Market assessment for modern energy cooking services in Malawi

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Executive Summary

This working paper presents in country research on the opportunities, barriers and perceptions around modern energy cooking in Malawi, and provides insight into cooking practises in different areas of the country. As part of the MECS programme, this paper is provided in order to improve understanding of Malawi's cooking ecosystem, with a view to encouraging an accelerated scale up of the transition from cooking with biomass to cooking with modern fuels.

The paper is presented as a market assessment for modern cooking in Malawi and is based on evidence collected through in-country partners and networks using a methodology inspired by previous MECS studies in neighbouring countries (Tanzania and Zambia in particular). The market assessment combines the collection of a top-down perspective via interactions with experts from Malawi's clean cooking sector (facilitated by United Purpose (UP)) and a bottom-up perspective through household surveys (facilitated by Community Energy Malawi (CEM)).

Background - Malawi

Malawi has a population of about 18 million and a largely rural (83%), agrarian economy (85% of employment). Poverty is widespread (70% earn under $1.90 per day and 22% under $0.20 per day). 18% of the population have access to electricity which is unreliable due to insufficient supply capacity.

Energy needs are mostly served by charcoal and wood for cooking, and paraffin, candles and non-rechargeable batteries for lighting. In fact, 99% of household energy is supplied by biomass. Consequently, Malawi's forests are depleting fast, with 32% reduction in forest cover in less than 40 years, leading to land degradation and soil erosion around watersheds. This compounds electricity supply shortages (almost all generation is hydroelectric) and increases the risk of flooding and its damage to farmland.

Most attention and interventions in Malawi's clean cooking sector have focussed on propagating improved firewood stoves in rural areas. National policies show that the political environment is beginning to recognise the importance of a transition to modern energy cooking services, LPG and electric cooking in particular, but very little data is available regarding cooking practises (i.e. how, what and with what Malawians cook).

Household level - Cooking fuels, devices and expenditures

Utilising the web-based surveying tool kobocollect[1], this study collected 57 household surveys (14 urban, 14 peri-urban and 29 rural) administered by CEM to collect information on cooking practises. The survey was split into three sections: participant and household background information, general cooking information and "indicative cooking diary". The following page summarises the findings of this survey, including differences in cooking fuel and device preferences, expenditures on cooking fuels and cooking habits.

[1] https://www.kobotoolbox.org/

Urban (100% grid connected)

Main cooking fuel: Electricity (93%), 14% also use charcoal, 12% also use LPG

Other devices: Kettle (36%), Rice cooker (21%), Microwave (14%)

Expenditure

Electricity: 4000-8000 MWK per capita per month
Weekly top-ups.

LPG: 6kg cylinder at 15000 MWK
or 9kg cylinder at 25000 MWK
twice a month - every three months

Cooking habits: Primarily cook with electricity (use charcoal only as a backup fuel during blackouts). Do not cook some meals (approximately 1/3 of the time) particularly at weekends.

Peri-urban (100% grid connected)

Main cooking fuel: Charcoal (71%), electricity (57%)

Other devices: Kettle (50%)

Expenditure

Electricity: 2000-6000 MWK per capita per month
Monthly top-ups

Charcoal: 1000-3000 MWK per capita per month
small bags at 300-500 MWK daily
or large bags at 3000-5000 MWK
weekly/monthly

Cooking habits: Three roughly equal groups use charcoal only, electricity only or both. Almost always cook breakfast and dinner, 1/3 of the time do not cook lunch.

Rural (off-grid with recently installed minigrid)

Main cooking fuel: Firewood (97%)

Other devices: None

Expenditure: None (gather wood for free)

Cooking habits: Always cook all meals and almost always use firewood (a very limited number do use charcoal in small quantities).

Household level - Additional findings

Core dishes

Meals in Malawi's urban, peri-urban and rural areas are commonly made up from 10 core dishes which constitute 90% of all the dishes collected in the survey (listed below). Modern energy cooking devices would need to be proven appropriate for cooking these dishes (at a minimum) in Malawian contexts in order to be successful at a large scale.

Breakfast	
Tea/Coffee	Eggs
Porridge	
Potatoes	

Lunch/Dinner	
Nsima/rice	Fish
Beans	Eggs
Vegetables	Meat/poultry

Other findings included differences between dish preferences when comparing the rural sample with the peri-urban and urban samples. Nsima/rice was more popular and beans more common in the rural sample, while meat/poultry was cooked more often in the urban and peri-urban samples. In addition, the rural sample cooked eggs for breakfast far less often than the urban and peri-urban samples, while the opposite was true for lunch and dinner. However, these findings can only be seen as indicative due to the small sub-sample sizes.

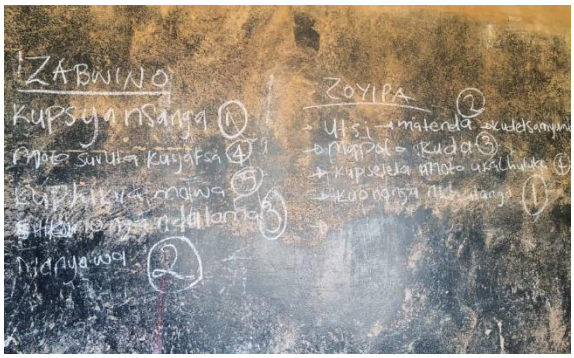
Charcoal and firewood are undesirable fuels

It appears that Malawian cooks prefer not to use charcoal when they have electricity as an alternative as shown by indicative diary data below:

Proportion of respondents who own a device which choose to cook with it [all locations aggregated]

	#	*Firewood – 3 stone*	*Charcoal – stove*	*Electric – hotplate*	*Electric – kettle*
Breakfast (drink)	79	100%	30%	53%	95%
Breakfast (dish)	79	100%	55%	89%	N/A
Lunch/dinner (dish)	341	100%	52%	79%	N/A

Focus group responses agreed: charcoal is used either for "cooking meals when there is no electricity" or "cooking meals when it's raining" and is considered dirty, bad for health, and the long-time taken to start a charcoal fire is inconvenient. Similar views were gathered about firewood; smoke was seen as an important issue, as well as being particularly challenging to gather in the rainy season (cold and slippery conditions) and cook with (dampness of wood).



Focus group responses recorded (left), focus group participants and facilitator (right)

Indicative diaries – an efficient method for gathering cooking practises data

The detailed insights, particularly what and with what Malawians cooked, were gathered by a novel survey approach referred to as an indicative cooking diary. This approach used multiple choice questions to produce similar data to full cooking diaries in a quickly and easily deployable format: household cooks were asked to generate a menu for two typical days including the dish and devices device they would usually use to cook each dish.

Alongside providing useful insight, these findings demonstrate the ability of the indicative diaries survey tool to gather data on cooking practises across populations in a fast and resource efficient way. Requiring a small amount of refinement for the local context (e.g. altering meal and dish options to match local cuisines) the survey has the potential to uncover national, regional and international trends in cooking practises if deployed more widely. Such data is important in the appropriate design of cooking policy and interventions, allowing them to be appropriately designed to match local cooking habits. Furthermore, coupled with kitchen performance testing to understand the energy requirements of different dishes, representative energy requirements and cooking costs could be calculated for individual or population averaged menus.

Practitioner level - Opportunities and barriers for modern cooking

Perceptions on Malawi's cooking ecosystem were collected via engaging with the National Cookstove Steering Committee[2], first by invitation to complete an online survey and then following up with expert interviews. These interactions showed that there are several significant barriers to both LPG and electric cooking in Malawi, and also highlighted the areas of opportunity. A summary of these findings is shown in Table 1 and Table 2 on the next page:

National Cookstove Steering Committee logo (left) and meeting attended by MECS researcher in November 2019 (right)

[2] http://www.mbaula.org/about/national-cookstove-steering-committee/

Table 1 - Summary of barriers to LPG and electric cooking in Malawi

	Summary of barrier	
Barrier type	Electric cooking	LPG cooking
Weakness/lack of infrastructure	**Low levels of electricity access and unreliable supply in grid connected areas** puts off consumers. Although positive change is likely in 5-10 years, in the short-medium term high **electrical demand requirements of grid-eCook could exacerbate this issue.**	**Very weak existing market** lacks economies of scale. This scarcity of LPG suppliers makes **fuel replenishment inconvenient for users** who must replace/refill large and heavy gas cylinders themselves. Many **rural areas are almost unserviceable due to poor roads.**
Unwillingness/inability to pay	**High upfront cost of electric cooking devices and perception that energy is expensive** relative to charcoal makes electric cooking unaffordable for many and puts off consumers who could afford it.	**High upfront costs of LPG cooking devices and large lump sum payments required for refill/replacement of cylinders** relative to charcoal and electricity make them unaffordable for the majority of Malawians.
Socio-cultural resistance to device adoption	**Lack of practice, understanding and awareness of efficient cooking techniques** (e.g. using lids and soaking beans) **and devices** (e.g. pressure cookers) make efficient electric devices unfamiliar to most Malawians.	**Widespread perception that cooking with LPG is dangerous** makes Malawians from all levels of society hesitant to adopt LPG as a cooking fuel.
Lack of agency of household cooks	**Disconnection and power imbalance between those who use cooking devices/fuels** (usually females and/or maids**) and those who control household activities/finances** (usually male household head) makes widespread engagement and behavior change difficult.	

Table 2 - Summary of short-medium term opportunities for LPG and electric cooking in Malawi

	Summary of opportunity (short-medium term)	
Opportunity type	Electric cooking	LPG cooking
Geographical	**Mini-grids** are likely to present the most immediate opportunity for electric cooking. **Reliable electricity supply,** the potential to incorporate **a pay-as-you-cook business model and high levels of community engagement** are all attributed to mini-grids, reducing the above barriers to electric cooking in Malawi.	**Urban areas** are most suited to LPG cooking as this is where there is **existing demand** (although currently very limited). This area will have the **lowest distribution costs, highest household incomes** and is perhaps most likely to be **receptive to awareness campaigns** around gas safety.
Behavioral	**Electric cooking is aspirational** for many Malawians. **Basic devices** (hotplates, kettles etc.) **are well understood by many** (though low power devices (e.g. EPCs) are not). Experts said that **the population cooking with electricity grew when the grid was reliable.**	**Cooking with LPG is very similar to cooking with firewood and charcoal**, so requires little behavior change in terms of cooking technique. Also, **it is fast (lighting and cooking), easy to control, smokeless and odorless,** all highly desirable attributes.

Roadmap for modern energy cooking in Malawi

The market for modern energy cooking services in Malawi is currently small, and therefore in the immediate-short term (perhaps the next 2-5 years), currently well-developed efforts to propagate improved biomass stoves must continue. In addition, significant short-term improvements could be made by educating cooks in using more efficient cooking practises such as using lids, soaking beans and using pressure cookers for long-cook foods. Alongside this, solutions to the technical, economic and social barriers to modern cooking should be investigated as there is a latent demand for fast, clean, controllable and convenient cooking options in Malawi.

In the short-medium term, electrification of rural areas via mini-grids – where electric cooking is perhaps most immediately suited in Malawi – is likely to be a slow process. There are also considerable knowledge gaps around mini-grids' ability to support electric cooking demand and the affordability of cooking Malawian dishes using mini-grid electricity on hotplates as well as more efficient electric cooking devices which have shown to have potential in other countries. Concurrently, in urban areas – where LPG is perhaps most suited – awareness raising, business development and the building of supply chains for LPG could catalyse significant transition towards this fuel. However, this will be not be immediate due to the barriers of public perception, convenience and affordability. In parallel, research and development of solutions to improve Malawi's electricity grid and options for bridging power outages should be continued.

In the medium-long term, economies of scale could make LPG cooking more feasible for expansion into peri-urban and more densely populated parts of rural areas, while it is possible that affordable mini-grid electric cooking penetration from rural areas would eventually meet the spread of LPG from urban areas to provide coverage across most locations. A national grid supported by the implementation of innovative engineering solutions and/or strengthened by large electrical infrastructure projects (such as Mozambique-Malawi Regional Interconnector) will allow electric cooking to compete with LPG for viability in urban areas.

This is likely to be a non-binary, inhomogeneous process, with some households and businesses finding a use for a variety of different cooking fuels and devices depending on their preference, application and context. *It is therefore important to consider the spread of modern energy cooking services as a gradual process of "cleaning the cooking stack", gradually reducing the amount of biomass use through an increase in modern energy cooking through various means and devices*.

Recommendations and areas for further study

Technical and economic investigations of LPG and electric cooking are needed in both rural areas (on mini-grids) and in urban areas (on the national grid). This must include improving understanding of the affordability of electric cooking on mini-grid tariffs, and system requirements and cost of upgrade/construction of mini-grids which can support increased demand due to electric cooking.

Further study is needed to understand the applicability of modern energy cooking devices to the Malawian context, particularly those uncommon and unconventional to Malawi such as electric pressure cookers. This must include user testing of modern cooking devices by Malawians when cooking staple foods at a minimum.

Awareness campaigns will also be required to dispel myths around the safety of LPG, and to improve understanding of efficient cooking practises across all areas of society. Such campaigns will need to consider observations throughout this study which have indicated that there is often a separation between those with the agency to make changes to the cooking practises, devices and fuels used in households (often males) and those who do the cooking (often females and maids).

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1. Introduction

This working paper presents in country research on the opportunities, barriers and perceptions around modern energy cooking in Malawi, and provides insight into cooking practises in different areas of the country. As part of the MECS programme, the research and findings of this paper are provided in order to improve understanding of Malawi's cooking ecosystem, with a view to encouraging an accelerated scale up of the transition from cooking with biomass to cooking with modern fuels.

The paper is presented as a market assessment for modern cooking in Malawi and is based on evidence collected through in-country partners and networks using a methodology inspired by previous MECS studies in neighbouring countries (Tanzania [1] and Zambia [2] in particular) and others [3] [4]. The market assessment combines a top-down perspective via interactions with experts from Malawi's clean cooking sector (facilitated by United Purpose) and a bottom-up perspective through interactions at a household level (facilitated by Community Energy Malawi) to better understand the cooking ecosystem in Malawi.

In country partners:

Community Energy Malawi[3] (CEM) works with individuals and organisations passionate about renewable energy in a national and international network, both implementing projects and influencing policy. They have over 6 years of experience working with off grid communities in renewable energy technologies and have strong relationships with the Government of Malawi Department of Energy Affairs, actively participating in the development of the Malawi Energy Policy, the Malawi SE4All Action Agenda and the Malawi Renewable Energy Strategy.

United Purpose[4] Malawi (UP) is an international development charity that has been working in Malawi since 1988. Today they are one of Malawi's largest NGOs, working in partnership with local government and communities across fourteen districts mainly in central and southern Malawi. They target impact across a wide range of SDGs but are in-country leaders on SDG7 (sustainable energy) and co-chair the National Cookstove Steering Committee (NCSC).

This paper begins by contextualising the market assessment through a background section including an overview of Malawi, focussing in on two major challenges it faces (reliable energy access and deforestation), followed by a review of policies pertinent to modern energy cooking in the country. This is followed by the findings of the primary data collection activities, including methodologies and results; online surveys and interviews with actors from Malawi's clean cooking sector (top-down) and household surveys and focus groups in urban, peri-urban and rural areas (bottom-up). The report concludes with a discussion of these findings and recommendations for the directions in which activities and strategies to scale up modern energy cooking in Malawi should be focussed.

[3] https://www.communityenergymalawi.org/
[4] https://united-purpose.org/malawi

2. Background

2.1. Malawi

Malawi is a landlocked country in South-eastern Africa, bordered by Zambia, Tanzania and Mozambique with a population of about 18 million people. The population growth rate is estimated at 2.8% per year, and is expected to reach 23 million by 2025. Malawi remains a rural economy; however, the country is urbanizing at an annual rate of about 3.5%, higher than the regional average. The country has a very young population with 56% of Malawians being younger than 20 years. Of the people over 15 years, 14.3% have never attended school and 70% have not completed primary school.

The economy is largely agrarian, and poverty is widespread. Agriculture represents about 30% of gross domestic product (GDP), over 80% of total export earnings and 85% of employment. The agricultural sector is dominated by two crops, maize for food security and tobacco for export revenues. The sector is heavily dependent on rainfall and, in recent years, climate variability has led to a recurrence of floods and droughts in various parts of the country.

It remains one of the poorest countries in the world, with over half its population living in poverty. In 2016, the proportion of households living below the poverty line ($1.9 per day) stood at 70%, while 22% are ultra-poor, living under 0.20 USD per day and 10% are ultra-poor and at the same time labour constrained. Even those achieving the national minimum wage will only earn 15000 MWK[5] per month for a six-day working week. Up to 90% of Malawi's adult population is unbanked, with 4.6% holding accounts with traditional commercial banks and 5.3% receiving microfinance services through one of the specialised service providers. The average bank lending interest rate is around 30 – 40%, with inflation averaging around 15% [5] [6].

2.2. Resources and energy

Less than 10% of the population are connected to the national grid, while electricity supply does not currently meet the existing demand, causing daily power outages, even with the recent introduction of diesel-powered generators. The electricity generation industry in Malawi is currently composed of one national company (EGENCO), with a total generation capacity of 361MW, but has recently been liberalised to allow for Independent Power Producers to enter the market. The transmission and distribution networks are owned and operated by the national Utility, ESCOM, and is isolated from neighbouring countries. Recent developments have increased transmission capacity to approximately 1000MW

However, given the imbalance between electricity supply and demand, as well as a predominantly rural population, the lighting and cooking needs of most people are served by traditional, carbon-based sources of energy such as charcoal and wood for cooking, and paraffin, candles and non-rechargeable batteries for lighting. 99% of household energy is supplied by biomass and 87% of the population uses biomass to satisfy their thermal energy needs [7]. Consequently, Malawi's forests are depleting at a terrifying rate, with 32% reduction in forest cover in less than 40 years, thereby putting pressure on natural resources leading to land degradation and soil erosion around watersheds. This in turn impacts on national electricity generation at hydro-electric dams, due to both flooding and siltation, while also increasing the risk of disasters, and impacting on agricultural production.

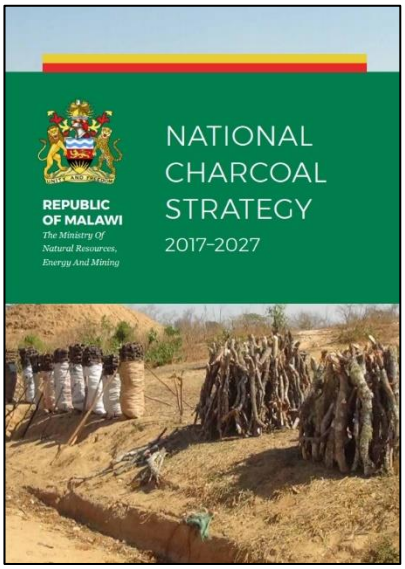
[5] 1 USD = 737 MWK as of 30/04/2020

As such, Malawi, with its relatively small land mass and growing population which depends heavily on fuel wood, is an increasingly water and energy-stressed country which is exerting significant pressure on its forest resources, leading to forest degradation and deforestation.

2.3. Summary of policies pertinent to modern energy cooking services

This section presents the findings of a literature review carried out by UP (edited for inclusion in this report by UoS). Four key policy documents pertinent to modern energy cooking services in Malawi are summarised (National Charcoal Strategy, National Energy Policy, Malawi Renewable Energy Strategy, Regulatory Framework for Mini-grids) highlighting particular elements which are relevant to modern energy cooking. Details are also given about the National Cookstove Steering Committee which is run by a variety of major stakeholders in Malawi's clean cooking sector.

2.3.1. National Charcoal Strategy



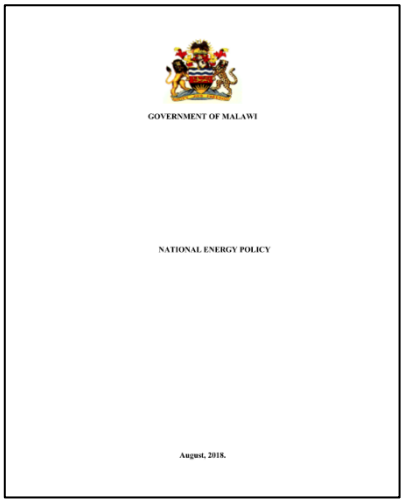
Objective: The National Charcoal Strategy's [8] (NCS) vision is a more climate-resilient Malawi with sufficient supply of affordable, safe and reliable sources of energy for cooking and heating, where deforestation has been reversed and a larger share of cooking and heating energy comes from modern sources of energy.

The NCS is structured around 7 inter-related pillars, as follows: (1) Promote Alternative Household Cooking Fuels (2) Promote Adoption of Fuel-Efficient Cookstove Technologies (3) Promote Sustainable Wood Production (4) Strengthen Law Enforcement (5) Regulate Sustainable Charcoal Production (6) Enhance Livelihoods (7) Promote Information, Awareness and Behaviour-Change Communications. As such, the key pillars regarding modern energy cooking are Pillar 1 and Pillar 2:

Pillar 1 clearly supports an environment for electric cooking in Malawi. More specifically, under Pillar 1 the strategy aims to strengthen the electricity supply industry and make it more efficient and capable of providing adequate, affordable and reliable electricity. This includes proposed actions such as promoting adoption of energy efficient technologies and behaviours, providing fiscal incentives to reduce installation fees for electricity and cooking devices and expanding rural electrification under the Malawi Rural Electrification Program. However, the NCS also states that LPG is the 'most promising alternative to urban charcoal use in the medium term' and aims to promote adoption of LPG for urban and semi-urban domestic and institutional cooking and heating.

Pillar 2's focus is to promote the adoption of improved charcoal and firewood cookstoves for household cooking and heating, as it was concluded that increasing adoption of fuel-efficient charcoal and firewood cookstoves presents the most immediate option to slow deforestation and forest degradation.

2.3.2. National Energy Policy 2018


GOVERNMENT OF MALAWI

NATIONAL ENERGY POLICY

August, 2018.

Objective: To increase access to affordable, reliable, sustainable, efficient and modern energy for every person in the country.

The National Energy Policy [9] (NEP) has identified 8 policy priority areas, as follows: (1) Electricity (2) Biomass (3) Petroleum Fuels (4) Bioethanol and other Biofuels (5) Liquified Petroleum Gas, Biogas and Natural Gas (6) Coal (7) Nuclear Energy (8) Demand Side Management. Three of the priority areas relate

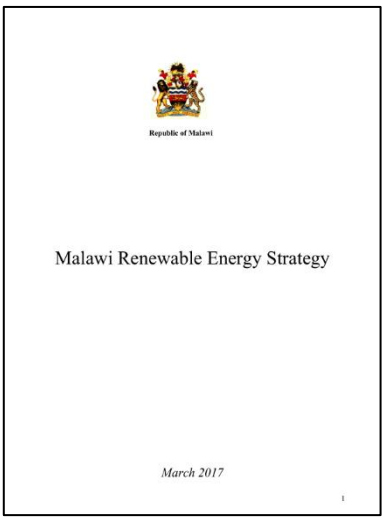
Priority area 1 (electricity) includes plans to incentivize distribution licensees to devise schemes that will enable consumers to connect electricity to their homes and afford basic energy efficient electrical appliances. Two strategies are put forward to achieve this, which include, removing duty and VAT on energy efficient domestic electric cooking and water heating appliances, as well as introducing lifeline tariffs to enable low income households to access electricity. Furthermore, under this priority area the GoM will intensify electrification of rural trading centres as well as villages by providing funding from the Rural Electrification Fund to off-grid rural electrification schemes. Finally, the NEP states that under priority area 1 the government will promote use of renewable energy technologies and manufacture of renewable energy products such as solar panels.

Priority area 2 (biomass) is firmly rooted in strategies to incentivize and scale-up the adoption of more efficient wood/charcoal burning cookstoves. The most significant strategy statement relates to introducing customs duty and VAT incentives to promote the wide availability of improved, locally made cook stoves. This has since been introduced and extended to LPG gas, as well as cylinders.

Priority area 5 (LPG, biogas and natural gas) recognizes the potential for LPG to reduce biomass use and therefore the environmental impact of cooking and heating. However, it also highlights the significant barriers to the gas sector's growth from its currently undeveloped state, namely the high cost of gas, the public perception that gas is dangerous and lack of gas distribution network either by pipeline or cylinders. Strategies to combat these are numerous and wide ranging, including fiscal incentives, capacity building and establishing public-private-partnerships.

Priority area 8 (demand side management) outlines the intention to institute appliance testing, labelling and standards, which will include minimum energy performance standards; reducing or eliminating import duty and taxes on energy efficient products; conducting public information campaigns to raise awareness amongst consumers; the provision of financing for energy efficiency measures, allowing consumers to repay loans as part of their utility bills; and, promoting energy saving electrical and biomass-fuelled devices.

2.3.3. Malawi Renewable Energy Strategy


Republic of Malawi

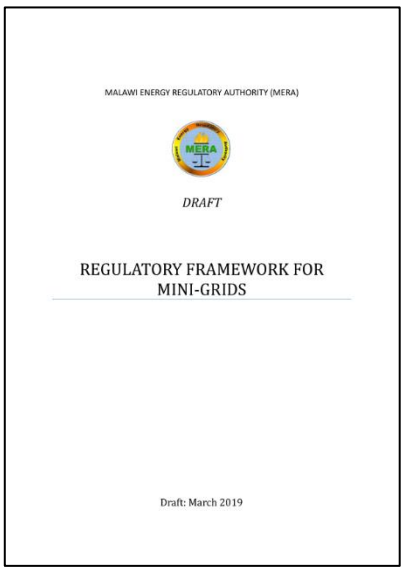
Malawi Renewable Energy Strategy

March 2017

Objective: The vision of the Malawi Renewable Energy Strategy [10] (MRES) is universal access to renewable electricity and sustainable bioenergy sector.

The MRES specifies actions required to deliver the above objective, focusing on grid-scale power, clean mini-grids, off-grid power, clean cookstoves, solid biofuels, biogas and biofuels in transport. Actions impacting the opportunities and barriers to electric cooking include: continued delivery of Malawi's Rural Electrification Programme (MAREP) phased grid extensions into rural trading centres; the development of an Independent Power Producer (IPP) framework and Power Purchase Agreement (PPA) process to increase generation capacity; implementation of streamlined regulations that are proportionate to the scale of mini-grid developments; the adoption and enforcement of international standards for solar products; working with the National Cookstove Steering Committee to achieve its goal of 2 million stoves by 2020; develop efficiency standards for cleaner cookstoves; and the roll out of district energy officers across the country by 2022.

2.3.4. Regulatory Framework for Mini-Grids


MALAWI ENERGY REGULATORY AUTHORITY (MERA)

DRAFT

REGULATORY FRAMEWORK FOR MINI-GRIDS

Draft: March 2019

Objective: The regulatory framework for mini-grids [11] is intended to achieve sustainable development and operation of mini-grids in Malawi, while striving towards the provision of modern energy services to remote communities where grid extension does not offer an economically feasible electrification solution.

Building from the commitments of the National Energy Policy and the Renewable Energy Strategy the regulatory framework sets out the guidelines for the development and operation of mini-grids in Malawi covering the following key areas: solicitation process; requirements for approval; terms and conditions for licensing and registration; governance structures; quality of supply and service standards; tariff methodologies and structures; linkages with the national grid.

Critically, concessions and waivers have been included for sites with generation capacity under 150kW and provision is made for a variety of subsidies that either reduce consumer tariffs, lower capital expenditure, or incentivise new connections; which will increase rural electrification rates.

The establishment of a regulatory framework sets a solid foundation for scaling up mini-grids in Malawi to achieve the target of 50 operational sites by 2025, providing developers with the clarity and reassurance to invest in new projects. This in turn provides opportunities for expanding electric cooking into more rural regions of the country, should the supporting elements, such as tariffs and appliances, be appropriately aligned.

2.3.5. National Cookstove Steering Committee

Objective: The objective of the National Cookstove Steering Committee [12] (NCSC) to is facilitate the dissemination of 2 million cleaner cookstoves by the end of 2020.

In 2012, concerned by the negative impacts of traditional cooking on women, the Ministry of Disability, Gender and Social Welfare signed on as a partner to the Global Alliance for Clean Cookstoves (GACC). The Government of Malawi pledged to contribute 2 million clean cookstoves towards this target. From this pledge, the NCSC was formed. The NCSC, chaired by the Department of Energy, has taken ownership of the 2 million by 2020 target and as such is advocating nationally for cleaner cooking. To guide its work, the NCSC drafted a 'Cookstoves Roadmap' which provided broad, policy level direction to its work. The Roadmap was subsequently endorsed by the Government of Malawi in 2015, with one of the key strategies to "harmonize relevant policy and regulations". Subsequently, one of the major achievements of the NCSC to date has been the integration of the "Cookstoves Roadmap" into policy documents such as the NEP, MRES, Malawi Sustainable Energy for All (SE4All) Action Agenda, the NCS, as well as commitments under Malawi's Nationally Determined Contributions (NDCs).

Through its three working groups the NCSC is supporting a range of firewood, charcoal and alternative fuel cooking solutions. Within these, the current priority areas are: further lobbying for VAT and Duty waivers on stoves and appliances (including electric); the development of a more conducive LPG business environment, in particular for small-and-medium enterprises; the development of voluntary standards for cooking technologies with optional labelling guidelines; lobbying for stricter regulations and enforcement of the 'illegal' charcoal trade. The ultimate aim of the NCSC is to create a more conducive enabling environment for the private sector to grow, providing a range of solutions to meet peoples cooking needs sustainably.

It was through engaging with the NCSC that UoS gained access to practitioners in Malawi's cooking sector with whom expert interviews were conducted. The findings from these interviews are detailed in the following section, which begins by describing the primary data collection methodologies used for this market assessment.

3. Methodology

This section begins by providing a description of the methods used during this study's primary data collection activities and is followed by the findings from these activities. The approach taken was to gain understanding of the cooking ecosystem in Malawi from both a bottom-up and top-down perspective. Survey data was collected on cooking practises at the household level and was supplemented by interview data collected at the practitioner level.

As such, this section is arranged as follows:

- 3.1 - Household surveys and focus groups
- 3.2 - Online survey and interviews with experts

3.1. Household surveys and focus groups

3.1.1. Sample areas

Households were surveyed in three locations targeting three different population groups which are described as "urban", "peri-urban" and "rural". The sample areas (Figure 1) were selected by the local enumerators using the following guidance:

- **Urban** – an area in the centre of Lilongwe which is likely to have relatively affluent households (where electric cooking is perhaps most likely).
- **Peri-urban** – an area towards the outskirts of the city which is likely to have less affluent households (where cooking with charcoal is perhaps most likely).
- **Rural** – selected as CEM have other ongoing projects in this area which his known to be very rural and a high chance of engagement with households.

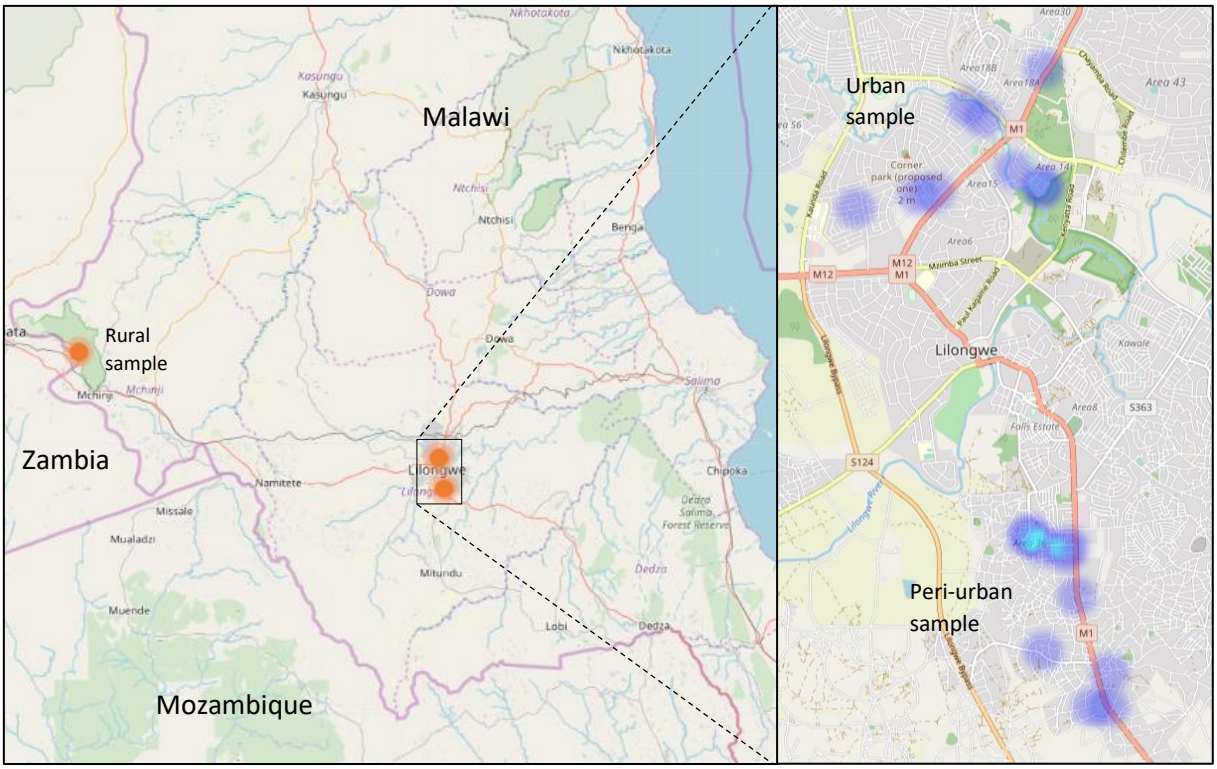


Figure 1 - Urban, peri-urban and rural sample locations

Convenience sampling was used in all locations, with urban and peri-urban participants being surveyed in their homes, while rural participants were surveyed in the village church. These different survey environments were used because; urban and peri-urban participants were dispersed over a

wide area, making the organisation of common meetings difficult (see section 3.1.3 for more details); while it was more convenient to make arrangements for the rural surveys to take place in a common location. 57 participants were surveyed (urban: 14, peri-urban: 14, rural: 29). Table 3 shows the size of the samples disaggregated by location and gender.

Table 3 - Sample size (by location and gender)

		Location			
		All	Urban	Peri	Rural
Gender	All	57	14	14	29
	Male	5	3	2	0
	Female	52	11	12	29

The survey targeted the self-identified "main household cook", and as such the sample does not necessarily always represent the homeowner, or even a family member as some of the urban and peri-urban participants were maids who are responsible for most of the household cooking. Also, the survey did not specifically target women, however most respondents were female (see section 4.2.1 for important considerations regarding gender and maids).

3.1.2. Household survey

The household survey was administered using the kobocollect[6] application, with the questionnaire designed by the UoS researcher in collaboration with the implementing partner Community Energy Malawi (CEM). The questionnaire was pre-tested and revised several times, firstly with the enumerators, and then on multiple occasions with other members of CEM. The main revisions were to select multiple-choice options which included cooking devices and foods which were most relevant to the Malawian context.

The survey was developed using several existing questionnaires including the MECS cooking diary registration survey[7] and household energy baselining surveys from a UoS energy access project [13] amongst others. The duration of the survey was 15-20 minutes; prioritising closed questions with multiple choice answers, with focus groups to be used to collect more open-ended information. The household survey included three sections (full questionnaire in Appendix A):

- **Basic participant and household information**
  - Name, age, gender, education
  - Household size, occupancy and roof/walls construction
  - Electricity sources and quality of supply
- **General cooking information**
  - Kitchen location, who cooks, what proportion and which meals
  - Heating water for bathing – devices used and frequency of event
  - Cooking – devices used and for which type of cooking
  - Cooking fuels – frequency of purchase/gathering, spend and quantity bought
  - Satisfaction level with current cooking situation
- **Indicative cooking diary**
  - One weekday and one weekend day
  - Breakfast, lunch, dinner, snack – maximum of three dishes and a hot drink for each
  - Dish cooked, device used and cooking method – for each dish or drink
  - Normal cooking hours

[6] https://www.kobotoolbox.org/
[7] See Appendix B in MECS Tanzania Cooking Diaries Working Paper [1]

The survey was accompanied by a sheet showing images of the cooking devices, and their names, to ensure that the correct options were being selected (see Appendix B).

3.1.3. Focus groups

It was attempted to carry out at least one focus group in Lilongwe, and at least one focus group in the rural area. Enumerators from CEM carried out the activity with guidance from UoS informed by an initial analysis of the household survey data.

The rural focus group was conducted in a location where CEM are already working on other projects, so attendance was high and engagement was strong (approx. 30 participants attended). Participants were first asked to clarify some of the findings from the household surveys which included:

- Reasons for cooking outdoors
- Reasons for lack of "chitetezo mbaula" (locally manufactured, improved firewood stove)
- Time spent gathering wood
- Challenges of gathering firewood

The second part of the focus group involved an idea generation and ranking exercise, during which participants were asked to come up with positive and negative aspects of using firewood and charcoal for cooking. These aspects were then ranked in order of importance.

Figure 2 - Focus group in the rural area

Unfortunately, it was not possible to conduct a focus group with urban participants due to a lack of attendance. It was evident that arranging focus groups in urban areas is likely to be more challenging than in rural areas due to the dispersion of participants across the city, their more structured work schedules and the expectation of remuneration for participation. It appears that other forms of engagement are needed to gather information from urban households beyond structured surveys.

3.2. Online survey and interviews with experts

Actors in Malawi's cooking sector were engaged with through three consecutive activities; an online survey, presentation of MECS activities in Malawi to the NCSC, and expert interviews. This was supplemented by a short visit to a shopping centre and local market to gain insight into the cost and availability of modern energy cooking devices in and around Lilongwe.

3.2.1. Online survey

In order to inform the topics and direction for expert interviews, a short online survey was created (also using kobocollect) and an invitation to complete was sent to those in UoS's and UP's energy and cooking networks in Malawi (see Appendix C). The survey covered the following topics:

- Cooking practices in urban and rural areas
- Drivers for a transition towards clean cooking in Malawi
- Most/least successful interventions and policies regarding clean cooking
- Characteristics of those currently using electricity for cooking
- Past/ongoing/planned policy/programmes involving electric cooking in Malawi
- Barriers and opportunities for electric cooking in Malawi

The survey received 15 responses in the two weeks leading up to the field visit by the UoS researcher. Respondents included clean cooking practitioners, academics and a government official (respondent profiles in Appendix D). Findings from the online survey informed the expert interview guide and strategy for in-country data collection.

3.2.2. Presentation of MECS activities in Malawi to NCSC

To understand more about the role of the NCSC, increase awareness of MECS in Malawi and attract more interest in participation in expert interviews, the UoS researcher attended the NCSC's end of year meeting on 28th November in Lilongwe and gave a short presentation introducing the MECS programme and the Malawi market assessment activities. Information about the project was received with interest, and lead to informal discussions during the lunch break and the organisation of some expert interviews.

Figure 3 - NCSC meeting in Lilongwe on 28th November

3.2.3. Expert interviews

Using responses to the online survey and contacts made at the NCSC meeting, expert interviews were organised with actors in Malawi's clean cooking sector. The topic guide for these semi-structured interviews (see Appendix E) was created using the MECS "policy/markets review framework"[8] and findings from the online survey. One important inclusion was a line of questioning around LPG, highlighted by several respondents to the online survey as having potential as a modern energy cooking fuel in Malawi alongside electricity.

In addition to the topics covered by the online survey (included for those who had not completed it), the interviews covered:

- Prior knowledge of electric/LPG cooking
- Viability of electric/LPG cooking in Malawi – opportunities and barriers
- Delivery methods for electric/LPG cooking – Policy? Capacity/awareness? Urban/rural areas?

Seven interviews were organized and completed, the responses to which have been collated to produce the majority of the following market review of modern energy cooking services in Malawi.

[8] See appendix B in MECS Tanzania Policy Review Working Paper [1]

4. Findings

The following section presents the results of the in-country data collection including interactions at a household level (4.1) and at a practitioner level (4.2).

4.1. Household surveys and focus groups

This section summarises the findings from the online survey, expert interviews and other engagement with actors in the clean cooking sector in Malawi. The findings from these interactions are arranged into section on drivers (4.1.1) and barriers and opportunities for electric cooking (4.1.2) and LPG (4.1.3).

Quotes from the online survey have been incorporated in the below to highlight many of the points made, however, many of these conclusions are drawn from extended conversations in expert interviews most of which were not audio recorded and so quotes could not be included. Also, it should be noted that the online survey focussed specifically on electric cooking, and it was not until the expert interviews that LPG was included as an important topic of conversation.

4.1.1. Drivers for modern clean cooking in Malawi

Main driver: Tackling deforestation

Almost all respondents to the online survey and expert interviews said that deforestation was the most important driver for transitioning to modern clean cooking in Malawi.

"High rate of deforestation threatening to wipe out forests in the next decade according to some estimates" – Online respondent 4

The various impacts of deforestation were also highlighted, with a strong emphasis on climate change, as well as scarcity of wood-fuel and damage to agricultural land.

"The cascading impacts of deforestation and forest degradation--on agricultural production and food security; on water security; and, on energy security (both wood-fuels and hydro) are further exacerbating climate and other shocks" – Online respondent 13

Box 1: Improved biomass stoves in Malawi

Deforestation has been acknowledged by the Government of Malawi as a key issue for several years but, most efforts have concentrated on the propagation of improved firewood stoves (often referred to as "chitetezo mbaula") in rural areas.

Rural areas have been targeted by improved firewood stove initiatives, not only as a strategy to reduce deforestation, but also to foster rural economic growth through enterprise and entrepreneurial development. As such, many respondents commented that the main cooking transition which has taken place, has been from 3 stone fires to improved/energy-efficient stoves.

"There are changes in terms of use of three-cornerstone open fire cooking in the rural communities. Most households migrated to the use of different kinds of stoves. The type of food and who cooks and how largely remains the same." – Online respondent 7

"There is a great change from use of 3 stone fire cooking to use of cleaner stoves in the rural areas. But urban areas are still using a lot of charcoal." – Online respondent 9

This focus on transitioning rural areas to improved firewood stoves also means that far more is known about cooking in rural areas, compared with urban areas.

Most interviewees highlighted the findings of the most extensive project in recent years seeking to understand and tackle deforestation, "Protecting Ecosystems and Restoring Forests in Malawi" (PERFORM[9]) , which found that it is in fact urban demand for wood fuels, particularly charcoal, which is the main cause of deforestation. The PERFORM study highlighted LPG in particular as having a key role in reducing biomass fuel use and thus deforestation, citing its efficiency as a cooking fuel and relatively stable price compared with charcoal and electricity [14].

Urban areas are also where there is most potential for the scale up of LPG and electric cooking, but it is also the area where the least is known about cooking habits and practises and have been the most difficult areas to engage with in this study.

Other drivers: Public health and poverty alleviation

Interactions with experts also highlighted the need to address public health issues caused by the smoke produced by cooking using firewood and charcoal. Poverty alleviation (particularly in rural areas), by reducing expenditure on fuels through encouraging the use of more efficient biomass stoves and fostering economic development in rural communities through creating businesses which manufacture improved stoves, was also mentioned as a driver. A wealth of experience and literature already exists on these topics, so will not be repeated here.

"Increased resiliency, poverty reduction and better quality of life for poor households achieved through improvement of their income, health, social position, cooking convenience and natural environment." – Online respondent 2

4.1.2. Electric cooking: Barriers and opportunities

Barrier 1: Lack of access to, and poor quality of, electricity supply

By far the most commonly mentioned barriers to cooking with electricity were the lack of access to electricity across Malawi and the chronic unreliability of the electricity supply in grid connected areas.

"The big set back has been frequent blackouts which has always forced people to use charcoal." – Online respondent 6

"Due to blackouts charcoal has always been a second option" – Online respondent 15

"Even those that are connected to the grid, cook on biomass due to unreliability of grid." – Online respondent 10

An increase in the number of electric cooking devices in particular presents a challenge for undeveloped and overstressed grids, as they have a much higher electrical demand than most other devices (such as phone chargers, radios, fans and TVs).

It was said that blackouts effect all grid connected areas including urban centres, and change in frequency according to the seasons[10] (rainy season has fewer blackouts due to higher dam water levels and thus more reliable hydro-electric power). One interviewee mentioned that four or five years ago, the electricity supply was more reliable and that as a result, there was a trend towards cooking with electricity. This was echoed by a response captured by the online survey:

[9] https://www.tetratech.com/en/projects/protecting-ecosystems-and-restoring-forests-in-malawi
[10] During the in-country data collection in Lilongwe (November 2019), blackouts were 6 hours per day on a 3-day continuous cycle of morning, afternoon and night-time blackouts.

"The percentage of urban [household] cooking on electricity has dropped from 20 years ago. And the percentage of urban [household] cooking on firewood has also dropped, making charcoal the predominant cooking and heating fuel in urban Malawi" – Online respondent 13

This study's household survey also indicated that an unreliable grid effects cooking (see sections 4.2.2 and 4.2.3.3). Others also highlighted the trend towards more charcoal use, not only by those unsatisfied with electric cooking, but also those with improved livelihoods transitioning from freely gathered or cheaply bought firewood to the more desirable, but also more expensive, charcoal (see section 4.2.6 for some reasons as to why charcoal is seen as desirable).

Barrier 2: Willingness and ability to pay for cooking with electricity

The upfront cost of cooking with electricity (including national grid connection fees) was considered also to be a barrier to adoption, with electric cooking devices being much more expensive than charcoal or firewood stoves, especially given the low income levels of most Malawians.

"[the most significant barriers to electric cooking in Malawi are] unreliable electricity supply high electricity connection fee, affordability of durable electric cooking devices" – Online respondent 15

"High poverty levels that makes it difficult for most households to access electricity and let alone afford to buy electric cooking appliances." – Online respondent 7

This was confirmed by an investigation of the costs of cooking products in Lilongwe and Blantyre (see Appendix F). For example, a firewood stove or "chitetezo mbaula" could be found for 1000 MWK[11] (3 stone fires are home-made), charcoal stoves could be found for 2500 MWK, but even the most basic electric hotplate costs 7500 MWK or more while several experts highlighted that the cheapest electric hotplates are usually of poor quality and would support less than a year or usage.

However, there was less consensus around the cost of energy to cook with electricity in comparison with charcoal, the main message being that there is emerging evidence (most referenced the PERFORM study) that electricity is the cheapest cooking fuel (excluding free firewood).

"Electric cooking is cheaper than biomass, but few people actually understand this." – Online respondent 14

"Mis-perception that electric cooking is expensive compared to charcoal." – Online respondent 4

The perception that electricity is expensive relative to charcoal was highlighted as being particularly strong around foods with long cooking times such as beans.

"foods like beans which takes time has also always forced people to use charcoal." – Online respondent 6

It was also highlighted that the price of electricity is increasing (it was also said that the same is true for charcoal), and therefore the comparative prices of cooking with different fuels is likely to change over time, while others noted that charcoal prices vary across the country.

"rural masses associate electric cooking with affluency" – Online respondent 2

[11] 1 USD = 737 MWK as of 30/04/2020

"[electricity] tariffs have increased three times in the last 2 years, and are scheduled to increase twice more in the near future… illegal charcoal, much from Mozambique, is significantly cheaper in Blantyre [than Lilongwe]" – Online respondent 13

As with Barrier 1, due to the concentration on biomass cooking in rural areas, there is a dearth of detailed understanding about the willingness and ability to pay for electric cooking in urban areas. Interviewees often commented that there has been an assumption that the transition to electric cooking in particular, will happen naturally if electricity is available, cheap and reliable.

Barrier 3: Efficient cooking practises have been neglected in Malawi

To date, as previously mentioned, almost all interventions seeking to reduce biomass fuel use in Malawi have focussed on burning these fuels more efficiently, mainly through the use of improved firewood stoves. However, little attention has been paid to efficient cooking practises. These range from simply encouraging the use of lids on pots and soaking beans to reduce cooking times, to those requiring additional cooking equipment such as using heat retention blankets or pressure cookers. In country data collection supports this, with the household surveys and indicative diaries finding no instances of the use of pressure cookers in any of the sample areas.

The efforts to alter this neglect of efficient cooking techniques and devices must be seen in the context of Malawian cooking habits which were considered by experts to be strongly entrenched, particularly around the traditional foods of nsima and beans. Other wide public perceptions are that cooking with charcoal produces more tasty food than cooking with electricity.

"there is basically one way to cook Nsima, you are not going to tell a Malawian there is another way to cook Nsima, if you are introducing a technology, they have to be able to use it to cook that. It has to look the same, and have the same consistency and taste the same" – Expert interviewee 1

"even [urban] households tend to use charcoal stoves due to some unique food preparation preferences. For instance, it is claimed that cooking beans on a charcoal stove makes beans taste better than when cooked on an electric cooking appliance" – Online respondent 7

Again, such comments are based on evidence collected primarily from rural areas, further research in urban areas would be required in order to understand the potential for changing cooking habits and introducing novel cooking devices in these areas. In fact, some respondents considered that urban residents would be willing to alter their cooking practises, as highlighted earlier (see opportunity 1).

Barrier 4: Cooks often lack the agency to change cooking practises

Expert interviews in particular highlighted that, with female members of the household often doing most of the cooking, and males often being the head of the household who is in control of the house's finances, there is a disconnection between those who use cooking devices, and those who have most of the agency to change cooking habits.

"Both urban and rural women do the cooking although men influence cooking fuel and technology used." – Online respondent 4

This is exacerbated in more affluent households in urban areas where sometimes the cooking is done by maids, who are even further disconnected from the decision making around cooking fuels and devices, and less aware of the financial and other benefits around cooking with modern cooking fuels.

"the house maids are the ones doing most of the cooking therefore some of them prefer to use charcoal being unfamiliar with the electronic cooker." – Online respondent 9

"most of the urban Malawians who have access to electricity are not cooking themselves… most of the meals are made by their [maid], who only cook on charcoal" – Expert interviewee 1

This relationship requires further study, particularly to understand ways in which this disconnection between the household cook, and those in control of household finances can be reduced, or the agency of females in Malawian households can be strengthened.

Opportunity 1: Electric cooking in urban areas

Almost all experts commented that urban areas have the most long-term potential to facilitate growth in the electric cooking sector due to the availability of national grid electricity, high levels of charcoal use, higher incomes relative to rural areas; and more households already cooking with electricity.

In addition, several experts commented that affluent households would likely be interested in any electrical device which could overcome the blackouts issue and would be willing to re-learn cooking practises to use it. Further research in urban areas would be required in order to understand the potential for changing cooking habits and introducing novel cooking devices in these areas, while the widespread scale up of electric cooking in urban areas will continue to be severely restricted as long as the national grid continues to be unreliable and under-supplied.

Although this is unlikely to be addressed in the near future, several large projects should come into operation in the next 5-10 years which could significantly boost the electrical capacity of Malawi's national grid (e.g. the Mozambique-Malawi Regional Interconnector and several large planned powerplants). This should significantly reduce the number of blackouts, and so reduce main barrier to electric cooking in urban areas.

Opportunity 2: Mini-grids and off-grid solutions for electric cooking

Another area mentioned by experts as having potential is mini-grids, a relatively undeveloped sector in Malawi, but one which is receiving increasing amounts of attention (national policy targets 50 mini-grids by 2025). Mini-grids' ability to provide reliable electricity in almost any location is their main strength compared with the national grid in Malawi.

Arguments as to mini-grids' capability to support cooking, and the potential for cooking to improve energy utilisation levels and financial sustainability are not Malawi specific and is a topic too complex to cover within this market assessment, but relevant and outstanding questions include: their ability to support the electrical demand of large numbers of electric cooking devices and provide electricity which is affordable for rural households and also earn sufficient revenue to be financially sustainable. Electricity prices on mini-grids also tend to be much higher than on the national grid, making electricity financially less attractive than charcoal as a cooking fuel, particularly given the low income levels of Malawians living in rural areas.

A potential strategy to make electric cooking more affordable for rural communities would be to spread the upfront cost of electric cooking devices over an extended period, including the repayments within their electricity bill, overcoming the difficulty in saving large lump sums of capital to purchase devices. The likelihood of success of such a strategy is boosted by the often high levels of community engagement and strong relationships between operators and consumers within mini-grid projects, which reduces the likelihood of missed repayments and the risk for mini-grid developers and financial institutions.

There were also mentions of entirely off-grid (or standalone) cooking solutions:

> *"[an] Offgrid solar solution, especially to cook beans/pulses with extended cooking times in low-wattage slow-cooking crockpot-type of devices could, really make a significant contribution to replace a larger share of biomass cooking." – Online respondent 10*

However, these are currently limited by the availability of electric cooking devices which are low powered enough to make solar home system type products viable, and cheap enough for rural communities for be able to afford them. Were such devices available, it is likely that they would also require changes to cooking habits, another major barrier to past clean cooking interventions in rural areas[12].

Opportunity 3: Electric cooking is aspirational for Malawians

Several experts highlighted that cooking with electricity is highly desirable for Malawians who recognise that it addresses many of the shortcomings of cooking with charcoal and firewood. Electric cooking removes time taken to start the fire and makes cooking indoors far more comfortable, safe and healthy as it is smoke free.

> *"The choice of electricity by many people is because it is cleaner and easy to use."*
> *– Online respondent 3*

> *"Those who use electricity are motivated by it being clean, cheaper as compared to charcoal or wood, easy to operate as it takes some time to light fire."*
> *– Online respondent 2*

This is reinforced by earlier comments that in previous years when electricity was more reliable, a transition to cooking with electricity was taking place (see barrier 1). As such, devices similar to traditional devices, such as electric hotplates would surely be adopted if cost effective and supported by a reliable supply of electricity. However, more evidence is needed to demonstrate whether currently available devices which are efficient and low powered are appropriate for Malawian cuisine and cooking practises,

4.1.3. LPG cooking: Barriers and opportunities

Barrier 1: Perceived danger of cooking with LPG

The overwhelming majority of respondents said that there is a widespread public perception in Malawi that cooking with LPG is dangerous. This does not appear to be uncommon in the region, as other interviewees mentioned the same issue was prevalent in Zimbabwe also. Despite this, no respondents knew of any evidence to back up this fear, other than gossip and hearsay.

Nevertheless, the myths surrounding the danger of using LPG, namely the risk of fire and/or explosion, are a significant barrier to its uptake as a cooking fuel. Such a belief is not only held by less educated Malawians, or those with poorer socio-economic backgrounds, but experts strongly suggested that the belief was prevalent across all of Malawian society. Country-wide awareness and training would be required before widespread adoption is likely.

[12] Particularly interesting work in this area is being done by Kachione LLC through the MECS TRIID fund with the title "Customizing Malawi-made solar electric cooking technology and business models to provide access to very low-income villagers".

Barrier 2: Lack of LPG infrastructure

There are currently no national figures on the number of people using LPG for cooking in Malawi but census data shows 0.1% of households using "other" fuels including paraffin and LPG, thus it is likely that as few as 6000 households are currently using LPG across the entire country[13]. This very small market can only be serviced by the transportation of cylinders (there is no mains gas infrastructure in Malawi) and as such, distribution is a major expense for businesses providing LPG. The challenges are exacerbated by Malawi having a largely rural population, often connected by very poor roads which can be impassable during the rainy season.

Although there are a small (and perhaps growing) number of urban LPG users, there is no option for collection and delivery of LPG cylinders to/from their homes (until very recently[14]). This means that users must travel themselves to refill or replace LPG cylinders, which are large, heavy and only available from a relatively small number of outlets which may require driving across congested cities.

Barrier 3: Limited ability and willingness to pay for LPG

Although there is not extensive evidence on the cost of cooking with LPG in Malawi, the combined device and fuel cost of cooking with LPG is likely to be higher than for electricity and charcoal, making it unaffordable for most Malawians.

The local market review showed that the cost of the cheapest LPG burner is likely to be around 20000 MWK[15] (compared with electric hotplate at 7500 MWK), and that the cost of a 3kg cylinder is around 30000 MWK, and 6kg cylinder around 60000 MWK.

Also, currently LPG cylinders must be purchased entirely up-front, thus requiring a lump sum of 15000-25000 MWK (perhaps monthly), which is high compared with charcoal and electricity purchase patterns; charcoal usually purchased in small bags for 300-500 MWK (perhaps daily of every few days), electricity usually topped up with 2000-10000 MWK (perhaps every one or two weeks) (further information see section 4.2.3.5).

To reducing the need for large lump sums, pay-as-you-go solutions for LPG are becoming more common in other East African countries (for example Paygo Energy, KopaGas and Envirofit in Kenya and/or Tanzania), but demand is currently far too low to make such technologies viable in Malawi. One expert said that a minimum of 10000 customers within the distribution network (e.g. one urban centre) would be needed. Also, due to the small LPG market size in Malawi, providing LPG cylinders and fuel on credit is high risk and therefore unattractive to financial institutions and businesses.

Barrier 4: Cooks often lack the agency to change cooking practises

See barrier 4 for electric cooking.

Opportunity 1: LPG in urban areas

Despite the above shortcomings, experts agreed with Malawi's national policies, that LPG cooking is likely to be the most viable medium-term solution to a clean cooking transition in urban areas. This is predominantly due to the issues of the undersupplied national electricity grid, which will not be solved

[13] Conservative estimate of household size at 3 persons (census data shows 4.3 persons), using 18,000,000 as population of Malawi and assuming all 0.1% using "other" fuels for cooking are LPG users.
[14] 265energy has begun distributing LPG in Lilongwe and Blantyre as of 2019.
[15] 1 USD = 737 MWK as of 30/04/2020

until large infrastructure projects (many of which are under construction or planned) have been completed, which is likely to be at least 5-10 years away.

Urban areas are best suited to LPG as distribution costs are lowest, incomes are highest, there is existing (although small) demand already present and perhaps raising awareness and improving perceptions around LPG are easiest. Urban areas are also where there is the most pressing need for reductions in charcoal use, providing the greatest incentive for public sector support as well as private sector opportunity.

Opportunity 2: LPG is a highly effective cooking fuel

Experts consistently stated that LPG is considered a highly effective and convenient fuel by those who use it. Reasons for this include the speed of lighting, ease of temperature control and that it is smokeless and odourless, attributes for which it is unrivalled by charcoal and to come extent also electrical cooking devices. In understanding this due to their involvement in the clean cooking sector, several of the experts said that they now cook with LPG themselves.

4.2. Online survey and interviews with experts

The majority if the findings are disaggregated by location (urban, peri-urban and rural) as notable differences were found in people's cooking behaviours the in three areas (see section 4.2.3.2 for examination of who the three samples represent). This is explored after a summary of observations around gender. As such, the following findings section is divided into the below sub-sections:

4.2.1 – Gender disaggregation – a short summary of observations around gender
4.2.2 – Basic participant and household information
4.2.3 – Cooking questions
4.2.4 – Indicative diary
4.2.5 – Other cooking information
4.2.6 – Focus groups

4.2.1. Gender disaggregation

Detailed analysis comparing responses by male and female respondents was not possible due to the small numbers of male respondents in each area (urban: 3/14, peri-urban: 2/14, rural: 0/29). Male and female responses have both been included in all other analysis because there did not appear to be any evidence to suggest differences which would invalidate their inclusion. However, the following observations were made during the data collection, and concur with the findings from expert interviews (see earlier section 0) that there is often a separation between those who are responsible for household finances and those who do the household cooking. This separation is often along gender lines, but also between household heads and maids (particularly in urban areas) and is an influencing factor when it comes to cooking practises and the uptake of new technologies. For example:

- The father in the household (who is often responsible for purchasing appliances/devices and paying for fuel/bills) may buy a modern cooking device, but the mother in the household chooses not to use it or struggles to cook their normal dishes with it.
- Particularly in urban households, maids are often responsible for cooking and have little agency around selecting cooking devices and fuels. It is also likely that they have less understanding of using, modern appliances such as electric cookers and LPG.

4.2.2. Basic participant and household information

The urban, peri-urban and rural samples demonstrated different socio-economic characteristics, which are summarised below (see Table 4 for statistics):

- **Education** – Education levels[16] varied between the sample areas: in the urban sample education levels were higher, the majority had completed form 3-4, compared with form 1-2 for peri-urban and standard 5-8 for rural respondents.
- **House size and occupancy** – Most households surveyed had between 3 and 6 occupants, and between 2 and 4 rooms. Urban households had the most rooms and lowest occupancies, while rural households had the least rooms and highest occupancies.
- **House construction** – House construction varied between the sample areas: in urban and peri-urban samples all houses had burnt brick walls and metal sheet roofs. In the rural sample most houses had mud or mud brick walls, with some metal and some grass roofs.
- **Electricity connection** – All respondents in the urban and peri-urban samples were connected to the national grid but have very frequent blackouts (5 times per week or more).

[16] Malawi's education system officially corresponds to: Primary = standard 1-8 (6-13 yrs), Secondary = form 1-4 (14-17). However, many children graduate primary school late, and attendance at secondary school is often not for four continuous years.

These blackouts effect urban households' cooking the most, with the majority saying that blackouts often effect cooking, while the effect of blackouts on peri-urban households' cooking was smaller. Most of the rural respondents were connected to the new mini-grid, of which all said they never experience blackouts, but this does not currently have any bearing on cooking as none of the rural households were currently cooking using electricity.

Table 4 - Basic participant and household information by sample area [urban: 14, peri-urban: 14, rural: 29]

		Sample location		
		Urban (14)	Peri-urban (14)	Rural (29)
Characteristic	Education (median)	Form 3-4	Form 1-2	Std 5-8
	Rooms per occupant	0.91	0.70	0.55
	Wall construction	100% burnt brick + cement		89% mud, 11% brick + cement
	Roof construction	100% metal sheets		55% metal, 41% grass
	Electricity connection	100% grid connected		83% connected to mini-grid
	Blackout frequency	100% "5 times per week or more"		100% never have blackouts
	Do blackouts effect cooking?	Often (57%) Rarely (14%) Never (29%)	Often (29%) Sometimes (7%) Never (64%)	N/A

Most households across the whole sample did not use sources of electricity other than the national grid (55% on average), however some households did use generators, solar home systems, pico-solar products and batteries (Figure 4).

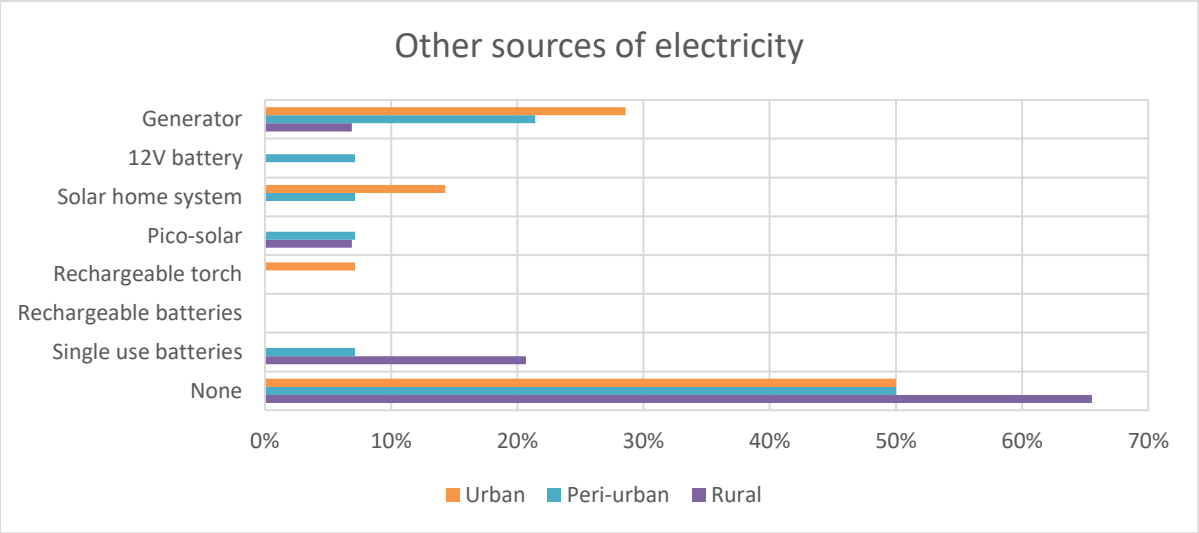


Figure 4 – Use of other sources of electricity as a percentage of the sample size (by location) (multiple responses permitted) [urban: 14, peri-urban: 14, rural: 29]

It is likely that the use of other electricity sources in the rural sample does not accurately represent rural areas in the majority of Malawi due to their recent connection to a mini-grid. For example, UoS research has shown that single use batteries were the only source of electricity for 78% of households in another rural, off-grid area [13].

4.2.3. Cooking Questions

4.2.3.1. Cooking device ownership

Responses to the question, *"Which of the listed devices do you own for cooking in your household?"* were different depending on the sample (shown in Table 5, Table 6, Figure 5 and Figure 6):

- **Urban households** – all but one respondent owned an electric hotplate (93%) with one respondent owning only an LPG burner and oven. Urban respondents also often owned other electrical cooking devices, including kettles (36%), rice cookers (21%), microwaves (14%) and fryers (7%).
- **Peri-urban households –** cooking device ownership was more mixed with charcoal stove ownership being the highest (71%), closely followed by electric hotplates (57%). Peri-urban respondents owned fewer other cooking devices than the urban respondents, but some did own electric kettles (50%) and microwaves (7%).
- **Rural households –** all but one household cooked with firewood (97%) while there were also a small number of charcoal stoves (17%). There was no ownership of any other cooking devices, which is not surprising given their lack of connection to the national grid, remote location and the prevalence of gathering firewood for free (see section 4.2.3.5).

Biomass use was mainly found in the in peri-urban and rural samples.

Table 5 – Hotplate type device ownership (by location) [urban: 14, peri-urban: 14, rural: 29]

	Urban	Peri	Rural
Firewood	0	1 / 7%	28 / 97%
Charcoal	2 / 14%	10 / 71%	5 / 17%
Electric	13 / 93%	8 / 57%	0
LPG	3 / 21%	0	0

"LPG" includes LPG responses for cylinder burner, portable burner and burner+oven
"Electric" includes Electric responses for hotplate+oven, hotplate, mini-oven+hotplate and induction

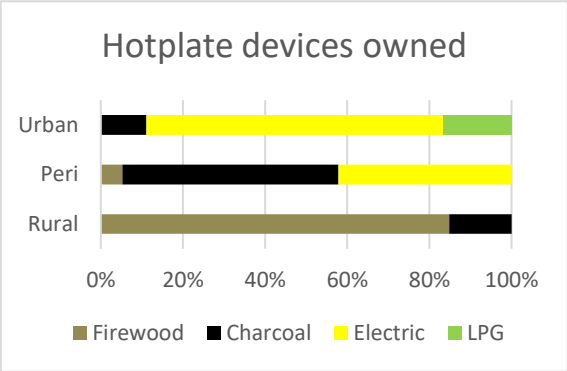


Figure 5 – Hotplate ownership proportions (by location) [each adjusted to total 100% for comparison]

Table 6 – Other device ownership (by location)

	Urban	Peri	Rural
Fryer	1 / 7%	0	0
Rice cooker	3 / 21%	0	0
Microwave	2 / 14%	1 / 7%	0
Kettle	5 / 36%	7 / 50%	0

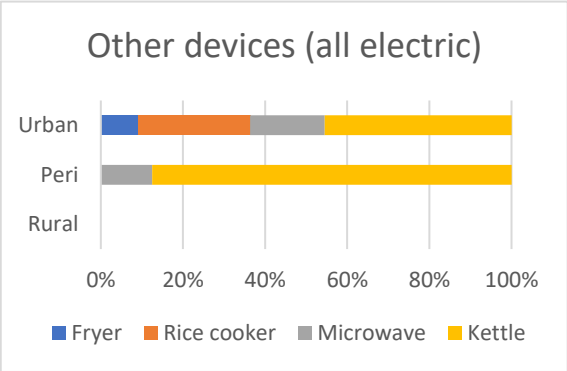


Figure 6 – Other device ownership (by location) [each adjusted to total 100% for comparison]

Reported ownership does not take into account the actual use of the devices, however, device use in the indicative diaries was almost exactly the same and responses to the device ownership question in the survey (see Appendix G).

4.2.3.2. Comparison of cooking device ownership with other data sources

This study's findings (here prefixed with MECS-) have been compared with similar data from:

- Malawi's National Statistics Office's Integrated Household Surveys [7] [15] (prefixed NSO-)
- PERFORM project [14] (prefixed with PER-)
- Japanese International Cooperation Agency's charcoal survey [16] (prefixed with JICA-)

shows that the MECS-urban and MECS-peri-urban samples are similar to the urban samples from PERFORM and JICA but different from the urban samples from NSO. The rural samples are similar across MECS, PERFORM and NSO (JICA did not have a rural sample).

These differences are likely due to differences in the areas described as "urban" in the studies. MECS-urban, PER-urban and all the JICA samples target specific areas of Lilongwe City and do not include the surrounding, not-so-urbanised areas, while NSO-urban includes the entire district area of Lilongwe City (see Figure 9) as well as Blantyre City, Mzuzu City and the Municipality of Zomba.

Another difference can be explained by the high proportion (100%) of the MECS-peri-urban sample being connected to the national grid, compared with the NSO-urban sample which has between 30-50% grid connection (PERFORM and JICA do not include data on this). An initial demonstration of the relationship between access to electricity and using electricity as the main cooking fuel is shown on

Figure 8, where all the NSO districts' grid connection levels are plotted against their use of electric cooking (MECS-urban data point is far out of this range and is therefore not shown).

As such, the findings from this study (similar to that of the findings of other similar studies) must be viewed as representative of particular household types or levels of affluency, as well as being located in rural, peri-urban and urban areas.

Table 7 - Comparison of cooking fuels from four studies MECS, NSO**, PERFORM*** and JICA*****

Location (study)	Firewood	Charcoal	Electric	LPG
MECS-rural	**97%**	**3%**	**0%**	**0%**
NSO-rural (IHS)	93%	5%	0%	-
NSO-rural (IHPS)	88%	9%	1%	-
PERFORM-rural	91%	9%	1%	0%
NSO-Lilongwe City (IHS)	28%	64%	8%	-
NSO-urban (IHS)	28%	62%	9%	-
NSO-urban (IHPS)	22%	68%	10%	-
PER-urban low income	4%	80%	10%	6%
PER-urban middle income	4%	53%	36%	7%
JICA-urban high density	0%	97%	3%	0%
JICA-urban med. density	0%	93%	7%	0%
MECS-peri-urban	**7%**	**50%**	**43%**	**0%**
PER-urban high income	1%	12%	72%	16%
JICA-urban low density	1%	60%	37%	0%
MECS-urban	**0%**	**0%**	**93%**	**7%**

* NSO- asked "what is your main source of cooking fuel?" (single response only)
** PER- asked respondents to rank the fuels in order of preference (most preferred fuel quoted here)
*** MECS- asked, "which of the listed devices do you own for cooking in your household?" (multiple responses)
**** JICA- asked "which is your main source of energy for cooking? (single response only)

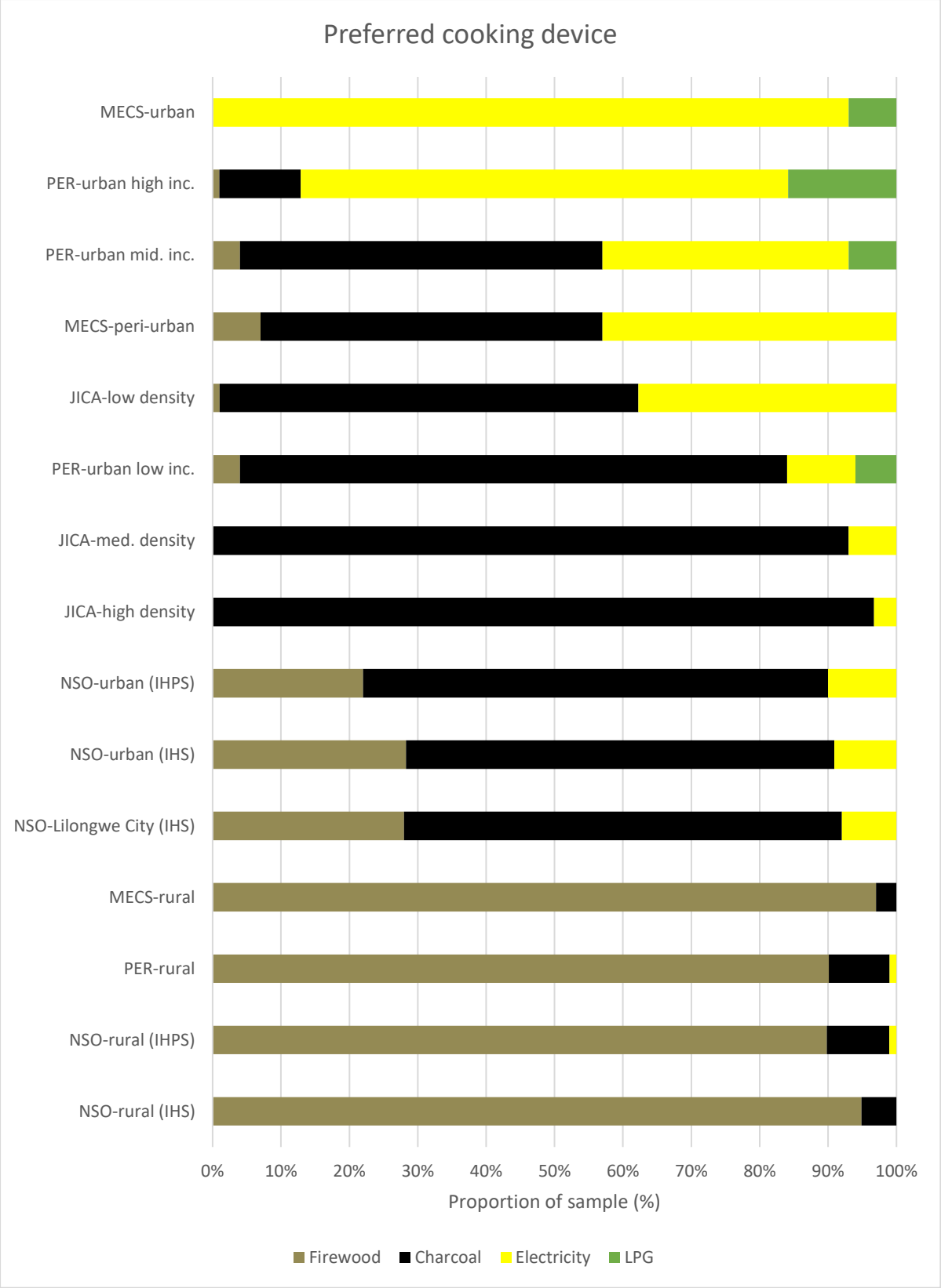


Figure 7 - Comparison of preferred cooking devices from three studies MECS, NSO**, PERFORM*** and JICA*****

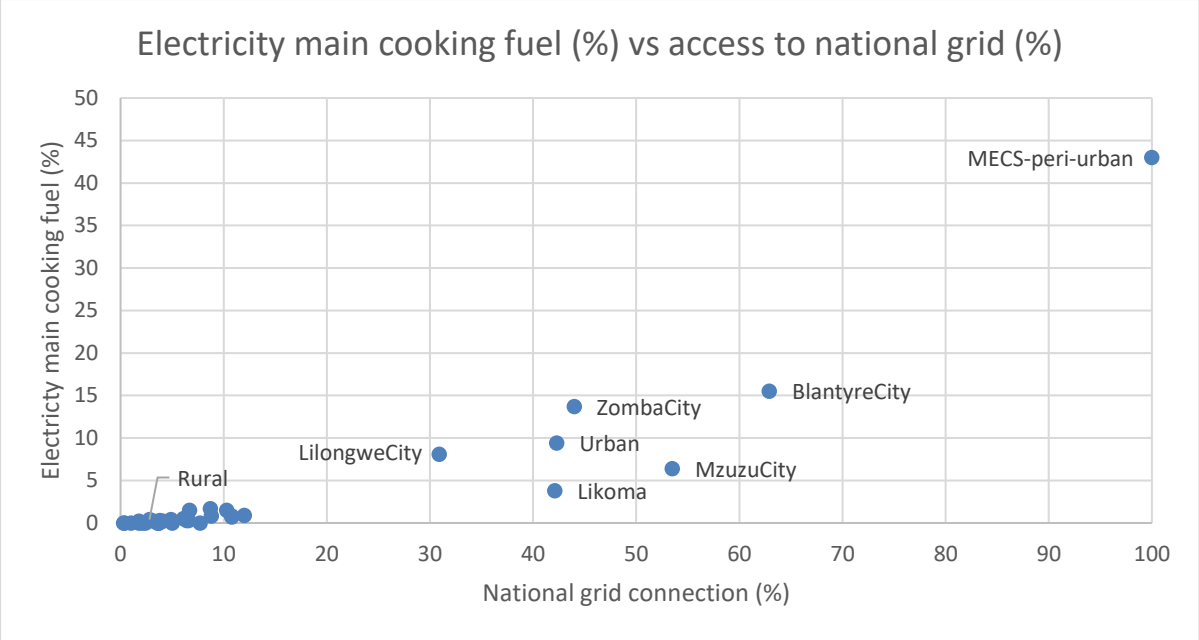


Figure 8 – Proportion using electricity as the main cooking fuel vs access to national grid electricity

Figure 9 - Map of "Lilongwe District" with "Lilongwe City District" and sample locations indicated (orange)

4.2.3.3. Cooking fuels and fuel stacking

The device ownership data (Table 5 and Table 6 above) show that the urban sample cooks predominantly on electricity, while the peri-urban sample shares cooking between charcoal and electricity, and the rural sample cooks mostly on firewood. However, 23% of all the surveyed households owned more than one hotplate type device (a heat source used to heat a pot from below). Multiple device ownership (often called fuel/device stacking [17]) again differed depending on the sample location (see Table 8).

Interestingly, 9/13 (69%) of the urban sample who cook with electricity reported only owning electric hotplates (also 3/7 (43%) of the peri-urban sample who cook with electricity), which is surprising given the regularity of blackouts (even removing the two urban households who own generators, over half the urban sample only selected electric hotplates), which raises the question, of how they cook during blackouts. This could be answered by several possible explanations, for example; perhaps the survey did not accurately record all the participants' cooking devices; or perhaps many respondents have found ways around the issue of blackouts. Some possible ways might be altering their cooking times (e.g. heating food earlier in the day for later meals during blackout periods or delay cooking to wait for power to resume) or choosing to buy food from elsewhere. Coping mechanisms for cooking during blackout periods is an area which could be the subject of further research and may reveal that biomass use is higher than the surveys suggest.

Table 8 - Stacking of hotplates (by location)

Urban (14)

Hotplates	Total	Firewood	Charcoal	LPG	Electricity	Comments
Firewood	0		0	0	0	
Charcoal	2	0		0	2	All charcoal users also use electricity
LPG	3	0	0		2	2/3 LPG users also use electricity
Electricity	13	0	2	2		9/13 electricity users use electricity only

Peri-urban (14)

Hotplates	Total	Firewood	Charcoal	LPG	Electricity	Comments
Firewood	1		0	0	0	
Charcoal	10	0		0	4	4/10 charcoal users also use electricity
LPG	0	0	0		0	
Electricity	7	0	4	0		3/7 electricity users use electricity only

Rural (29)

Hotplates	Total	Firewood	Charcoal	LPG	Electricity	Comments
Firewood	28		4	0	0	Only 4/28 use charcoal with firewood
Charcoal	5	4		0	0	Only 1/5 uses charcoal only
LPG	0	0	0		0	
Electricity	0	0	0	0		

4.2.3.4. Cooking device uses

The respondents were also asked what they use each of the devices for, to which most responses were simply "cooking/preparing meals". However, perhaps more interesting are responses from those who own more than one device, these are summarised below:

- Firewood + charcoal (4) – all respondents were in the rural sample
  - Firewood for "cooking most/all meals" (4/4)
  - Charcoal for "cooking meals when it's raining" (2/4)
- Charcoal + electricity (6) – respondents from urban (2) and peri-urban (4) samples
  - Charcoal for "cooking meals when we have no electricity" (5/6)

What the experts said (cooking devices/fuels)

Reponses from experts to the online survey and interviews generally agreed with the findings from primary data shown above (sections 4.2.2 - 4.2.3.4). All experts said that firewood was the main cooking fuel used in rural areas either on 3 stone fires or improved firewood stoves. Although the rural sample in this study does not show any use of improved firewood stoves, it is likely that interventions to encourage the use of this device simply have not yet reached this community.

"Rural areas (villages) are almost exclusively cooking on firewood (with the large majority of HH using a 3-stone fire)." – Online respondent 13

"In the rural setting… the cooking is either done on three-cornerstone open fire or using locally fabricated stoves especially 'Chitetezo Mbaula.'" – Online respondent 7

Responses varied in their account of cooking devices/fuels used in urban areas highlighting the complexity of urban cooking due to the likelihood of there being a variety of different practises and also the knowledge gaps around this. Some believed that charcoal was the main fuel, others electricity and some said that there was still a large amount of firewood use in urban areas.

"Charcoal is the predominant cooking fuel in urban areas (roughly 2/3 of urban HH use charcoal)" – Online respondent 13

"In Urban areas, majority use charcoal and very few use electricity or gas." – Online respondent 6

"Cooking using electric appliances is a common practice in the urban areas" – Online respondent 7

"In Urban areas improved cookstoves are increasingly being adopted." – Online respondent 3

"Urban: half/half charcoal and firewood (which is unique for African cities, where normally no firewood is found for retail markets)." – Online respondent 10

Although there is evidently more research needed into cooking practises in urban areas, experts agreed that fuel/device stacking is a common and necessary practise, mainly due to the unreliable electricity supply but also the affordability of different fuels.

"Surely households are stacking electricity with biomass as we are all aware that ESCOM supply is not that reliable." – Online respondent 2

"fuel & stove stacking is the order of the day but also a desired situation from the users perspective." – Online respondent 10

"There are cases where families have electric appliances but still decide to use charcoal stoves especially during blackouts or in order to manage their electricity bills." – Online respondent 7

4.2.3.5. Cooking fuel expenditure

Fuels were bought in different amounts with a variety of different regularities which do not appear to be common to the specific fuel types:

- **Firewood** (mainly used in rural areas only) – almost always gathered for free (27/29 responses) with some gathering daily, weekly or monthly in varying quantities. Those who gather monthly mentioned that they gather using a cart and store for use over a month.
- **Charcoal** (mainly used in peri-urban areas) – bought in a variety of sizes and regularities. Usually either daily (4/17 buy a small plastic bag at 300-500 MWK[17]) or weekly/monthly (11/17 buy a large "50kg"[18] bag at 3000-5000 MWK).
- **Electricity** – usually bought monthly or weekly at a range of different expenditures. It was more common for peri-urban areas to buy electricity less often (7/9 buy monthly) than urban areas (5/13 buy monthly); possibly due to higher electricity consumption levels in urban areas. Monthly purchases were usually between 10000-30000 MWK, and weekly purchases were usually between 2000-10000 MWK.
- **LPG** (three, users all urban) – bought far less regularly (responses from "2 times per month", to "after three months") costing 15000 MWK for 6kg and 25000 MWK for 9kg cylinder.

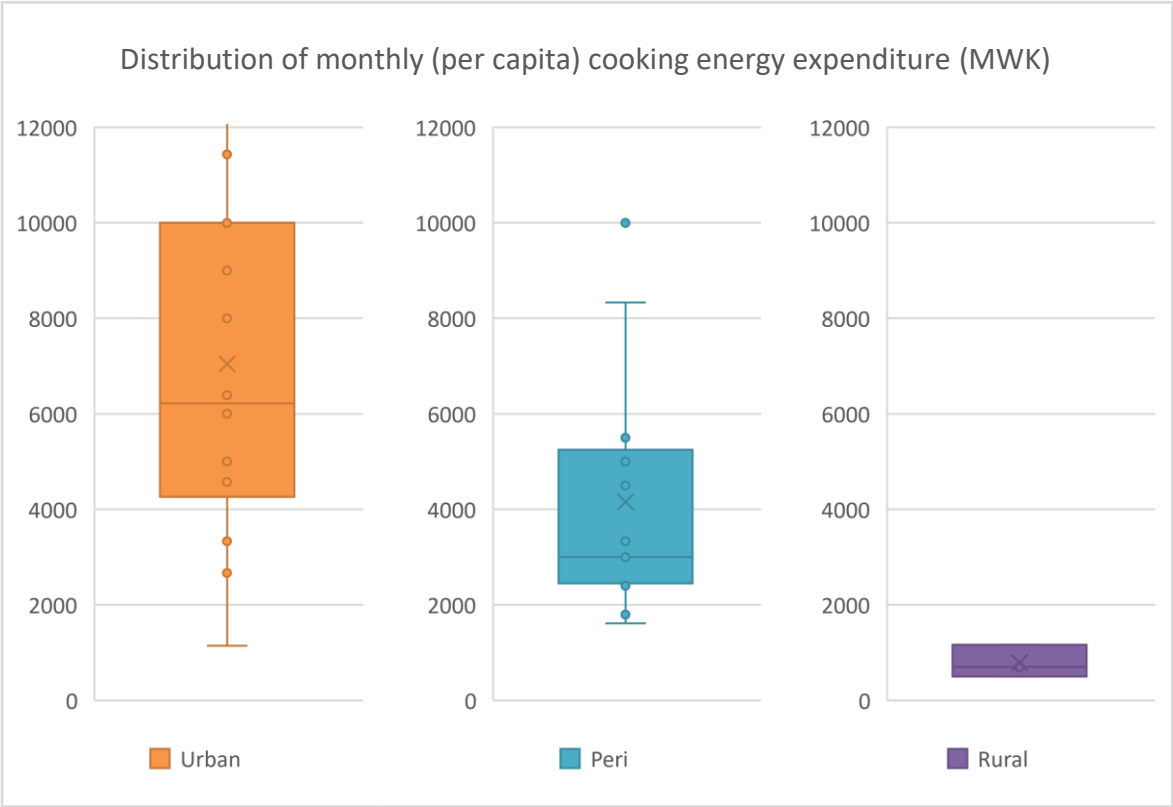


Figure 10 - Distribution of monthly cooking energy expenditure [urban: 14, peri-urban: 14, rural: 29]

[17] 1 USD = 737 MWK as of 30/04/2020

[18] "50kg" bag does not correspond to the weight of the charcoal, but the weight of the maize which the bag is made to contain. Previous studies have shown that "50kg" bags contain around 12kg of usable charcoal.

The total household cooking fuel expenditure for this study can be compared with the PERFORM and JICA studies previously mentioned (section 4.2.3.2), which shows some similarity (Figure 11). "Urban" in this study could perhaps be referred to as "urban middle-high income" whilst peri-urban could be referred to as "urban low-middle income".

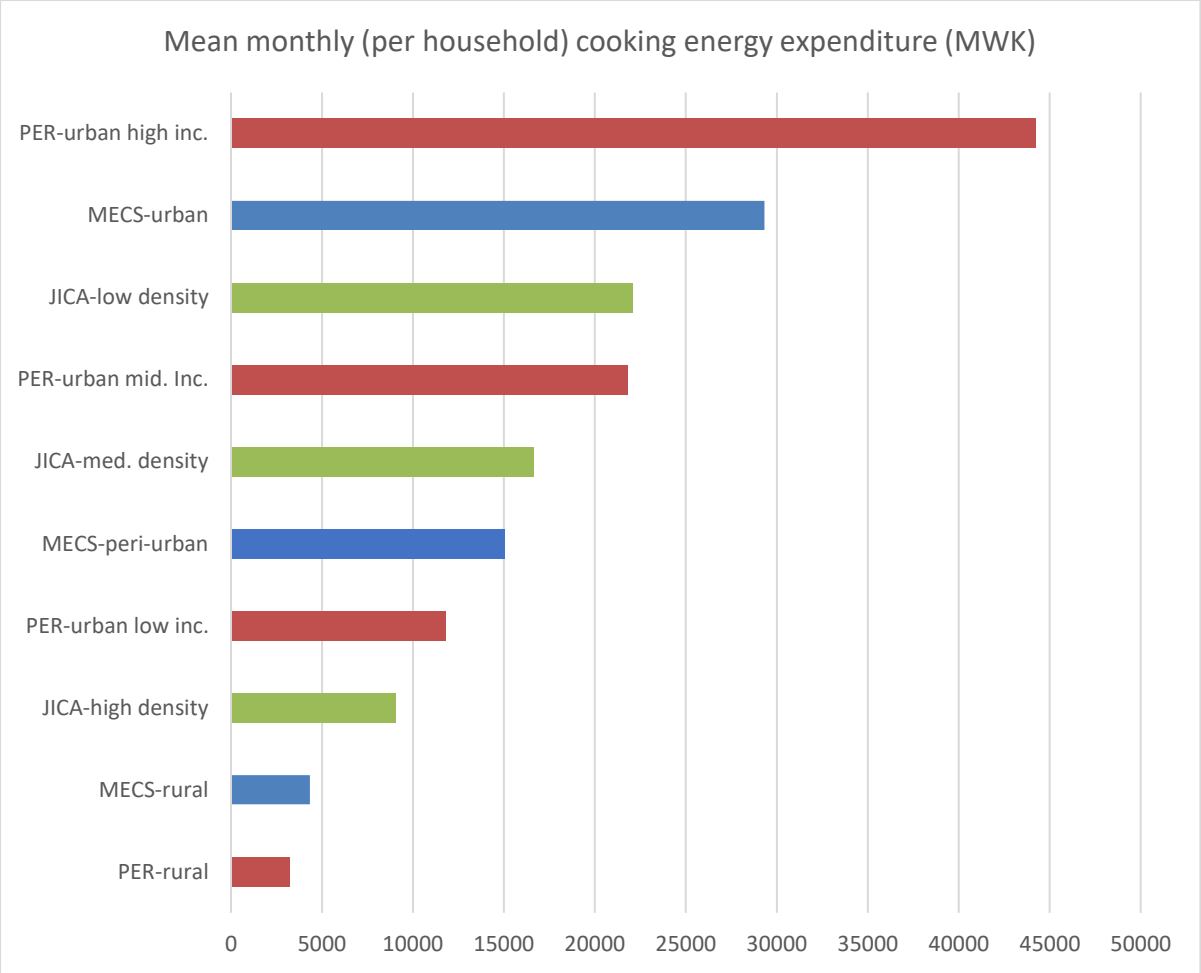


Figure 11 - Monthly cooking expenditure comparison between this study (MECS) and similar study (PERFORM)

For comparison within this study's data, a more useful metric is per capita expenditure. Table 9 presents one such comparison, although the sample sizes are very small, indicating that in urban areas cooking with electricity-only appears to be the cheapest option (6571 MWK per capita/month) compared with cooking on electricity and charcoal (7525 MWK per capita/month) and cooking on electricity and LPG (8129 MWK per capita/month).

Table 9 – Per capita energy expenditure by location/fuel (MWK) [sample sizes in brackets]

	Overall	Electricity only	Electricity + charcoal	Electricity + LPG
Urban	7042 (14)	6571 (9)	7525 (2)	8130 (3)
Peri	4152 (13)	4792 (4)	4802 (5)	-
Rural	789 (3)	-	-	-

In peri-urban areas there appears to be little difference between cooking on electricity only, and cooking with electricity and charcoal.

4.2.4. Indicative diaries

Survey respondents were asked to complete an indicative diary, giving the number of people cooked for, food/drink cooked, cooking device and cooking method used for the three meals (breakfast, lunch and dinner) of an indicative weekday and weekend day. Each meal could consist of up to three dishes plus a hot drink. This allowed a detailed comparison of the preferred devices and cooking methods for the different foods and dishes in the three different sample locations. All 57 participants completed this section, which generated 672 data points.

The majority of this analysis concentrates on the most commonly cooked food/drinks which allows for comparison between the samples. These food/drinks are shown below (Table 10), alongside the number of instances they were mentioned in the whole sample over the two indicative days. It was found that 90% of meals can be characterised by a set of 10 food/drinks. Given that the diary was only indicative, it is intended that the findings in this section (and also the above section) be confirmed during a future workshop or focus group activity.

For each food/drink the following cooking method options were given: boil, steam, grill, dry fry, wet (shallow) fry, deep fry, bake, pressure cook. The same cooking device list was given as in previous questions.

Table 10 - Foods cooked and number of instances in indicative cooking diaries

Core food/drinks

Breakfast	Total	Urban	Peri	Rural
Tea/Coffee	79	22	25	32
Porridge	31	6	5	20
Potatoes	35	11	10	14
Eggs	13	7	6	0

Lunch	Total	Urban	Peri	Rural
Nsima/rice	85	13	17	55
Beans	20	3	0	17
Vegetables	51	10	9	32
Fish	13	5	3	5
Eggs	8	1	1	6
Meat/poultry	34	10	13	11

Dinner	Total	Urban	Peri	Rural
Nsima/rice	97	20	22	55
Beans	13	0	3	10
Vegetables	55	13	13	29
Fish	12	2	7	3
Eggs	15	0	2	13
Meat/poultry	40	20	12	8

Other food/drinks

Breakfast	*Total*
meat	*3*
mandasi	*3*
banana	*1*
rice	*4*
meats	*1*
pumpkin	*1*
vegetables	*1*
thobwa	*1*

Lunch	*Total*
relish	*1*
potatoes	*4*
pumpkin	*3*
soya pieces	*1*
nyemba	*6*
mushrooms	*1*
tea/coffee	*6*
purifying water	*1*

Dinner	*Total*
unripe bananas	*1*
potatoes	*7*
spaghetti	*1*
pumpkin	*1*
sweet potatoes	*2*
nyemba	*5*
porridge	*1*
relish	*2*
soya	*5*
tomatoes	*1*
tea/coffee	*7*
purifying water	*1*

Foods were usually cooked by boiling, however potatoes, eggs, fish and meat which were also cooked by deep frying, shallow frying and grilling in different amounts Table 11.

Table 11 - Cooking methods used for each food and fuel

Dish (any meal)	Boil	Deep fry	Shallow fry/grill
Tea/coffee	92	-	-
Porridge	32	-	-
Potatoes	18	18	-
Eggs	21	12	3
Nsima/rice	186	-	-
Beans	33	-	-
Vegetables	107	-	-
Fish	15	5	5
Meat	40	27	4

4.2.4.1. Meals cooked

There were some differences between the different sample locations in terms of meals which they indicated they usually cook (Table 12). All respondents from the rural sample indicated that they would do some cooking for all meals on both weekends and weekend days, while the urban and peri-urban respondents' cooking habits were less consistent. Urban areas also said they cook fewer weekend meals than weekday meals, particularly lunch and dinner.

Table 12 - Likelihood of a meal being cooked[19] (by location and day) [urban: 14, peri-urban: 14, rural: 29]

	Breakfast		Lunch		Dinner	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Urban	86%	79%	71%	57%	100%	71%
Peri	93%	100%	64%	64%	100%	93%
Rural	100%	100%	100%	100%	100%	100%

Although this could be taken to mean that urban and peri-urban areas could have lower cooking demand relative to rural areas, comparing the responses to the question "Do blackouts effect your cooking habits?" between those who said that they do not cook some meals and those who said that they do cook for all meals, showed a difference:

Do not cook all meals[20]: 12/18 (67%) said that blackouts effect cooking
Cook all meals: 3/10 (30%) of those who do cook all meals.

It is therefore possible that given a reliable electricity supply, urban and peri-urban areas would be more likely to cook more meals, and the difference shown in (Table 12) may be less severe.

What the experts said (meals cooked)

Differences between the meals cooked for in urban and rural areas were also highlighted by experts. It was generally corroborated that lunch in particular was less likely to be cooked in urban areas, due to people buying lunch while at work. It was also agreed that in urban areas people would generally be more likely to eat out, which backs up the findings above; fewer meals are cooked at weekends perhaps because people choose to eat out during their free time.

"Urban: …Food habits don't vary a lot, eating out only for better-off salaried employees at lunch, most not so affluent bring packed food from home." – Online respondent 10

"due to urbanisation eating out during the lunch time has dominated in urbans and other parts of rural areas especially for the employed individuals who operate away from their communities" – Online respondent 15

[19] For example, Breakfast-Urban-Weekday: 12/14 urban respondents indicated that they cook at least one dish on a weekday for breakfast = 86%

[20] "those who said that they do not cook some meals" describes respondents who indicated that they would not cook at least one of the six meals included in the indicative cooking diary. Only urban and peri-urban respondents are included.

4.2.4.2. Dishes cooked

For the core dishes, some differences can be seen between which dishes are most commonly cooked in which of the three areas (Table 13). The following differences can be seen (only the largest differences are commented on due to the small sample sizes):

- **Eggs** – rarely cooked for breakfast in rural areas compared with urban and peri-urban areas, while far more common for lunch and dinner in rural areas than urban and peri-urban.
- **Beans** – far more commonly cooked in rural areas than urban and peri-urban areas. However, overall, beans was not a very common dish which is perhaps surprising given that it is often considered a staple of Malawian cooking.
- **Meat/poultry** – far more common in urban and peri-urban areas than in rural areas for both lunch and dinner.

Table 13 – Proportion each dish cooked in each location[21] [urban: 14, peri-urban: 14, rural: 14]*

Breakfast

	Tea/Coffee	Porridge	Potatoes	Eggs
Urban	35%	29%	40%	54%
Peri	40%	24%	36%	46%
Rural *	25%	47%	24%	0%
Total *	62	21	28	13

Lunch

	Nsima/rice	Beans	Vegetables	Fish	Eggs	Meat/poultry
Urban	23%	27%	29%	48%	20%	35%
Peri	30%	0%	26%	29%	20%	46%
Rural *	47%	73%	45%	23%	59%	19%
Total *	57	11	34	10	5	28

Dinner

	Nsima/rice	Beans	Vegetables	Fish	Eggs	Meat/poultry
Urban	29%	0%	33%	19%	0%	56%
Peri	32%	38%	33%	67%	24%	33%
Rural *	39%	62%	35%	14%	76%	11%
Total *	69	8	40	10	8	36

* Rural totals proportionally adjusted from sample size of 29 to 14 to match urban and peri-urban datasets

Table 14 shows the popularity of a dish within the different sample locations:

- **Tea/coffee** – heating water for tea/coffee less popular in rural areas compared with urban and peri-urban areas. This may be because the time and effort required to heat water on a 3 stone fire is significantly more than that required to heat water in an electric kettle.
- **Nsima** – less popular in urban and peri-urban areas compared with rural areas.
- **Meat/poultry** – as shown above, meat/poultry is less popular in rural than in urban and peri-urban areas. This may be due to meat being more difficult to source and relatively more expensive for rural households, compared with the peri-urban and urban populations.
- **Eggs** – as shown above, cooking eggs for breakfast is more popular in urban and peri-urban areas than in rural areas which more commonly cook eggs for dinner. This may be because it is cooked as a cheaper replacement for meat.

[21] For example, Breakfast-urban-tea/coffee: 22 urban respondents said that they cook tea/coffee for breakfast out of a total of 62 responses between the three samples = 35%

Table 14 - Popularity of a dish[22] (by location and meal) [urban: 28, peri-urban: 28, rural: 58]

	Breakfast			
	Tea/coffee	Porridge	Potatoes	Eggs
Urban	79%	21%	39%	25%
Peri	89%	18%	36%	21%
Rural	55%	34%	24%	0%

	Lunch					
	Nsima/rice	Beans	Vegetables	Fish	Eggs	Meat/poultry
Urban	46%	11%	36%	18%	4%	36%
Peri	61%	0%	32%	11%	4%	46%
Rural	95%	29%	55%	9%	10%	19%

	Dinner					
	Nsima/rice	Beans	Vegetables	Fish	Eggs	Meat/poultry
Urban	71%	0%	46%	7%	0%	71%
Peri	79%	11%	46%	25%	7%	43%
Rural	95%	17%	50%	5%	22%	14%

The differences between the number of dishes cooked on weekdays and weekend days is shown in Table 15. The totals highlight the trend that as well as urban areas cooking less meals at weekends (see earlier Table 12), they also cook fewer dishes at weekends; the number of weekend dishes is almost half the number cooked on the weekday (a difference which is similar across the three meals). Exploring the reasons why urban households cook fewer meals and dishes at weekends could be the subject of future study (some are mentioned in the "What the experts said box in section 4.2.4.1)

Table 15 – Number of dishes cooked (by location, meal and weekday/weekend) [urban: 14, peri-urban: 14, rural: 29]

	Urban		Peri-urban		Rural	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Breakfast	30	16	23	23	34	32
Lunch	27	15	22	21	67	59
Dinner	37	18	32	27	61	57
Total dishes (all meals)	94	49	77	71	162	148

What the experts said (dishes cooked)

Experts largely concurred with the findings in sections 4.2.4 - 4.2.4.2. In particular, they said that nsima and vegetables would be the most common dishes cooked, with those who gave adequate detail also highlighting that tea/coffee with porridge/potatoes was a common breakfast food.

"[nsima] served with boiled greens flavored with onions, tomatoes and sometimes peanut flour… Tea with sugar in the morning and for breaks." – Online respondent 1

"The most commonly cooked food is "Nsima" which is usually accompanied by different local relish mostly belonging in the vegetable category." – Online respondent 7

Some experts also concurred with the finding that meat is cooked less in rural areas.

"Rural:… Mostly nsima with beans, usipa, eggs, soya pieces and rarely meat is cooked" – Online respondent 6

[22] For example, Breakfast-Peri-Tea/coffee: 11/14 peri urban respondents cook Tea/coffee for breakfast on a weekday and 14/14 cook Tea/coffee for breakfast on a weekend day = 89% averaged over the two days.

4.2.4.3. Devices and dishes cooked

The indicative diary also gathered information about which devices are used to cook the different dishes.

Table 16 confirms the findings in the device ownership section; that urban areas cook mostly with electricity, peri-urban areas cook mostly with a mixture of charcoal and electricity, and the rural areas cook with firewood. It does not appear that any specific devices are particularly preferred for cooking particular foods, however comparison between locations is restricted by the relatively small sample sizes for most data points.

Table 16 - Likelihood of dish being cooked using a particular device[23] (by location) [urban: 28, peri-urban: 28, rural: 58]

Breakfast

Tea/coffee

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	Electric - kettle	LPG - burner
Urban	22	0%	0%	55%	45%	0%
Peri	25	8%	28%	16%	48%	0%
Rural	32	97%	3%	0%	0%	0%

Porridge

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	Electric - fryer	LPG - burner
Urban	6	0%	0%	100%	0%	0%
Peri	5	0%	100%	0%	0%	0%
Rural	10	100%	0%	0%	0%	0%

Potatoes

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	Electric - fryer	LPG - burner
Urban	11	0%	0%	73%	18%	9%
Peri	10	10%	40%	50%	0%	0%
Rural	14	100%	0%	0%	0%	0%

Eggs

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	Electric - fryer	LPG - burner
Urban	7	0%	0%	100%	0%	0%
Peri	6	0%	33%	67%	0%	0%
Rural	0	-	-	-	-	-

Lunch/dinner

Nsima/rice

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	LPG - burner
Urban	33	0%	0%	85%*	9%*
Peri	39	8%	56%	36%	0%
Rural	110	97%	3%	0%	0%

Vegetables

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	LPG - burner
Urban	23	0%	0%	96%	4%
Peri	22	14%	50%	36%	0%
Rural	61	95%	5%	0%	0%

Beans

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	LPG - burner
Urban	3	-	-	-	-
Peri	3	-	-	-	-
Rural	27	96%	4%	0%	0%

Fish

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	LPG - burner
Urban	7	0%	0%	86%	14%
Peri	10	0%	70%	30%	0%
Rural	8	88%	13%	0%	0%

Meat/poultry

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	LPG - burner
Urban	30	0%	0%	87%	13%
Peri	25	8%	40%	52%	0%
Rural	19	89%	11%	0%	0%

Eggs

	#	Firewood - 3 stone	Charcoal - stove	Electric - hotplate	LPG - burner
Urban	1	-	-	-	-
Peri	3	-	-	-	-
Rural	19	100%	0%	0%	0%

* one record not included (respondent cooks rice with a rice cooker)
- insufficient number of respondents who indicate they cook this dish for this meal
"LPG - burner" includes LPG responses for cylinder burner, portable burner and burner+oven
"Electric - hotplate" includes Electric responses for hotplate+oven, hotplate, mini-oven+hotplate and induction

[23] For example, Tea/coffee-Urban-Hotplate: 10 responses from the urban sample cook tea/coffee with an electric hotplate out of 22 responses (11 weekday and 11 weekend) from the urban sample who cook tea/coffee with any device = 55%

4.2.4.4. Selection of devices to cook dishes

To gain some additional insight into device choices, the responses from the different locations have also been aggregated (Table 17) to take into account respondents' ability to choose which device they cook with. Here, the statistics represent the proportion of those who cook a dish with a device, out of those who cook that dish and own the device. In other words, 100% corresponds to all those who own that device and cook that dish, choosing to cook that dish with it (either meaning they prefer that device, or have no other device with which to cook that meal). Perhaps more interestingly, a low percentage corresponds to a small proportion of those who own the device choosing to cook that dish with it, the following trends are apparent:

- **3 stone fire** – as shown earlier (section 4.2.3.1), this device is mainly used by rural respondents and for many is their only cooking device, hence most data points are 100%.
- **Charcoal stove** – for almost all dishes, this device has the lowest proportion of those who own it, using it. In other words, given the choice, it appears that a higher proportion of people choose not to cook with charcoal, than choose not to cook with other devices.
- **Electric hotplate** – in most cases, given the option, respondents appear to choose to cook with electric hotplates. The exception to this is tea/coffee which is usually by electric kettle.
- **LPG** – due to the small number of LPG users, none of this data is displayed as the small sample is too small for this analysis.

Table 17 - Proportion of respondents who own a device which choose to cook with it[24] (by dish) [all locations aggregated]

Breakfast

	#	Firewood – 3 stone	Charcoal – stove	Electric – hotplate	Electric – kettle	Electric – fryer	LPG – burner
Tea/Coffee	79	100%	30%	53%	95%	*	*
Porridge	31	100%	63%	86%	N/A	*	*
Potatoes	35	100%	50%	87%	N/A	100%	*
Eggs	13	*	50%	100%	N/A	*	*

Lunch

	#	Firewood – 3 stone	Charcoal – stove	Electric – hotplate	LPG – burner
Nsima/rice	85	100%	48%	84%	*
Beans	20	100%	0%	100%	*
Vegetables	51	100%	64%	93%	*
Fish	13	100%	75%	80%	*
Eggs	8	*	*	*	*
Meat/poultry	34	100%	57%	88%	*

Dinner

	#	Firewood – 3 stone	Charcoal – stove	Electric – hotplate	LPG – burner
Nsima/rice	54	100%	44%	87%	*
Beans	10	90%	*	*	*
Vegetables	33	100%	70%	100%	*
Fish	9	*	83%	83%	*
Eggs	4	*	*	*	*
Meat/poultry	20	100%	29%	96%	*

* insufficient number of respondents who could choose to cook this meal with this device
"LPG - burner" includes LPG responses for cylinder burner, portable burner and burner+oven
"Electric - hotplate" includes Electric responses for hotplate+oven, hotplate, mini-oven+hotplate and induction

[24] For example, Breakfast-Tea/coffee-Charcoal: 8 responses cook tea/coffee with a charcoal stove out of 27 which cook tea/coffee and own a charcoal stove = 30%

4.2.5. Other cooking information

4.2.5.1. Kitchen location

The different sample groups had their kitchens, and cooked, in different locations. As seen in Figure 12, urban households all had their kitchens indoors and did only a small amount of cooking outdoor. Peri-urban kitchens were also mostly indoor, with some cooking being done outdoor, but 29% considered their kitchen and cooking to be outdoor only. All but one rural household considered their kitchen and cooking to be outdoor only, with one saying their kitchen was indoor but mostly cooked outdoors.

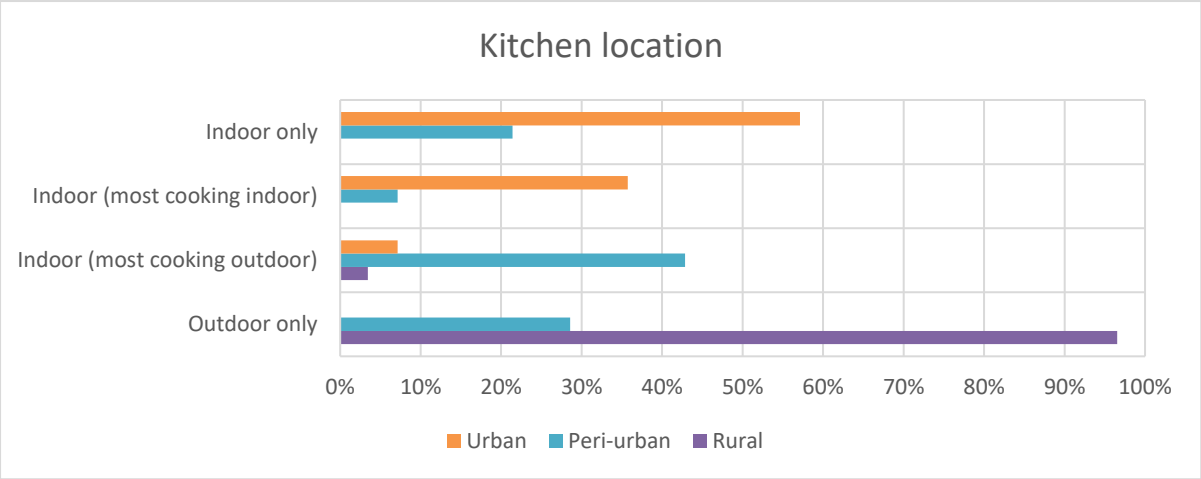


Figure 12 - Kitchen location as a percentage of the sample in that location [urban: 14, peri-urban: 14, rural: 29]

Unsurprisingly, when comparing kitchen location and cooking device use (Table 18), electrical devices are strongly linked with cooking indoors, while cooking with firewood or charcoal is strongly linked with cooking outdoors.

Table 18 - Comparing kitchen locations and devices used

	Firewood – 3 stone	Charcoal – stove	Electric - hotplate	LPG - burner
Indoor only	0	0	20	2
Indoor (cooking mostly indoor)	0	3	10	0
Indoor (cooking mostly outdoor)	1	7	8	1
Outdoor only	28	7	0	0

"LPG - burner" includes LPG responses for cylinder burner, portable burner and burner+oven
"Electric - hotplate" includes Electric responses for hotplate+oven, hotplate, mini-oven+hotplate and induction

Factors which are likely to contribute to this are: the smokelessness of cooking with electricity and electricity sockets being indoors; dirty/smoky burning of charcoal/firewood and 3 stone fires usually being located outdoors. The causality of the relationship between cooking device and where the kitchen/cooking is located is complicated by the different cooking devices used in the urban, peri-urban and rural locations, further research would be required to understand if cooking outside is purely linked to the devices used, or whether cultural/habitual or practical factors (such as availability of outside space) also contribute, and whether cooking outdoors is out of choice or necessity.

4.2.5.2. Water for bathing

The other main event which cooking devices are used for, is heating water for bathing[25]. Again, significant differences were evident between the three sample areas (see Figure 13). Urban households used a combination of electric geysers (36%), electric kettles (21%) and charcoal stoves (43%). Peri-urban households used electric kettles (43%) and charcoal stoves (50%), while rural households all used 3 stone fires. The regularity of heating water for bathing also differs (see Figure 14), with all rural respondents heating water for bathing everyday (excluding one which said it depends on the weather), compared with peri-urban and urban respondents heating water on a mixture of different regularities. Like the practises of cooking indoor/outdoor, it is not clear whether the device used has a causal effect on regularity of the heating of water for bathing.

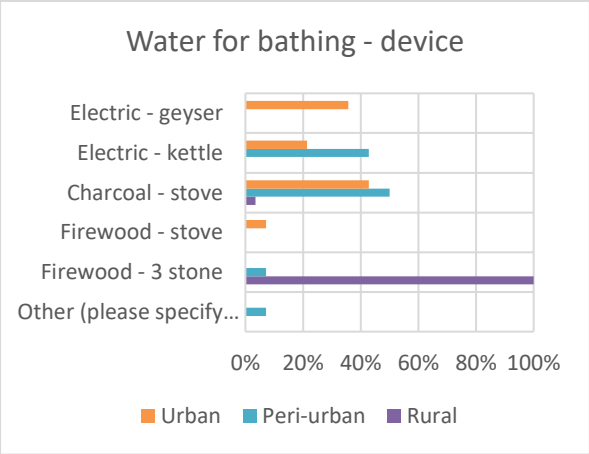


Figure 13 - Devices used to heat water for bathing as a percentage of the sample in that location

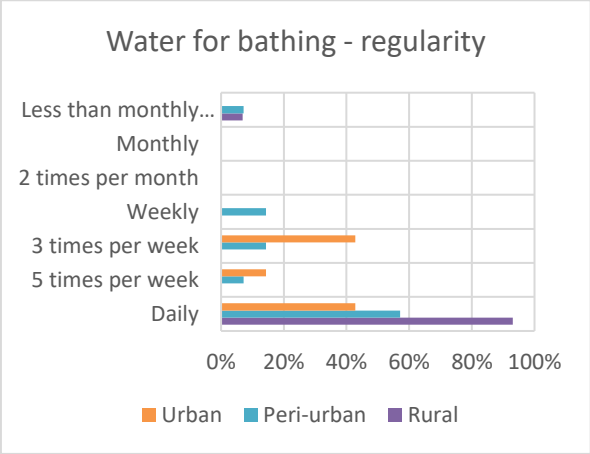


Figure 14 - Regularity of water heating for bathing as a percentage of the sample in that location

4.2.5.3. Satisfaction with cooking devices

Respondents were also asked, "*Overall, on a scale of 1 - 5, how happy are you with your current cooking devices?*". Across the three sample areas, the most common answer was "very happy". In rural areas there was the highest proportion of those who said "very happy" (45%) but also the highest proportion of those who said "very unhappy" (31%).

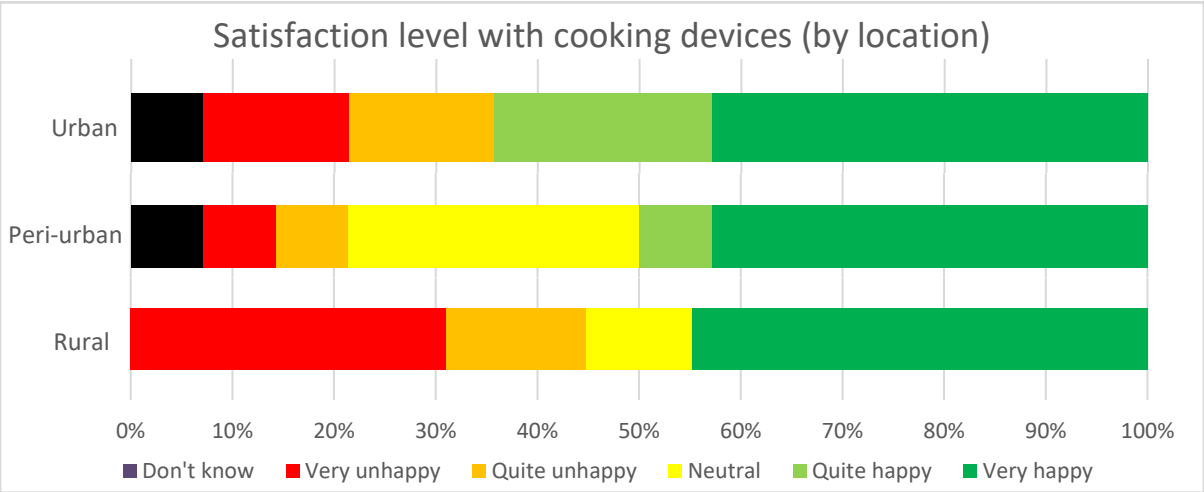


Figure 15 - Satisfaction level with cooking devices (by location) [urban: 14, peri-urban: 14, rural: 29]

[25] Surveys also included questions about heating water for laundry, no respondents said that they do this.

A slightly clearer difference was found when comparing by device (aggregating the three sample areas), where those predominantly using electric hotplates are happier with their cooking devices than those using charcoal or firewood.

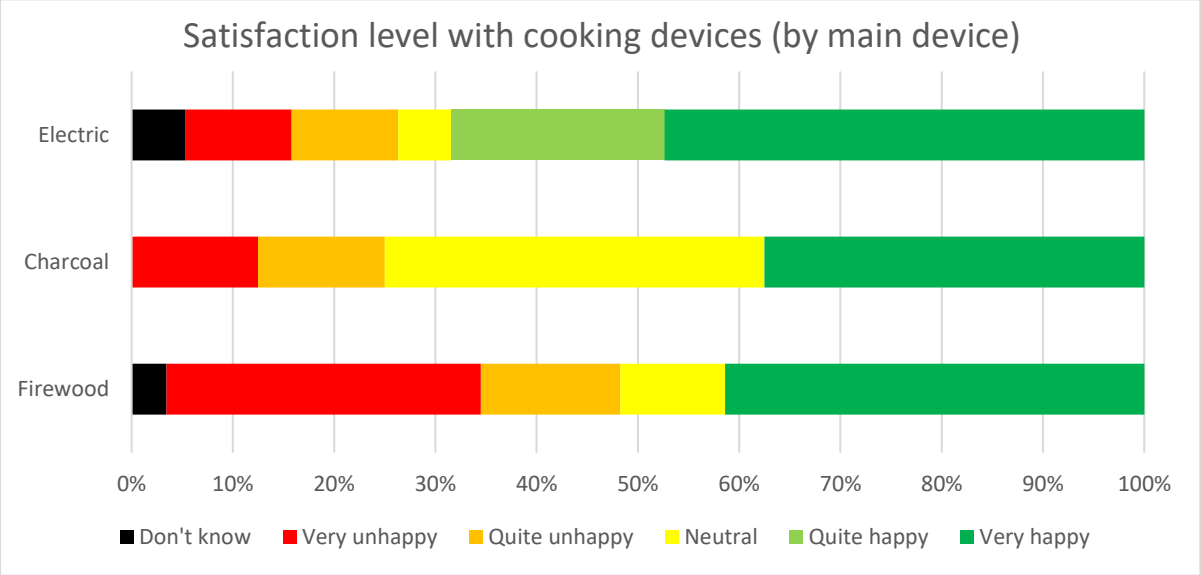


Figure 16 - Satisfaction level with cooking devices (by main cooking device) [urban: 14, peri-urban: 14, rural: 29]

Respondents were then asked, *"What impact does cooking with these devices have on your life and your household?"* to which they could make a free comment. Table 19 shows the themes of the responses. The most common responses were that, electricity is fast (13), firewood is difficult to use during the rainy season (6), and is unhealthy and/or smoky (6) (details mentioned that smoke gets in eyes and makes things/houses dirty). Similar responses were gathered during the focus group in the rural area (see next section (4.2.6)).

Table 19 - Themes mentioned around cooking with different fuels

Charcoal

Negative
Time to start fire (3)
Unhealthy/smoky (1)
Expensive (1)
Positive
Fast (2)
Cheap (1)

Firewood

Negative
Difficult in rainy season (6)
Unhealthy/smoky (6)
Takes time to gather (3)
Bad for the environment (1)
Positive
Cheap (2)
Fast (1)

Electricity

Negative
Unreliable (4)
Expensive (1)
Positive
Fast (13)
Easy (2)
Clean (2)
Cheap (1)

LPG

Negative
Dangerous (1)

Other

- Wish they had more devices/hotplates which would make cooking faster (1)
- All we can afford/satisfied with what we have (11)

4.2.6. Focus groups

As mentioned in the methodology section, one focus group was successfully completed (rural area).

Figure 17 – Focus group in the rural area; participants rank positive and negative aspects of firewood in order of importance

Four topics were identified from an initial analysis of the household surveys from the rural area, which were discussed in the first part of the focus group. The following was highlighted:

- **Reasons for cooking outdoors**
  - *Firewood is smoky so makes the walls dirty and causes illness*
  - *Lack of space in their kitchens*
- **Reasons for lack of "chitetezo mbaula" (locally manufactured, improved firewood stove)**
  - *Some members in the village do have these, but they are not common*
  - *There is no one in the village who knows how to make them*
  - *They are too expensive*
- **Time spent gathering wood**
  - *This depends on the season and availability of wood*
  - *Usually spend between 1.5 and 3 hours each time they go to collect wood*
- **Challenges of gathering firewood**
  - *The local forest is protected by forest guards. When they are caught, they are arrested and sometimes beaten or stripped naked and have to pay a fine in order to be released.*
  - *Collecting wood in the rainy season is particularly difficult because it is slippery which causes them to fall. They also get ill (pneumonia mentioned) as they get cold and wet.*
  - *They sometimes get injured from using the axes and from thorns.*

This was followed by an idea generation and ranking exercise, which focussed on the positive and negative aspects of using firewood and charcoal (Figure 18, Figure 19). Comparing these results with the use of electricity and/or LPG indicates that modern cooking fuels (if cheap enough) would satisfy the needs of the rural sample. For example, concerns about ease/speed of starting the fire, ability to control cooking temperature, smoky/dirtiness of biomass fuels and ability to cook during the rainy season would all be overcome. Demonstrating modern cooking devices' versatility and ability to cook more quickly than traditional ones, would also improve their uptake.

Firewood

Positive	**Negative**
1. Cooks fast	1. Costs money
2. Can also burn manure	2. Smoke causes illness and makes walls dirty
3. Its free	3. Makes pots dirty
4. Can easily start the fire	4. Burns food when there is too much fire
5. Brewing local beer	

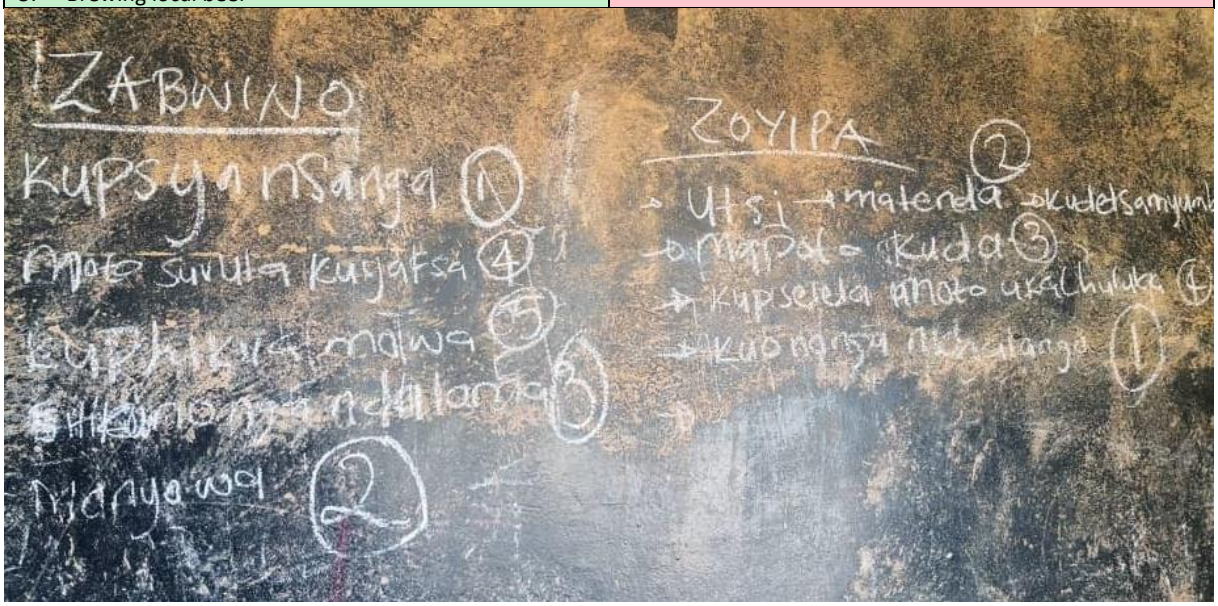


Figure 18 - Positive and negative aspects of firewood [top – translated, bottom – original]

Charcoal

Positive	**Negative**
1. Not too much smoke	Deforestation
2. Doesn't make pots dirty	Health issues because of smoke
3. Can be used for space heating	Slow to start the fire
4. Makes cooking easier in rainy season	Expensive
5. Fast to cook (once fire is started)	

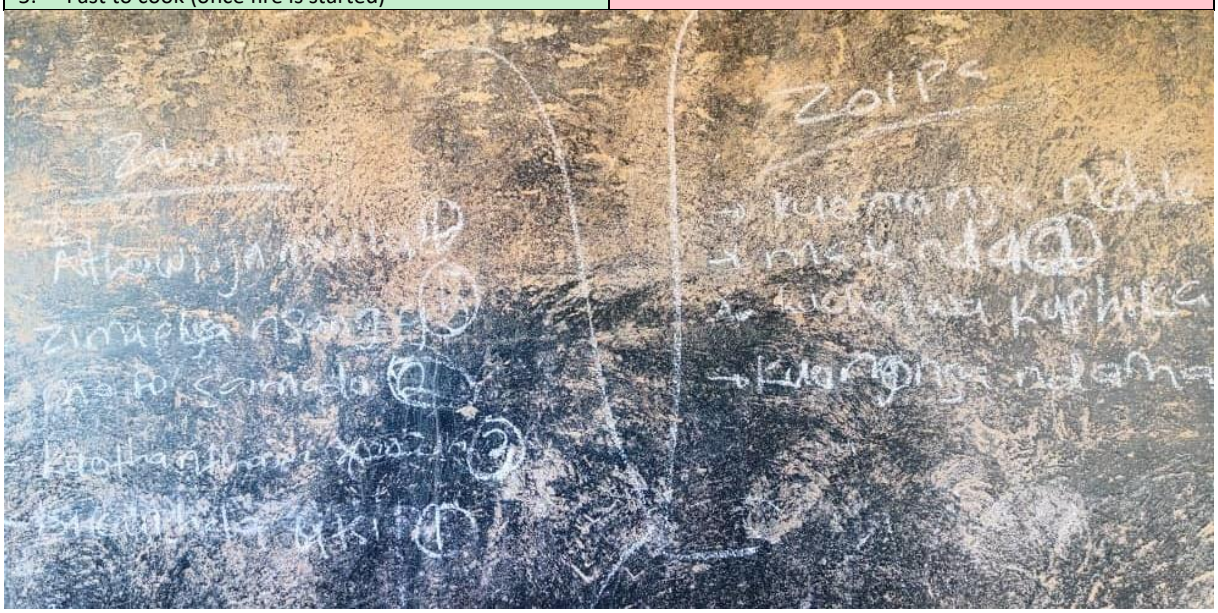


Figure 19 - Positive and negative aspects of charcoal [top – translated, bottom – original]

5. Discussion

This discussion begins by summarising the cooking practises and preferences in Malawi using the findings from the household surveys and focus groups, including some areas which should be considered when further study in this area is carried out. Then the findings of the policy review and expert interviews are discussed, concluding with a short description of what the journey might and should look like for modern energy cooking services in the short to medium term in Malawi and key considerations for future activities.

5.1. From the bottom – Household cooking practises

The cooking context

The household cooking information collected by the indicative cooking diaries in this study was, to the author's knowledge, the first of its kind and depth for Malawi. The findings have been broadly confirmed by discussions with experts about cooking practises, and has been contextualised by making comparisons with other cooking information gathered by similar studies. It has been shown that the "urban" sample from this study may more specifically correspond to "middle-high income urban" households and the "peri-urban" sample may correspond to "low-middle income urban" households.

With this in mind, a summary of the key data gathered from the cooking questions is provided below, also represented in (Table 20).

Urban (100% grid connected)
Households in the urban sample cooked mostly on electricity using electric hotplates and a variety of other electric cooking devices including kettles, rice cookers and microwaves. Half of households reported that they cook with electricity only (excluding those with generators). Most households spend 4000-8000MWK per capita per month. Electricity is usually paid for on a weekly basis by top-up meters installed in their houses. Three (out of 14) households used LPG, either buying a 6kg cylinder for 15000MWK or 9kg cylinder for 25000MWK between twice a month and every three months.

Peri-urban (100% grid connected)
Over half of the cooking in the peri-urban area was done using charcoal, and half using electricity. Device ownership was split approximately equally three ways between those who use electricity only, those who use charcoal only, and those who use both. Many households also owned electric kettles. Electricity expenditure was 2000-6000MWK per capita per month, paid for on a monthly basis by top-up meters installed in their houses. Charcoal expenditure was 1000-3000MWK per capita per month, which was bought either daily in small plastic bags costing between 300-500MWK, or weekly/monthly in large "50kg" bags costing between 3000-5000MWK.

Rural (off-grid with connections to a solar mini-grid which was recently installed)
Almost all rural households mainly used firewood (gathered for free) on 3 stone fires. Although a small number do pay for cooking with charcoal, this is very minimal 500-1000MWK per month. As such, there is very limited ability to pay for modern energy cooking services.

Table 20 – Tabulated summary of cooking fuel and device findings

	Main cooking fuel(s)	Other devices	Cooking fuel expenditure (per capita per month)	Fuel stacking (% of sample population)
Urban (mid-high income) (14 respondents)	Electricity (93%)	Kettle (36%) Rice cooker (21%) Microwave (14%)	4000-8000MWK (weekly top up)	Electricity only (64%) (inc. 14% own generator) + charcoal (14%) + LPG (21%)
Peri-urban (low-mid income) (14 respondents)	Electricity (57%)	Kettle (50%)	2000-6000MWK (monthly top up)	Electricity only (21%) + charcoal (29%)
	Charcoal (71%)	-	1000-3000MWK (small bags daily / "50kg" bag monthly)	Charcoal only (43%)
Rural (29 respondents)	Firewood (97%)	-	None (gathered for free)	Firewood only (83%) + charcoal (17%)

Cooking context - considerations for future study

- In order to estimate the proportion of Malawians who cook with such practises, a future study with larger samples might seek to draw parallels between cooking practises data and data collected by national censuses such as household income. Further study is needed to determine whether whether there is regional variation in cooking practises, for example between northern, central and southern regions, or between districts.
- The number of respondents cooking with electricity only was surprisingly high, which raises the question of how they cook during blackouts, which will be an important part of further study around cooking in Malawi.
- Further study is needed into a wider range of population groups which could fill the apparent void between this study's rural and peri-urban samples. For example, it would be beneficial to perform a similar exercise for an "urban-poor" sample which may be off-grid or on the edge of the electricity grid and also a sample which is in a rural, but more densely populated area with more economic activity.
- This study has shown that two samples in Lilongwe separated by just a few kilometres used different cooking fuels and had different cooking expenditures; whether there are similar levels of inhomogeneity in rural areas should be a consideration for further studies.
- The indicative diaries methodology has strong potential for use in other countries to quickly gather data on cooking practises. Its deployment in other countries could quickly provide comparable data on the core cuisines and cooking practises across the globe.

Cooking preferences

The indicative diaries showed that meals in urban, peri-urban and rural areas are commonly made up from 10 core dishes which constitute 90% of all the dishes collected in the indicative diaries (listed below). Modern energy cooking devices would need to be proven appropriate for cooking these dishes (at a minimum) in Malawian contexts in order to be successful at a large scale.

Breakfast	**Lunch**	**Dinner**
Tea/Coffee	Nsima/rice	Nsima/rice
Porridge	Beans	Beans
Potatoes	Vegetables	Vegetables
Eggs	Fish	Fish
	Eggs	Eggs
	Meat/poultry	Meat/poultry

The majority of analysis was focussed on comparing cooking practises and preferences between the three sample areas. The following key differences were highlighted:

- Nsima was more popular and beans more common in the rural sample areas than urban and peri-urban samples, while the opposite was true for meat/poultry. There is no indication as to whether these dish trends are due to cooking devices/fuels – perhaps 3 stone fires are more suited to cooking nsima and beans – or perhaps due to relatively higher costs and lower availability of meat in rural areas compared with urban areas.
- The rural sample also cooked eggs for breakfast far less often than the urban and peri-urban samples, while the opposite is true for lunch/dinner; again, the reasons for this are not clear but perhaps eggs are cooked instead of meat as a cheaper alternative in rural areas.
- The urban sample also cooked almost half as many dishes at weekends than on weekdays, while the peri-urban and rural samples cook roughly the same number for both.

The potential of the indicative diaries for gathering detailed information which allows the comparison of device choices for cooking different dishes was also demonstrated (although its accuracy needs to be validated by other methodologies such as focus groups and/or cooking diaries). However, numerous strong conclusions cannot be made due to the small number of datapoints in some individual categories, and as such the following key findings must be seen as indications only.

Cooking preferences – Key findings

It appears that Malawian cooks prefer not to use charcoal when they have electricity as an alternative. Survey and focus group responses indicated that charcoal is seen as an undesirable but necessary fuel in both urban and rural areas. In the urban sample, reasons as to why charcoal is used to cook were often either “for cooking meals when there is no electricity” or “for cooking meals when it’s raining”. Negative aspects highlighted by the focus group were that charcoal smoke is dirty (for clothes/homes), bad for health, and that the long time taken to start a charcoal fire is inconvenient.

Firewood, although used almost exclusively in rural areas due to factors including the lack of electricity, low-incomes and prevalence of free-to-gather fuel, was also seen as undesirable. Again, smoke was seen as an important issue, as well as being particularly challenging to gather in the rainy season (cold and slippery conditions) and cook with (dampness of wood). In addition, with the rural sample collecting the wood from a protected forest, there was also danger for women (who are usually responsible for collecting wood) being caught for doing so and punished severely.

Devices using modern fuels may overcome many of the reservations about traditional fuels. For example, electric or LPG devices do not suffer from issues around ease/speed of starting the fire, ability to control cooking temperature, smoky/dirtiness and difficulties in the rainy season. However, such devices' versatility, speed of cooking and most importantly their ability to cook local foods (at a minimum the 10 core foods identified) in ways which are acceptable to Malawian people would all need to be tested and proven in-country. Gathering insight beyond house-to-house surveys has proven difficult in urban areas and may require more novel approaches to engaging with the public.

5.2. From the top – Malawi's clean cooking sector

Reducing the alarming rate of deforestation continues to be the most important driver for a transition away from cooking with charcoal and firewood in Malawi.

To date, the vast majority of attention and interventions in Malawi's clean cooking sector have been focussed on propagating improved firewood stoves (known in Malawi as chitetezo mbaula) in rural areas. Until recently, national policy has also focussed almost exclusively on such activities. A review of the latest set of relevant policy documents however shows that the political environment is beginning to recognise the importance of a transition to modern energy cooking services, understanding the need for the scale up of LPG and electric cooking in particular, but also biogas, and alternative biomass fuels. Expert interviews have shown that there are several significant barriers to both LPG and electric cooking in Malawi, but considering their specific barriers and strengths shows the contexts in which they provide the most opportunity for scale up and positive impact.

Barriers to modern energy cooking in Malawi

Through discussions with experts from Malawi's cooking sector including practitioners, political actors and academics, four key barrier types which broadly sit across both LPG and electric cooking were highlighted; weakness/lack of infrastructure, unwillingness/inability to pay, socio-cultural resistance to device adoption and lack of agency of household cooks. A summary of each of these barriers is shown in Table 21.

Table 21 - Summary of barriers to LPG and electric cooking in Malawi

	Summary of barrier	
Barrier type	Electric cooking	LPG cooking
Weakness/lack of infrastructure	**Low levels of electricity access and unreliable supply in grid connected areas** puts off consumers. Although positive change is likely in 5-10 years, in the short-medium term high **electrical demand requirements of grid-eCook could exacerbate this issue.**	**Very weak existing market** lacks economies of scale. This scarcity of LPG suppliers makes **fuel replenishment inconvenient for users** who must replace/refill large and heavy gas cylinders themselves. Many **rural areas are almost unserviceable due to poor roads.**
Unwillingness/inability to pay	**High upfront cost of electric cooking devices and perception that energy is expensive** relative to charcoal makes electric cooking unaffordable for many and puts off consumers who could afford it.	**High upfront costs of LPG cooking devices and large lump sum payments required for refill/replacement of cylinders** relative to charcoal and electricity make them unaffordable for the majority of Malawians.
Socio-cultural resistance to device adoption	**Lack of practice, understanding and awareness of efficient cooking techniques** (e.g. using lids and soaking beans) **and devices** (e.g. pressure cookers) make efficient electric devices unfamiliar to most Malawians.	**Widespread perception that cooking with LPG is dangerous** makes Malawians from all levels of society hesitant to adopt LPG as a cooking fuel.
Lack of agency of household cooks	**Disconnection and power imbalance between those who use cooking devices/fuels** (usually females and/or maids**) and those who control household activities/finances** (usually male household head) makes widespread engagement and behavior change difficult.	

Opportunities for modern energy cooking in Malawi

The experts were also asked to highlight the areas of opportunity for modern energy cooking in Malawi. These take into account the barriers associated with electric and LPG cooking and are broadly geographical (electric cooking on mini-grids, LPG cooking in urban areas) as well as behavioural (electric cooking is aspirational, LPG cooking has highly desirable attributes) in nature. The short-medium term opportunities are summarised in Table 22.

Table 22 - Summary of short-medium term opportunities for LPG and electric cooking in Malawi

	Summary of opportunity (short-medium term)	
Opportunity type	Electric cooking	LPG cooking
Geographical	**Mini-grids** are likely to present the most immediate opportunity for electric cooking. **Reliable electricity supply,** the potential to incorporate **a pay-as-you-cook business model and high levels of community engagement** are all attributed to mini-grids, reducing the above barriers to electric cooking in Malawi.	**Urban areas** are most suited to LPG cooking as this is where there is **existing demand** (although currently very limited). This area will have the **lowest distribution costs, highest household incomes** and is perhaps most likely to be **receptive to awareness campaigns** around gas safety.
Behavioral	**Electric cooking is aspirational** for many Malawians. **Basic devices** (hotplates, kettles etc.) **are well understood by many** (though low power devices (e.g. EPCs) are not). Experts said that **the population cooking with electricity grew when the grid was reliable.**	**Cooking with LPG is very similar to cooking with firewood and charcoal**, so requires little behavior change in terms of cooking technique. Also, **it is fast (lighting and cooking), easy to control, smokeless and odorless,** all highly desirable attributes.

5.3. Roadmap for modern energy cooking in Malawi

The market for modern energy cooking services in Malawi is currently small, and therefore in the immediate-short term (perhaps the next 2-5 years), currently well-developed efforts to propagate improved biomass stoves must continue. In addition, significant short term improvements could be made by educating cooks in using more efficient cooking practises such as using lids, soaking beans and using pressure cookers for long-cook foods. Alongside this, solutions to the technical, economic and social barriers to modern cooking should be investigated as there is a latent demand for fast, clean, controllable and convenient cooking options in Malawi.

In the short-medium term, electrification of rural areas via mini-grids – where electric cooking is perhaps most suited in Malawi – is likely to be a slow process. There are also considerable knowledge gaps around mini-grids' ability to support electric cooking demand and the affordability of cooking Malawian dishes using mini-grid electricity on hotplates as well as more efficient electric cooking devices which have shown to have potential in other countries [18] [19].

Concurrently, in urban areas – where LPG is perhaps most suited – awareness raising, business development and the building of supply chains for LPG could catalyse significant transition towards this fuel. However, this will be not be immediate due to the barriers of public perception, convenience and affordability. In parallel, research and development of solutions to strengthen Malawi's electricity grid and bridge power outages should be continued.

In the medium-long term, economies of scale could make LPG cooking more feasible for expansion into peri-urban and more densely populated parts of rural areas, while it is possible that affordable mini-grid electric cooking penetration from rural areas would eventually meet the spread of LPG from urban areas to provide coverage across most locations. A national grid supported by the implementation of innovative engineering solutions and/or strengthened by large electrical infrastructure projects (such as Mozambique-Malawi Regional Interconnector) will allow electric cooking to compete with LPG for viability in urban areas.

This is likely to be a non-binary, inhomogeneous process, with some households and businesses finding a use for a variety of different cooking fuels and devices depending on their preference, application and context. *It is therefore important to consider the spread of modern energy cooking services as a gradual process of "cleaning the cooking stack", gradually reducing the amount of biomass use through an increase in modern energy cooking through various means and devices*.

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Appendices

Appendix A

Household survey

My name is ..... from Community Energy Malawi. We are collecting data for a project on cooking practices in Malawi. This is part of an international research programme that aims to promote a transition from hazardous and polluting biomass fuels to clean, modern cooking fuels. This survey must be completed by the person responsible for most of the cooking in the household.
Can you confirm that you are the main cook?
Yes, I am the main cook for this household
No, I am not the main cook for this household
During this survey I will ask basic information about yourself and your household and detailed information about cooking. This will include who cooks, the devices which are used to cook, what is cooked and how it is cooked. The survey will only take around 15 minutes of your time. Your responses will be kept anonymous and you may skip a question or stop the survey at any time. You will not receive anything for completing this survey, but honest and accurate answers could help to improve access to clean, modern cooking for all.
Do you agree to participate in this survey?
Yes
No
There will also be the opportunity to participate in future activities recording your cooking over a longer period. I will ask you about this at the end of the survey.
Name of Enumerator
start time
Name of Participant
Phone number of participant (use 999 if don't know)
GPS
Personal information
First, I would like to record some information about you
Gender of Respondent
Male
Female
Age of Respondent
What is the highest level of education you have reached?
Std 1-4
Std 5-8
Form 1-2
Form 3-4
Higher Education
Other (please specify)
General information
Now I would like to record some general information about your household
What type of area do you live in?
Urban
Peri-urban
Rural
How many ADULTS live in the household? (adult = 18yrs or more)
How many CHILDREN live in the household? (child = 17yrs or less)
What type of house do you live in?
Flat/Apartment
Attached house (both sides)
Semi-detached house
Detached house
Other (please specify)
What are your house's walls made of?
Mud bricks
Mud bricks with cement
Burnt bricks with mud
Burnt bricks with cement
Cement blocks
Metal sheets
Wood

	Other (please specify)
What are your house's roofs made of?	
	Grass
	Plastic sheets
	Metal sheets
	Other (please specify)
How many rooms are in your house?	
Where is the kitchen located?	
	Outdoor only
	Indoor (cooking mostly outdoor)
	Indoor (cooking mostly indoor)
	Indoor only
Who cooks? 1	
Now I would like to ask about who in the household does the cooking	
What proportion of the cooking do you do?	
	10%
	20%
	30%
	40%
	50%
	60%
	70%
	80%
	90%
	100%
Which types of cooking do you do?	
	Breakfast
	Lunch
	Dinner
	Snack
	Heat water
Are there other members of the household who cook?	
	Yes
	No
Who cooks? 2	
Who cooks? 3	
Who cooks? 4	
Who cooks? 5	
Quality of electricity supply	
Is your household connected to an electricity grid?	
	Yes, I am connected to the national grid
	Yes, I am connected to a mini/micro-grid
	No, I have no grid connection
How often do you experience blackouts?	
	Daily
	5 times per week
	3 times per week
	Weekly
	2 times per month
	Monthly
	Less than monthly (please specify)
Do blackouts effect your cooking habits?	
	Yes, often
	Yes, sometimes
	Yes, rarely
	No, never
How do your cooking habits change when there is a blackout?	
Which other sources of electricity do you own/use?	
	Single use batteries
	Rechargeable batteries
	Pico-solar
	Solar home system
	12V battery
	Generator

None
Other (please specify)
Water heating
The next questions are about water heating
Water for bathing
Which device do you REGULARLY use to heat water for bathing? (REFER TO THE IMAGES SHEET)
Firewood - 3 stone fire
Firewood - basic stove
Firewood - improved stove
Charcoal - basic stove
Charcoal - improved stove
Kerosene - stove
LPG - cylinder burner
LPG - portable burner
LPG - burner+oven
Electric - hotplate
Electric - induction
Electric - kettle
Electric - geyser
Electric - basic water heater
Electric - pail
Other (please specify fuel and device)
How often do you heat water for bathing?
Daily
5 times per week
3 times per week
Weekly
2 times per month
Monthly
Less than monthly (please specify)
Cooking devices
The next questions are about your cooking devices
Which of the listed devices do you own for cooking in your household? (REFER TO THE IMAGES SHEET)
Firewood - 3 stone fire
Firewood - basic stove
Firewood - improved stove
Charcoal - basic stove
Charcoal - improved stove
Kerosene - stove
LPG - cylinder burner
LPG - portable burner
LPG - burner+oven
Electric - hotplate
Electric - induction
Electric - hotplate+oven
Electric - rice cooker
Electric - microwave
Electric - mini-oven+hotplate
Electric - pressure cooker
Electric - fryer
Electric - kettle
Combi - Electric-hotplate + LPG-oven
Combi - LPG-burner + electric-oven
Other (please specify fuel and device)
Probe for answers to the next questions, RECORD AS MUCH DETAIL AS POSSIBLE. For example (Which meals? Heating water? Reheating? Quick cooking? Long cooking? When there is no gas/electricity? Cooking for many people?)
What do you usually use the [device] for?
Cooking devices
The next questions are about your fuel use
[fuel]
How often do you purchase [fuel]?
Daily

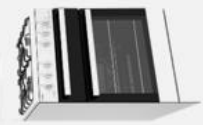
5 times per week
3 times per week
Weekly
2 times per month
Monthly
Less than monthly (please specify)
How much do you spend on [fuel] each time? (answer in MWK)
How much [fuel] do you purchase? (Weight? Bag/bundle size?)
What other electrical devices do you own and regularly use? (e.g. TV, washing machine, hairdryer etc)
Satisfaction
Overall, on a scale of 1 - 5, how happy are you with your current cooking devices?
1 - Very unhappy
2 - Quite unhappy
3 - Neutral
4 - Quite happy
5 - Very happy
0 - Don't know
What impact does cooking with these devices have on your life and your household? [DETAILED RESPONSES REQUIRED, PROBE FOR BOTH POSITIVE AND NEGATIVE IMPACTS]
Weekly menu
The final section is about the meals and dishes you commonly cook in your household
I would like you to provide example breakfasts, lunches and dinners which you often cook and the number of people you would cook this for. Each meal may be made up of multiple dishes (for example nsima, meat and vegetables), for each dish you will be asked for the cooking method (for example boiling, frying etc) and which fuel and device you used (for example firewood-3 stone fire, LPG-portable burner). I will ask for cooking details for two typical week days, and one typical weekend day.
Weekday 1 - Breakfast
Weekday 1
Breakfast
Number of people cooked for (if do not cook at breakfast, write "0")
Breakfast - Hot drink
Drink type
Tea
Purifying water
Coffee
Other (please specify)
Cooking method
Boil
Steam
Grill
Dry fry
Wet (shallow) fry
Deep fry
Bake
Pressure cook
Other (please specify)
Fuel - device used
Firewood - 3 stone fire
Firewood - basic stove
Firewood - improved stove
Charcoal - basic stove
Charcoal - improved stove
Kerosene - stove
LPG - cylinder burner
LPG - portable burner
LPG - burner+oven
Electric - hotplate
Electric - induction
Electric - hotplate+oven
Electric - rice cooker
Electric - microwave
Electric - mini-oven+hotplate
Electric - pressure cooker
Electric - fryer

	Electric - kettle
	Combi - Electric-hotplate + LPG-oven
	Combi - LPG-burner + electric-oven
	Other (please specify fuel and device)
Is this a reheated drink?	
	Yes
	No
Breakfast - Dish 1	
Food cooked	
	beans
	cake
	corn
	eggs
	fish
	mandasi
	meat
	meats
	nsima
	nyemba
	porridge
	potatoes
	poultry
	pumpkin
	relish
	rice
	soya
	sweet potatoes
	thobwa
	vegetables
	Other (please specify)
Cooking method	
	Boil
	Steam
	Grill
	Dry fry
	Wet (shallow) fry
	Deep fry
	Bake
	Pressure cook
	Other (please specify)
Fuel - device used	
	Firewood - 3 stone fire
	Firewood - basic stove
	Firewood - improved stove
	Charcoal - basic stove
	Charcoal - improved stove
	Kerosene - stove
	LPG - cylinder burner
	LPG - portable burner
	LPG - burner+oven
	Electric - hotplate
	Electric - induction
	Electric - hotplate+oven
	Electric - rice cooker
	Electric - microwave
	Electric - mini-oven+hotplate
	Electric - pressure cooker
	Electric - fryer
	Electric - kettle
	Combi - Electric-hotplate + LPG-oven
	Combi - LPG-burner + electric-oven
	Other (please specify fuel and device)
Is this a reheated dish?	
	Yes

No
Breakfast - Dish 2
Breakfast - Dish 3
Weekday 1 - Lunch
Weekday 1 - Dinner
Weekday 1 - Snack
Weekday cooking times
During which hours do you usually cook on a week day?
Before 04:00
04:00 - 05:00
05:00 - 06:00
06:00 - 07:00
07:00 - 08:00
08:00 - 09:00
09:00 - 10:00
10:00 - 11:00
11:00 - 12:00
12:00 - 13:00
13:00 - 14:00
14:00 - 15:00
15:00 - 16:00
16:00 - 17:00
17:00 - 18:00
18:00 - 19:00
19:00 - 20:00
20:00 - 21:00
21:00 - 22:00
22:00 - 23:00
After 23:00
Weekend day - Breakfast
Weekend day - Lunch
Weekend day - Dinner
Weekend day - Snack
Weekend day cooking times
Follow up?
That is the end of the survey.
We would like to study cooking in more detail to record what people cook, how they cook, and how much energy they use when cooking. This will be done by recording a "cooking diary". For a 2 week period, you would be asked to complete a quick record of every meal you cook, and to measure how much fuel/electricity you have used.
Would you be interested in participating?
Yes
No
We would like to organise a focus group discussion where we would talk about cooking in more detail. This would take place during the next few weeks.
Would you be interested in participating?
Yes
No
Thank you for your interest, I will be in touch soon to arrange this.
end time
Thank you for your time!

Appendix B

Cooking devices image sheet

Biomass	Kerosene	LPG only	Electric				Combination
(Firewood – 3 stone fire) 	(Kerosene - stove) 	(LPG – cylinder burner) 	(Electric – hotplate) 	(Electric – rice cooker) 	(Electric – pressure cooker) 	(Electric-hotplate + LPG-oven) 
(Firewood – stove) 		(LPG – portable burner) 	(Electric – induction plate) 	(Electric – microwave) 	(Electric – frying pan) 	(LPG-burner + Electric-oven) 
(Charcoal – stove 		(LPG – hotplate+oven) 	(Electric – hotplate+oven) 	(Electric – mini-oven+hotplate) 	(Electric – kettle) 	
			(Electric – basic water heater) 	(Electric – pail heater) 	(Electric – geyser) 	

Appendix C

Online survey sent to energy and cooking sector actors through UoS and UP networks.

Introduction
Biomass-fuelled cooking is contributing to severe deforestation, pollution and poor indoor air quality in many households in Malawi. The transition towards electric cooking is an important step towards addressing these challenges. You are invited to become involved in the MECS programme (Modern Energy Cooking Services https://www.mecs.org.uk/) which seeks to "rapidly accelerate the transition from biomass to clean cooking on a global scale". Malawi is one of the Tier 1 priority countries for this programme. As a first step, United Purpose is carrying out a policy and markets review of electric cooking in Malawi, in partnership with the University of Strathclyde. A key element of this review is to gather information and insight from experts. You are kindly asked to spare a small amount of your time (2-10 minutes) to complete this online questionnaire (to any level of detail which you have time for), which aims to provide the foundation for future discussions, partnerships, collaborations and activities to scale-up electric cooking in Malawi. We would like to follow up some of these surveys with in-depth interviews, if you are interested, please provide your details at the end of the survey. The survey is separated into three short sections: 1) Cooking in Malawi 2) Cooking interventions in Malawi 3) Electric cooking in Malawi
Background information
Organisation name
Your position within your organisation
If applicable, please describe your organisation's involvement in cooking/electric cooking related activities.
Which countries are you active in?
The first section is about cooking in Malawi.
What are the most common cooking practises in rural/urban areas of Malawi?
Is this changing? How?
Why is the transition towards clean cooking important for Malawi?
The second section is about cooking interventions in Malawi.
Which interventions/policies have been MOST successful in transitioning Malawi towards cleaner cooking? What made them successful?
Which interventions/policies have been the LEAST successful in transitioning Malawi towards clean cooking? What restricted their success?
The final section is about electric cooking in Malawi.
According to statistics, over 200,000 people currently use electricity for cooking in Malawi. If possible, using your experience in the cooking sector, please describe the characteristics of those currently using electricity for cooking in Malawi.
Are you aware of any PAST or ONGOING policy/programmes involving electric cooking in Malawi?
Are you aware of any PLANNED policy/programmes involving electric cooking in Malawi?
What are the most significant barriers/difficulties faced by the electric cooking market in Malawi?
Where are the key areas of opportunity for the growth of the electric cooking market in Malawi?
Invitation to interview
We would like to speak to a number of experts about these topics in more detail, and to discuss the opportunity for collaboration in clean/electric cooking activities in Malawi in the future. If you would like to be contacted regarding this, please provide your name and contact details below:
Name
Email address
Whatsapp contact number (optional)
Thank you for completing this survey, if you would like any further information please contact ……

Appendix D

Online survey respondent profiles

Organisation name	Your position within your organisation
Department of Energy Affairs	Energy Officer
NeverEndingFood	Sustainable Nutrition
Mulanje Renewable Energy Agency (MUREA)	Projects Coordinator
Malawi University of Science and Technology (MUST)	Staff Associate in Energy Resources
Renew'N'Able Malawi	Programmes Manager
Ungweru youth organisation	Executive Director
United Purpose	Distribution Manager
FOOD AND FUEL CONSULTANTS	DIRECTOR
CISONECC	Project Officer
Polytechnic - UNIMA	Lecturer
Ethical Tea Partnership	Natural Resources Management
Modern Cooking for Healthy Forest (Tetra Tech)	Chief of Party
GIZ	Team Leader
AFREPREN/FWD & MZUZU UNIVERSITY	Project Researcher
MEGA	General Manager

Appendix E

Expert interviews guide

Organisation name
Your position within your organisation
If applicable, please describe your organisation's involvement in (electric) cooking related activities.
Which countries are you active in?

If have **not** completed online survey

This section is about cooking in Malawi.

What are the most common cooking practises in rural/urban areas of Malawi?

- Is this changing? How?

Why is the transition towards clean cooking important for Malawi?

This section is about cooking interventions in Malawi.

Which interventions/policies have been MOST successful in transitioning Malawi towards cleaner cooking?

- What made them successful?

Which interventions/policies have been the LEAST successful in transitioning Malawi towards clean cooking?

- What restricted their success?

The final section is about electric cooking in Malawi.

According to statistics, over 200,000 people currently use electricity for cooking in Malawi.

- Who are these people? Where do they live? Why do they cook with electricity?

Are you aware of any PAST or ONGOING policy/programmes involving electric cooking in Malawi?
Are you aware of any PLANNED policy/programmes involving electric cooking in Malawi?
What are the most significant barriers/difficulties faced by the electric cooking market in Malawi?
Where are the key areas of opportunity for the growth of the electric cooking market in Malawi?

If have completed online survey [cover questions twice (electric cooking and LPG)]

How much do you already know about electric/LPG cooking? In Malawi/elsewhere?
How viable do you think electric/LPG cooking is as solution to cleaner cooking?

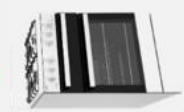
- Is there demand?
  - From consumers?
    - Why? Why not?
  - From sellers?
    - Why? Why not?
  - From policy makers/government?
    - Why? Why not?
- What is lacking?
  - Ability to pay?
    - Availability of products?
    - At an affordable price?
  - Willingness to pay?
    - Desire to use electricity/LPG for cooking? Are products suitable?
    - Perceived cost vs other methods?

How and where is best to deliver electric/LPG cooking in Malawi?

- Policy?
- Engagement/awareness raising?
- Urban areas?

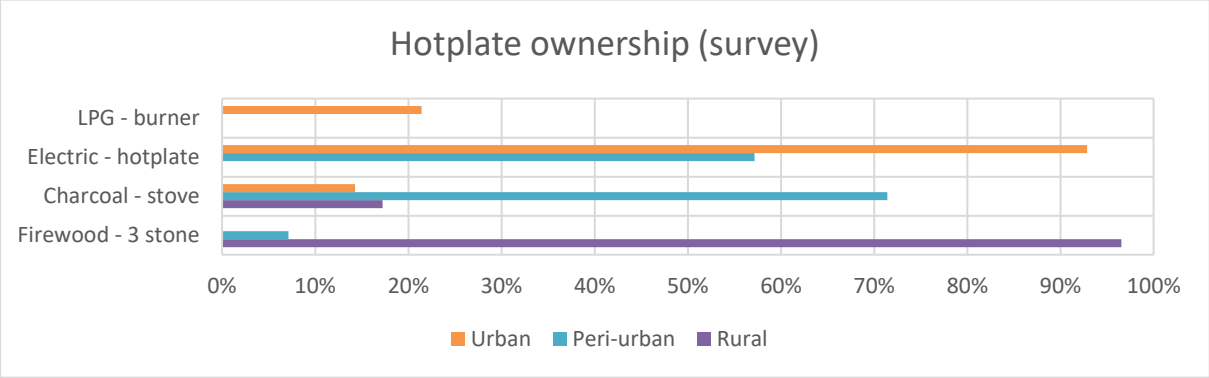
Appendix F

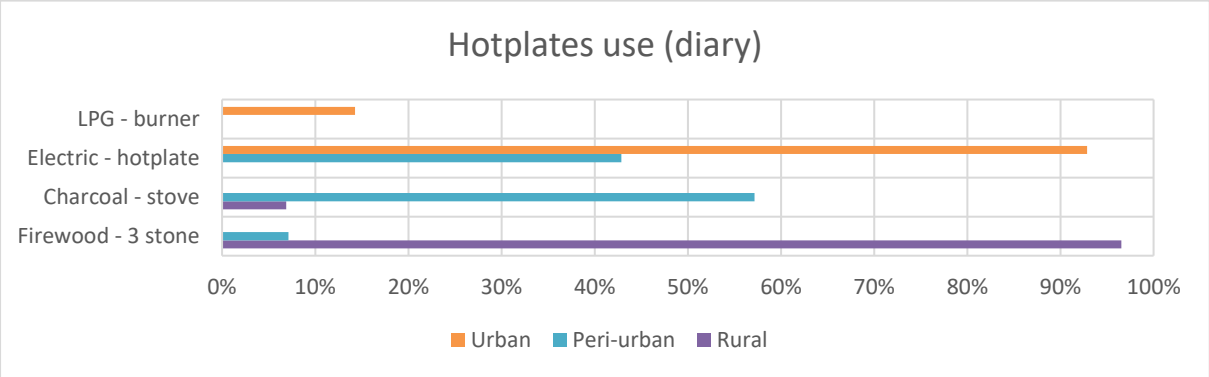
Cooking device costs from market review in Lilongwe and Blantyre

Biomass	Kerosene	LPG only	Electric			Combination
(Firewood – 3 stone fire)	(Kerosene - stove)	(LPG – cylinder burner)	(Electric – hotplate)	(Electric – rice cooker)	(Electric – pressure cooker)	(Electric-hotplate + LPG-oven)
						
Free	N/A	30000 MWK (3kg)	7500 - 20000 MWK	20000 - 48000 MWK	67000 - 95000 MWK	135000 MWK
(Firewood – stove)		(LPG – portable burner)	(Electric – induction plate)	(Electric – microwave)	(Electric – frying pan)	(LPG-burner + Electric-oven)
						
1000 MWK		20000 - 30000 MWK	25000 MWK	60000 - 185000 MWK	40000 MWK	N/A
(Charcoal – stove)		(LPG – hotplate+oven)	(Electric – hotplate+oven)	(Electric – mini-oven+hotplate)	(Electric – kettle)	
						
2500 MWK		190000 MWK	170000 MWK	55000 – 75000 MWK	14000 - 50000 MWK	
			(Electric – basic water heater)	(Electric – pail heater)	(Electric – geyser)	
						
			2500 MWK	10000 – 30000 MWK	250000 MWK	

Appendix G

Comparing device ownership to device use (from indicative diary) shows little difference. Where there are differences, this is usually a slightly smaller proportion of the sample using the device, than owning it, which is to be expected.





"LPG - burner" includes LPG responses for cylinder burner, portable burner and burner+oven
"Electric - hotplate" includes Electric responses for hotplate+oven, hotplate, mini-oven+hotplate and induction