Zambia; Cooking transitions

An analysis of Multi-Tier Framework Data for insights into transitions to modern energy cooking.

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Abstract

In "Zambia – Beyond Connections" (Luzi et al, 2019), the authors present a diagnostic of the multi-tier framework data from Zambia. The multi-tier framework is an approach to understanding the nuances of energy use both for electricity and clean cooking, and thus provides a level of detail rarely captured by existing national data sets. The report was among the first in a series of country-specific reports to be published, and intended to set a new standard in data collection and to present the findings in a useful format for policy actors.

Their report summarises access to both electricity and clean cooking in Zambia, whilst also providing an analysis of the gender dynamics at play across varying levels of energy access. In this working paper, we consider whether the multi-tier framework data could provide additional insights into 'transitions to modern energy', where access to electricity and clean cooking form part of an integrated policy agenda. Our interest lies in the use of electricity for cooking, and here we explore the data for linkages between groups of households across the electricity/clean cooking divide. In what follows, we relate the cooking fuel demographics to electricity use, in order to understand the influences behind household electric cooking choices, and what these dynamics tell us about transitions to modern energy cooking in Zambia. By taking this approach, this report is among the first to analyse households that choose to stack electric cooking solutions with biomass stoves.

The report begins by exploring the current state of electricity access and modern energy cooking fuels in Zambia. An integrated analysis of these trends at the household level then follows, taking account of the different electric cooking appliances owned in Zambia and the financial cost, time burden, and quality and reliability issues associated with household cooking. Before concluding, the report explores how households make purchasing decisions. Gender dynamics are integrated throughout the report, and particularly in relation to women's prominent role in both cooking and purchasing decisions.

This is an independent analysis conducted within the MECS programme, and the analytical conclusions are not necessarily endorsed by the World Bank and the Government of Zambia. This material has been funded by UK aid from the UK government. However, the views expressed do not necessarily reflect the UK government's official policies.

Executive Summary

The official diagnostic (Luzi et al, 2019) reveals the following background information:

- 42.4% of households in Zambia have access to electricity (37.7% are grid-connected; 4.7% have off-grid solutions)
- 74.8% of urban households have grid access, but 88.1% of rural households to not have any kind of electricity
- 60.7% of urban households use a traditional charcoal stove (Mbaula) as their primary cooking solution, while 83.6% of rural households use open fires. Electric stoves are the primary cooking solution for 32.5% of urban households.

In this working paper, we consider whether the multi-tier framework data could provide additional insights into 'transitions to modern energy', where access to electricity and clean cooking form part of an integrated policy agenda. Our interest lies in the use of electricity for cooking, and here we explore the data for linkages between groups of households across the electricity/clean cooking divide. The analysis below separates households into two sets of categories: those who cook with only one fuel ('Scenario 1'), and those who have access to electricity and choose to cook with either biomass, electricity, or both ('Scenario 2'). The underlying, unweighted MTF dataset was used to perform this analysis, and therefore figures in this report do not necessarily correspond to the equivalent findings in the official diagnostic.

Our analysis shows the following:

Electricity Access and Cooking Fuel Choices

- Almost half of grid-connected households in Zambia are cooking with electricity, and a third of these households do not use any biomass for cooking. The vast majority of grid-connected households have Tier 3 appliances or higher, suggesting they have sufficient electricity capacity to support electric cooking
- Of urban households not connected to the grid, more than half find the cost of connection too expensive and an additional quarter state this is due to rental agreements or landlords. Only 10% say they are too distance from the grid or they think the service is too unreliable
- Compared to households cooking exclusively with electricity, grid-connected households stacking electricity with biomass have higher average incomes, are more highly educated, and are more likely to have a bank account
- Grid-connected households cooking exclusively with biomass have the same median income band as households cooking exclusively with electricity
- Of households connected to the grid in the last 5 years, 27% use electricity for some or all of their cooking
- Households cooking with electricity are more likely to pay for their electricity with a pre-paid card (21%) compared to exclusive biomass cooking households with a grid connection (10%), and were more likely to have a private electricity meter (97%, compared to 75%)
- A majority of households report no issues with the availability and quality of electricity supply, but 35% report significant concerns over daytime availability and blackouts in certain months of the year. Those stacking electricity with biomass report the most significant challenges on average during the worst month of the year.

Costs of Cooking: Money and Time Spent

- Cooking with electricity appears to save 20 minutes per day in fuel preparation, and a further 20 minutes (at least) per day in cooking time
- Households that stack electricity with biomass cook for much longer on average, and they spend almost as much on energy as exclusive biomass and exclusive electricity households combined. However, female spouses in electricity/biomass stacking households cook less regularly (80.4% cook everyday as opposed to 87-89% for the other two groups) and are more likely to be income earners
- Households that stack electricity with biomass also spend significantly more on the energy than households cooking exclusively with either biomass or electricity. Exclusive biomass cooking households with a grid connection spend significantly more on energy than households cooking exclusively with electricity
- This suggests that, on average, stacking biomass with electricity does not reduce biomass consumption and is therefore unlikely to lead to a reduction in cooking fuel costs, nor to a reduction in household air pollution.

Gendered Analysis

- Grid-connected, female-headed households are more likely to cook with electricity (exclusively or stacked with biomass) compared to grid-connected, male-headed households
- Cooking with electricity seems to increase the share of cooking among men and boys, relative to women and girls
- Men were more likely to purchase an electric cookstove, and women were more likely to purchase a traditional cookstove. Electric stove purchasers also tended to be slightly younger, educated to a slightly higher level, and earning a regular salary (as opposed to being self-employed, in casual work, or not earning).

Implications for Modern Energy Cooking in Zambia

- Electric cooking is commonly practiced in Zambia and the grid tariff is among the lowest in sub-Saharan Africa. The exclusive or partial use of electricity for cooking seems to indicate a willingness to transition to modern energy cooking services
- There is enormous potential for modern energy cooking among urban households cooking only with biomass: those with a grid connection spend 33% more on energy on average compared to households cooking exclusively with electricity
- On average, households stacking electricity with biomass have high enough incomes to substitute their use of dirty fuels with modern fuels
- Households to date have little experience of energy efficient cooking appliances, and so the average energy expenditure of cooking exclusively with electricity could be reduced further if energy efficient appliances were used
- While Zambia has experienced challenges with load shedding and this does effect household choice of cooking fuel, it does not prevent the use of electricity per se
- Wider policy planning and the inclusion of renewable energy expanding grid generation, combined with an energy efficiency approach, should reduce the amount of load shedding over the coming 10 years
- The effects of any remaining load shedding on household cooking could be mitigated in the future by strategic use of energy efficient appliances, battery-supported electric cooking, and pay-as-you-go LPG.

Table of Contents

1 Introduction

In “Zambia – Beyond Connections” (Luzi et al, 2019), the authors present a diagnostic of the multi-tier framework (MTF) data from Zambia. The multi-tier framework is an approach to understanding the nuances of energy use both for electricity and clean cooking, and thus provides a level of detail rarely captured by existing national data sets. The MTF approach diverges from the traditional binary assessment of ‘access’/‘no access’, and instead explores the differences in technology, attributes, tiers, and use, with respect to electricity and clean cooking. This report was among the first in a series of country-specific reports to be published, and intended to set a new standard in data collection and to present the findings in a useful format for policy actors.

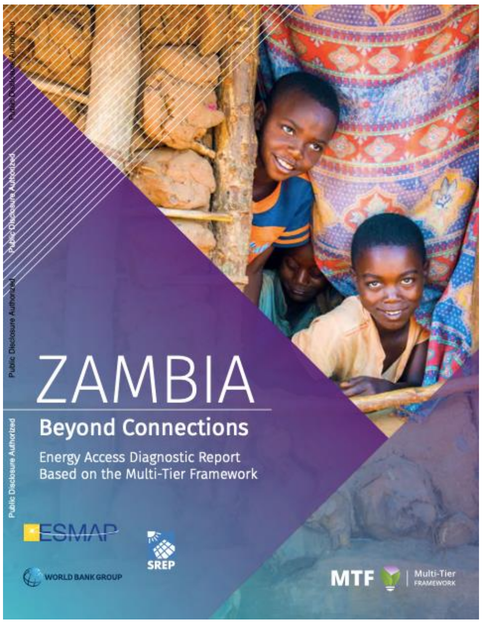

Figure 1 Front cover of Luzi et al (2019)

Luzi et al (2019) summarise access to electricity and access to clean cooking in distinct sections, offering frequency analysis of the key parameters that shape varying levels of access. The modules of access to electricity and access to cooking are treated in the diagnostic as independent outcomes in separate chapters.

As a research programme interested in the use of modern energy cooking services, MECS is seeking to gain understanding of how access to modern energy can impact on cooking services. Does the presence of electricity influence the choices made in cooking?

To that end we ask: can the MTF approach in Zambia provide insight into modern energy transitions more broadly, and with specific reference to electric cooking?

1.1 Multi-Tier Framework

As stated above, the MTF approach moves away from a binary approach to electricity access (do survey respondents have electricity or not), and from a limited focus on the primary fuel households use for cooking (without due consideration of context and fuel stacking). The MTF thus seeks to provide more nuanced data that takes the discussion forward, enabling greater clarity in planning and policy. For instance, on electricity it seeks to identify the quality of the supply, and for cooking it seeks to understand the exposure of the cook to household air pollution and attributes such as convenience and safety. The MTF data is used to summarise the household access in a tier framework (1 to 5), albeit in two frames: a) energy access (meaning electricity access) and b) access to modern energy cooking solutions. Luzi et al (2019) expand on this in their report:

“The MTF approach measures **energy access** provided by any technology or fuel based on seven attributes that capture key characteristics of the energy supply that affect the user experience [...]:

- **Capacity:** What appliances can I power?

- **Availability:** Is power available when I need it?
- **Reliability:** Is my service frequently interrupted?
- **Quality:** Will voltage fluctuations damage my appliances?
- **Affordability:** Can I afford to purchase the minimum amount of electricity?
- **Formality:** Is the service provided formally or by informal connections?
- **Health and Safety:** Is it safe to use my electricity service or do I risk injuries from using this service?"

Additionally, "the MTF approach measures access to **modern energy cooking solutions** based on six attributes [...]:

- **Cooking Exposure:** How is the user's respiratory health affected? This is based on exposure to pollutants from cooking activities, which depends on stove emissions, ventilation structure (which includes cooking location and kitchen volume), and contact time (time spent in the cooking environment). Kitchen volume and contact time were not analysed for Zambia.
- **Cookstove Efficiency:** How much fuel will a person need to use?
- **Convenience:** How long does it take to gather and prepare the fuel and stove before a person can cook?
- **Safety of Primary Cookstove:** Is it safe to use the stove, or does a person expose himself or herself to possible accidents? This can be based on laboratory testing and the absence of serious accidents in the household.
- **Affordability:** Can a person afford to pay for both the stove and the fuel?
- **Fuel Availability:** Is the fuel available when a person needs it?" (ibid.)

1.2 Integrating the two frames

This paper analyses the significance of these two strands of the MTF approach, with a view of devising integrated strategies to accelerate transitions from traditional to modern energy cooking fuels. As we move towards genuine modern energy cooking solutions and services, it is necessary to consider how the survey data relating to electricity access and clean cooking relate to one another. This report illustrates how the household survey questionnaires used for the MTF might shed light on various aspects of how people choose cooking fuels and devices.

The paper presents an exploratory analysis of the MTF survey data in Zambia, which is publicly available on the World Bank website. It is important to note that this working paper is an additional analysis to Luzi et al (2019), who have undertaken the official diagnostic of the data.

The report begins by exploring the current state of electricity access and modern energy cooking fuels in Zambia. An integrated analysis of these trends at the household level then follows, taking account of the different electric cooking appliances owned in Zambia and the financial cost, time burden, and quality and reliability issues associated with household cooking. Before concluding, the report explores how households make purchasing decisions. Gender dynamics are integrated throughout the report, and particularly in relation to women's prominent role in both cooking and purchasing decisions.

The MTF data comprises a **sample of 3,612 households**. It should be noted that the official diagnostic has adjusted the survey data to be nationally representative, while our analysis, which compares and contrasts households, has not been through the same process of national weighting. However, due to the urban bias of the survey (50:50 urban/rural, compared to the national ratio of 43:57 urban/rural), this unweighted analysis may provide a window into the future direction of electricity access and modern energy cooking in Zambia. It is projected that **at least 50% of the population in Zambia will reside in urban areas by 2030**[1].

2 Background Information

In 1996 the Zambian Government set the goal of universal grid coverage for 2030.

Electricity accounts for 10% of the national energy supply with hydropower being responsible for 95% of Zambia's installed capacity. However, climate change is increasingly challenging Zambia's dependency on hydropower; the Kariba Dam has an installed capacity of 1050MW, almost half Zambia's total installed hydropower capacity at 2257MW, but severe droughts has led to a significant reduction in generation capacity. Droughts in 2015 led to the announcement by Zambia's utility company ZESCO that at least eight hours per day would be lost due to load shedding (ERB, 2019).

At the time of the MTF survey, in August 2017, the Kariba Dam reservoir level was 482m (minimum operational level 475.5m, maximum supply level 488.5m). However, 2019 proved a particularly bad year, and the reservoir level registered below 477m towards the end of the year. At the time of writing this report (February 2021), the level stands at 480m (10% full)[2].

Figure 2 Kariba Dam in 1994 (credit: Rhys Jones)

While electric cooking has a relatively long history in Zambia and tariffs are among the least expensive worldwide, a combination of load shedding and tariff increases has turned many households away from modern energy and towards charcoal to meet their cooking fuel needs[3]. In fact, Zambia has one of the highest deforestation rates in the world (ibid.). As charcoal prices rise and the impact on public health and the environment worsens, a range of modern energy cooking solutions will be required in Zambia, including more efficient electric cooking appliances, an expansion of the solar mini-grid sector and LPG sector, and battery-supported electric cooking.

Changes to the frequency and duration of load shedding has been cited as a reason for changes in the use of LPG by Zambian households. In a survey conducted by the Energy Regulation Board (ERB) in Zambia in 2019,

[1] World Bank data, available from: Population Estimates and Projections | Data Catalog (worldbank.org)
[2] Lake Kariba Weekly Levels in Meters | Zambezi River Authority (zambezira.org)
[3] Blackouts, High Cost of Electricity Drive Zambians to Strip Forests for Cooking Charcoal (globalpressjournal.com)

46.4% of households that had started using LPG said it was due to load shedding (ERB, 2019). Earlier reductions in load shedding were given as a reason for stopping LPG usage by 28.8% of households that had done so (ibid.).

3 Cooking practices: an overview

3.1 Cooking fuels

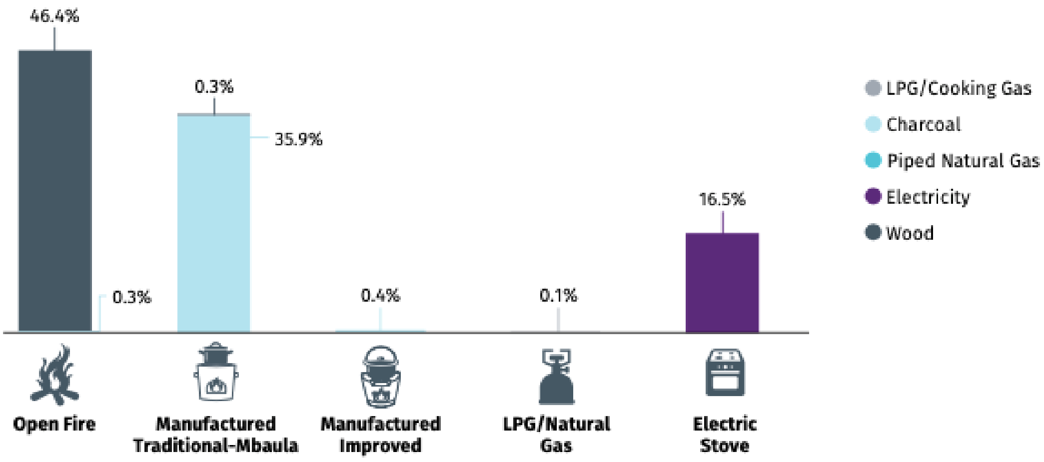

Figure 3 Primary stoves for households in Zambia (Luzi et al, 2019)

Figure 3 shows that at the time of study, almost all clean fuel stoves in Zambia use electricity rather than gas. Traditional Mbaula stoves[4] are popular in Zambia, and are almost exclusively used with charcoal. Improved versions of the Mbaula stove have been in existence for at least a quarter of a century (Kaoma, Kasali and Ellegard, 1994), and yet improved cookstoves as a broad category account for only 0.4% of stoves in use in Zambia. This is crucial, as it refutes the traditional view within the clean cooking sector that improved cookstoves represent the best opportunity for cleaner cooking practices in the global South.

Due to the fact that a focus on primary fuels may misrepresent the extent to which electricity has been incorporated into a household's cooking solutions, we analyse the underlying survey data to look at fuel *use* for each household. Table 1 provides an overview of the fuels used by surveyed households, for any activity (column 1) and for cooking (column 2). It shows that the cooking landscape in Zambia is dominated by biomass fuels, predominantly charcoal (usually urban) and collected wood (usually rural). A third of households use electricity, and half of these use electricity for cooking. Figure 4 shows that electric cooking tends to be concentrated in urban areas.

[4] Mbaula stoves hold great cultural significance in Zambia, in urban areas and among electric cooking households as well as in village life (Jürisoo et al, 2019).

While we expect LPG to form a part of the modern energy cooking landscape in Zambia, due to the ongoing issue of load shedding, the number of surveyed households using LPG were too small to include in the analysis that follows.

	Household Fuel			
	Any purpose		Cooking only	
Charcoal	1827	50.6%	1799	49.8%
Wood (collected)	1535	42.5%	1504	41.6%
Electricity	1089	30.1%	545	15.1%
Wood (purchased)	50	1.4%	48	1.3%
LPG	13	0.4%	11	0.3%
Solar	174	4.8%	4	0.1%
Kerosene	48	1.3%	2	0.1%

Table 1 Fuel use among surveyed households (unweighted)

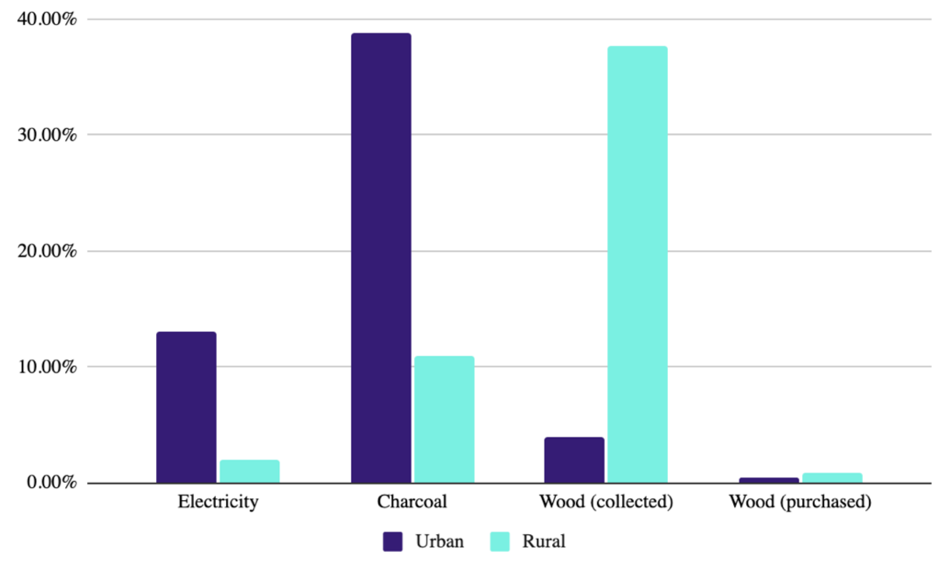

Figure 4 Urban/Rural split of households using (unweighted)

The analysis in this report separates households into two sets of categories:

Scenario 1. The first category focuses on households that exclusively use one cooking fuel only. Of these households, the analysis concentrates on the three most popular fuels: collected wood, charcoal, and electricity (>99% of all households surveyed). In this scenario, we compare demographic characteristics, fuel consumption, and other data points collected by the MTF survey.

Scenario 2. The second category resembles a transition scenario, where electricity may or may not be integrated into the cooking fuel choices of households. In this second set, exclusive biomass cooking households are analysed in relation to a) those who stack biomass with electricity, and b) those who cook exclusively with electricity, in order to shed light on stacking behaviour and the potential for biomass cooking households to integrate electricity into their cooking practices. Crucially, this second scenario focuses on electricity users only (i.e. biomass cooking households that do not use electricity for other purposes are excluded). Table 2 summarises these two categories and the number of households in each group.

Scenario 1 – Exclusive Cooking Fuels				Scenario 2 – Electricity Stacking		
Wood (collected)	1278	46.3%		Exclusively cooks with electricity	217	18.5%
Charcoal	1265	45.8%		Stacks electricity and biomass	324	27.7%
Electricity	217	7.9%		Exclusively cooks with biomass	630	53.8%
Total	**2760**			**Total**	**1171**	

Table 2 Household groupings for analysis (unweighted)

'Biomass' in Scenario 2 refers to charcoal, wood, and other dirty fuels, used by households either exclusively or in combination with one another. However, 96.5% of the 'exclusively cooks with biomass' category happen to be charcoal users. In the 'stacks electricity and biomass' category, 97.8% stack charcoal with electricity. **Biomass is therefore a proxy for charcoal in this context, but for purposes of clarity this report will continue to use the term biomass in Scenario 2**. Other dirty fuels are not excluded from Scenario 2 because we are interested in the potential transition of *any* households that have a grid connection.

Figure 5 Charcoal for sale (Credit: Wikimedia Commons)

However, it is worth reflecting briefly on the reasons why certain households are not currently connected to the grid. Table 3 shows the four main reasons for not being connected, split between urban and rural households. It is worth remembering that the vast majority of urban households that are not connected to the grid cook exclusively with charcoal (>95%), whereas rural households tend to use firewood they have collected (78% as the exclusive cooking fuel). This table below shows that the **cost of connection is a barrier** in both rural and urban areas. Whereas rural households can often be **too distant** from the grid to gain access (57.6%), urban households are disproportionally lacking access because of **landlord decisions or rental conditions** (27.2%).

	Urban	Rural	Total
Grid is too far from household/not available	**69** 9.9%	**929** 57.6%	**998** 43.1%
Cost of initial connection is too expensive	**390** 55.8%	**588** 36.4%	**978** 42.3%
Renting, Landlord decision	**190** 27.2%	**21** 1.3%	**211** 9.1%
Service unreliable	**5** 0.7%	**46** 2.9%	**51** 2.2%
Other	**48** 6.9%	**30** 1.9%	**78** 3.4%

Table 3 Top four reasons why households are not grid connected (no. and % of households using a particular fuel)

3.2 Cooking appliances

In the official diagnostic, the quality of the electricity supply is grouped according to six tiers, which provide a nuanced understanding of how electricity supply may relate to electricity use in the home. Households in tier 0 are those that have less than 4 hours of electricity available per day, or less than 1 hour per evening (Bhatia and Angelou, 2015). The other 5 tiers are detailed in Table 6, with electric cooking appliances featuring in tiers 3-5.

Load level	Indicative electric appliances	Capacity tier typically needed to power the load
Very low load (3–49 W)	Task lighting, phone charging, radio	TIER 1
Low load (50–199 W)	Multipoint general lighting, television, computer, printer, fan	TIER 2
Medium load (200–799 W)	Air cooler, refrigerator, freezer, food processor, water pump, rice cooker	TIER 3
High load (800–1,999 W)	Washing machine, iron, hair dryer, toaster, microwave	TIER 4
Very high load (2,000 W or more)	Air conditioner, space heater, vacuum cleaner, water heater, electric cookstove	TIER 5

Table 4 Load levels, indicative electric appliances, and associated capacity tiers (Bhatia and Angelou, 2015, in Luzi et al, 2019)

The official diagnostic states that, nationwide, only 38.4% of the population have at least Tier 3 capacity, which would be sufficient to support electric cooking. For urban populations, this figure is 75.2% and in rural areas it is just 4.2%. However, the authors use the electricity supply as a proxy for capacity: all grid-connected households are assumed to have Tier 5 capacity, and households with sufficient off-grid solutions (generating 200-799W) are placed into Tier 3.

However, we can also use appliance ownership data as a proxy for electricity capacity. If a household owns an appliance, it is plausible to assume that their electricity supply is sufficient for the appliance to function. To get an accurate picture of appliance ownership, we combine data concerning household appliances with electric cookstove usage. As we would expect, all households that cook exclusively with electricity have at least Tier 4 appliances. **96% of households that stack electricity with biomass have at least Tier 3 capacity appliances** at the time of the survey. **83.3% of grid-connected, exclusive biomass cooking households also have Tier 3 appliances or higher**, suggesting that electricity supply is not a barrier to transitioning to modern energy cooking for a significant majority of (urban) biomass using households.

The survey data on appliance ownership also allows us to understand the ways in which households might supplement their cooking practices with secondary electrical appliances, such as microwaves, kettles, and rice cookers. Figure 6 below shows the percentage of households in Scenario 2 (transition) that reported to own these appliances. Households that stack electricity with biomass are more likely to use these kinds of appliances than those who cook exclusively with electricity. This suggests that cooking exclusively with electricity does not necessitate the purchase of many kinds of appliances, and it also shows that there is demand for such appliances among those who cook with biomass. All three of these appliances serve specific purposes, and their high level of performance in carrying out these specific tasks may make them well suited to helping to encourage biomass cooks to transition to modern energy alternatives. Interestingly, **10 – 15% of exclusive biomass cooking households reported to own these appliances.** This could point to the difference between ownership and use, or it might relate to how an individual chooses to define 'cooking'. Boiling water, preparing rice, and reheating food may be viewed separately to cooking in pots directly over a flame or heat source.

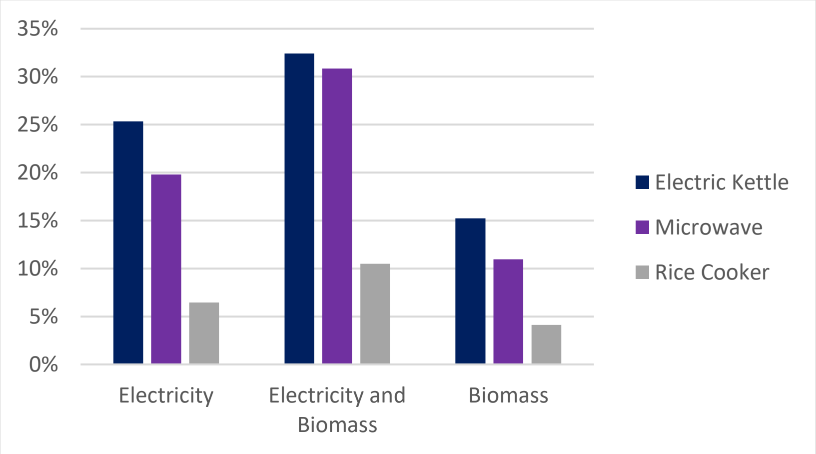

Figure 6 Ownership rates of secondary electrical cooking appliances, according to household cooking fuels (unweighted)

4 Household demographics

4.1 Exclusively used fuels

A focus on household demographics enables us to build an understanding of the different types of households that use a particular cooking fuel.

Of households exclusively cooking with **collected wood**:

- 99% are not grid-connected
- 93% live in rural areas
- 91% own their home
- Household size averages 4.7 people
- Predominantly self-employed agricultural workers
- Only 4% have a bank account
- Lowest average income and education level

Figure 7 Preparing nshima (Zambia's national staple) next to an open fire in Kasisi, 2012 (Credit: Gerhard302)

There is a clear contrast between households cooking with firewood and those exclusively cooking with **charcoal**:

- 46.6% are connected to the grid (37% of these have been connected for more than 10 years)
- 84% live in an urban environment
- 55% own their own home
- Household size averages 5.1 people – the largest of the three groups
- Split across salaried and self-employed non-agricultural work, as well as day labouring or unemployed
- 35% have a bank account
- Average income and education levels, relative to the other two groups

Figure 8 Charcoal sellers, 2010 (Credit: SuSanA)

Households cooking exclusively with **electricity** are the most affluent of the three groups:

- 15% have been connected to the grid for less than 5 years
- 83% live in an urban environment
- 53% rent their home
- Household size averages 3.8 people – the lowest of the three groups
- Tend to be salaried employees or self-employed in non-agricultural work
- 73% have a bank account
- Highest average income and education levels, compared to exclusive charcoal and firewood users.

Transitioning to exclusive electric cooking can take place in a reasonably short period of time following grid connection. However, more than a third of grid-connected households cooking exclusively with charcoal have been connected for over a decade. This suggests there are significant additional barriers to the modern energy cooking transition, and *exclusive* electric cooking does tend to suggest higher household incomes, better financial connectivity, and urbanised living.

Exclusive charcoal users tend to have bigger families and are situated between exclusive wood users and electricity users in terms of income and education. The fact that only 46% of exclusive charcoal users have a grid-connection but 84% live in an urban environment suggests that this group's cooking practices may be out of necessity rather than mere preference, and **this provides an opportunity for modern energy cooking**

solutions in the form of battery-assisted cooking, the development of urban mini-grids, and the expansion of LPG networks. Certainly, these demographics suggest that urban charcoal users have higher incomes than rural wood users, and would therefore be *more* suited to a mini-grid business model for energy access.

4.2 Stacking fuels

It is possible to conduct the same analysis for households who use electricity and stack multiple cooking fuels. However, it must be noted that we are unable to disaggregate these sub populations based on their relative use of fuels; some households may use traditional stoves frequently and cook with charcoal for long periods of the day, while others may use this cooking method either for very specific dishes, or when they experience a power failure. The survey only asked households whether they had cooked with a particular fuel in the last 12 months, rather than asking about the regularity and extent of fuel stacking. Nevertheless, performing this analysis provides us with a window into the types of households that have already transitioned to modern energy cooking, to varying extents.

	Cooking fuel(s)		
	Biomass	**Biomass and Electricity**	**Electricity**
At least Tier 3 appliances*	83.3%	96%	100%
Grid-Connected at least 5 years	61%	75%	85%
Urban population	88%	90%	83%
Rented accommodation	47%	55%	53%
Household size	5.4	5.5	3.8
Bank account access	53%	77%	73%
Income (median range)	2000-3500	3500-6500	2000-3500
Education level (mean)**	4.2	4.9	4.5

Table 5 Household demographics for Scenario 2 (electricity users only, unweighted)

**A proxy for electricity capacity reflects a combination of cookstove use and appliance ownership data. Households are placed in Tiers 1-5, based on the highest-powered appliance they own or use.*

***1 = none, 2 = primary, 3 = junior secondary, 4 = senior secondary, 5 = trade school, 6 = college, 7 = university*

The 'exclusive fuels' section above clearly showed that electricity cooking households tend to be more affluent, urban and 'modern' than exclusive charcoal cooking households. We might therefore expect electricity and biomass stacking to represent a transitional stage, as households become less attached to traditional cooking methods and become more willing to embrace cleaner and more modern alternatives. Table 5 shows that this does not seem to be the case. On average, **households stacking biomass with electricity tend to have much higher incomes and a slightly higher level of education compared to the other two populations, and a greater proportion reside in urban areas and have bank accounts.**

The major difference between grid-connected biomass households and electricity/biomass stacking households is income. However, these exclusive biomass users have the same median income bracket as exclusive electricity households and tend to live in urban areas. They have similarly sized households compared to stacking households, and when combined this data suggests that this demographic could be well suited to the adoption of electric cooking.

The transition narrative (from exclusive biomass, to stacking, to exclusive electricity) does seem to make sense if we turn attention to the number of years these households have been connected to the grid. Table 6 below sheds further light on this:

Cooking fuel(s)	Less than 5 years	5 to 10 years	More than 10 years
Electricity	18 (7%)	23 (12%)	78 (22%)
Electricity and Biomass	51 (20%)	57 (29%)	97 (28%)
Biomass	187 (73%)	114 (59%)	176 (50%)
Total	**252 (100%)**	**194 (100%)**	**351 (100%)**

Table 6 Number of years connected to the grid for Scenario 2 (electricity users only, unweighted)

Of recently connected households (less than 5 years), only 27% are cooking with electricity – either exclusively or stacked with biomass. For households connected for between 5 and 10 years, this increases to 41%, and for households connected for more than a decade the figure is 50%. This suggests that the adoption of modern energy cooking can be a very gradual process, particularly if we assume that barriers to transition – such as cost, quality of electricity, availability of goods – will affect households regardless of how long they have been connected. However, it could be argued that recent challenges to transition, such as increased load shedding, might lead to different behaviours depending on prior experience of modern energy cooking. In other words, a household who has been cooking with electricity for a number of years may be resistant to replacing modern appliances with a biomass stove, and thus see greater value in these appliances.

5 Household practices and perspectives

5.1 Labour of cooking

The survey also asked households how much time they spend on average a) preparing their cooking fuel and b) cooking a meal. Analysis of this data sheds light on how different cooking fuels can exert a time burden on the family or, conversely, how they can free up time for cook and the household. As expected, Table 7 shows that biomass fuels take significantly more time to prepare compared to electric cooking alternatives. In fact, **households save on average 20 minutes per day in preparing the fuel and 20 minutes in the cooking time**.

However, we must remain cognisant of the fact that households who have transitioned to electricity may be cooking different foods and recipes. There may also be a greater incentive to minimise the use of electricity to save energy, whereas the financial costs of biomass cooking are incurred at the collection and/or preparation stages; once sufficient biomass has been lit, it is possible to continue cooking without incurring any further costs.

Fuel		Preparing fuel	Cooking meal
Wood (collected)	N	1272	1274
	Mean	28	87
	Median	4	60
Charcoal	N	1258	1256
	Mean	25	103
	Median	8	60
Electricity	N	217	217
	Mean	6	62
	Median	0	40

Table 7 Average time spent cooking, including set-up (minutes per day)[5], at a household level (unweighted)

[5] Kruskal Wallis p-value <0.001 when comparing all fuels, Kruskal Wallis p-value =0.160 when comparing only the three biomass fuels

We can also analyse fuel preparation times and cooking times in Scenario 2. Table 8 below provides the breakdown for these three sub-categories, all of whom are grid-connected.

Table 8
Average time spent cooking, including set-up (minutes per day)[6], for electricity-using households only (unweighted)

Cooking fuel(s)		Preparing fuel	Cooking meal
Biomass	N	625	622
	Mean	26	109
	Median	10	68
Biomass and Electricity	N	324	323
	Mean	25	139
	Median	1	120
Electricity	N	217	217
	Mean	6	62
	Median	0	40

What is most striking from this analysis is the significant amount of time spent cooking by the group of households stacking biomass and electricity. On average, this group spent almost 2.5 hours cooking, in contrast to households cooking exclusively with electricity, who spend 1 hour. This suggests that stacking is not practiced in order to reduce the time burden of cooking. Rather, it appears that these households 'double up' their cooking, spending more time and more energy to cook meals. **On average, it appears that stacking biomass with electricity does not reduce biomass consumption and is therefore unlikely to lead to a reduction in cooking fuel costs, nor to a reduction in household air pollution**. The first of these two assumptions will be explored further in Section 5.2.

Before turning attention to costs, we must acknowledge the gendered aspects of cooking, and the implications of modern energy transitions on the gendered dynamics of cooking labour. The MTF survey allows us to analyse the frequency with which female spouses of male-headed households cook, according to the fuels used. Table 9 below details this for both analysis scenarios.

	Scenario 1					Scenario 2			
	Wood (collected)	Charcoal	Electricity	Total		Exclusive biomass	Biomass and electricity	Exclusive electricity	Total
Every day	767 94.1%	753 90.0%	94 88.8%	**1614 91.8%**		386 87.7%	193 80.4%	94 88.7%	**673 85.6%**
A few times a week	23 3.1%	51 6.1%	9 8.4%	**85 4.8%**		33 7.5%	32 13.3%	9 8.5%	**74 9.4%**
Weekly – Monthly	10 1.2%	17 2.1%	0 0%	**27 1.5%**		17 3.9%	9 3.8%	0 0%	**26 3.4%**
Never	13 1.6%	16 1.9%	3 2.8%	**32 1.8%**		4 0.9%	6 2.5%	3 2.8%	**13 1.7%**
Total	**815 100%**	**837 100%**	**106 100%**	**1758 100%**		**440 100%**	**240 100%**	**106 100%**	**786 100%**

Table 9 Average time spent cooking by female spouse of male-headed households (unweighted)

[6] Mann-Whitney U test shows that the differences between exclusive biomass and electricity/biomass stacking is statistically significant for the time preparing the fuel (0.012) and cooking (< 0.001).

In Scenario 1, there is only a marginal difference between female spouses cooking exclusive with charcoal and exclusively with electricity. Both groups have a similar urban/rural distribution (approximately 90% live in urban areas), and therefore the difference between these groups and collected wood households, in terms of female spouse cooking time, may reflect urban/rural differences rather than traditional/modern cooking practices.

In Scenario 2, the biomass/electricity stacking group are again the outliers. Female spouses of this group, which on average have higher incomes, larger households, and longer cooking times, tend to cook *less* frequently than female spouses in the other two groups. Almost 20% of female spouses in the stacking group work a few times a week or less, compared to only 11-12% in the other two groups. Modern appliances do not necessarily free up time for female spouses of male-headed households, and there must be other explanations for why women in this group cook less frequently. One possible explanation is that these women are far more likely to be income earners themselves – 39% as opposed to 23% (Table 10).

	Exclusively cooks with electricity	Stacks electricity with biomass	Exclusively cooks with biomass
Female Non-earner	82 77.4%	145 61.2%	331 77.2%
Female Earner	24 22.6%	92 38.8%	98 22.8%
Total	**106** **100.0%**	**237** **100.0%**	**429** **100.0%**

Table 10 Female employment status according to cooking fuels (Scenario 2, unweighted)

This suggests that stacking electricity with biomass has benefits to households where the female spouse is an income earner. A higher proportion of non-earners exclusively cook with electricity than earners. If female earners have less flexibility in terms of *when* they cook, but also must deal with the challenge of regular load shedding, cooking exclusively with electricity may be less feasible. **This shows the importance of other forms of modern energy cooking services, such as battery-supported cooking appliances and LPG.**

Figure 9 Dried foods being sold in Kanyama compound, Lusaka, 2014 (credit: SuSanA)

It is also important to note that a smaller proportion of grid-connected, male-headed households cook exclusively with electricity (14%), compared to all grid-connected households in Scenario 2 (18.5%). This suggests that there might be a gendered dynamic to cooking fuel preferences, with **women more likely to favour**

electricity over biomass. Grid-connected, male-headed households are slightly more likely to cook exclusively with biomass (56%) or stack electricity with biomass (31%), compared to all grid-connected households (54%; 28%).

Returning to the gendered aspects of cooking, Figure 10 shows, for Scenario 1, the number of minutes per day a member of the household spends a) preparing the cooking fuel(s) and b) cooking the meals. The time spent cooking meals using firewood is much more evenly distributed between adult men (30 minutes) and adult women (40 minutes), than is the case for cooking with charcoal (25 minutes and 80 minutes respectively). Cooking exclusively with electricity seems to involve boys and girls more regularly – between 10 and 15 minutes on average, and this may be due to increased safety and a lack of exposure to smoke. On average, girls spend longer cooking than adult men when the cooking fuel is charcoal, but the opposite is the case for electric cooking. This suggests that **electric cooking may be a factor in a more even distribution of cooking burden across genders**. Boys spend much less time than girls cooking on charcoal, but there is almost no difference in cooking time when the cooking fuel is electricity.

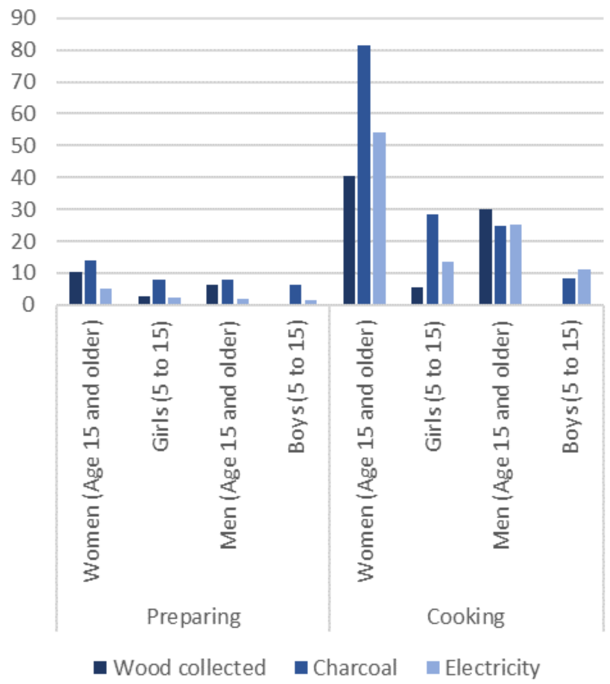

Figure 10 Average time spent cooking per day (mins), according to age and gender (unweighted)

5.2 Fuel costs

Table 11 details the total monthly fuel expenditures for households using a single cooking fuel, and using electricity for non-cooking purposes. While the cooking fuels may be used for non-cooking tasks, it can be assumed that cooking represents the largest single energy load on the household's expenses, and that other uses of the fuel (e.g. heating the home) may overlap with the time and energy spent cooking. Electricity expenditure in these households is also included in the table. Note that the sample size is smaller in the 'electricity' column; the missing households either do not have electricity access or did not provide information about their electricity expenditure.

Single cooking fuel		Total Monthly Expenditure (ZMK)	
		Charcoal	Electricity
Charcoal	**N**	**1250**	**485**
	Mean Median	81.7 65	141.5 100
Electricity	**N**	N/A	**217**
	Mean Median		156.2 100

Table 11 Selected fuel expenditures for electricity-using households that cook using one fuel only (ZMK/month, unweighted)

Households cooking exclusively with charcoal spend on average 141.5 ZMK on electricity per month for non-cooking purposes, which is only 15 ZMK ($0.75) less than the average household that does all of its cooking with electricity. **This suggests that a transition to electric cooking would not be too expensive for many of these households, and it may in fact be a much cheaper option** given that over 80 ZMK ($4) is spent on charcoal on average each month. Note also that the median spend on electricity and on fuels overall is 100 ZMK for both sets of households.

Single cooking fuel		Monthly Expenditure per capita (ZMK)	
		Charcoal	Electricity
Charcoal	**N**	**1250**	**485**
	Mean	18.6	30
	Median	17	25
Electricity	**N**	N/A	**217**
	Mean		48.5
	Median		35

Table 12 Selected fuel expenditures for electricity-using households that cook using one fuel only (ZMK/month)

When we turn attention to energy spend per capita (Table 12), it becomes clear that some of this additional expensive for charcoal cooking households is related to fact that the average household size is higher (5.1 people) than for electric cooking households (3.8). The former spend approximately 18.5 ZMK less on electricity per person a month than the latter, and this is almost exactly the same as the average expenditure on charcoal for this group. This suggests that it is financially viable for many of these households to transition to exclusive electric cooking.

We can conduct the same analysis for fuel stacking households, while continuing to acknowledge the fact that we are unable to make any assumptions about the relative use of these fuels over the 12-month period referenced during data collection. **There appears to be no financial benefit to cooking with biomass when modern fuels are available** (Table 13).

Cooking fuel(s)		Monthly Expenditure (ZMK)		
		Charcoal	**Electricity**	**Total**
Electricity	N	N/A	217	217
	Mean		156.2	158.6
	Median		100	100
Electricity and Biomass	N	317	324	324
	Mean	86.7	203.9	295.5
	Median	80	200	270
Biomass	N	609	512	624
	Mean	87.9	144.1	210.4
	Median	75	100	170

Table 13 Selected fuel expenditures for electricity-using households that cook using one fuel only (ZMK/month)

When we limit our investigation to grid-connected households, we see that **households cooking exclusively with biomass spend more on energy than households cooking exclusively with electricity.** Exclusive biomass cooks spend only marginally less on electricity than those who also use electricity for all their cooking needs. This suggests that cooking is a small fraction of electricity consumption in Zambian households, where the majority of expenditure relates to the use of lighting, charging, entertainment, fans, refrigeration, and other such services.

Another important finding is that **households stacking electricity with biomass spend 30% more on electricity than households that cook exclusively with the modern fuel**. In addition, **stacking households pay virtually the same for charcoal each month compared to households that cook exclusively with charcoal**. This suggests that stacking biomass with electricity represents a 'doubling up' of energy consumption, and that stacking is not an indicator for reduced biomass consumption. On average, this group do have larger families and higher incomes, and it may be the case that stacking multiple fuels is perceived to be better suited to their needs, and does not reflect a position of necessity. Table 14 below looks at expenditures on a per capita basis, and reveals that stacking households do in fact spend more per person on energy than the other two categories on a per capita basis, exclusive electricity cooking households do spend more than stacking households on electricity (15% more), and exclusive biomass cooking households spend marginally more than stacking households on charcoal (9% more). Nevertheless, the overall figures suggest that stacking biomass with electricity is not the cheapest way of cooking.

Cooking fuel(s)		Monthly Expenditure per capita (ZMK)		
		Charcoal	**Electricity**	**Total**
Electricity	N Mean Median	N/A	217 48.5 35	217 49.1 35
Electricity and Biomass	N Mean Median	317 17.2 15	324 42.2 31	324 60.2 50
Biomass	N Mean Median	609 18.7 17	512 30.5 25	624 44.7 35

Table 14 Selected fuel expenditures for electricity-using households that cook using one fuel only (ZMK/month)

Returning briefly to the official diagnostic (Luzi et al, 2019), Figure 11 shows that the affordability of electricity is not a major barrier to improved access, and when coupled with the energy expenditure data above, this suggests that affordability is not a major barrier to modern energy cooking. The majority of the population lack basic access to electricity, while others in the lowest tiers have off-grid solutions with limited capacity. For those with Tier 3 access (grid quality electricity), the barriers to improved access are almost entirely issues of reliability and availability during the day and/or evening.

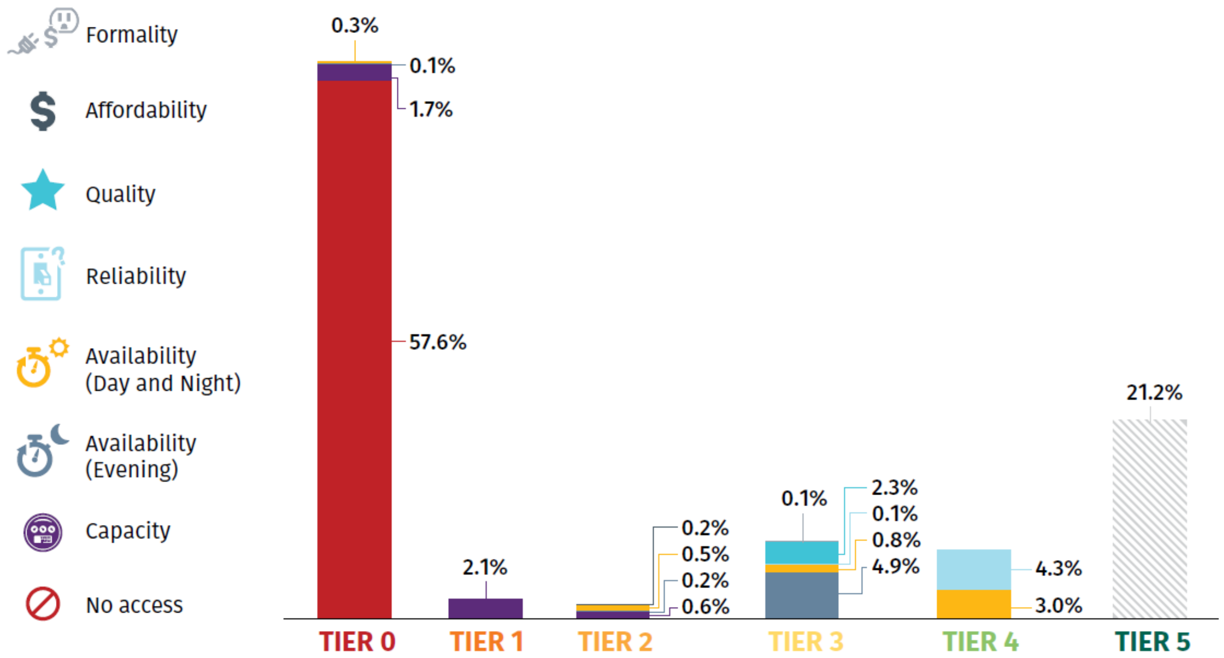

Figure 11 Factors preventing Zambian households from reaching higher tiers of electricity access (Luzi et al, 2019). This data has been weighted.

The official diagnostic includes a similar visual representation of the barriers to reaching a higher tier of cooking solution (Figure 12 below). Affordability (cooking fuel costing more than 5% monthly income) is viewed as a major constraint for approximately 9% of the population (weighted). However, this is not limited to the cost of cooking with electricity, and when coupled with the fuel cost analysis above, we can see that affordability issues may relate to biomass just as much as – or possibly more than – electricity users.

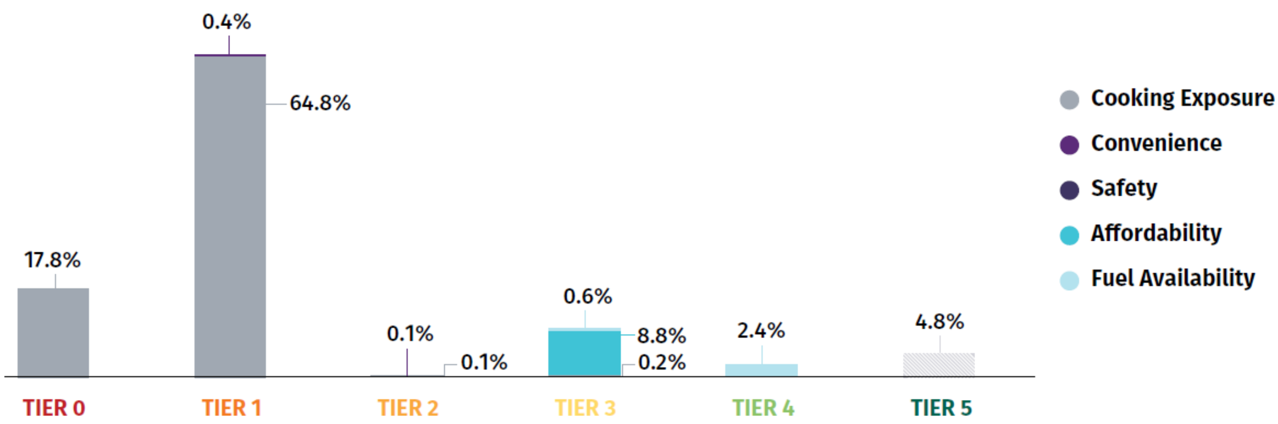

Figure 12 Factors preventing Zambian households from reaching higher tiers of cooking solution (Luzi et al, 2019). This data has been weighted.

5.3 Quality and reliability considerations

With urbanisation and increasing household incomes and electricity access, the data presented so far provides a snapshot of a changing modern energy environment in Zambia. Of particular relevance to the MECS programme are the barriers preventing households from shifting to a higher tier of modern energy solutions, where electricity is more widely available and reliable. Figure 11 above suggests that the barriers to reaching Tiers 4 and 5 are overwhelmingly about the reliability and quality of electricity, rather than affordability.

It is therefore worth taking a closer look at households currently stacking biomass with electricity, to explore other factors that may be preventing households from increasing their use of electricity, and especially for cooking. Quality and reliability are assessed here according to the following indicators:

- Availability of electricity throughout the day, and in the evening
- Frequency of blackouts, and duration of blackouts during the worst week
- How seriously households experience voltage fluctuations
- If these changes in voltage damaged any appliances

Despite the significant challenges that load shedding presents, **65% of households stated that their quality of electricity service is the same throughout the year** and does not tend to fluctuate. Even for grid-connected households cooking exclusively with biomass, 59.4% felt that their supply remained stable. It is not surprising that those who cook with electricity were less likely to report fluctuations: 17.1% of exclusive electric cooking households and 35.8% of electric/biomass stacking households, compared to 40.6% of exclusive biomass households.

Given that two-thirds of grid-connected households reported relatively stable electricity supplies, a majority of households also reported:

- 24 hours of electricity availability per day
- No blackouts in a typical week

That said, it is important to acknowledge that the quality of electricity supply does vary considerably, and Table 15 below shows the quality and reliability indicators for the worst month of a given year, for the households that reported fluctuation in the quality of electricity:

Cooking fuel(s)		Availability in a day (hours)	Availability at peak time 6-10pm (hours)	Number of blackouts in a week	Total duration of blackouts in a week (hours)
Electricity	N	26	29	23	24
	Mean	15.6	3.0	3.0	14.0
	Median	16	3	3	3
Electricity and Biomass	N	106	112	102	103
	Mean	15.6	2.5	4.7	17.4
	Median	16	2	3	5
Biomass	N	230	235	222	220
	Mean	8.9	1.8	4.3	9.2
	Median	6	2	3	5

Table 15 Availability of electricity in the worst month, for Scenario 2 households that experience fluctuations in electricity supply over a 12-month period (unweighted)

The table shows significant differences for those cooking with electricity (exclusively or stacked with biomass) and those that cook only with biomass. On average, exclusive biomass households with fluctuating quality of electricity experience:

- 9 hours of electricity per day
- 2 hours of electricity between 6-10pm
- More than 4 blackouts per week
- Blackouts averaging 9 hours per week

Figure 13 Solar panel installation in Zambia, 2019 (credit: Genna brand)

Meanwhile, those cooking with electricity state that they have almost double the availability of electricity per day in their worst month. Households stacking biomass with electricity report having more frequent blackouts on average and a higher number of hours of blackouts each week. This suggests that problems with the quality of electricity supply may prevent exclusive electric cooking, but it **does not seem to be an impediment to some form of electric cooking**. It might be that these households choose to cook with electricity in the months where the electricity supply is more stable and performing to a higher standard.

It should also be emphasised that the quality of electricity is not reported to be a significant concern for the majority of households surveyed. For households that use biomass either exclusively or alongside electricity:

- 80% report no experience of voltage fluctuations
- 90% report no damage to appliances.

Again, it was households that stack electricity with biomass that were more likely to report significant voltage fluctuations (14.2%, compared to 5.1% (electricity) and 9% (biomass)) and damage to appliances (12.5%, compared to 2.3% (electricity) and 9.2% (biomass)). Again, this suggests that quality concerns may be a factor in preventing households from switching exclusively to electricity, but not in including electricity in their cooking stack.

5.4 Electricity access and payment

Having established that significant opportunities exist in Zambia to improve access to modern energy cooking services, this section turns to the different ways in which households pay for their electricity. The rationale for this focus is that certain payment mechanisms and institutional relationships will suit certain types of households, depending on urban/rural locations, energy needs (high-load or low-load appliances) and how much they spend on electricity. By exploring the pathways that are currently used by households cooking with electricity, we can understand the contexts and institutional arrangements that would best support the expansion of modern energy cooking in Zambia.

All households in Scenario 2 are connected to the grid, and yet we **find biomass cooking households are more likely to share their meter with other households** (25% of exclusive biomass households and 15.2% of electricity/biomass stacking households, compared to 7% of households cooking exclusively with electricity). If electric cooking is perceived to be expensive, then financial and social pressure to reduce consumption for households sharing meters may be an important barrier to transition. The capacity of electric meters does not seem to be a barrier, with all households reporting a meter of at least 60 Amps.

Table 16 below shows that the majority of grid-connected households pay for their electricity by directly paying the utility company. However, households that cook with electricity are more likely to purchase pre-paid cards for their electricity (20%), compared to households cooking exclusively with biomass (10%). It could be argued that pre-paid cards help facilitate the use of electricity for cooking, because it provides households with an element of financial control. This is likely to be important given the widespread believe that electric cooking is expensive in Zambia.

	Exclusively cooks with electricity	Stacks electricity with biomass	Exclusively cooks with biomass	Total
ZESCO / Utility Office	168 77.4%	240 74.1%	521 82.7%	929 79.4%
Pre-paid meter card seller	45 20.7%	68 21.0%	63 10.0%	176 15.0%
Other	4 1.8%	16 4.9%	46 7.3%	66 5.6%
Total	217 100.0%	324 100.0%	630 100.0%	1171 100.0%

Table 16 The most common way households pay for their electricity bills (unweighted)

6 Decision-making

6.1 Mindsets

One of the major limitations of the MTF survey in Zambia is that households were not asked about their attitudes towards different fuels and different cooking practices. In previous sections of this report, patterns in the quantitative data have allowed for cautious speculation as to the mindsets that drive certain survey responses. For instance, households that stack biomass with electricity are, in theory, no more or less likely to experience issues with the quality of electricity supply, and yet these households tended to report more severe voltage fluctuations, resulting damage to appliances, and more frequent and longer lasting blackouts, compared to exclusive biomass households connected to the grid. This might suggest that these households stack electricity with biomass in part due to electricity quality concerns. However, without access to attitudinal survey data or qualitative data, it is impossible to say for certain *why* behavioural patterns are the way they are, nor can we speculate about the potential for future transitions to modern energy cooking.

6.2 Purchasing a cookstove

The official diagnostic states that male-headed households tend to be more willing to pay for a) gid connection, b) a solar home system, and c) an improved biomass cookstove, compared to female-headed households, and for a range of price points. Although the differences between the two categories is sometimes marginal, the willingness to pay data suggests it is important to understand the gender differences in decision-making capacity, and how this related to decisions related to cooking.

In order to explore the implications of gender in purchasing a cookstove, we compared households who have obtained a traditional biomass cookstove to those who purchased an electric cookstove. For each stove, the questionnaire asked which household member decided to purchase the cookstove. Unfortunately, this methodology prohibits any response representing joint decision making, and this data is presented in Table 17, Table 18, and Figure 15 below.

Figure 14 Homemade sausages cooked on a traditional Mbaula stove (Credit: Bioversity International/E.Hermanowicz)

While women tended to be responsible for the acquisition of a traditional cookstove, men were more likely to decide on the purchase of an electric cookstove (Table 17).

	Biomass Stove		Electric Stove	
	Frequency	%	Frequency	%
Male	461	32.3	262	58.6
Female	965	67.7	185	41.4

Table 17 Individual purchasing cookstoves – gender (unweighted)

Electric cookstoves were usually bought by people who were slightly younger and better educated than those who acquired a traditional cookstove (Table 18).

	Biomass Stove (N=1426)		Electric Stove (N=447)	
	Age (years)	Education (level)	Age (years)	Education (level)
Mean	39	2.9	38	4.4
Median	37	3	35	4
Std. Deviation	13.4	1.5	12.3	1.7

Table 18 Individual purchasing cookstoves – age and education (unweighted)

Female purchasers of a biomass stove tend overwhelmingly to be either housewives or not working. In contrast, females buying an electric stove tend to have salaried income (48.1%). Men purchasing an electric stove also tend to be salaried (41.6%), whereas the employment status of men purchasing a biomass stove tends to be more evenly distributed between salaried employment (42%), self-employed (28%), casual work (10%), and not working (20%).

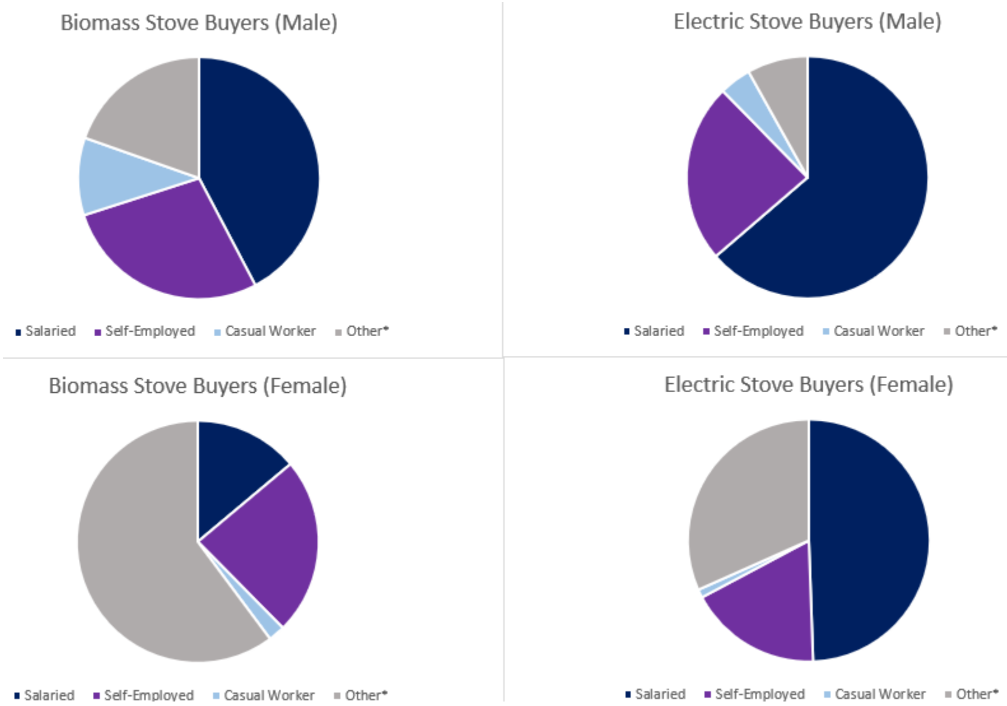

Figure 15 Employment information for male/female buyers of biomass/electric stoves (unweighted)
**Other = housewife/husband, retired, unemployed, not working*

Analysed together, these two tables and four pie charts show that, compared to purchasers of biomass stoves, purchasers of electric stoves tend to be younger, better educated, male, and in salaried employment. This suggests that a transition to modern electric cooking might be more straightforward for men with more 'modern' lifestyles, and that more research is needed to understand the barriers facing other men and women when it comes to transitioning to modern energy cooking.

7 Learning points from Zambia

7.1 Cooking fuel choices

This report has shown the importance of nuanced data collection and analysis when attempting to understand the opportunities and challenges of transition to modern energy cooking. The official diagnostic focuses on primary cooking solutions and in doing so overlooks the extent to which electricity is used for cooking as part of a stacking solution. In fact, 50% more grid-connected households stack electricity with biomass, compared to the number of households that cook exclusively with electricity.

The MTF survey did not include attitudinal questions in the Zambia version of the research, and so it is impossible to draw conclusions about household perceptions of the benefits/limitations associated with electrification and load shedding, nor can we know how they view energy efficient electrical appliances as opposed to traditional cookstoves, such as the Mbaula. However, the data does enable us to make connections between cooking fuel choices, demographics, and experience of the electricity supply.

Charcoal and electricity are used as cooking fuels in urban areas predominantly, whereas rural areas tend to collect firewood and the overwhelming majority do not have a grid connection. Given low average incomes in rural households, off-grid solutions will most likely need to offer electricity for cooking at sufficiently low tariffs, and energy efficient appliances will be vital if modern energy cooking is to be affordable.

Exclusive charcoal users in comparison tend to be much more urban and have larger families, but have lower incomes and are less likely to have a bank account than exclusively electric cooking households. Although grid-connected households cooking exclusively with biomass tend to have greater challenges in terms of the availability and reliability of the electricity supply, compared to exclusive electric cooking households, the group that seem to be worst affected by blackouts and voltage fluctuations happen to be those cooking with both electricity and biomass.

Concerns over reliability and quality of electricity seem to be a significant barrier to transitioning exclusively to modern energy for cooking, and this is where LPG and battery-supported cooking solutions may offer viable alternatives. We may also conclude that the success of further transition to electric cooking rests on the availability of hydropower and the expansion and diversification of the renewable energy sector in Zambia.

7.2 Costs of cooking

From a financial perspective, there seems to be no benefit to choosing to cook with charcoal over electricity, whether we look at the household as a whole or per individual. Exclusive biomass cooking households that use electricity in some capacity spend significantly more on their energy needs than households that do all their cooking with electricity. Households that cook with both electricity and biomass spend even more on their electricity and on their energy overall, and this fits with the fact that this group have (on average) higher incomes and female spouses are more likely to be income earners themselves.

Cooking with electricity also saves time for those responsible for cooking at home. These households save an average of 20 minutes each day in the time taken to prepare the cooking fuel (e.g. light the fire or charcoal stove), and save an average of 25 minutes in cooking time compared to households cooking with firewood, and 40 minutes compared to households cooking with charcoal. However, electric cooking may take place simultaneously (e.g. using multiple hot plates), whereas much of the expense of a biomass fire is incurred in lighting and setting up the stove, so cooking can be cost-effective if additional dishes are cooked after the meal is ready.

Overall, electricity appears to be a cheap and convenient cooking fuel for a typical Zambian household. If concerns over the quality and reliability of electricity can be overcome, and assuming the cost of charcoal increases relative to electricity/renewable technology in the coming years, it is likely that their will be significant and increased demand for modern energy cooking services in Zambia.

7.3 Gender implications

Female-headed households appear to cook with electricity to a greater extent than male-headed households. And yet, it is men who are more likely to purchase an electric stove and women are more likely to purchase a traditional stove. This suggests that the gendered dynamics of cooking decisions and practices needs to be considered when devising modern energy cooking interventions in Zambia.

Cooking with electricity seems to increase the share of cooking among men and boys, relative to women and girls. In male-headed households where electricity and biomass are both used as cooking fuels, female spouses are more likely to be income earners and cook less regularly; almost 20% cook a few times a week or less, compared to 10% for all other groups considered in this analysis. When we compare cooking frequency for female spouses in male-headed households cooking exclusively with biomass or exclusively with electricity, there is very little difference in grid-connected households and where charcoal is the biomass used (i.e. urban settings). Of these households cooking exclusively with wood (i.e. rural households), a greater proportion of women cook every day, in comparison to all other groups studied.

Figure 16 ZESCO area manager at the newly built power substation in Kabompo, northwestern Zambia, 2017 (credit: Tigana Chileshe)

8 End note

This working paper is created to stimulate discussion and to prompt others to analyse the data further. We thank the World Bank and the Government of Zambia for their collection of the data and making it available as a public good. We are sure there may be more in the data that could assist guiding the collective to transition from biomass to modern energy cooking solutions and we present this only as a start.

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