needed to inform potential future interventions by gaining a deeper understanding of the key actors in the eCooking value chain and the key market segments that have already adopted eCooking.

Mozambique data snapshot from ALER (2021), MECS eCooking Global Market Assessment and Energising Finance 2021:



**34%** now connected to electricity, but still primarily cooking with polluting fuels

## Cooking energy

### Primary fuel use:

**1.4%** cook primarily with electricity



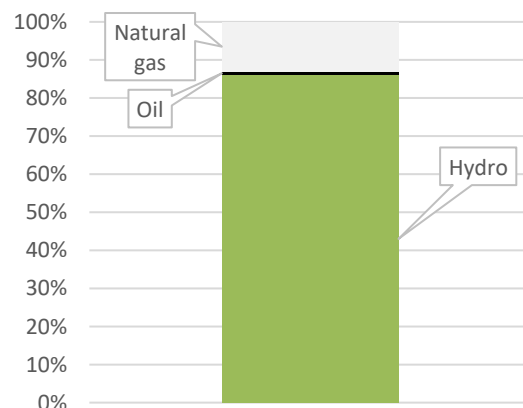
**22%** cook primarily with commercialized polluting fuels (charcoal)

**95%** cook primarily with polluting fuels

## Electricity generation

### On-grid:

**86%** renewable



**Surplus** power generation – exporting regionally

**Moderate reliability: 73%** power availability (SAIDI\*SAIFI=2,400hrs/yr)

## Off-grid:

Emerging mini-grid & off-grid sectors: 14,000 mini-grid customers, 50 mini-grid developers, 116,000 off-grid lighting/appliance customers

## eCooking GMA viability scores/rankings

Overall:	On-grid eCooking:	Mini-grid eCooking:	Off-grid eCooking:
<b>115<sup>th</sup>/130</b>	<b>0.34 – 115<sup>th</sup>/130</b>	<b>0.317 – 110<sup>th</sup>/130</b>	<b>0.279 – 121<sup>st</sup>/130</b>

## Key opportunities

- A strong and ambitious commitment by the Government of Mozambique (GoM) to achieve universal energy access, as well as clean cooking, by 2030.<sup>1</sup>
- Electricity access has doubled in the past decade (2009 – 2019), testament to the Government's commitment to accelerate electricity access.
- Very low cost of electricity: \$0.10/kWh regular tariff and \$0.02/kWh lifeline tariff for the first 100 kWh/month. eCooking is already the cheapest way to cook.
- Existing eCooking sector and proximity to other countries, such as South Africa, Zimbabwe and Zambia, where uptake of eCooking is already much higher can potentially yield positive spill over effects in Mozambique.
- Growth in underserved off grid energy markets, as well as the clean cooking sector.

<sup>1</sup> <https://www.seforall.org/system/files/2021-10/TTP-Mozambique-Brief.pdf>

## Key challenges

- Reliability challenges in electricity supply.
- High import costs for businesses in the sector, due to taxes and tariffs.
- Financial institutions (FIs) view of the sector as nascent limits partnership between FIs and eCooking companies to break down the high upfront cost of energy-efficient eCooking appliances for end-users.
- Low consumer awareness of electric cooking and low availability of electric cooking appliances outside of the Provinces of Maputo and Manica.

## Potential impacts of scaled uptake in most viable market segment

If 40% of Mozambique's grid-connected charcoal users (1.7m ppl, 0.4m HHs) switched to eCooking, the [WHO's BAR-HAP](#) tool suggests that:

- 1,412 DALYs/yr avoided
- 557,000 tonnes/yr CO<sub>2</sub>eq emissions reduced
- 71,000 tonnes/yr reduction in unsustainable wood harvest
- 104m hrs/yr of women's time saved (hrs/HH/yr)
- 5 months payback for eCooking appliances (\$80/HH upfront cost, \$195/HH/yr savings on fuel energy costs)
- n/a GWh demand for electricity stimulated

For further detail, please see *Appendix E: Impact of Scaled Uptake*.



# 1 Introduction

## The Mozambique eCooking Market Assessment

This study is one of a series of publications from GIZ/EnDev and the Modern Energy Cooking Services (MECS) Programme. This series of market assessments offer strategic insight into the current state of electricity access and clean cooking in eight countries across sub-Saharan Africa and South Asia. This study identifies the key opportunities and challenges to the scale-up of electric cooking in the coming decade and concludes with a series of recommendations for targeted interventions that could support the development of the eCooking sector. The market assessments are structured according to the MECS transition theory of change (TToC), which consists of three interrelated dimensions: the enabling environment, consumer demand and the supply chain.

## Clean cooking and electricity access in Mozambique

The market potential for eCooking is growing rapidly given the upward rise in the proportion of the population with access to electricity. Grid electricity access has doubled in the last ten years, from 15% in 2009 to 30% in 2019, as a result of grid extension, and an off-grid energy industry is beginning to emerge. Mozambique increased electricity access at a higher rate than the worldwide average among the 20 nations with the biggest access deficit. Rural electricity access also doubled approximately - from 2% to 5%, similar for urban access - from 39% to 73%. However there is a large gap between rural and urban energy access. The Electricity Company of Mozambique (EDM) now serves about 1.89 million clients, with around 1.76 million of them having prepaid metres. Currently, 82% of Mozambique's electricity generation capacity comes from hydro, but the country has a vast diversity of energy resources, approximately 88% of which are renewable, representing an aggregate potential of more than 23,026 GW.

Although there are only a few private companies commercialising off-grid technologies, they are consistently growing with a market potential of around 4 million households. Most of the country's direct experience with off-grid technologies derives from the implementation of pilot projects by the Fundo de Energia/National Fund for Rural Electrification (FUNAE)<sup>2</sup>. By the end of 2015, FUNAE had installed roughly 70 diesel-based mini-grids run by local communities, as well as approximately 1,500 solar home systems (SHS). Emerging new players in the off-grid area have begun to provide high-quality certified solar products with more flexible payment schemes, such as the pay-as-you-go (PAYGO) model, in the last two years. In Mozambique, PAYGO companies now serve roughly 70,000 consumers (ALER, 2021).

With only 9 SMEs registered with the Clean Cooking Alliance (CCA), the clean cooking sector in Mozambique has a small number of market players. NGOs have played a key role in increasing access to clean cooking solutions (CCS) through collaborations with international organisations and with 18 NGOs recognised by CCA as active in Mozambique. Although Burn Manufacturing is active in Mozambique, their electric stove, ecoa, is only available in Kenya. Other players that have recently entered the market include Green 66 – Garner Advisors, Ignite, Yuzu and Pamoja International.

eCooking is already present in Mozambique, with the WHO estimating that 1% of the population reportedly already cooking primarily with it and UNDP (2020) estimating this figure to be as high as 7%. Further expansion of eCooking is constrained by low overall access to the central grid and low reliability in places where the grid exists. According to the UNDP (2020), 17% of urban households already cook using electricity. However, stakeholder interviews indicate that electric cooking is not widely used due to grid reliability difficulties and bottlenecks in the distribution system that may constrain large-scale electric cooking.

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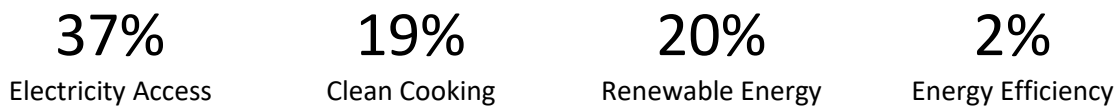
<sup>2</sup> <https://www.get-invest.eu/market-information/mozambique/>

## 2 Enabling environment

**eCooking policy outlook:** Mozambique’s National Electrification Strategy aims to achieve universal access to electricity and clean cooking by 2030, but the Strategy separates electrification efforts from clean cooking. The country’s electrification policy is enshrined in the National Electrification Strategy, but the clean cooking sector is not guided by a clear set of policies.

**Key policy stakeholders:** Electricity Company of Mozambique (EDM), Ministry of Energy (MIREME), Energy Fund (FUNAE), Conselho Nacional de Electricidade (CNELEC), National Inspectorate for Economic Activities (INAE), Mozambican Renewable Energy Association (AMER), National Petroleum Institute, and the Energy Regulatory Authority, “Autoridade Reguladora de Energia -ARENE”.

### RISE scores:



### Targets:

<b>Electricity access</b>	<b>Clean cooking</b>
100% electricity access by 2030 (grid/off-grid)	100% by 2030

### Key government/NGO programmes creating the enabling environment, in which eCooking can scale:

- GoM is reducing energy poverty by providing electricity to the poorest groups in remote areas using social tariffs. The World Bank-funded “Energy Development and Access” programme also aims at improving access to electricity. So far, 42,500 new peri-urban clients have been added to the distribution network. Through a combination of grid densification, mini-grids, and stand-alone SHS, the World Bank plans to help connect around 272,000 more households (1.35 million people) to electricity.
- GIZ/Energising Development Mozambique – EnDev Mozambique supports households in connecting to the national grid, assists in the distribution of high-quality photovoltaic products, and strengthens the distribution of clean cooking solutions. Between 2009 and 2021, over 1.9 million people gained access, including over 850,000 people with access to ICS and over 500,000 people gained access to the grid. EnDev has set up a results-based financing fund - FASER<sup>3</sup> (Fundo de Acesso sustentável as energias renováveis em Moçambique, Fund for Sustainable Access to Renewable Energies and Efficient Technologies) - hosted and managed by FDC (Foundation for Community Development) that through the support to more than 20 private companies, has provided access to more than half a million people since July 2019. One of the key energy segments targeted under FASER is clean cooking. A special incentive, the TierPlus, especially encourages the promotion of high-tier cooking solutions. Furthermore, an eCooking pilot has been recently kicked off with Burn Manufacturing to pilot the viability of commercializing EPC (Electric Pressure Cookers) in urban and peri-urban areas of Maputo.
- Furthermore, EnDev supports the GoM in establishing a SDG7 tracking tool that will help to monitor the progress on SDG7, including electricity and clean cooking.

- **BRILHO Mozambique** – This is a five-year £22.8 million energy access programme in Mozambique funded by FCDO. The programme, which runs 2019-2024, provides catalytic grants, RBF grants, and TA to private energy access and clean cooking companies.
- **Beyond the Grid Fund for Africa (BGFA)** – BGFA, through its second call for proposals (BGFA2), aims to accelerate the provision of off-grid energy services in Mozambique.
- **SDG Results: Access to Renewable Energy** – The objective of the SDF Results Facility is to provide 2 million people in developing countries, including Mozambique, with access to renewable energy.
- **EEP Africa** – The 15th EEP Africa Call for Proposals (CfP15) attracted applications from early stage off-grid and on-grid clean energy projects in active development phase in Southern and East Africa, including Mozambique.

### Key drivers/barriers in the enabling environment:

#### *Key drivers for eCooking include:*

- A strong and ambitious target/commitment by the Government of Mozambique (GoM) to accelerate universal energy access by 2030, as expressed in the 2018 national programme 'Energia Para Todos'.
- Electricity access has doubled in the past decade (2009 – 2019), testament to the Government's commitment to accelerate electricity access.
- Relatively low cost of electricity: US\$0.141 per kWh for households (compared to the continent's average) and US\$0.061 per kWh for businesses.
- Proximity to other countries, such as South Africa and Zambia, where eCooking is mainstream can potentially yield positive spill over effects in Mozambique.
- Inclusion of eCooking in the two main RBF funds active in Mozambique: BRILHO - which is one of the largest single-country RBF Funds for clean energy access (£22.8 million for 5 years), representing FCDO's contribution to Mozambique's Energy Africa Compact and universal energy access ambitions with support intended to leverage the private sector's innovation and investment capacity to accelerate growth in underserved off grid energy markets, as well as the clean cooking sector – and FASER, which is a basket fund established by the GIZ Energy Cluster in partnership with FDC and which currently executes more than 14 million Euro from Norway, Germany, Switzerland, The Netherlands and the EU for energy access and productive use of energy, with a significant portion flowing into the clean cooking sector.

#### *The key barriers in the eCooking ecosystem include:*

- Low access to electricity amongst the rural population
- Unreliable electricity supply – the reliability of grid-supplied electricity can be improved (Mozambique ranks 114<sup>th</sup> out of 137 countries)
- High import costs for businesses in the sector due to taxes and tariffs. Off-grid renewable energy solutions, such as eCooking appliances, are subject to a VAT rate of 17% and import duties vary between 7.5% and 20%, depending on the component type. It must be noted that in reality the tax brunt could rise to 30-40% if fees for customer, as well as "facilitation" fees, are taken into consideration<sup>4</sup>.
- The distribution infrastructure in the eCooking and off-grid sectors can be improved. There are high distribution costs due to the thinly dispersed population in rural areas and the vast

<sup>4</sup> [https://www.lightingafrica.org/wp-content/uploads/2019/07/Mozambique\\_off-grid-assessment.pdf](https://www.lightingafrica.org/wp-content/uploads/2019/07/Mozambique_off-grid-assessment.pdf)



distances between the ports of Nacala, Beira, and Maputo and the interior regions, which is worsened by the poor state of the road network, significantly driving up transportation and logistics costs.

- Financial institution's (FIs) view of the sector as nascent limits partnerships between FIs and eCooking companies to reduce the high upfront cost of available energy efficient, electric cooking appliances for the end user.
- Low consumer awareness of electric cooking and low availability of electric cooking appliances. However it must be noted that there is higher awareness in the Provinces of Maputo and Manica.

For further detail, please see *Appendix B: Enabling Environment*.



### 3 Consumer demand

#### What's on the menu?

In an average week, a typical Mozambican household might prepare:

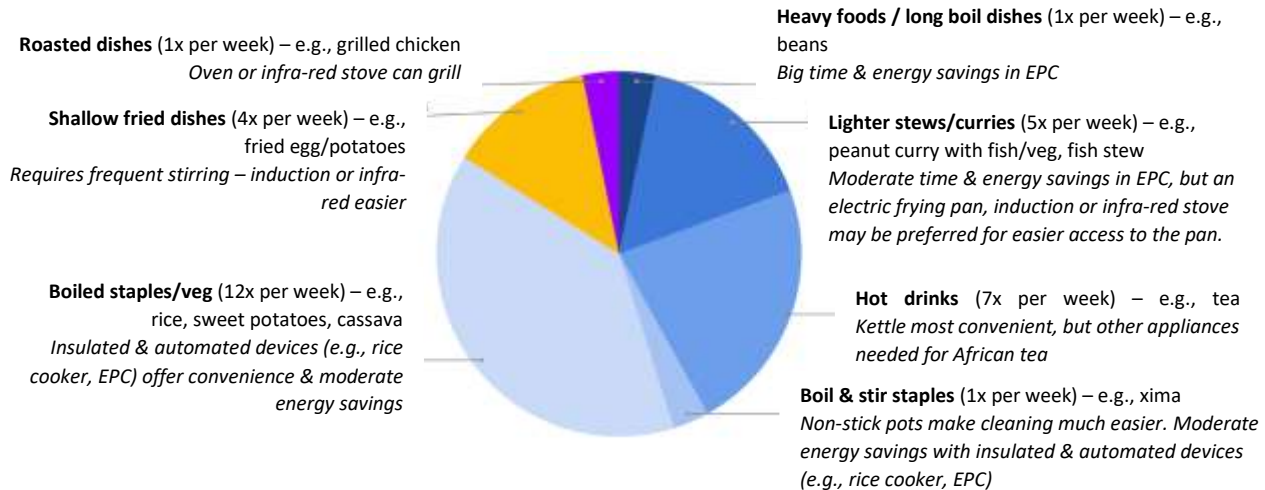


Figure 1: Visualisation of the results of a culinary analysis carried out during this market assessment by asking local team members to map out the dishes that a typical Mozambican household might prepare in an average week and assessing their compatibility with modern energy-efficient appliances.

Popular meal combinations in Mozambique include:

- **Rice and peanut curry** – rice is the most important staple meaning that rice cookers are likely to play an important role. Rice is often accompanied by a peanut curry, either fish or vegetable. Although boiling is the dominant cooking process, frying is also likely to be used to develop flavour. Fish and vegetables are relatively quick to cook, so induction/infra-red or an electric frying pan may be a good match.
- **Fried egg/potatoes and tea** – Although you can cook African tea very easily on an EPC (without pressurizing), many people will choose a sufuria (saucepan) on an infra-red/induction stove instead. The same applies for eggs/potatoes, but a shallow frying pan is likely to be preferred.

Most viable energy-efficient appliances: **rice cookers, induction, infra-red, electric frying pan, kettle**

Key marketing messages:

- **Energy-efficient appliances offer substantial time and cost savings and enable multi-tasking.**
- **EPCs are the cheapest and most convenient way to cook heavy foods, but as boiling times are relatively short (<1hr) for most dishes, EPCs are likely to offer less value than in other contexts where 'heavy foods' make up a greater proportion of the menu.**

**Key demand side barriers/drivers:**

A demand-side survey conducted by [Mudombi et al. \(2018\)](#) show that eCooking in Mozambique is driven by the following perceived advantages of eCooking appliances:

- Simplicity in usage
- Convenience
- More economical - cheaper than charcoal and LPG
- Clean to use

**However, large-scale uptake is constrained by:**

- Limited consumer knowledge on the associated health and safety benefits of eCooking
- Low consumer awareness of electric cooking and low availability of electric cooking appliances
- Cultural values and preferences
- Several suitable consumer financing mechanisms are already in use in Mozambique, but have not yet been applied to eCooking:
  - Several companies offering PayGo consumer financing for SHS.
  - Hire purchase model, where customers pay an initial deposit with the remaining balance spread over several months, is also widely available for the purchase of SHS and ICS.
  - Payment in instalments, with mobile money and through xitiques (informal savings groups) are also available for the purchase of electrical devices.

**Key demand creation programmes:**

- n/a

**Key market segments:**

- *Charcoal users* – 6 million Mozambicans use charcoal as their primary fuel and many more use it as part of their fuel stack. The majority of whom are in urban areas and are now connected to the national grid. Unlike firewood, charcoal is almost always purchased, creating an attractive existing expenditure to convert into electricity units. Charcoal is now the most expensive way to cook, leaving many looking for an alternative. Mozambique has a relatively low electricity tariff, so even cooking with inefficient electric appliances is already cheaper than charcoal. Energy-efficient appliances, such as rice cookers or induction stoves, offer a highly attractive modern alternative that can further reduce expenditures on cooking fuel. However the upfront cost is a substantial barrier for many who use charcoal, which can be purchased in small quantities.
- *Electricity users* – 0.3 million Mozambicans already cook primarily with electricity, the majority of whom are in urban areas. Neighbouring Zambia, Zimbabwe and South Africa already have much higher proportions of the population cooking with electricity and in South Africa most of the population already rely upon electricity for cooking.

For further detail, please see *Appendix C: Consumer Demand*.

## 4 Supply chain

**Key domestic eCooking appliance manufacturers:** n/a

**Key eCooking appliance distributors:** n/a

- eCooking products are mostly imported from South Africa (with a share of 56%), China (with a share of 25%) and Turkey (with a share of 6.75%)<sup>5</sup>, with ICS sometimes locally assembled using parts from South Africa. EPCs are mostly imported from India.
- Imported products are available through local distributors in urban areas, with the bulk of the more well-known retailers mentioned below having a presence in Maputo. eCooking appliances are not currently available in rural areas.

**Innovative eCooking pilot projects:** n/a

- Emerging mini-grid and SHS industries, but not yet experimenting with eCooking.
  - Some solar mini-grid pilots were financed by the Government of South Korea, but most installed mini-grids were financed by Fundo de Energia/National Fund for Rural Electrification (FUNAE)<sup>6</sup> and are diesel powered with operational and reliability concerns, an issue that is likely to slow the uptake of these larger systems.
  - Last year, FUNAE launched a tender for the development of 5 solar mini-grids, under the second phase of the Renewable Energy for Rural Development programme introduced by the government in 2018 and partly financed by Belgium. There is also an issuance of a request for expressions of interest to seek consultants to draft feasibility studies and project outlines for additional 11 solar mini-grids.
  - The focus on off-grid systems has shifted from standalone systems to mini-grids, due to their greater rural development potential. EnDev is currently prioritising pico-and micro-hydro (PHP and MHP), and small-scale PV, while BRILHO is expected to attract regional off-grid energy market leaders into the Mozambican market.

**Key supply side barriers/drivers:**

- eCooking is already a mainstream solution, with [UNDP \(2020\)](#) reporting that 17% of urban households already use electricity to cook.
- Strong supply chains for importation of appliances from China and South Africa are in place, with many companies now expanding their product range to energy-efficient eCooking appliances.
- Limited access to after-sales services for modern energy-efficient electric cooking appliances, especially outside of the major cities.
- Reliability of electricity prevents many from using it for cooking. Although it is improving in major cities, it remains poor at the fringes of the grid (slums, rural areas) and most of the country still off-grid.
- Several international companies who are piloting eCooking in other countries are operating in Mozambique, e.g., Engie, Burn Manufacturing. It is worthy to note that that an eCooking pilot has recently kicked off with Burn Manufacturing (supported by EnDev) to pilot the viability of commercializing EPC (Electric Pressure Cookers) in urban and peri-urban areas of Maputo

<sup>5</sup> <https://trendeconomy.com/data/h2/Mozambique/7321>

<sup>6</sup> <https://www.get-invest.eu/market-information/mozambique/>

Popular appliances in Mozambique today: n/a

**Relative cost of eCooking vs. popular cooking fuels:**

- The regular grid tariff is low enough that in urban grid connected areas, cooking with electricity is already the cheapest way to cook your food in Mozambique.
- The lifeline tariff is 5x lower and at 100kWh is generous enough to enable households with few other appliances to cook all their food with electricity at very low cost.
- Mini-grids are also obliged to charge the same tariff as the national grid in Mozambique, meaning that eCooking is just as cheap for mini-grid customers as it is for grid-connected households. It is important to note here that a new mini-grid regulation has been implemented which allow for Decentralised Renewable Energy providers to build mini-grid systems that will provide reliable, sustainable and affordable electricity to underserved rural communities in Mozambique.

**Grid electricity tariffs:**

- **Regular: 6.63 MZN/kWh** (0.10 USD/kWh)
- **Lifeline: 1.07 KES/kWh** (0.02 USD/kWh) < **100kWh/mnth**

**Mini-grid tariffs:**

- Universal tariff policy: mini-grids = grid tariff

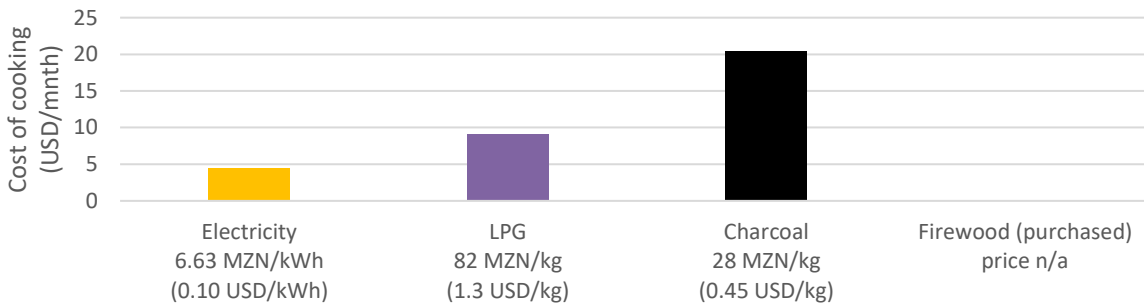


Figure 2: Cost comparison of different cooking fuels based on international averages for cooking energy demand from [ESMAP \(2020\)](#) and local electricity/fuel prices from [Mudombi et al. \(2018\)](#)

For further detail, please see *Appendix D: Supply chain & delivery models*.

## 5 Recommendations for interventions

Table 1: Decision matrix/board highlighting key factors and viability of specific interventions.

		Current status (inc. summary of key opportunities & challenges)	Recommended interventions
Market segments	On-grid	Mozambique has made significant progress to address the substantial access deficit, doubling the electrification rate in the past 10 years. Access rates in urban areas are also much higher than rural (73% vs. 2%). Mozambique's national utility is keen to stimulate demand for its surplus predominantly renewable electricity, so it is exporting to neighbouring countries and offering a very generous lifeline tariff (\$0.02/kWh < 100 kWh/month). Even the regular tariff is low (\$0.10/kWh). However many households are afraid to use above this amount for fear of being reclassified as a regular consumer and losing lifeline status. Reliability is still a challenge, especially at the fringes of the grid.	<p><b>Pilot battery-supported eCooking to mitigate grid reliability concerns.</b></p> <p><b>Target urban Mozambicans with awareness raising campaigns, focussing on the fact that electricity is already the cleanest and cheapest way to cook and that the lifeline tariff allowance is more than enough to allow low-income households to cook with energy-efficient appliances and make substantial savings on cooking fuels. Lobby the Utility to safeguard the lifeline amount for consumers to make eCooking more attractive is important.</b></p> <p>Develop consumer financing mechanisms that enable lower-income households to pay back the high upfront cost of eCooking appliances with the savings they will make on cooking fuels.</p>
	Mini-grid	Most existing mini-grids are diesel powered, however, there is a growing interest in the development of renewable energy mini-grids to improve rural electricity access, in particular solar mini-grids. The universal tariff policy means that Mozambique's lifeline tariff also applies to mini-grids.	<p><b>Support piloting of eCooking on solar and hydro mini-grids, leveraging the universal tariff policy to offer very affordable eCooking services using the generous lifeline tariff allowance.</b></p> <p>Support FUNAE and consultants developing EoIs to integrate eCooking into the planning for forthcoming solar mini-grids.</p>
	Off-grid (SHS)	The awareness and ownership are high for a relatively early-stage SHS market – 68% of households have heard of solar products and 27% of households already own and use them. However, none of Mozambique's SHS companies have started experimenting with eCooking yet.	Support Mozambican SHS companies to explore eCooking with grant funding for conceptual design and pilot projects.
TToC dimensions	Supply chain	<p>Supply chains for eCooking appliances are already in place, importing products from South Africa, China and India. However, the key market players, the types of appliances and the volumes of products imported are not known.</p> <p>Several multinational companies that are present in Mozambique are already piloting eCooking in the other countries that they operate in.</p>	<p><b>Support RBF funds like FASER and BRILHO to connect the electricity access and clean cooking dimensions to ensure demand is created for electricity from the onset, e.g., by incentivising the combined provision of electricity connections with eCooking appliances.</b></p> <p><b>Carry out a more detailed study of the existing eCooking market involving primary research to understand the supply chain, e.g., who the key market</b></p>

			<p><b>players are, the most popular types of appliances.</b></p> <p>Support multinational companies already piloting eCooking in other countries to expand their pilots into Mozambique.</p>
	<b>Consumer demand</b>	<p><a href="#">UNDP (2020)</a> report that 17% of urban Mozambicans already cook with electricity, however little is known about this market segment. Electricity already presents the cheapest option to cook in Mozambique.</p>	<p><b>Carry out a more detailed study of the existing eCooking market involving primary research to understand the key market segments who have already adopted eCooking, the compatibility of different types of appliances with local cuisine and the barriers constraining further uptake.</b></p>
	<b>Enabling environment</b>	<p>Current policy framework is supportive of electrification, but not clean cooking.</p>	<p>Raise awareness amongst policy makers of the need to address the clean cooking challenges, highlighting the role of eCooking in addressing them, whilst simultaneously stimulating demand for surplus renewable electricity.</p>



## 6 Appendices

### Appendix A: Electricity Access and Clean Cooking in Mozambique

Mozambique's National Electrification Strategy aims to achieve universal electricity access by 2030, but the Strategy separates electrification efforts from clean cooking. The country's electrification policy is enshrined in the National Electrification Strategy, but the clean cooking sector is not guided by a clear set of policies.

As we will see below most of the projects or programmes that seek to promote clean cooking and electricity access are largely donor-driven:

- In 2018, Mozambique's government established the National Energy for All Program in order to move the country closer to attaining SDG7 (universal electricity access) by 2030. The World Bank will provide financial assistance for the programme's implementation. The initiative prioritises grid development and densification, but it also recognises the importance of off-grid, renewable-energy-based solutions (such as solar home systems and RE-based mini-grids) in reaching the most distant locations and populations.
- GIZ Energy Cluster: Multi-donor programme Energising Development (since 2009, over 35 million EUR) with focus on energy access including cooking, Green People's Energy (GBE 2019-2023, 6 million EUR) with focus on productive use and social infrastructure, GET.invest (5.8 million EUR) and GET.transform (350,000 EUR)
- FASER implemented by FDC and funded by GIZ programmes EnDev and GBE, BMZ, NORAD and the EU.
- The Indicative Cooperation Programme (Belgian Technical Cooperation, BTC) works with the Energy Fund (FUNAE) to implement measures that establish a policy climate that is more favourable to private sector participation in rural electricity provision.
- Joint Declaration (JD) on Sustainable Energy – The EU Delegation to Mozambique, in collaboration with ESWG, is promoting the signing of a Joint Declaration (JD) on Sustainable Energy with the Mozambique government. The goal of this JD is to enhance access to sustainable energy, increase power generation from renewable sources, and improve energy efficiency.
- Renewable Energy and Adaptation to Climate Technologies (REACT) Challenge Fund (AECF) – The Challenge Fund is a DFID-funded initiative that runs from 2010 to 2021 with the goal of accelerating private sector investment and innovation that improves rural businesses and households' access to low-cost, clean energy and/or provides products and services that help rural people and farmers adapt to climate change. The Fund supports innovative household solar enterprises in Africa (including Mozambique) with the goal of increasing access to affordable electricity in rural and peri-urban areas via off-grid and solar home systems.
- Sustainable Economic Development, KfW – In 2014, the government established a credit line of \$16.7 million under the Sustainable Economic Development project, with financing from KfW, to provide working capital loans to small and medium-sized businesses engaged in the off-grid solar industry.
- Rural Energy for Rural Development (RERD) – This is a \$13.6 million Belgium (Enable)-funded programme with the objective to support FUNAE to improve its capacity on planning and project management and fund the construction of hydro mini-grids.
- ProEnergia is a \$16 million World Bank-funded project, which runs from 2018-2023, and aims to increase access to electricity service in Mozambique. There are three components to the project, the first component being peri-urban and rural electrification. The second component is the off-grid electrification - this includes two subcomponents: mini-grids, and off-grid RBF. Finally, the third component is the technical assistance and implementation support to EDM and FUNAE.
- The Beyond the Grid Fund for Africa is a US\$13 million project funded by the Embassy of Sweden to provide financial incentives for private firms for energy solutions for off-grid. It is managed by NEFCO and implemented by REEEP, and aims to replicate the results of the Beyond the Grid Fund for Zambia ([www.bgfz.org](http://www.bgfz.org)) and bring clean, affordable off-grid energy access to millions of people in Burkina Faso, Liberia, Mozambique and Zambia

#### 2030 Targets

Government of Mozambique aims to achieve a target of 50% electrification by 2023, and universal access by 2030.

- *What proportion will be grid/mini-grid/off-grid (SHS)?*



The World Bank through its Mozambique Energy for All (ProEnergia) Project plans to support the electrification targets by connecting 250,000 customers through grid densification, 4,000 through mini-grids and 18,000 by incentivising the private sector-led

SHS market. However, over the course of the project's five years (2019-2023), this only translates to 54,400 extra households per year, which is insufficient to fill EDM's annual shortfall of 75,000 households if it is to meet the government's goal of 50% electrification by 2023.

- *What is the targeted generation mix for each?*

Grid: hydro 75%; gas 5%; solar 1%; others 19%

Off-grid: N/A

- *What is the targeted share of clean cooking and eCooking specifically?*

To the best of our knowledge there is no targeted share of clean cooking and eCooking specifically.

## Appendix B: Enabling Environment

### *Key drivers for eCooking include:*

- A strong and ambitious target/commitment by the Government of Mozambique (GoM) to accelerate universal energy access by 2030, as expressed in the 2018 national programme 'Energia Para Todos', and the 2013 National Biomass Energy Strategy (BEST) to ensure access to clean cooking including eCooking.
- Electricity access has doubled in the past decade (2009 – 2019), testament to Government's commitment to accelerate electricity access.
- Relatively low cost of electricity: US\$0.141 per kWh for households (compared to the continent's average) and US\$0.061 for businesses.
- Proximity to other countries such as South Africa and Zambia where eCooking is mainstream can potentially yield positive spillover effects in Mozambique.
- Inclusion of eCooking in one of the largest single-country RBF (BRILHO) on clean energy access currently in implementation. BRILHO is a £22.8 million 5-year programme, representing FCDO's contribution to Mozambique's Energy Africa Compact and universal energy access ambitions with support intended to leverage the private sector's innovation and investment capacity to accelerate growth in underserved off grid energy markets as well as the clean cooking sector.
- Fiscal benefits for renewable energy investors. These benefits include discounts in corporate income tax, import duty exceptions, deductions in the taxable income, but it must be noted that these only apply if the investments generate electricity that feed into the national grid.

### *The key barriers in the eCooking ecosystem include:*

- Low access to electricity amongst the rural population
- Unreliable electricity supply – The quality of grid-supplied electricity can be improved (Mozambique ranks 114<sup>th</sup> out of 137 countries)
- High import costs for businesses in the sector due to taxes and tariffs. Renewable energy solutions such as eCooking appliances are subject to VAT rate of 17% and import duties vary between 7.5% and 20% depending on the component type. It must be noted that in reality the tax brunt could rise to 30-40% if fees for customer as well as "facilitation" fees are taken into consideration.<sup>7</sup>
- The distribution infrastructure in the eCooking and off-grid sectors can be improved. There are high distribution costs due to the thinly dispersed rural areas and the vast distances between the ports of Nacala, Beira, and Maputo and the interior regions, which is worsened by the poor state of the road network, significantly driving up transportation and logistics costs.
- Financial institutions (FIs)' view of the sector as nascent limits partnership between FIs and eCooking companies to reduce the high upfront cost of available energy efficient electric cooking appliances for the end user.
- Low consumer awareness of electric cooking and low availability of electric cooking appliances, however it must be noted that there is higher awareness in the Provinces of Maputo and Manica.

<sup>7</sup> [https://www.lightingafrica.org/wp-content/uploads/2019/07/Mozambique\\_off-grid-assessment.pdf](https://www.lightingafrica.org/wp-content/uploads/2019/07/Mozambique_off-grid-assessment.pdf)

GoM is reducing energy poverty by providing electricity to the poorest groups in remote areas using social tariffs. The World Bank-funded programme called Energy Development and Access Project is also improving access to electricity. So far, 42,500 new peri-urban clients have now been added to the distribution network. Through a combination of grid densification, mini-grids, and stand-alone SHS, the World Bank plans to help connect around 272,000 more households (1.35 million people) to electricity.

**GIZ/EnDev Mozambique** – EnDev Mozambique supports households in connecting to the national grid, assists in the distribution of high-quality photovoltaic products, and strengthens the distribution of clean cooking solutions. Furthermore, an eCooking pilot has been recently kicked off with Burn Manufacturing to pilot the viability of commercializing EPC (Electric Pressure Cookers) in urban and peri-urban areas of Maputo.

**FASER fund** - EnDev has set up a results-based financing fund - FASER<sup>8</sup> - hosted and managed by FDC (Foundation for Community Development) that, through the support to more than 20 private companies, has provided access to more than half a million people since July 2019. One of the key energy segments targeted under FASER is Clean Cooking. A special incentive, the TierPlus, especially encourages the promotion of high-tier cooking solutions.

**BRILHO<sup>9</sup> Mozambique** – This is a five-year £22.8 m energy access programme in Mozambique funded by FCDO. The programme, which runs 2019-2024, provides catalytic grants, RBF grants, and TA to private energy access and clean cooking companies. It also supports the development of the off-grid energy ecosystem, including info sharing, quality standards, and advocacy on policy and regulations. As highlighted above, the technologies eligible for the BRILHO RBF includes eCooking solutions. There is an ongoing collaboration between SNV Mozambique and Burn Manufacturing to contribute to scaling up eCooking in the country.

**Beyond the Grid Fund for Africa (BGFA)** – BGFA, through its second call for proposals (BGFA2), aims to accelerate the provision of off-grid energy services in Mozambique<sup>10</sup>.

**SDG Results: Access to Renewable Energy** – The objective of the SDF Results Facility is to provide 2 million people in developing countries, including Mozambique, with access to renewable energy. Projects funded under this Facility should contribute to increasing access to electricity in homes as well as access to clean cooking (including eCooking).

**EEP Africa** – The 15th EEP Africa for Proposals (CfP15) attracted applications from early stage off-grid and on-grid clean energy projects in active development phase in Southern and East Africa including Mozambique.

BRILHO is actively promoting eCooking in Mozambique through their RBF programme. So far, it's contracted three clean cooking companies to help them scale up the distribution of higher tier cooking solutions including eCooking appliances. Preliminary lessons from the programme include the lack of support from financial institutions to partner participating companies to offer consumer financing to end-users. This is affecting the scale-up efforts for the sector.

## Appendix C: Consumer Demand

A demand-side survey conducted by Mudombi et al. (2018) show that eCooking in Mozambique is driven by the following perceived advantages of eCooking appliances:

- Simplicity in usage
- Convenience
- Cheaper than charcoal
- More economical
- Clean to use

However, large-scale uptake is constrained by:

- Limited consumer knowledge on the associated health and safety benefits of eCooking
- Consumer preference – still a heavy reliance on charcoal, firewood or other biomass fuels for cooking: 95% of the population heavily rely on polluting fuels and technology for cooking.
- Low consumer awareness of electric cooking and low availability of electric cooking appliances

<sup>8</sup> [www.faser.co.mz](http://www.faser.co.mz)

<sup>9</sup> <https://brilhomo.com/about-us>

<sup>10</sup> <https://beyondthegrid.africa/news/the-beyond-the-grid-fund-for-africa-launches-its-second-call-for-proposals-for-micro-grid-enterprises-in-mozambique/>

- Cultural values and preferences
- Educational level

Campaigns to raise awareness among potential users should emphasise the health and safety benefits of using modern energy cooking solutions. Considering that Mozambique is a low-income country, with 42% of the population living below the poverty line, it is important to also drive home the potential cost-savings that accrue to the user from the use of eCooking compared to other lower tier technologies like charcoal. Demonstrations and hands-on experience help consumers gain trust and develop an interest in eCooking. This would also play an important role in educating people on how to utilise the product/appliance and increase their technological know-how of the product. Consumers desire products that are appealing to them and make them feel proud to use them.

The urban population has seen substantial uptake of eCooking with 17% of them already cooking with electricity. Access to electricity is currently low in rural Mozambique, however there is a steady growth of minigrids to support rural electrification, which can potentially

## Appendix D: Supply chain & delivery models

- *What are the key supply side barriers/enablers for eCooking?*

Please see section on enabling environment

Barriers:

1. Energy access (overall: 29%; urban: %/rural 4.9%)
2. Lack of access to financial services for clean cooking companies
3. The national utility EDM's fragile financial health undermines its capacity to fund capex related to electricity access expansion.
4. Off-grid market is nascent.
5. Weak supply of skills in the labour market
6. Lack of clarity on the institutional landscape for rural electrification.

- *Which private sector organisations, research institutions, parastatals or NGOs are already piloting eCooking and which are already offering commercial eCooking products/services?*

With only 9 SMEs registered with Clean Cooking Alliance (CCA), Mozambique has a small number of market players. NGOs have played a key role in increasing clean cooking solutions (CCS) access through collaborating with international organisations, with 18 NGOs recognised with CCA as active in Mozambique<sup>11</sup>. Although Burn Manufacturing is active in Mozambique, their electric stove, ecoa, is only available in Kenya. Other players that have recently entered the market include Green 66 – Garner Advisors, Ignite, Yuzu, Pamoja International

- *Which business models have been piloted and which have reached scale in the clean cooking and electrification sectors?*

Clean cooking solutions, such as ICS, are sold by promoters to low-income households in peri-urban areas of Maputo, using the door-to-door sales approach. Household and data from each sale are recorded for tracking purposes. Companies receive incentives from donor funded programs, so they can sell stoves at affordable prices for low-income households with lower purchasing power. A good example of this kind of distribution model was implemented by FASER with a COVID-PLUS incentive, in order to minimize the financial and economic impact caused by COVID-19 pandemic in Mozambique. Payments for the stoves are made in instalments to enable the population to afford them (the beneficiary makes a 30% down payment and the remaining balance is paid in average over six months period).

<sup>11</sup> <https://cleancookingalliance.org/sector-directory/>

PAYGO has reached scale in the purchase/sale of SHS and mini-grids, however it is yet to even be piloted in the eCooking sector although BRILHO is planning to incentivise the provision of PAYGO in the eCooking sector in its next call for applications. Hire purchase is also available for the purchase of mini-grids and SHS.

Although we do not have the exact price points for clean cooking appliances in Mozambique, research by MECS/E4I indicates the following price ranges for clean cooking in sub-Saharan Africa (including Mozambique):

Table A1: Pricing of Clean Cooking

Appliance	Price Range
Improved biomass stoves	\$5 to \$40
LPG solutions	\$30 to \$100 (depends on size of cylinder and accessories)
Ethanol stoves	\$25 to \$36
Electric hotplates	\$10 to \$30
Induction stoves	\$35 to \$80
Microwaves	\$30 to over \$110
EPCs	\$60 to over \$100
Gasification stoves	\$110 to \$130
Biodigesters	\$500 to \$750
Battery-supported eCooking appliances, e.g. solar electric systems	\$150 to \$2,000

Source: MECS/E4I (2021)<sup>12</sup>

- *Are any manufactured/assembled locally?*

eCooking products are mostly imported from South Africa (with a share of 56%), China (with a share of 25%) and Turkey (with a share of 6.75%)<sup>13</sup>, with ICS sometimes locally assembled using parts from South Africa. EPCs are mostly imported from India. International organizations, such as AVSI and SNV are the main driver for imported CCS including EPCs, bringing in Envirofit and Rocket Works Chazam ICS from China and South Africa, respectively. Gross margins are reportedly under 30%, and credit sales of up to 30 days are provided to consumers. Private sector organisations that buy these imported CCS include Shanti Trading and RG Industries.

Imported products are available through local distributors in urban areas, with the bulk of the more well-known retailers mentioned below having a presence in Maputo. eCooking appliances are not currently available in rural areas.

- *Which organisations are importing (or manufacturing/assembling) eCooking appliances?*

International organizations such as AVSI and SNV are the main drivers for imported ICS, bringing in Envirofit and Rocket Works Chazam ICS from China and South Africa, respectively. In 2012, CleanStar established one of the first ethanol manufacturing plants for cooking solutions. It is one of the few vertically integrated players in Mozambique and has the capacity to produce 2 million litres of ethanol per annum. The entire marketing and sales operation of CleanStar is branded

<sup>12</sup> <https://mecs.org.uk/wp-content/uploads/2021/07/Clean-Cooking-Financing-Appliances-for-End-Users.pdf>

<sup>13</sup> <https://trendeconomy.com/data/h2/Mozambique/7321>

under NDZiLO to enhance visibility and customer loyalty. Companies such as CleanCook, Restio Energy and RealRelief are involved in marketing and distribution of clean cooking solutions in Mozambique. These companies also offer after-sales service.

Burn Manufacturing operates in Mozambique, but their electric cookers are not yet available in the country. BRILHO is working with the company to introduce their electric cookers in Mozambique, as well as support their scale up activities.

The Mozambican government has appointed Petromoc as the official importer of cooking gas (LPG - liquefied petroleum gas) in the country. Petromoc has the power to sign contracts with suppliers to ensure constant supply of LPG in the country. Distribution of LPG in Maputo is carried out primarily by PetroGAS, a subsidiary of Petromoc, and GALP. AFROX and VITAGAZ are focused on the rest of the country.

## Appendix E: Impact of Scaled Uptake

This section explores the likely costs and benefits for one simple illustrative scenario of scale-up of eCooking in selected key segments. The World Health Organisation (WHO) revised “Benefits of Action to Reduce Household Air Pollution” (BAR-HAP) tool<sup>24</sup> has been applied to quantify the expected financial costs, health and environmental benefits of the scale-up.

The scenario modelled is chosen to reflect the first part of the MECS programme’s suggested “40, 60, by 2030” goals: a target of 40% for all households connected to grid or off-grid electricity in Low and Middle Income Countries to be using it for cooking by 2030, and a target of 60% of households utilising modern energy for cooking to be utilising energy generated from low carbon sources by 2030 (low carbon interpreted here to include electricity coming from relatively low carbon fuel mix, and excluding fossil-derived LPG). For this illustrative analysis of costs and benefits, the focus is just on urban households that are grid connected, but currently cooking with charcoal. While specific data are not available for this demographic, an estimate was made based on the evidence earlier in the report about different categories of users, suggesting approximately 1 million households. Consistent with the MECS 40% goal, the scenario models transition of 40% of those, so 400,000 households. Details are in the first part of the table. BAR-HAP models a ramp-up of transitioning households over the first 5 years to 2025 and then a further 5 years operation.

BAR-HAP has been implemented here using its policy option of a ban on charcoal use, which comes in gradually from 2020 to 2030. This is clearly not a realistic policy and is simply used here to effect the transition wanted for this illustration, with clarity about the impacts and where costs fall; it can be regarded as a proxy for other specific actions used to mobilise a major transition from charcoal to eCooking. The assumption is that transitioning households are fuel stacking, with 20% of cooking still delivered using charcoal. The full costs of the new MECS devices have been assumed to be paid for by the Government, as a convenient simplification for this illustration. Other policy options that could have been modelled would see a different distribution of stove and fuel costs and savings between parties. eCook devices are assumed to cost \$80 and to have an average efficiency of 75% (MJ input to MJ useful heat output). eCooking is assumed to save 30% of the typical 2.6 hours cooking per day. Mozambique’s grid electricity generation mix is dominated by hydro (75%) with most of the balance from oil-fired generation (19%) and a small amount from gas-fired generation. Whilst the aim is to grow the role of renewables, the mix is already very low carbon and so the existing mix has been used to calculate emissions.

The lower part of the table shows the outputs of BAR-HAP for the modelled scenario. The figure shows the structure of costs and benefits.

Table A2 Cost-Benefit Analysis of Scaling up eCooking

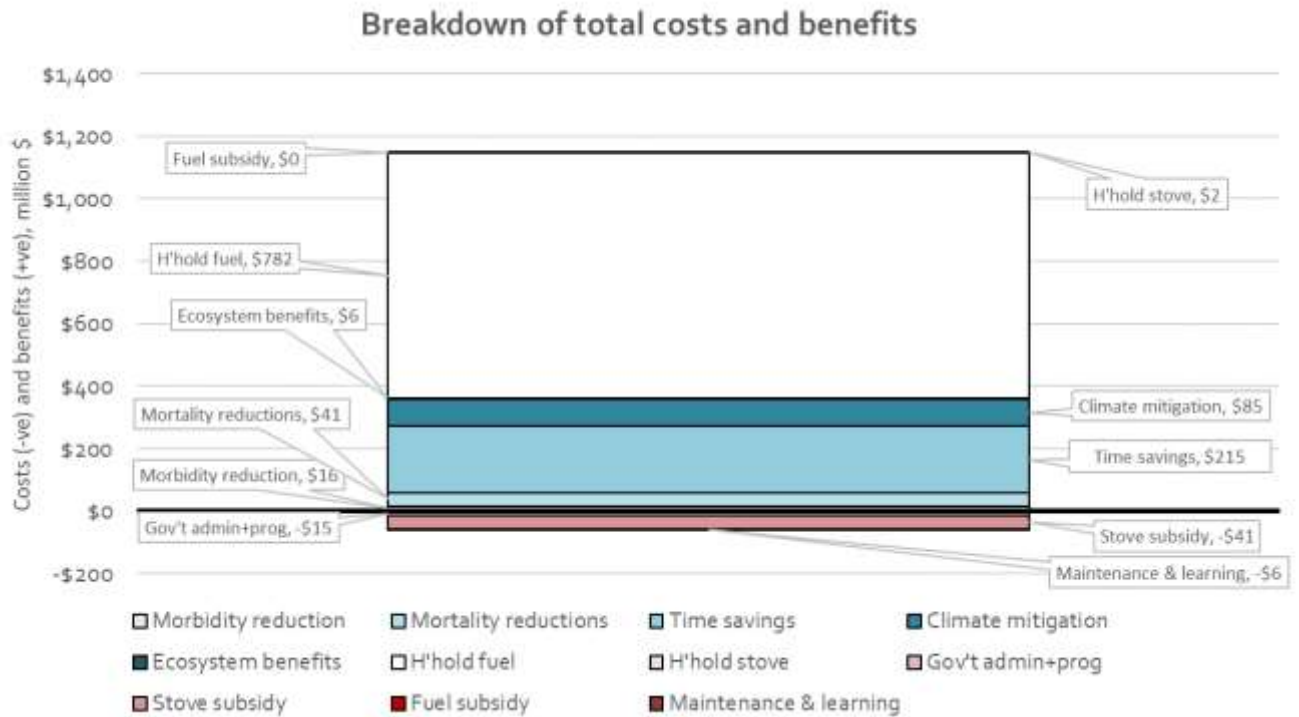
Grid connections projections and eCook target		Population	households	% grid connected		
National population, 2020		30.80	7.05			
Grid connections, 2020		9.70	2.22	31%		
Of which, using charcoal		4.27	1.00			
<b>Scenario modelled</b>						
Transition from charcoal to eCooking		1.71	0.40			
<b>Costing (costs are -ve, benefits are +ve)</b>						
				\$/yr	\$M total	\$total per household transitioning
<b>Total present value (ie net social benefits of the transition)</b>				108,581,635	1,086	2684
<b>Total costs of transition, government+private</b>				72,225,396	722	1785
<b>Private cost to households: total</b>				77,745,096	777	1922
	Stove			162,581	2	4
	Fuel			78,174,001	782	1932
	Maintenance			-591,486	-6	-15
<b>Costs to government: total</b>				-5,519,700	-55	-136
	Stove			-4,064,520	-41	-100
	Fuel			0		
	Admin+Programme			-1,455,180	-15	-36
<b>Health, Time, and Environmental Benefits: total</b>				Physical: change/yr	Physical: % of national cooking total	
<b>Health impacts total: DALYs avoided</b>				1,412		
	Mortality reduction	DALYs		5,745,797	57	142
	Mortality reduction	YLL	968	0.1%	4,099,250	41
	Mortality reduction	Lives	86	0.2%		
	Morbidity reduction	YLD	444	0.4%	1,646,547	16
	Morbidity reduction	Cases	2,185	0.4%		
<b>Time savings</b>				104,524,674	3.5%	215
	Time savings per adopting household	Hours/HH	258			
<b>CO2-eq reduction (CO2,CH4,N2O)</b>				557,685	5.2%	85
<b>Unsustainable wood harvest reduction</b>				71,033	2.3%	6

Note: costs are discounted across programme period.  
Totals are Net Present values; costs/year are NPV divided by the ten years of the programme

The table shows that while this transition would cost government some \$140 per household for equipment and programme costs, it would save households 15 times that in reduced energy bills over the ten years of the programme: electricity tariffs are exceptionally low. Furthermore, health benefits would include more than 80 lives saved per year. Some 2% of current unsustainable wood harvesting would be avoided. These impacts may seem modest, but this scenario is targeting only 5% of the total population. The transition from charcoal to electric cooking would make a significant reduction in greenhouse gas emissions, due to the importance of hydro in the fuel mix.

The chart summaries the various physical and financial impacts of the transition in monetary terms. The social benefits from avoided time spent cooking are significant, reflecting mainly time savings using an EPC, and the opportunity cost for peoples' time, as used in BAR-HAP. However, this saving is not as large as for some countries: it is assumed here that average cooking time before transition is 2.6 hours/day, which is lower than suggested for some others. Health benefits are also considerable, mainly associated with the lives saved. By far the largest benefit though comes from reduced fuel costs to households. Charcoal prices in urban areas were assumed to be \$0.4/kg, and electricity tariffs are very low: the existing 0-100kWh/month lifeline tariff of \$0.015 was used and combined with cooking energy savings from use of more efficient electric devices this leads households to very significant cost reductions. The largest element of cost is from the purchase of modern stoves by government.

Figure 3 Breakdown of total costs and benefits



This is an impact analysis for one simple scenario for just one particular segment (grid connected charcoal users) of Mozambique's population. The scenario has very significant net social benefit overall, based on the WHO's physical impact and impact monetisation methodologies

