Myanmar; Cooking transitions

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

Working Paper 06/Apr/2021

Author: M Price, T Jones, N Scott

Working Paper for Comment

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.

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Abstract

In "Myanmar – Beyond Connections" (Koo et al, 2019), the authors present a diagnostic of the multi-tier framework data from Myanmar. 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 Myanmar, 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 Myanmar. 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 Myanmar. An integrated analysis of these trends at the household level then follows, taking account of the different electric cooking appliances owned in Myanmar 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 Myanmar. 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 (Koo et al, 2019) reveals the following background information:

- 86.5% of households in Myanmar have access to electricity (38.6% are grid-connected; 48% have off-grid solutions)
- 85.3% of urban households have grid access, while 61.1% of rural households have off-grid solutions
- 56.2% of urban households cook with electricity, while 58% of rural households use three-stone stoves.
- LPG and improved cookstoves are viewed as promising solutions for lower tier households, assuming both become more affordable relative to electricity in the future.

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 modern energy (electricity, LPG) 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 are at a certain phase of the biomass to modern energy transition ('Scenario 2'). At one end of the transition are households cooking with biomass only, and the other end represents a modern energy stack (electricity and LPG).

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

- 68% of electricity-using households cook with electricity, either exclusively (27%) or stacked with other fuels (41%)
- 43.9% of households without an electricity connection are too remote to gain access, suggesting the need for further electrification and the use of LPG as a transition fuel. 27.2% remain unconnected due to upfront costs
- Modern energy cooking is common for households connected to the national grid (79%) or the border/Thai grid (76%), and less common in mini grid contexts (33%) and township grids (21%)
- Virtually all electric cooking households use a rice cooker and the vast majority use an electric pot/wok/pan
- Grid-connected households cooking with biomass tend to have lower average incomes, a lower education level, and larger average family sizes. LPG and electricity users are affluent and urban, but only half are connected to the national grid (35% are regional/border grids, 13% are mini grids)
- 67% of electricity-using, exclusive biomass cooking households have a higher quality of electricity supply than 25% of households cooking exclusively with electricity.

Costs of Cooking: Money and Time Spent

- Compared to using firewood, cooking with electricity appears to save 100 minutes per day in fuel collection, 10 minutes in fuel preparation, and a further 30 minutes per day in cooking time
- However, stacking biomass with electricity will not save households much time each day, and if biomass stoves or three-stone fires are used to a similar extent as if they were used exclusively, there will not be a positive impact on cooking-related concerns for public health and forest degradation
- LPG users spend on average 10 minutes collecting their fuel each day, but this is much shorter than the average time collecting wood (80mins), and also shorter than charcoal collection (17 mins)
- Electricity is by far the cheapest cooking fuel on average. Exclusive electricity cooking households spend 8000 MMK/month on average, compared to 11000 MMK for exclusive wood users and 13000 MMK for exclusive charcoal users. Adding electricity to biomass is not associated with an increase in cost
- Households cooking exclusively with LPG spend less on their cooking fuel on average (7,100 MMK/month) than households cooking exclusively with either purchased wood (13,600 MMK) or charcoal (10,300 MMK)
- Households stacking biomass with LPG are high energy consumers on average, but the majority of their fuel spend is on electricity for non-cooking purposes (20,200 MMK)

Gendered Analysis

- At least 95% of female spouses of male-headed households cook every day, across all fuels
- Female heads of household spend less time cooking than female spouses of male-headed households, and independence for female spouses is also associated with a reduced cooking time burden
- Men in Myanmar tend to make decisions about household finances and energy consumption, although this seems to more common among biomass using households
- Despite men being the main decision makers, cookstove purchasing decisions are made by wives far more often than husbands. This is true for traditional, improved, and modern cookstoves.

Implications for Modern Energy Cooking in Myanmar

- Despite a relatively low electrification rate in Myanmar, electric cooking is commonly practiced in the country and the grid tariff is among the lowest in South-East Asia. The exclusive or partial use of electricity for cooking seems to indicate a willingness to transition to modern energy cooking services
- Grid-connected households cooking exclusively with biomass spend 50% more on energy on average compared to households cooking exclusively with electricity
- Virtually all electric cooking households use a rice cooker, reducing the need or usage of a biomass stove. By adding more modern energy cooking devices (kettles, electric frying pans/induction stoves, other energy efficient cooking appliances), biomass can be eradicated from a household's cooking practices altogether as demonstrated by those cooking exclusively with electricity.
- Incorporating LPG into a household's cooking practices appears to be a particularly effective way of reducing biomass use. Households that stack biomass with LPG spend 10,300 MMK/month less on average on their biomass, compared to those who cook exclusively with biomass. This is an important finding for households that live too far away from existing electricity infrastructure, or have access only to low-capacity systems (e.g. solar home systems).

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1 Introduction

In "Myanmar – Beyond Connections" (Koo et al, 2019), the authors present a diagnostic of the multi-tier framework (MTF) data from Myanmar. 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.

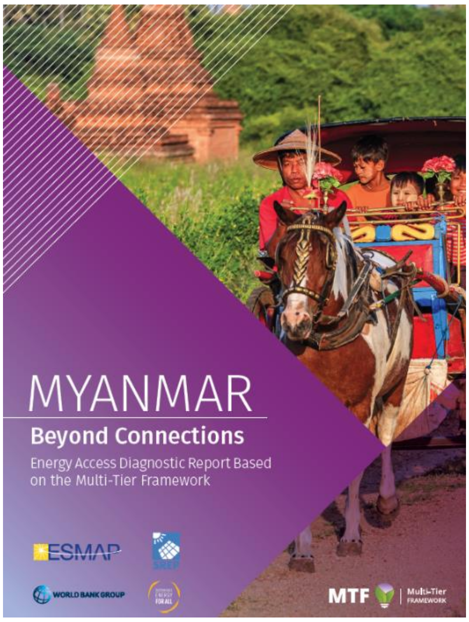

Figure 1 Front cover of Koo et al (2019)

Koo 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 Myanmar 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. Koo 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 Myanmar.
- **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 Myanmar, which is publicly available on the World Bank website. It is important to note that this working paper is an additional analysis to Koo 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 Myanmar. An integrated analysis of these trends at the household level then follows, taking account of the different electric cooking appliances owned in Myanmar 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.

We fully acknowledge that our particular interest lies in the use of electricity for cooking, and that Myanmar is an outlier in terms of its widespread use of LPG for cooking, and its high level of economic development relative to its largely rural population.

The MTF data comprises a **sample of 3,446 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 30:70 urban/rural in 2017[1]), this unweighted analysis may provide a window into the future direction of electricity access and modern energy cooking in Myanmar. It is projected that almost 50% of the population in Myanmar will reside in urban areas by 2050[2].

2 Background Information

Myanmar has a population of 53 million. With the exception of Cambodia, Myanmar has the lowest GDP per capita and lowest rate of urbanisation among ASEAN countries[3][4]. Despite also having one of the lowest rates of electrification in the region, enormous progress has been made in the decade. As recently as 2016, only 34% of Burmese households were electrified, but this had increased to 50% by the end of 2019. In the Myanmar National Electrification Plan (NEP), the objective is to achieve universal electrification by 2030[5].

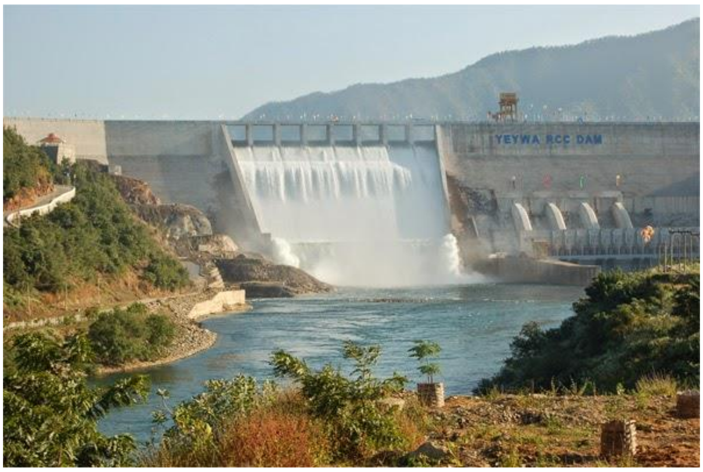

Figure 2 Ye-ywar Dam Hydro-Electric Generating Plant (credit: Hla Oo)

Electricity generation in Myanmar derives largely from hydropower and natural gas[6]. Solar PV contributed a minimal amount to Myanmar's generation capacity (19 GWh in 2019), although this has doubled between 2018 and 2019. Electricity consumption has more than doubled in 10 years (ibid.).

The national grid does not extend to all regions in Myanmar. Tanintharyi region, for instance, has its own regional grids ('township grids' and 'border/Thai' grids in the MTF survey), and despite exporting natural gas to Thailand, Tanintharyi has the lowest official electrification rate of all states and regions in Myanmar[7].

Myanmar is reported to have the highest rate of mangrove loss in Southeast Asia, where mangroves account for 90% of charcoal production[8]. Charcoal production and firewood harvests are thought to be significantly under reported in Myanmar, thus contributing to the severe economic and environmental costs related to biomass use.

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[1] https://www.statista.com/statistics/761124/share-of-urban-population-myanmar/
[2] World Bank data, available from: Population Estimates and Projections | Data Catalog (worldbank.org)
[3] https://aseanup.com/asean-infographics-population-market-economy/
[4] https://www.statista.com/statistics/804503/urbanization-in-the-asean-countries/
[5] https://www.seforall.org/sites/default/files/Myanmar_IP_EN_Released.pdf
[6] https://www.iea.org/countries/myanmar
[7] https://asiafoundation.org/wp-content/uploads/2019/04/Myanmar-Decentralizing-Power_report_11-April-2019.pdf
[8] https://www.forest-trends.org/wp-content/uploads/2020/10/Charcoal-Production-in-Myanmar-FINAL.pdf

3 Cooking practices: an overview

3.1 Cooking fuels

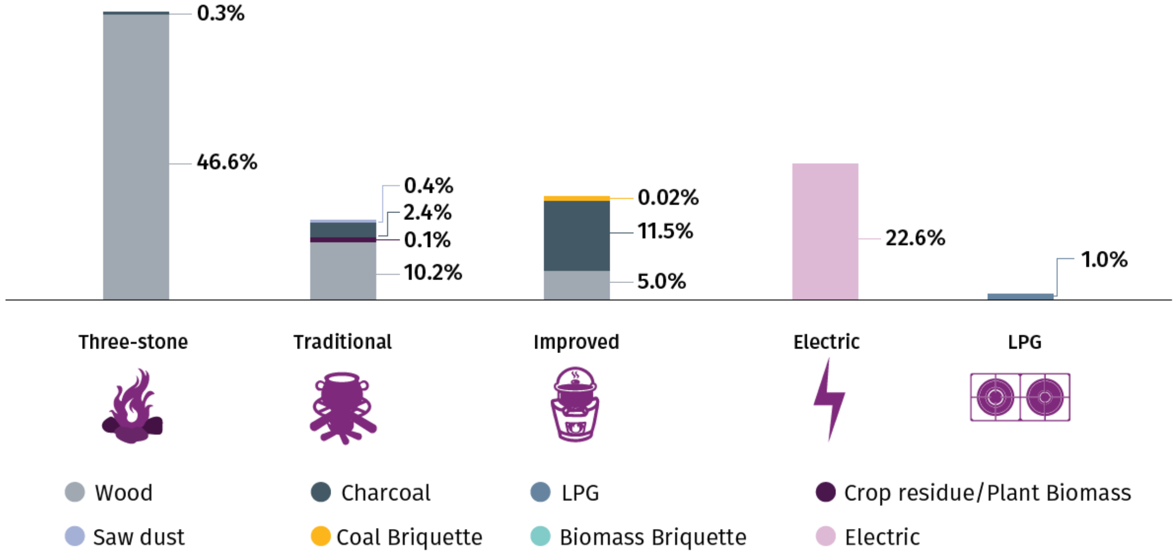

Figure 3 Primary stoves for households in Myanmar, weighted (Koo et al, 2019)

Figure 3 is taken from the official diagnostic, and shows that almost all clean fuel stoves in Myanmar use electricity rather than gas. The market for improved cookstoves (ICS) is relatively well established; charcoal ICS make up 22% of cookstoves in urban areas, whereas the fuels for the 13.6% of rural stoves that are ICS are more evenly split between charcoal (7.6%) and wood (6%). The vast majority of rural stoves are three-stone stoves, but these stoves and traditional stoves make up more than 15% of cookstoves in urban areas.

The official diagnostic does acknowledge that 13.3% of households partake in stove stacking, where different cooking fuels play a primary or secondary role in cooking practices. **However, its focus on primary fuels may misrepresent the extent to which modern energy has been incorporated into a household's cooking solutions, and thus 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, and the extent to which fuel stacking takes place. The table shows almost 70% of these households use one fuel for cooking: wood is the most popular, followed by electricity, then charcoal. The vast majority of the remaining households use two cooking fuels, most often electricity or charcoal, rather than wood. Overall, electricity and wood are used by almost half of all households surveyed.

	Total		LPG	Wood[9]	Charcoal	Electricity
1	2280 68.4%		23 0.7%	1203 36.1%	408 12.2%	646 19.4%
2	1009 30.3%		140 4.2%	376 11.3%	544 16.3%	958 28.8%
3	42 1.3%		25 0.8%	21 0.6%	38 1.1%	42 1.3%
Total	**3331** **100%**		188 5.6%	1600 48.0%	990 29.7%	1646 49.4%

Table 1 Fuel use among surveyed households (unweighted)

Figure 4 shows that electric cooking tends to be concentrated in urban areas, as does charcoal. Almost as many urban households pay for wood than those that pay for LPG.

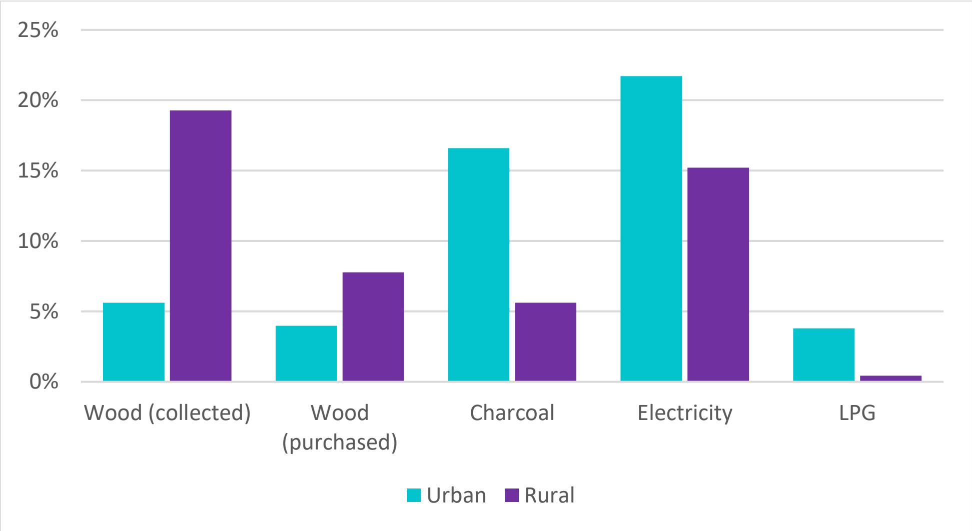

Figure 4 Cooking fuels used in Myanmar (% of all households surveyed, unweighted)

Given the extent of stacking and the range of fuels used for cooking in Myanmar, 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: wood, charcoal, and electricity. The sample size for LPG use was too small to include in this scenario, and while there were a number of survey questions relating to briquettes and crop residue as potential fuels, this data was not recorded in a way that allows for comparison with other fuels.

Scenario 2. The second category resembles a transition scenario, where electricity and LPG 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, b) those who cook exclusively with electricity, and c) those who stack LPG with electricity, in order to shed light on stacking behaviour and the potential for biomass cooking households to integrate modern energy into their cooking practices. Crucially, this

[9] Approximately two-thirds of these households collect their wood, while a third purchase wood

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.

In both scenarios, we compare demographic characteristics, fuel consumption, and other data points collected by the MTF survey.

Scenario 1 – Exclusive Cooking Fuels				**Scenario 2 – Electricity Stacking**		
Wood (collected)	821	37%		Stacks electricity with LPG	126	5%
Wood (purchased)	376	17%		Exclusively cooks with electricity	643	27%
Charcoal	408	18%		Stacks electricity and biomass	848	36%
Electricity	646	29%		Exclusively cooks with biomass	767	32%
Total	**2257**	**100%**		**Total**	**2384**	**100%**

Table 2 Household groupings for analysis (unweighted)

'Biomass' in Scenario 2 refers to charcoal and/or wood, used by households either exclusively or in combination with one another. Exclusive biomass users tend to be wood users rather than charcoal users, while the opposite is true for households that stack biomass with electricity. Charcoal/wood users are grouped together in Scenario 2 because we are interested in the potential transition of *any* biomass-using households that have a grid connection.

Figure 5 Irrawaddy Delta, where mangrove forests supply the majority of charcoal for Yangon (Credit: European Space Agency)

However, it is worth reflecting briefly on the reasons why certain households are not currently connected to the grid. Table 3 shows the five main reasons for not being connected, split between urban and rural households. This table below shows that the main barriers to electrification are a) distance from the grid network and b) upfront costs of connection, in terms of both the connection itself and network construction. While both of these factors are often understood as challenges in rural locations, this analysis reveals that a substantial proportion of urban households suffer from these same issues. It suggests that mini grids could play a role in urban areas as well as rural areas, and that payment plans are needed in both urban and rural settlements.

	Urban	Rural	Total
Grid is too far from household/not available	**146** 33.5%	**379** 49.9%	**525** 43.9%
Cost of initial connection is too expensive	**58** 13.3%	**157** 20.7%	**215** 18.0%
Cost of initial network construction too expensive	**27** 6.2%	**83** 10.9%	**110** 9.2%
Application submitted, waiting for connection	**41** 9.4%	**48** 6.3%	**89** 7.4%
Service provider refused to connect	**13** 3.0%	**19** 2.5%	**32** 2.7%

Table 3 Top five reasons why households are not grid connected (no. and % of households)

In Section 6.1, we will explore how these households feel about different cooking fuels.

3.2 Cooking and connection type

The official diagnostic places households in each of these different grid systems into the highest tier (Tier 5) for electricity capacity, except mini grid households that have a limited capacity due to the actions of the supplier. Table 4 and Table 5 show the range of grid connections relevant to the two cooking fuel scenarios. By looking at cooking fuel usage across each of these different grid contexts, we can begin to understand how some grid connections may make electric cooking difficult, and potentially for a wide variety of reasons not solely linked to capacity.

Households that exclusively cook with electricity are nearly always connected to the national grid (94.6%), whereas charcoal users are move evenly split between the national grid (26%), township grid (19%), mini grid (19%), or have no grid connection (31%). Of households with a connection but cooking exclusively with wood, most are connected to the grid and nearly half that number are connected to a mini grid.

	National grid	Border or Thai grid	Township's own grid	Mini grid connection	No grid connection	Total
Wood (collected)	**163** 19.9%	**9** 1.1%	**37** 4.5%	**71** 8.6%	**541** 65.9%	**821** 100%
Wood (purchased)	**97** 25.8%	**5** 1.3%	**39** 10.4%	**43** 11.4%	**192** 51.1%	**376** 100%
Charcoal	**106** 26.0%	**21** 5.1%	**76** 18.6%	**77** 18.9%	**128** 31.4%	**408** 100%
Electricity	**611** 94.6%	**16** 2.5%	**7** 1.1%	**9** 1.4%	**3** 0.5%	**646** 100%
Total	**977** 43.4%	**51** 2.3%	**159** 7.1%	**200** 8.9%	**864** 38.4%	**2251** 100%

Table 4 Type of grid connection, according to exclusive cooking fuel (unweighted)

In Scenario 2 (the modern energy cooking transition), we see that LPG is used extensively in the regions with a border/Thai grid: 35% of households that cook with LPG have this type of grid connection. Exclusive biomass cooking is dominant in mini-grid (75%) and township grid (79%) contexts, despite this group representing only 32% of households in Scenario 2. This warrants further investigation into mini-grid and township grid contexts and how it relates to cooking practices (See Section 5.3).

Figure 6 Rural mini-grid in Kan Byin, southeast Myanmar (credit: Sunpower)

	National grid	Border or Thai grid	Township's own grid	Mini grid connection	Total
Stacks electricity with LPG	**64** 50.8%	**44** 34.9%	**2** 1.6%	**16** 12.7%	**126** 100%
Exclusively cooks with electricity	**611** 95.0%	**16** 2.5%	**7** 1.1%	**9** 1.4%	**643** 100%
Stacks electricity with biomass	**722** 85.1%	**51** 6.0%	**34** 4.0%	**41** 4.8%	**848** 100%
Exclusively cooks with biomass	**375** 48.9%	**36** 4.7%	**158** 20.6%	**198** 25.8%	**767** 100%
Total	**1772** 74.3%	**147** 6.2%	**201** 8.4%	**264** 11.1%	**2384** 100%

Table 5 Type of grid connection for Scenario 2 households (unweighted)

3.3 Cooking appliances

While the survey does not ask households about the electric appliances they own, it does ask about appliances used for cooking or boiling in the last 12 months. The data shows that rice cookers are used almost universally by households cooking with electricity to some degree. LPG/electricity stacking households are less likely to own a hot plate or an appliance for electric frying, presumably as an LPG stove is well suited to this mode of cooking. Over 60% of households that continue to cook with biomass alongside electricity own an electric frying pan/pot/wok. This suggests that biomass stoves have a limited role in cooking within these households, perhaps used as a back-up stove when the electricity supply is down or multiple dishes need cooking simultaneously. Kettles are also popular across all three groups, but only 2% of electricity-connected households cooking with biomass report using a kettle. Insight into the extent of biomass stove use will be analysed in the fuel costs section (5.2), but this data suggests that stacking electricity with biomass in Myanmar will likely have significant effects on household air pollution and deforestation.

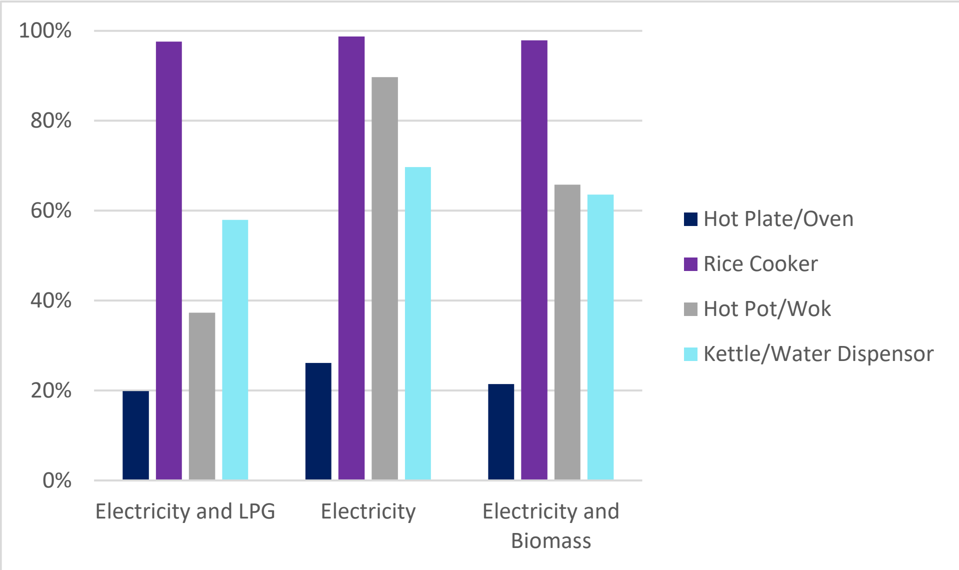

Figure 7 Usage of electric cooking appliances, according to household cooking fuels (unweighted)

We can also analyse the use of electrical appliances according to the type of grid connection households have. Figure 8 below shows that in national grid contexts, the majority of households have used a rice cooker, hot pot/wok and a kettle in the last 12 months. Rice cookers are the only frequently used appliance in border/Thai grid contexts, where households tend to supplement electric cooking with either biomass or LPG. In all grid types except the national grid, kettles have been used by more households than a hot pot/wok. Rice cookers remain the most popular electrical appliance in every grid context.

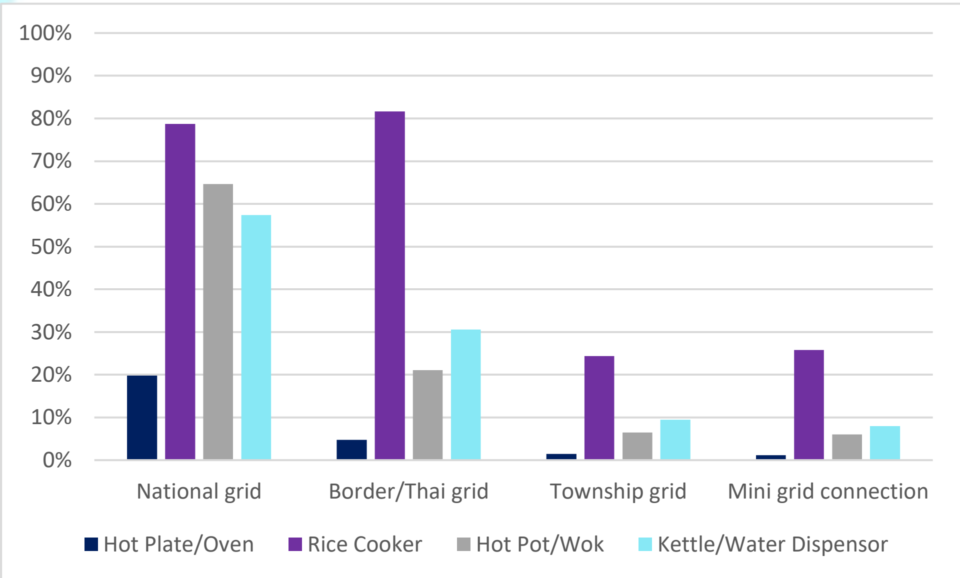

Figure 8 Usage of electric cooking appliances, according to type of electricity connection (unweighted)

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.

Figure 9 Cooking with firewood in a Shan household (Credit: Vyacheslav Argenberg)

Of households exclusively cooking with **wood** (purchased or collected)[10]:

- Spent an average of 28 years living in their community
- 22% are connected to the national grid
- 73% live in rural areas
- 93% own their home
- Household size averages 4.6 people
- Predominantly self-employed agricultural workers
- Only 2% have a bank account
- Lowest average income and education level

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

- Spent an average of 20 years living in their community
- 26% are connected to the grid (38% to a township grid or mini-grid)
- 76% live in an urban environment
- 80% own their own home
- Household size averages 4.7 people
- Involved in small business enterprises, waged work or day labouring
- 7% have a bank account
- Average income and education levels, relative to the other two groups

Figure 10 Food enterprise using charcoal stoves, Mawlamyaing (Credit: Anagoria)

[10] The demographics for wood collectors and purchasers are similar, but with a couple of exceptions; purchasers are more likely to be living in an urban area and are thus less likely to be employed in the farming/agricultural sector

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

- Spent an average of 30 years living in their community
- 94.6% are connected to the national grid
- 61% live in an urban environment
- 78% rent their home
- Household size averages 4.1 people
- Predominantly waged workers or involved in small business enterprises
- 12% have a bank account
- Highest average income and education levels, compared to exclusive charcoal and firewood users.

These demographic groups appear similar to exclusive cooking fuel households in other MECS contexts; wood users tend to be more rural (73%) whereas charcoal users tend to be more urban (76%), and electricity users in comparison to both biomass groups have higher incomes on education, are educated to a higher level, and have smaller sized households on average. A major difference in the Myanmar context is that electricity users are not overwhelmingly urban: 39% live in remote areas, which reflects the country's advances in national grid electrification in rural areas and, to a less extent, the expansion of other electrification solutions, including township grids, mini grids, and the use of border/Thai grids. A significant proportion of households cooking exclusively with charcoal have one of these types of grid connection (64%), suggesting further opportunity for a transition to electric cooking in Myanmar. Exclusive electricity users do not tend to have bank accounts, which can be used as a proxy for financial inclusion. **Overall, this analysis suggests that electric cooking is relatively accessible in Myanmar.**

Each of the three groups have on average spent multiple decades living in their community, which isn't often the case with urban households using charcoal and electricity. This suggests that further rural electrification – whether through network expansion or new mini grids – could be long-term, sustainable solutions for modern energy provision in Myanmar.

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 traditioned to modern energy cooking, to varying extents.

	Stacks LPG with electricity	Exclusively cooks with electricity	Stacks biomass with electricity	Exclusively cooks with biomass
Years spent in the community	15.8	20.4	24.1	26.7
Connected to the national grid	51%	95%	85%	49%
Urban population	91%	61%	52%	54%
Rented accommodation	76%	78%	85%	88%
Household size	4.4	4.1	4.8	4.8
Bank account access	27%	12%	12%	5%
Income (mean)	500	335	285	217
Education level (mean)**	11.2	10.9	10	8.5

Table 6 Household demographics for Scenario 2 (electricity users only, unweighted)

**0 = none, 1-2 = pre-primary, 3-6 = primary, 7-10 = middle school, 11-12 = high school, 13-15 = college/tertiary, 16-18 = university*

Demographic data for Scenario 2 appears to support the theory of an energy ladder and a modern energy cooking transition related to urbanisation, financial inclusion, income and education. In other words, modern energy cooking fuels are used more extensively when a household tends to be urbanised, have a bank account, have high incomes and a high education level.

Connection to the national grid seems to be an important factor in the use of electricity for cooking: only half of those cooking exclusively with biomass are connected to the national grid, but this rises to 85% for biomass/electricity stacking households, and 95% for exclusive electricity cooking households.

However, households cooking with electricity and LPG show that a transition to exclusive modern energy cooking is possible in national grid and other grid contexts. LPG users tend to be far more affluent, more urban and with a higher proportion having bank account access. Given that electricity is relatively cheap in Myanmar, this suggests that LPG may also have an aspirational quality to it.

Table 7 below helps to add clarity to the role LPG might play for different households in Myanmar. Although the sample sizes are small, and the results cannot be extrapolated, it shows any use of LPG for cooking is associated with higher incomes on average than households cooking exclusively with electricity, including those who stack LPG with biomass.

		Head of household income (1000 MMK)
Exclusively LPG	N	19
	Mean	**401**
	Median	**350**
Electricity and LPG	N	93
	Mean	**500**
	Median	**300**
Biomass and LPG	N	10
	Mean	**353**
	Median	**215**
Total	N	122
	Mean	**473**
	Median	**300**

Table 7 Head of household income for households using LPG for cooking (unweighted)

5 Household practices and perspectives

5.1 Labour of cooking

The survey also asked households how much time they spend on average a) collecting their cooking fuel, b) preparing the fuel and c) 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 8 shows that biomass fuels and biomass cooking is associated with a more significant time burden when compared to electric cooking. Compared to exclusive wood using households (collected wood), exclusive electric cooking **households save on average 100 minutes per day in fuel collection, 10 minutes in fuel preparation, and 30 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. That said, Burmese homes included in this table tend to cook for between two to three hours per day, suggesting that electric cooking is affordable enough that it can be used more extensively rather than minimally.

Fuel		Collecting fuel	Preparing fuel	Cooking meal
Wood (collected)	N	821	821	821
	Mean	**103.4**	**12.8**	**165.3**
	Median	**60**	**0**	**150**
Wood (purchased)	N	376	376	376
	Mean	**31.2**	**7.1**	**155.4**
	Median	**20**	**0**	**120**
Charcoal	N	408	408	408
	Mean	**16.9**	**1.6**	**156.7**
	Median	**10**	**0**	**120**
Electricity	N	646	646	646
	Mean	**3.1**	**0.4**	**133.9**
	Median	**0**	**0**	**120**

Table 8 Average time spent cooking, including set-up (minutes per day)[11], at a household level (unweighted)

We can also analyse fuel preparation times and cooking times in Scenario 2. Table 9 below provides the breakdown for these three sub-categories, all of whom are grid-connected.

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

Table 9 Average time spent cooking, including set-up (minutes per day)[12], for electricity-using households only (unweighted)

Fuel		Collecting fuel	Preparing fuel	Cooking meal
Exclusive biomass	N	767	767	767
	Mean	53.2	8.2	159.1
	Median	20	0	120
Electricity and biomass	N	848	848	848
	Mean	37.9	5.5	161.5
	Median	15	0	120
Exclusive electricity	N	643	643	643
	Mean	3.1	0.4	133.7
	Median	0	0	120
Electricity and LPG	N	126	126	126
	Mean	10.4	0.6	137.6
	Median	0	0	120

This table shows there is a clear difference in the time burden for households that use biomass (either exclusively or with electricity) and households that use only modern energy fuels (electricity and/or LPG). If biomass is used for some or all of a household's cooking fuel needs, 38-53 minutes per day is spent collecting fuel on average, and the average cooking time is 160 minutes. For modern energy cooking households, little time is spent collecting the fuel, and the cooking time tends to be approximately 25 minutes less. **This suggests that stacking biomass with electricity will not save households much time each day, and if biomass stoves or three-stone fires are used to a similar extent as if they were used exclusively, there will not be a positive impact on cooking-related concerns for public health and forest degradation.**

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)	Wood (purchased)	Charcoal	Electricity		Exclusive biomass	Biomass and electricity	Exclusive electricity	Electricity and LPG
Every day	567	236	250	400		445	503	397	73
A few times a week	12	6	8	1		17	22	10	3
Weekly – Monthly	5	1	1	6		3	3	6	1
Total	**584 100%**	**243 100%**	**259 100%**	**407 100%**		**465 100%**	**528 100%**	**413 100%**	**78 100%**

Table 10 Frequency of cooking by female spouse of male-headed households (unweighted)

The table shows that the frequency with which female spouses cook does not change according to the cooking fuels used. In Scenario 1, 96-99% of women cook every day. In Scenario 2, the range for this frequency is 95-97%.

[12] 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).

The MTF data also enables us to understand whether the gendered time burden of cooking is related to different social, economic and cultural factors, if not cooking fuel. It might be expected, for instance, that the time burden on women will decrease in households where the woman is earning, is independent, and does not suffer from financial exclusion. This hypothesis rests on the assumption that cooking is a burdensome activity, and that a greater decision-making capacity allows for more convenient cooking and eating habits.

- **Independence:** Female heads of household tend to spend less time cooking (131mins) than female spouses of male heads of household (143mins). The cooking time for female spouses does seem to reduce according to other factors that indicate independence: the freedom to go to markets, to visit others or to leave the local area. Spouses who are unable to do any of these three mobility indicators cook for an average of 165 mins per day, whereas female spouses able to do all 3 cook for an average of 137 mins).
- **Income Earners:** Perhaps counter-intuitively, female heads of households who earn money spend more time cooking each day on average (137 mins) compared to those that do not earn money (128 mins). The difference is negligible for female spouses of male headed households (141 mins for earners, 144 mins for non-earners).

This analysis reveals that the gender dynamics related to the labour of cooking remain relatively stable, regardless of levels of independence, income earning status, or cooking fuel usage for women within the household. This suggests that modern energy fuel use is not a predictor of a reduction in cooking time and the burdensome tasks associated with cooking, which women tend to be responsible for. However, modern energy cooking fuels do seem to substantially reduce the cooking time required, and can thus reduce cooking times if a household wishes to.

Figure 11 Street food stall, Mandalay (credit: Adam Cohn)

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 sometimes 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 (1000 MMK[13])				
		Wood	Charcoal	Electricity	Total	Per Capita
Wood (collected)	N	N/A	N/A	186	186	552
	Mean			**3.2**	**3.2**	**0.8**
	Median			**2.0**	**2.0**	**0.5**
Wood (purchased)	N	354	N/A	120	363	363
	Mean	**13.6**		**5.0**	**15.2**	**3.9**
	Median	**10.0**		**2.5**	**10.0**	**2.6**
Charcoal	N	N/A	401	184	404	404
	Mean		**10.3**	**5.7**	**12.9**	**3.1**
	Median		**8.5**	**3.5**	**10.5**	**2.5**
Electricity	N	N/A	N/A	595	595	595
	Mean			**7.3**	**8.1**	**2.2**
	Median			**5.0**	**5.0**	**1.4**

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

This table clearly shows that, for the average household connected to the grid and using electricity, **money will likely be saved if the household switches its cooking fuel from purchased biomass to electricity**. This is despite the fact that households already cooking exclusively with electricity tend to have higher incomes, and therefore could afford to spend more on their energy needs. Charcoal users tend to spend more on electricity than wood users, and this ties in with the fact that a greater proportion of the latter live in urban areas, and household income tends to be higher. However, the cost of wood appears to be a significant financial burden, as average expenditure (13,600 MMK) is higher than all energy expenditure for charcoal users (12,900 MMK) and electricity cooking households (8,100 MMK). Per capita and overall, households purchasing wood for cooking spend more on energy than any other exclusive fuel group. Unsurprisingly, exclusive electricity cooking households spend the most on electricity of the three groups, but total energy spend tends to be lower.

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 electricity is available** (Table 12).

[13] At the time of the survey (July, 2017), $1 USD = 1,340 MMK

		Total Monthly Expenditure (1000 MMK)					
		Wood	Charcoal	Electricity	LPG	Total	Per Capita
Exclusively Biomass	N	183	298	506	N/A	665	665
	Mean Median	**14.6** **10.0**	**10.5** **8.0**	**4.5** **2.6**		**12.2** **8.3**	**2.9** **1.9**
Electricity and Biomass	N	97	508	777	N/A	837	837
	Mean Median	**7.9** **5.0**	**7.8** **4.5**	**7.8** **4.8**		**13.0** **8.3**	**2.9** **1.9**
Exclusively electricity	N	N/A	N/A	595	N/A	595	595
	Mean Median			**7.3** **5.0**		**8.1** **5.0**	**2.2** **1.4**
Electricity and LPG	N	N/A	N/A	107	123	126	126
	Mean Median			**19.2** **15.0**	**9.8** **7.5**	**26.4** **22.0**	**6.5** **5.0**

Table 12 Selected fuel expenditures for electricity-using households (unweighted)

Stacking biomass with electricity does seem to lead to a reduction in biomass usage: a 46% reduction in average expenditure on wood, and a 26% reduction in charcoal spending. We know from earlier sections of this report that rice cookers are the most popular electric cooking appliance in Myanmar, and it follows that households with this appliance no longer need to cook rice using a biomass stove. As a household adopts more electrical appliances such as an electric frying pan, hot plate or induction stove, the need for biomass is likely to continue to decline. The partial adoption of electricity as a cooking fuel appears to be associated with a marginally higher monthly expenditure on average (800 MMK/$0.53 USD), compared to electricity-using households cooking exclusively with biomass, but this is fully accounted for by a larger household size: there is no different in per capita expenditure.

Compared to any biomass use, exclusive electric cooking is cheaper in terms of both total household expenditure and on a per capita basis. Given that these households have higher average incomes than biomass users, and that all households in Scenario 2 use electricity for other purposes, it is important to probe further as to why a transition has not taken place for these biomass using households.

Households that cook with electricity and LPG spend substantially more on their energy than other groups: more than three times the average expenditure of exclusive electricity households, and more than twice the average expenditure of biomass households (exclusive and stacked). Electricity expenditure for this affluent group is 2.5 times the expenditure of exclusive electric cooking households, showing that the demand for and consumption for energy is extremely high.

In order to understand whether LPG is more affordably than the data above suggests, we can look at the expenditures of other LPG users and compare it with the group that cooks with both electricity and LPG.

		Total Monthly Expenditure (1000 MMK)				
		Charcoal	Electricity	LPG	Total	Per Capita
Exclusively LPG	N	N/A	16	22	23	23
	Mean		**9.5**	**7.1**	**13.4**	**3.8**
	Median		**7.0**	**5.8**	**11.5**	**3.3**
Electricity and LPG	N	N/A	107	123	126	126
	Mean		**19.3**	**9.8**	**26.4**	**6.5**
	Median		**15.0**	**7.5**	**22.0**	**5.0**
Biomass and LPG	N	12	10	13	14	14
	Mean	**4.3**	**20.2**	**6.6**	**24.3**	**5.7**
	Median	**4.0**	**7.8**	**4.0**	**14.8**	**3.6**
All LPG users	N	13	133	158	163	163
	Mean	**8.5**	**18.2**	**9.2**	**24.4**	**6.0**
	Median	**4.0**	**13.0**	**6.7**	**20.6**	**4.6**

Table 13 Selected fuel expenditures for LPG-using households (unweighted)

Table 13 above shows that **households cooking exclusively with LPG spend less on their cooking fuel on average (7,100 MMK) than households cooking exclusively with either purchased wood (13,600 MMK) or charcoal (10,300 MMK).** Households stacking biomass with LPG are high energy consumers on average, but the majority of their fuel spend is on electricity for non-cooking purposes (20,200 MMK). This is almost five times the group's average charcoal expenditure (4,300 MMK) and three times the average LPG expenditure (6,600 MMK). Again, stacking biomass with LPG seems to significantly reduce the amount of biomass cooking, thus adding weight to the argument that stacking behaviours can contribute to lower household air pollution, lower demand for unsustainable solid fuels, and server as an interim state in the transition to modern energy cooking. While the sample sizes are small, this data gives the impression that LPG can be a more affordable fuel for cooking than charcoal and wood.

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 Myanmar. 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

The analysis identified 3 factors that contribute to the quality of an electricity source. These factors align closely to the variable themes above: availability, reliability (blackout frequency) and voltage behaviour. Summing these factors and splitting the sub-sample into four roughly equal groups created a new, categorical variable representing the overall quality of a household's grid connection (where the 1st quartile is the highest quality).

		Electricity and LPG	Exclusively electricity	Electricity and biomass	Exclusively Biomass	Total
	Mean	1.98	2.40	2.52	2.77	2.52
Quartiles	**1st**	44 **47.8%**	158 **29.9%**	124 **19.0%**	68 **15.6%**	394 **23.0%**
	2nd	18 **19.6%**	134 **25.3%**	199 **30.5%**	110 **25.2%**	461 **26.9%**
	3rd	18 **19.6%**	105 **19.8%**	197 **30.2%**	113 **25.9%**	433 **25.3%**
	4th	12 **13.0%**	132 **25.0%**	133 **20.4%**	146 **33.4%**	423 **24.7%**
	Total	529 100.0%	529 100.0%	653 100.0%	437 100.0%	1711 100.0%

Table 14 Quality of electricity supply for Scenario 2 cooking fuel categories (unweighted)

Figure 12 Quality of electricity supple for Scenario 2 cooking fuel categories (unweighted)

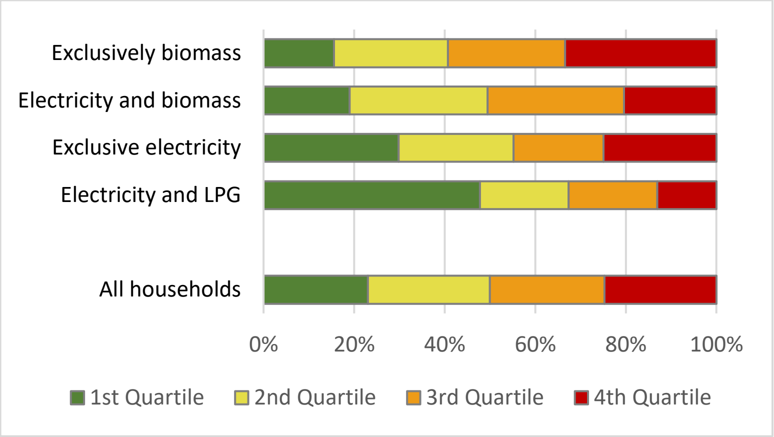

Table 14 and Figure 12 show that almost half of households stacking electricity with LPG are in the top quartile for quality of electricity supply, suggesting that the use of LPG is a choice rather than a necessity. 25% of exclusive electricity cooking households belong to the bottom quartile for quality of electricity supply, suggesting that many 4th quartile households across the different categories have a sufficient quality of electricity that allows for exclusive electric cooking. If this is true, it means that **67% of grid-connected households cooking exclusively with biomass have a sufficient quality of electricity to completely transition to electric cooking. Coupled with the fact that electric cooking is on average cheaper than biomass cooking, this shows enormous potential for middle- and low-income households connected to the grid. At least 80% of households stacking electricity with biomass should also be able to switch to exclusive electric cooking, based on their quality of electricity supply.**

The survey asks respondents about the most serious challenges they face regarding the overall experience of grid electricity. Unsurprisingly, the vast majority of households (61.3%) cooking exclusively with electricity state that they do not face any problems. However, even among households cooking exclusively with biomass, 48.2% also report not having any problems. Voltage fluctuations and limited capacity are the greatest challenge for one fifth of households (12% and 8.6% respectively), while costs and billing are the greatest challenge for one in ten. Whereas **costs and billing do not seem to be correlated with the extent to which a house cooks with electricity**, voltage fluctuations and limited capacity do seem to affect biomass households more than electricity cooking households.

	Electricity and LPG	Exclusively electricity	Electricity and biomass	Exclusively Biomass	Total
No problems	15 **55.6%**	122 **61.3%**	147 **51.2%**	94 **48.2%**	378 **53.4%**
Voltage problems	3 **11.1%**	23 **11.6%**	32 **11.1%**	26 **13.3%**	84 **11.9%**
Supply Shortage	1 **3.7%**	15 **7.5%**	27 **9.4%**	27 **13.8%**	70 **9.9%**
Cannot power large appliances	4 **14.8%**	6 **3.0%**	28 **9.8%**	23 **11.8%**	61 **8.6%**
High cost of electricity/unexpectedly high bills	2 **7.4%**	17 **8.5%**	26 **9.1%**	14 **7.2%**	59 **8.3%**
Unpredictable bills	1 **3.7%**	15 **7.5%**	23 **8.0%**	7 **3.6%**	46 **6.5%**
Other	1 **3.7%**	1 **0.5%**	4 **1.4%**	4 **2.1%**	10 **1.4%**
Total	27 100%	199 100%	287 100%	195 100%	708 100%

Table 15 Greatest challenge relating to the experience of electricity supply for Scenario 2 (unweighted)

5.4 Electricity access and payment

Having established that significant opportunities exist in Myanmar to improve access to modern energy cooking services, this section turns to electricity access and the different ways in which households pay for their electricity. The rationale for this latter 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 Myanmar.

Figure 13 Low-volage power line, Inle Lake (credit: Etan J. Tal)

	N	Mean	Median
Electricity and LPG	60	12.6	10
Exclusively electricity	434	9.3	5
Electricity and biomass	621	9.9	7
Exclusively biomass	428	8.6	5
Total	**1543**	**9.5**	**6**

Table 16 Number of years with an electricity connection

Table 16 shows that users of modern energy for cooking tend to have been using electricity for a longer time than those still cooking with biomass. Although we cannot tell when the former households may have switched to modern energy fuels, this suggests that having an electricity supply does not necessarily lead to electric cooking. If households continue to cook exclusively with biomass after an average of 8.6 years of connection, it is safe to assume that these households require additional incentives to make the transition.

Table 17 below shows that the majority of grid-connected households pay for their electricity according to a meter reading, although the proportion increases relative to the use of modern energy cooking fuels. Paying a fixed fee or according to the number of appliances appears to provide a disincentive for electric cooking, given the larger proportion of exclusive biomass households that pay these ways (15% in total, compared to 4.6% of exclusive electric cooking households). Given that a fixed fee would imply that electric cooking would not lead to additional costs, it suggests that there may be other factors that explain why electricity use might be limited, such as landlord preferences and neighbours wanting to avoid future fee increases.

	Electricity and LPG	Exclusively electricity	Electricity and Biomass	Exclusively Biomass	Total
Meter reading	106 96.4%	571 90.1%	719 89.1%	435 76.4%	1831 86.4%
Fixed fee	2 1.8%	26 4.1%	50 6.2%	66 11.6%	144 6.8%
No bill	2 1.8%	24 3.8%	17 2.1%	34 6.0%	77 3.6%
Number of appliances	0 -	3 0.5%	12 1.5%	19 3.3%	34 1.6%

Table 17 The most common methods of calculating electricity bill (unweighted)

6 Decision-making

6.1 Mindsets

In order to know what approach Myanmar should take towards transition to modern fuels, it is important to understand how households feel about using LPG and electricity for cooking, relative to biomass. Electricity is widely seen as *the* aspirational fuel for cooking in Myanmar, but the market for LPG may grow in the coming years to serve households with electricity supply challenges, and for those who enjoy the quick-cook, strong flame that an LPG stove provides, and works well with south-east Asian cuisine.

Households were asked for their opinions on statements about cooking. They were given three options for their reply: agree (1), disagree (-1), or hold no opinion (0). For Scenario 1, the average scores from these statements are recorded in Table 18. The highlighted rows refer to the statements where the difference between the 3 household types is statistically significant.

Exclusive wood users were marginally less likely to see electricity as a financial burden (and electricity as an expensive cooking fuel) when compared to charcoal users, despite the fact that charcoal users have – on average – higher incomes, higher education levels, and are more urbanised. This ties into earlier analysis that suggests charcoal users may face additional financial pressures such as the costs of urban living, or heightened costs associated with upfront electricity connection costs[14]. Those that do cook exclusively with electricity do not seem to view the energy bills as a financial burden. All groups tend to view firewood as expensive and difficult to obtain, particularly those who purchase wood for cooking.

	Wood (collected)	Wood (purchased)	Charcoal	Electricity	Kruskal-Wallis p-value
The monthly electric bill is or would be a financial burden for my family*	-0.04	-0.06	-0.01	-0.23	0.731
Smoke from stove is good at chasing insects away	0.73	0.65	0.60	0.57	<0.001
Smoke from cooking fuels is a big health problem in my family*	0.69	0.70	0.69	0.56	0.617
Firewood is expensive for cooking	-0.07	0.53	0.21	0.20	<0.001
Cooking with firewood is harmful to a person's health	0.31	0.41	0.43	0.33	0.08
Electricity is expensive for cooking*	0.12	0.14	0.22	-0.27	0.064
Firewood is hard to obtain	0.09	0.35	0.25	0.28	<0.001
LPG is expensive for cooking household meals	0.31	0.37	0.39	0.41	0.013
Certain food tastes better when cooked with biomass compared to gas or electricity	-0.09	0.00	-0.10	-0.01	0.063
Charcoal is hard to obtain in the market	0.18	0.19	-0.39	-0.22	<0.001
I prefer to use "Three/five Stone" as the firewood stove at home	0.14	0.15	-0.16	-0.33	<0.001
Collecting and preparing firewood is a burden for my family	0.42	0.54	0.59	0.62	0.025

Table 18 Attitudinal question responses for exclusive cooking fuel households (unweighted)

**responses relating to these statements are statistically significant when collected and purchased wood categories are merged to form a comparison of differences between exclusive wood, charcoal and electricity cooking households.*

On average, households across all 4 groups in Scenario 1 see biomass smoke as a) good for repelling insects and b) bad for human health and wellbeing. Responses are stronger for current users of biomass, relative to exclusive electricity users. Biomass users also view firewood collection and preparation as a burden, and a preference for

[14] A disproportionate number of charcoal users are connected to township and mini grids (19% each, compared to 7% (township) and 9% (mini grid) of all scenario 1 households).

using wood over other fuels is not particularly strong (0.14/0.15) among existing users. On average, none of the groups associate biomass cooking with better tasting food. This suggests that exclusive biomass cooking is not very desirable for these households on average, and results to the statement 'charcoal is hard to obtain in the market' shows that charcoal use is strongly correlated to the convenience of the supply: charcoal users score -0.39 whereas wood users score 0.180.19. Interestingly, LPG is seen as expensive by exclusive electricity users to a greater extent than exclusive biomass households.

	Electricity with LPG	Exclusively electricity	Electricity with biomass	Exclusively biomass	Kruskal-Wallis p-value
The monthly electric bill is or would be a financial burden for my family	-0.14	-0.24	-0.17	-0.07	0.007
Smoke from stove is good at chasing insects away	0.66	0.57	0.66	0.65	0.338
Smoke from cooking fuels is a big health problem in my family	0.82	0.56	0.71	0.70	0.001
Firewood is expensive for cooking	0.32	0.21	0.15	0.14	0.211
Cooking with firewood is harmful to a person's health	0.54	0.33	0.37	0.30	0.055
Electricity is expensive for cooking	0.12	-0.27	-0.11	0.17	<0.001
Firewood is hard to obtain	0.39	0.29	0.26	0.13	0.002
LPG is expensive for cooking household meals	-0.02	0.41	0.32	0.34	<0.001
Certain food tastes better when cooked with biomass compared to gas or electricity	-0.04	-0.01	-0.08	-0.07	0.213
Charcoal is hard to obtain in the market	-0.42	-0.22	-0.27	-0.07	<0.001
I prefer to use "Three/five Stone" as the firewood stove at home	-0.44	-0.33	-0.11	0.02	<0.001

Table 19 Attitudinal question responses for Scenario 2 (unweighted)

The 4 household groups in scenario 2, all of which have electricity connections, do not tend to see electricity bills as a financial burden. Households that have incorporated LPG into their cooking practices are more likely to view electricity as expensive for cooking (0.12) compared to LPG (-0.02), but this reflects the fact that these households are more likely (relative to other categories) to be connected to a township grid or border/Thai grid (see Section 3.2).

Charcoal is particularly difficult to obtain for the average household cooking with electricity and LPG. This suggests that LPG may have a role to play not just for households without adequate electricity supply, but also where there are challenges in the supply of biomass.

Finally, we are able to analyse attitudinal data for households without any electricity connection. 44% of these households were located too far from an electricity grid, while 27% cited the costs of connection were the major barrier to a lack of access. Table 20 below shows that both electricity and LPG are generally seen as expensive cooking fuels, although wood users tend to believe that electricity will not be a financial burden for their family. Despite a lack of electricity access, firewood exerts a time burden on the family and is see as harmful to health. These households tend also to believe that food does not taste better when cooked using biomass. Together, these suggest that biomass cooking is not overly desirable, and modern energy alternatives would be expensive. Previous sections of this report suggest that this would not be the case in reality.

	Wood	Charcoal	Kruskal-Wallis p-value
The monthly electric bill is or would be a financial burden for my family	-0.20	0.13	0.057
Smoke from stove is good at chasing insects away	0.73	0.85	0.35
Smoke from cooking fuels is a big health problem in my family	0.74	0.77	0.742
Firewood is expensive for cooking	0.05	0.28	0.255
Cooking with firewood is harmful to a person's health	0.17	0.51	0.074
Electricity is expensive for cooking	0.35	0.26	0.416
Firewood is hard to obtain	0.08	0.31	0.246
LPG is expensive for cooking household meals	0.59	0.46	0.286
Certain food tastes better when cooked with biomass compared to gas or electricity	-0.17	-0.31	0.331
Charcoal is hard to obtain in the market	0.09	-0.33	0.021
I prefer to use "Three/five Stone" as the firewood stove at home	0.11	-0.33	0.008
Collecting and preparing firewood is a burden for my family	0.28	0.64	0.047

Table 20 Attitudinal question responses for LPG using households (unweighted)

6.2 Purchasing a cookstove

Before finishing with the different factors that influence a household members' decision to purchase a cookstove, it is important to understand what role gender plays within household dynamics. In Section 5.1, we saw how cooking-related tasks tend to be divided along gender lines, with most female spouses cooking everyday regardless of whether they partook in traditional or modern cooking methods. Koo et al (2019) are attentive to how male- and female-headed households differ in terms of their access to both electricity and modern energy services, but before analysing these differences it is necessary to consider the decision-making norms across all types of households.

	Scenario 1					Scenario 2			
	Wood (collected)	Wood (purchased)	Charcoal	Electricity		Exclusive biomass	Biomass and electricity	Exclusive electricity	Electricity and LPG
Men usually make decisions on the distribution of the family budget	0.46	0.47	0.41	0.45		0.39	0.40	0.45	0.03
Men usually make decisions on purchasing of energy and energy-consuming activities	0.71	0.68	0.67	0.68		0.63	0.63	0.68	0.49

Table 21 Responses related to decision-making for Scenarios 1 and 2 (1=agree; -1=disagree, unweighted)

Table 21 shows that it is men that tend to make decisions on energy-related purchases and activities and, to a lesser extent, decisions concerning the distribution of the family budget. This appears to be irrespective of cooking fuel usage, except in Scenario 2. There are statistically significant differences between groups of electricity-using households that cook using biomass, stack biomass with electricity, use only electricity, or use both electricity and LPG. In the final group, which tends to be more affluent and urban, the distribution of the family budget is not dominated by men.

Figure 14 3 stone stoves, a home in Shan Hills (Credit: Vyacheslav Argenberg)

In the table below, we compare households who have obtained a modern energy cooking technology with those who have obtained a more traditional stove. For the purposes of clarity, we compare three major categories of stove: a 3-stone stove (traditional), a ceramic stove (improved biomass stove), and an electric stove (modern).

	3 stone stove		Ceramic stove		Electric stove	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Wife	844	81.1%	834	89.7%	1062	82.6%
Husband	121	11.6%	53	5.7%	123	9.6%
Both	56	5.4%	34	3.7%	85	6.6%
Total	1041	100%	930	100.0%	1285	100%%

Table 22 Individual purchasing cookstoves – gender (unweighted)

There appears to be no clear correlation between the type of stove purchases and the family member making the purchase. Despite the fact that men are said to be the decision-makers when it comes to energy, wives are far more likely to make the cookstove purchase decision than husbands. There is very little difference in gender dynamics between purchasers of a 3-stone stove and an electric stove, but wives are even more likely to purchase a ceramic stove in comparison to the two others. Joint decision making is slightly more common in relation to the electric stove, and least likely for the improved cookstove.

7 Learning points from Myanmar

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, households that stack their cooking fuels make up 32% of the households that form the focus of this report. This excludes households that stack wood and charcoal without an electricity connection.

This paper also reveals that modern energy cooking is extremely common in the contexts of the national grid (79%) and grids on the border with Thailand (76%), and virtually all electric cooking households use a rice cooker, reducing the need or usage of a biomass stove.

While households cooking with modern energy fuels tend to have higher incomes, 67% of exclusive biomass cooking households report having a higher quality of electricity supply than 25% of those cooking exclusively with electricity. This suggests that electricity supplies are sufficient to support a further transition ti modern energy cooking services in Myanmar.

7.2 Costs of cooking

From a financial perspective, there seems to be no benefit to choosing to cook with charcoal over electricity or LPG. Despite the fact that LPG is largely seen as being an expensive cooking fuel, households that cook exclusively with LPG spend less on their cooking fuel than households cooking exclusively with purchased wood or charcoal.

Cooking with electricity saves time and money for Burmese households. These households save an average of 100 minutes each day in the time taken to collect the cooking fuel, 10 minutes in fuel preparation (e.g. light the fire or charcoal stove), and 30 minutes in cooking time compared to households cooking with firewood. 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.

Stacking biomass with modern energy fuels appears to reduce the use of biomass, rather than represent an addition to the household's cooking practices. Households stacking electricity with biomass for cooking spend half the amount on biomass each month (7,900 MMK compared to 14,600 MMK, on average). The cost saving is even more significant for households stacking LPG with biomass (4,300 MMK).

7.3 Gender implications

At least 95% of female spouses of male-headed households cook every day, regardless of the cooking fuel(s) used, illustrating that cooking is a highly gendered activity throughout Myanmar. Female heads of household spend less time cooking than female spouses of male-headed households, and other factors that indicate independence (freedom to go to markets, leave the local area, and visit relatives and friends) for female spouses are also associated with a reduced cooking time burden.

Men in Myanmar tend to make decisions about household finances and energy consumption, although this seems to more common among biomass using households as opposed to households cooking with electricity and LPG. Despite men being the main decision makers, cookstove purchasing decisions are made by wives far more often than husbands. This is true for traditional, improved, and modern cookstoves.

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 former Government of Myanmar 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.

9 References

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