Ethiopia; Cooking transitions

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

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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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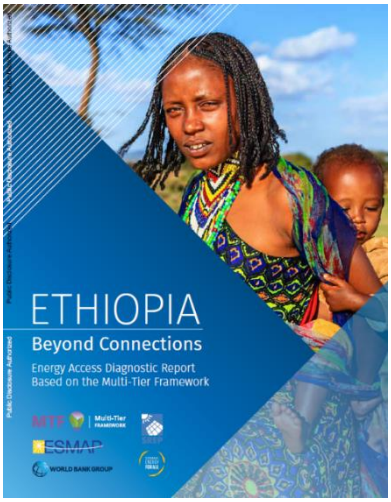
Abstract

In "Ethiopia - Beyond Connections" (Padam et al 2018), the authors present a diagnostic of the multi-tier framework data from Ethiopia. The multi tier framework is an approach to understand the nuances of energy use both for electricity and clean cooking, and to work towards a greater degree of understanding than existing national data sets can reach. Ethiopia was one of the first to undertake the survey, and the data set and the report were intended to set a new standard in data collection, and to present the findings in a useful format to policy actors.



Given that the analysis and report were based on one of the first analyses of such data, we considered whether the data could give greater insights into **'transitions to modern energy'**. The analysis in Padam et al 2018, summarises access to electricity and access to clean cooking in sections offering frequency analysis of the key parameters.

In this working paper we explore the data for linkages between groups of households and across the electricity, clean cooking divide exploring for insights on transitions. Our particular interest lies in the use of electricity for cooking, and Ethiopia is an outlier in Sub Sharan Africa in that it has a significant proportion of its urban population using electricity for cooking. In particular we relate the cooking fuel demographics to their use of electricity, what influences household electric cooking choices including who the decision makers are and summarise some key learning points on transition.

The analysis starts by considering households that cook with a single fuel. By sidestepping the complexity of fuel stacking for the moment, insights into the characteristics of 'household personas' can be brought out. From this sub sample, the analysis considers differences in time taken to undertake cooking (collecting, lighting and cooking), the task allocation across genders, how access to electricity affects the choice of fuels and what attitudes each persona has. In section 4, the analysis narrows down on households with an electricity supply and looks at a range of factors that might influence their decision to cook with electricity. This focuses on the quality of the supply, and at this point draws in those undertaking fuel stacking. Finally, it focuses on specific individuals and takes a gendered perspective on household decision making as it relates to the purchase of cooking devices. Section 6 summarises the learning points of the analysis.

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 Ethiopia. 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.

Contents

1 Introduction

In "Ethiopia - Beyond Connections" (Padam et al 2018), the authors present a diagnostic of the multi-tier framework data from Ethiopia. The multi-tier framework is an approach to understand the nuances of energy use both for electricity and clean cooking, and to work towards a greater degree of understanding than existing national data sets can reach. Ethiopia was one of the first to undertake the survey, and the data set and the report were intended to set a new standard in data collection, and to present the findings in a useful format to policy actors.

Given that the analysis and report were based on one of the first analyses of such data, we considered whether the data could give greater insights into 'transitions to modern energy'?

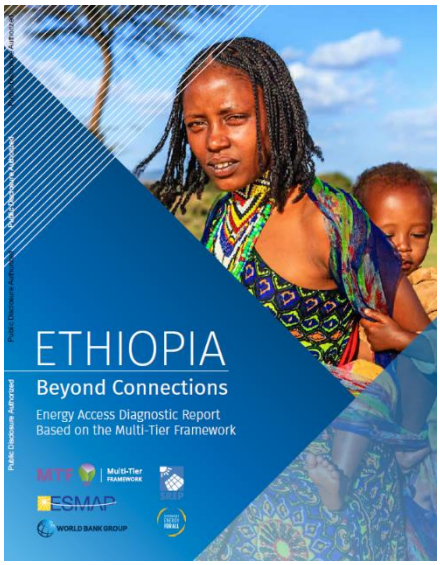


Figure 1 Front cover of Padam et al 2018

Research Question:- Can the MTF data (in Ethiopia) give insight into transitions to modern energy, by considering the data across all modules as a single whole.

The analysis in Padam et al 2018, summarises access to electricity and access to clean cooking in distinct sections offering frequency analysis of the key parameters.

"*The Mutli Tier Framework is an approach to identify MTF Attributes. A key question that the MTF survey seeks to answer is what prevents a household from moving to a higher tier for access to electricity. This is the value added of the MTF survey: by capturing full-spectrum data, it empowers policymakers to pursue data-informed energy access policies and to design interventions that remove barriers to households moving to a higher tier. The value of access to electricity for households is defined by analysing MTF attributes (as answered by questions embedded in the MTF survey):*

- ***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?*" (Padam et al 2018)

While this focuses on the use of electricity, a different module (and potentially a different respondent within the same household) is used to capture a comparable tier system for cooking. This module constructs an access to modern energy cooking solutions tier based on a focus on 'stoves', and considers the issues are:

- ***"Cooking Exposure**: How is the user's respiratory health affected? This is based on personal exposure to pollutants from cooking activities, which depends on stove emissions, ventilation structure (which includes cooking location and kitchen volume7), and contact time (time spent in the cooking environment).*
- ***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)*

In the analysis in this paper we are looking for insights likely to be valuable in devising strategies to accelerate transitions from traditional to modern energy cooking fuels. As we move towards genuine modern energy cooking solutions (or services) we would encourage a more integrated view of the two tier systems described above. How does access to electricity as captured in the surveys relate to the data captured in the cooking module?

This document presents an exploratory analysis of data from the MTF survey in Ethiopia, which is publicly available on the World Bank website. It is important to note that this working paper is an additional analysis to Padam et al 2018 who have undertaken the main official diagnostic.

The analysis starts by considering households that cook with a single fuel. By sidestepping the complexity of fuel stacking for the moment, insights into the characteristics of 'household personas' can be brought out. From this sub sample, the analysis considers differences in time taken to undertake cooking (collecting, lighting and cooking), the task allocation across genders, how access to electricity affects the choice of fuels and what attitudes each persona has. In section 4, the analysis narrows down on households with an electricity supply and looks at a range of factors that might influence their decision to cook with electricity. This focuses on the quality of the supply, and at this point draws in those undertaking fuel stacking. Finally, it focuses on specific individuals and takes a gendered perspective on household decision making as it relates to the purchase of cooking devices. Section 6 summarises the learning points of the analysis.

We fully acknowledge that our particular interest lies in the use of electricity for cooking, and Ethiopia is an outlier in Sub Sharan Africa in that it has a significant proportion of its urban population using electricity for cooking.

2 Background information

The MTF data utilised comprised a sample of 4,317 households, in an urban:rural ratio of 58:42. In the absence of a weighting factor, this is not representative of the country as a whole, in which 79% of the population are rural. The majority of households were low status, having mud walls and floor, and thatch roofs.

2.1 Electricity access demographics

Launched in 2017, the government's National Electrification Programme aims to achieve universal access by 2025 . With the support of the World Bank, the programme aims to increase access to the national grid from 30% to 65%. The remaining 35% will be served by off-grid technologies. Doubling access to the grid also represents an expansion of the market for electric cooking.

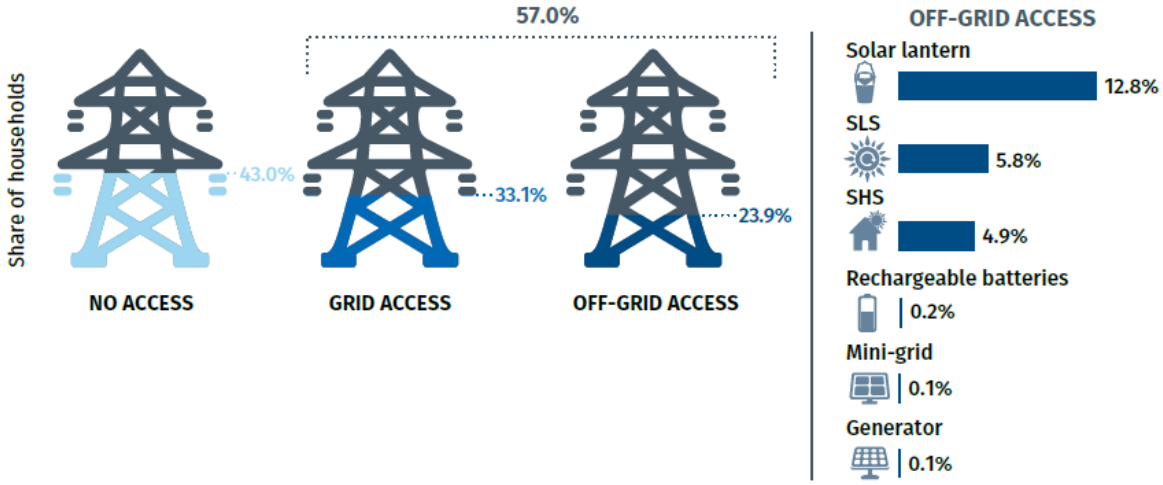


Figure 2 Summary of electricity access in Ethiopia (Padam et al 2018). Please note that Padam et al apply weighting factors, and therefore the frequencies do not necessarily match our direct use of the data.

As discussed earlier, the main official diganostic applied some weighting to the data to make it nationally representative. Figure 2 presents the summary of electricity access as graphically presented in Padam et al 2018. For the unweighted data analysed here, the electricity access identified in the data gave 63% connected to the national grid (n=2,697). 16% (n=677) have some sort of solar device, be it a solar home system, lighting or lantern.

It should be noted that the use of electricity for cooking is high in this country, at least relative to other East African countries. This is at least partly due to the relative low electricity tariffs prevailing at the time of the survey (2017).

Figure 3 summarises the analysis from Padam et al 2018, graphically presented in terms of the electricity access tiers of the multi-tier framework.

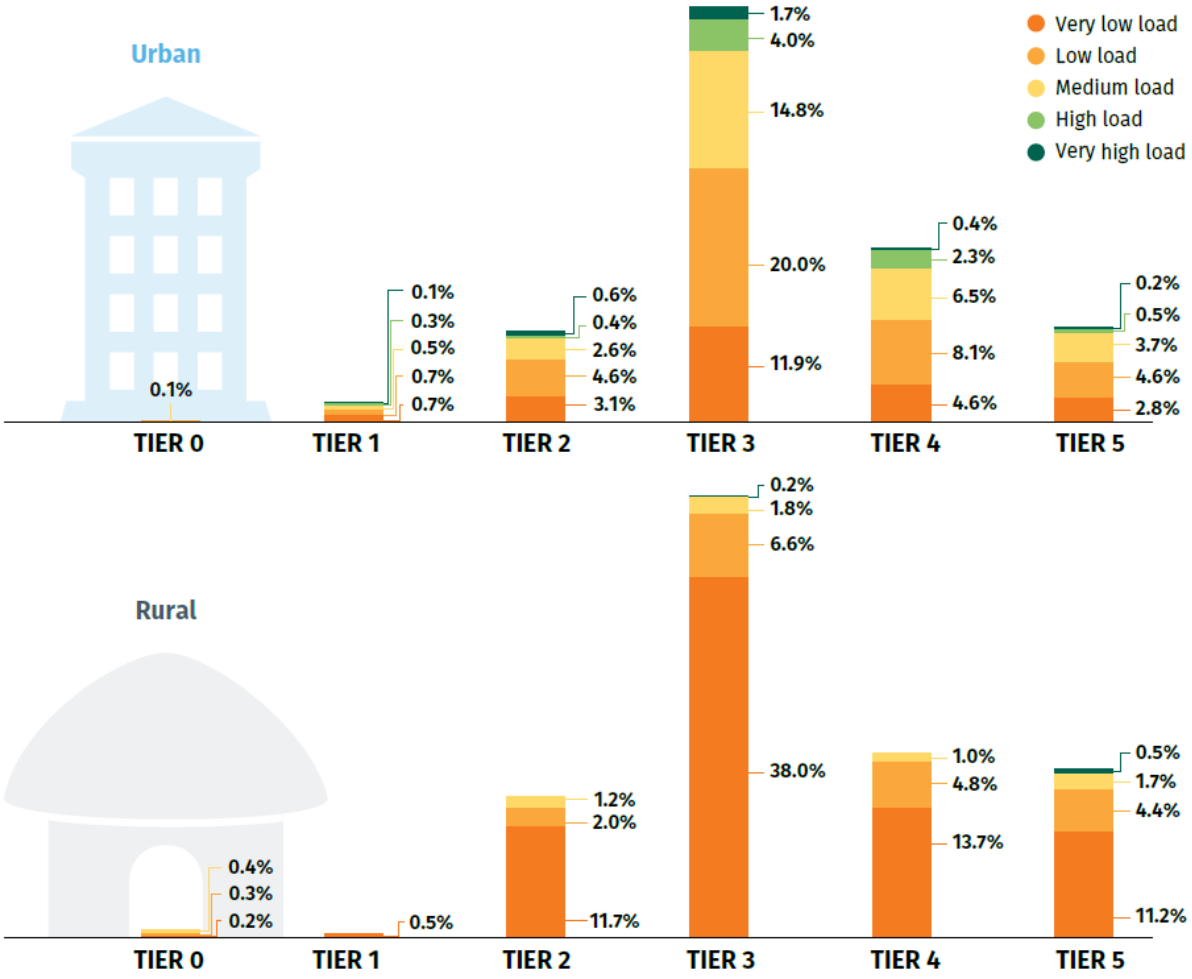


Figure 3 Three-quarters of rural grid-connected households in Tiers 2–5 own only Tier 1 appliances (Padam et al 2018)

2.2 Cooking fuel demographics

Figure 4 presents the summary of access to different cooking fuels as graphically presented in Padam et al 2018. Again it should be noted that weightings applied in the official diagnostic of the MTF data have not been applied to the data analysis in this paper.

Table 1 shows how many households are using a given fuel as well as the number of households that only use that fuel for cooking. The most common household fuel in the unweighted sample is wood at around 35% followed by charcoal and electricity, where the wood is split relatively evenly between those who pay for it and those who collect it themselves. It is a lot more common for households who pay for their wood to fuel stack with only 12% of households solely using purchased wood for cooking. This is a relatively few compared to the 44% of households who collect their wood and only use wood for cooking.

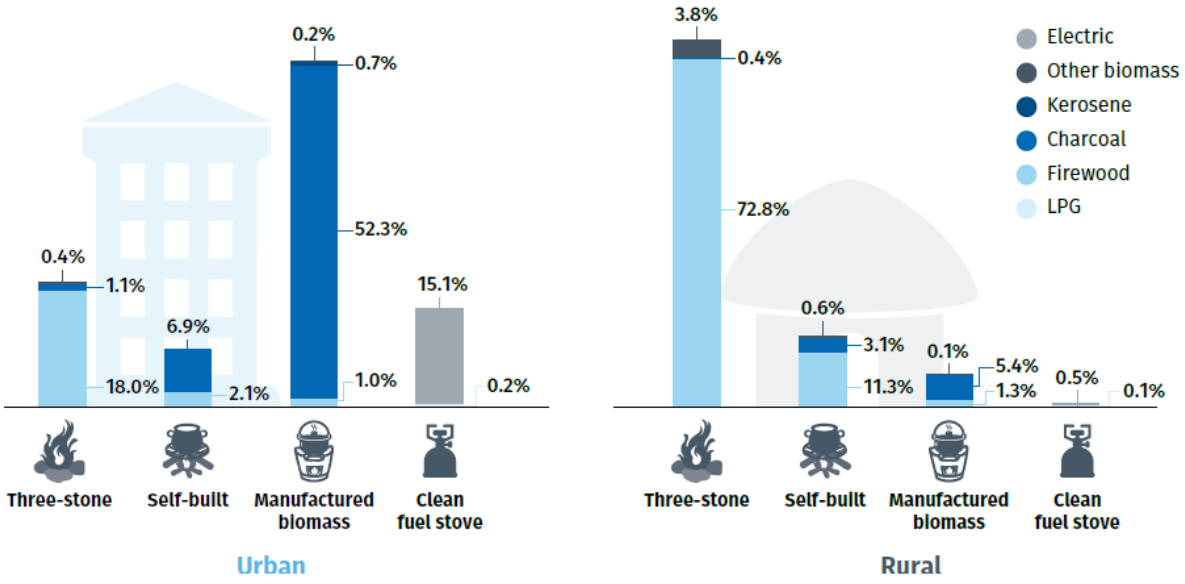


Figure 4 Urban and rural households use different cooking technologies and fuels (Padam et al 2018)

Table 1 Household fuels

	Number of households using this fuel	Percent of total sample using this fuel	Number of households only using this fuel for cooking	Percent of this fuel only used for cooking
LPG	93	1.1	5	5.4
Wood purchased	1323	15.9	152	11.5
Wood collected	1714	20.5	751	43.8
Charcoal	2416	28.9	371	15.4
Solar	4	0.0	0	0.0
Kerosene	143	1.7	15	10.5
Piped natural gas	2	0.0	1	50.0
Coal/ lignite	0	0.0	0	0.0
Animal waste	529	6.3	5	0.9
Crop residue	444	5.3	12	2.7
Sawdust	34	0.4	0	0.0
Coal briquette	10	0.1	0	0.0
By products	133	1.6	1	0.8
Electric	1139	13.6	119	10.4
Wood fragments	194	2.3	1	0.5
Biogas	85	1.0	0	0.0
Ethanol	1	0.0	1	100.0
Garbage/ Plastic	81	1.0	1	1.2
Other	2	0.0	0	0.0
Total	8347	100	1435	

Figure 5 summarises the analysis from Padam et al 2018, graphically presented in terms of the clean cooking tiers of the multi-tier framework.

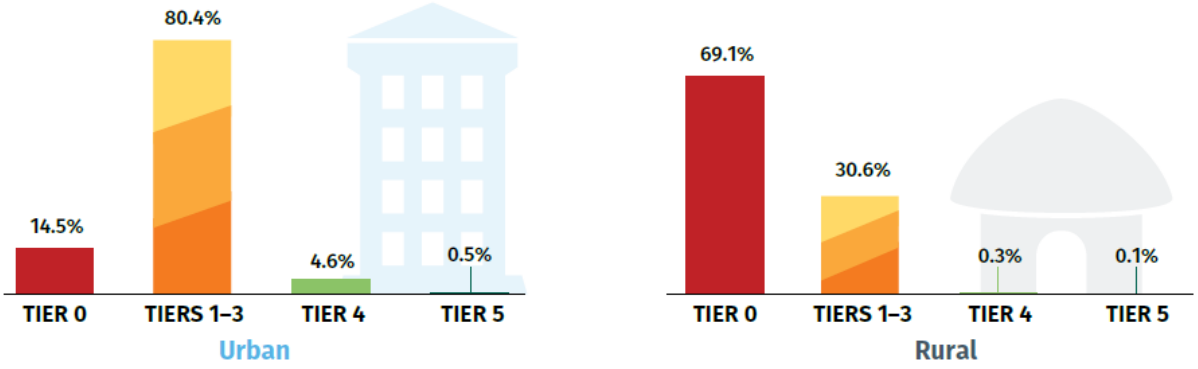


Figure 5 Most urban households are in Tier 3, while most rural households are in Tier 0 (ibid)

The focused MECS analysis examines the linkages between choice of cooking fuels and household demographics by comparing the characteristics of households **using only a single cooking fuel**. The sub-sample of households using the main cooking fuels (N>100) is summarised in Table 2. Households who stack cooking fuels have been omitted for the moment because it is difficult to interpret linkages when a household uses multiple fuels (and the proportion of each is unknown).

Table 2 Households using a single fuel only for cooking

Fuel	Frequency	Percent of sample
Wood collected	751	43.8
Charcoal	371	15.4
Wood purchased	152	11.5
Electric	119	10.4
Total	1393	81.1

3 Household cooking personas

- *63.3% of households use a three-stone stove as their primary cooking solution.*
- *Only 4.1% of households use a clean stove with electricity as a fuel. The penetration of electric stoves is higher in urban areas (15.3%) than in rural areas (0.6%).*
- *51.5% of households use a three-stone stove exclusively, while only 2.4% use a clean fuel stove exclusively.*
- *Stove stacking (use of multiple stove types) occurs in 27.2% of households.*

- *Only 18.2% of households use a manufactured stove, despite high willingness to pay for such a stove: 62.2% of households are willing to pay full price upfront for an improved charcoal stove priced at 175 birr1, and 28% of households are willing to pay full price with a 6- to 24-month payment plan.*
- *Penetration of manufactured biomass stoves and clean fuel stoves increases with household spending quintile: 6.1% of households in the top spending quintile use a manufactured biomass stove, compared with 1.3% of households in the bottom spending quintile, and 2.6% of households in the top spending quintile use a clean fuel stove, compared with 0.1% of households in the bottom spending quintile.*
- *64.3% of households that use a biomass stove have poor ventilation—they cook indoors with no exhaust system and have two or fewer doors or windows in the cooking space.*
- *53.3% of households—including 59.1% of rural households and 32% of urban households—spend more than 7 hours a week acquiring (through collection or purchase) fuel and more than 15 minutes preparing the stove for each meal.*
- *28.4% of households use more than 5% of their monthly spending for fuel.*

Executive Summary highlights from Padam et al 2018

This section suggests that transitioning to cooking with electricity may be a subsequent stage of urbanisation.

While Padam et al (2018) note that penetration of manufactured biomass stoves and clean fuel stoves increases with household spending quintile, Table 3 to Table 7 compare demographics of households **who exclusively use single cooking fuels**. These tables help paint a picture of the personas of households that use different fuels for cooking:

Households that exclusively use **collected wood**: lowest status group; relatively homogeneous group of rural farmers with low income levels:

- Almost all live in rural areas (Table 3).
- 97% own their own home (Table 4).
- Have the largest household sizes (mean of 5.2) (Table 6).
- Predominantly self employed agricultural workers (Figure 1).
- Largely financially excluded (10% have bank account) (Table 5).
- Poorly educated with lowest income (Table 7).

Figure 6 Wood collection, Ethiopia

Households that exclusively use **charcoal**: less well off mix of urban dwellers, including high proportion of self employed workers.

- Almost all live in an urban settlement (Table 3).
- 54% rent their home (Table 4).
- Small household sizes (mean of 3.7) (Table 6).
- Mix of small businesses and waged workers, and elderly (Figure 1).
- 65% financially included (have bank account) (Table 5).
- Well educated with high incomes (Table 7).

Figure 7 Charcoal purchase, Ethiopia

Households that exclusively use **purchased wood**: heterogeneous mix of urban dwellers, including high proportion of elderly and some highly educated elites.

- Split equally between rural and urban areas (Table 3).
- 68% own their own home (Table 4).
- Average household sizes (mean of 4.4) (Table 6).
- Mix of small businesses and farmers, as well as unemployed (Figure 1).
- 35% financially included (have bank account) (Table 5).
- Average levels of education and incomes (Table 7).

Figure 8 Wood purchase, Ethiopia

Households that exclusively use **electricity**: highest status group; heterogeneous mix of urban dwellers, including high proportion of elderly and some highly educated elites.

- Almost all live in an urban settlement (Table 3).
- 66% rent their home (Table 4).
- Have the smallest household sizes (mean of 3.5) (Table 6).
- Predominantly waged workers mixed with pensioners and small businesses (Figure 1).
- 70% financially included (have bank account) (Table 5).
- Highest levels of education and highest incomes (Table 7).

Figure 9 Electricity users, Ethiopia

Table 6 shows a high degree of consistency in the length of time people have lived in their community – around 25 years. However, it is interesting to note that households that exclusively use electricity for cooking have, on average, lived in their property for 7 years longer than charcoal users. Considering that both fuel users almost exclusively live in urban environments, this could be interpreted as charcoal users having more recently moved from a rural settlement to an urban one. A preference for charcoal could be linked to familiarity with traditional (rural) cooking practises, insecurity of tenure and type of dwelling, perceptions around affordability of fuels, or income levels, for example. **It suggests that transitioning to cooking with electricity may be a subsequent stage of urbanisation.**

3.1.1 Data tables for Household personas

Table 3 Settlement type

	Electricity	Charcoal	Wood purchased	Wood collected	Total
urban	118 99.2%	352 94.9%	78 51.3%	36 4.8%	584 41.9%
rural	1 0.8%	19 5.1%	74 48.7%	715 95.2%	809 58.1%
Total	119 100.0%	371 100.0%	152 100.0%	751 100.0%	1393 100.0%

Table 4 Property ownership

	Electricity	Charcoal	Wood purchased	Wood collected	Total
Property owner	33 27.7%	156 42.0%	104 68.4%	725 96.5%	1018 73.1%
Renting	79 66.4%	199 53.6%	46 30.3%	18 2.4%	342 24.6%
Using for free	7 5.9%	16 4.3%	2 1.3%	8 1.1%	33 2.4%
Total	119 100.0%	371 100.0%	152 100.0%	751 100.0%	1393 100.0%

Table 5 Household banking

	Electricity	Charcoal	Wood purchased	Wood collected	Total
n	119	371	152	751	1393
Has a bank account at a formal institution	83 69.7%	241 65.0%	53 34.9%	73 9.7%	450 32.3%

Table 6 Household size and time in the community

		Household size	Years spent living in community
Electricity	Mean Median	3.5 3	25.3 14
Charcoal	Mean Median	3.7 3	18.3 10
Wood purchased	Mean Median	4.4 4	23.3 15
Wood collected	Mean Median	5.2 5	27.3 26
Total	Mean Median	4.6 4	24.3 20

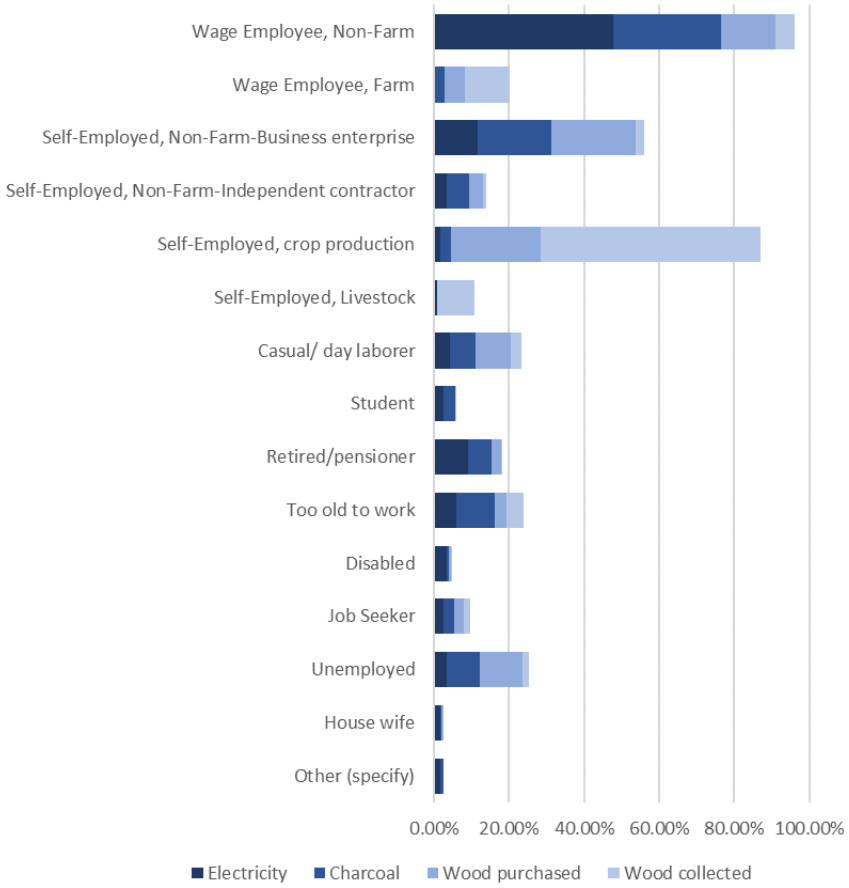


Figure 10 Household occupations

Table 7 Household education and income

		Max Education	Total monthly income
Electricity	Mean	12.4	3555
	Median	13	2800
Charcoal	Mean	10.51	2674
	Median	10	2000
Wood purchased	Mean	8.24	1891
	Median	9	1500
Wood collected	Mean	5.72	1325
	Median	5	1000
Total	Mean	7.84	1937
	Median	8	1300

3.2 Household energy costs

Households that cook exclusively with electricity spend much less on fuels than households cooking with charcoal and purchased wood. A monthly expenditure of $1.50 at the prevailing tariff of $0.02/kWh gives an electrical cooking load of around 2.5 kWh/day, which is not unreasonable, given conventional rather than efficient cooking devices.

The total monthly expenditure figures presented in Table 8 represent the sum of expenditure on all fuels used by the household, not only for cooking, but also for additional tasks. However, it can be assumed that cooking represents the largest single energy load on the household. The table reveals some interesting features:

Figure 11 Ethiopia has culturally sensitive Ethiopian made electric cookers (although they are not in the energy efficient class)

- **Households that cook exclusively with electricity spend much less on fuels than households cooking with charcoal and purchased wood.** Note that a small number of households that cook exclusively with electricity paid little or nothing for their electricity; for example, the cost of electricity was included in their rent, or the utility never issued a bill.
- Households cooking exclusively with electricity spent a mean figure of 84 Birr/month on electricity for cooking and other domestic loads. Households connected to the grid, but cooking exclusively with charcoal or purchased wood, spent 56 and 42 Birr/month respectively on electricity for domestic loads only. This indicates that the cost of electricity used for cooking is around 30 – 40 Birr/month ($1.30 - $1.80/month). **A monthly expenditure of $1.50 at the prevailing tariff of $0.02/kWh gives an electrical cooking load of around 2.5 kWh/day, which is not unreasonable, given conventional rather than efficient cooking devices.**
- Among all households who collected wood, two thirds collected this for free (in the last month), but the remaining third made some kind of payment. No detail is available on what this payment was for, but it may be that people had to pay the landowner to gather wood from a forest, for example.
- Few households exclusively cooking with electricity or wood (both purchased and collected), make use of additional fuels, e.g. 7% of households exclusively cooking with electricity also use charcoal, 2% of households exclusively cooking with purchased wood also use charcoal (but a much higher proportion, 28%, also use electricity). However, a relatively large proportion of households that cook exclusively with charcoal also use wood for other purposes (15%).

Table 8 Monthly expenditures on all fuels – single cooking fuel users (Birr/month[1])

		Monthly expenditure on electricity	Monthly expenditure on charcoal	Monthly expenditure on purchased wood	Monthly expenditure on collected wood	Total monthly expenditure
Exclusively uses electricity for cooking	N	81	6	5	1	85
	Mean	84.04	129.00	128.00	0	96.7
	Median	57	135	120	0	80
Exclusively uses charcoal for cooking	N	179	370	46	11	370
	Mean	56.89	189.23	124.70	16.36	234.6
	Median	34	150	120	.00	200
Exclusively uses purchased wood for cooking	N	42	3	152		152
	Mean	42.43	66.67	236.53		258.6
	Median	20.5	100	180		197.5
Exclusively uses collected wood for cooking	N	36	14		522	539
	Mean	19.08	19.29		83.30	96.3
	Median	14.50	.00		.00	0
Total	N	338	393	203	534	1146
	Mean	57.57	181.32	208.52	81.77	162.5
	Median	30	150	150	.00	130

3.3 Cooking related tasks – collecting fuel and lighting the stove

There are no significant differences in the time taken to cook a meal between each of the cooking fuels, but there are differences in the times taken to collect fuel and to get the stove ready to cook. There is a difference in collecting time for wood and charcoal even in urban areas – this is likely due to distance to selling points (charcoal can be available in small quantities through a multiplicity of small retailers) and storage space (households with limited storage space will need to buy wood more frequently).

Cooking practices within a household show how different fuels can exert a time burden on the family or, conversely, how they might free up time for the cook to get into employment. While there are no significant differences in the time taken to cook a meal between each of the cooking fuels (Table 9), there are differences in the times taken to collect fuel and to get the stove ready to cook. Not surprisingly, the time spent collecting fuel is highest among people who collect wood, but it is interesting to find that almost twice as much time is spent collecting purchased wood as collecting charcoal. Given that this group is split equally between urban and rural households (Table 3), it might be that people in rural areas have to travel further to purchase wood. However, disaggregation of the data suggests this is not a major effect. The time taken among rural wood purchasers is 32 minutes, compared with 25 minutes among urban households (means). Spending 25 minutes/day collecting purchased wood in urban areas is still higher than the 17 minutes/day spent collecting charcoal, which is a predominantly urban fuel. The difference in collecting time will likely be due to a range of

[1] Conversion rate in mid 2017 was 23 Ethiopian Birr/USD

other factors such as distance to selling points (charcoal can be available in small quantities through a multiplicity of small retailers) and storage space (households with limited storage space will need to buy wood more frequently).

Times taken to prepare the stove (Table 9) reflect both the time taken to prepare the fuel, and the time to light the fire. For example, the time taken to light a wood fire (purchased or collected) should be consistent (notwithstanding differences in quality and moisture content of wood), so the differences in preparation time between these two categories reflect the need to saw and chop up collected wood.

Table 9 Average time spent cooking including set up (minutes per day)

		Time collecting fuel	Time preparing stove	Time cooking meal
Electricity	Mean	4.7	4.0	90.8
	Median	0	0	60
Charcoal	Mean	16.6	9.6	92.2
	Median	0	0	70
Wood purchased	Mean	28.5	27.0	91.8
	Median	25	15	60
Wood collected	Mean	107.9	37.7	96.1
	Median	70	25	60

3.4 Cooking related tasks - gender

Women who are earners cook less often, and spend less time cooking. A higher proportion of women who cook exclusively with electricity are engaged in some kind of income generation, suggesting that cooking exclusively with electricity liberates time for women to engage in income generating activities. (Or that they can afford the capex on the electric stoves)

The gender division of cooking labour can be seen among households when both a man and woman are living in a partnership. Table 10 shows that women in these households do almost all of the cooking, irrespective of the fuel used. However, the table does show that women cooking exclusively with wood cook most often, and women cooking exclusively with electricity cook least frequently.

For these women there is a close relationship between the cooking burden and their income generating status, such that women who are earners cook less often (MW U-test, $p < 0.001$), and spend less time cooking (82 minutes/day, compared with 91 minutes/day among non-earners, MW U-test, $P < 0.001$). Table 11 shows that a higher proportion of women who cook exclusively with electricity are engaged in some kind of income generation, suggesting that cooking exclusively with electricity liberates time for women to engage in income generating activities. (Or that they can afford the capex on the electric stoves)

Table 10 Frequency at which women cook meals (female spouses in male headed households)

	Electricity	Charcoal	Wood purchased	Wood collected
Everyday	34 85.0%	163 91.1%	101 98.1%	611 97.6%
A few times in a week	1 2.5%	9 5.0%	1 1.0%	6 1.0%
Once a week	0 0.0%	1 0.6%	0 0.0%	3 0.5%
A few times in a month	1 2.5%	2 1.1%	0 0.0%	1 0.2%
Once a month	0 0.0%	1 0.6%	0 0.0%	0 0.0%
Never	4 10.0%	3 1.7%	1 1.0%	5 0.8%
Total	40 100.0%	179 100.0%	103 100.0%	626 100.0%

Table 11 Income generating status of women (female spouses in male headed households)

	Electricity	Charcoal	Wood purchased	Wood collected
Non-earner	26 65.0%	131 73.6%	75 72.8%	520 83.1%
Earner	14 35.0%	47 26.4%	28 27.2%	106 16.9%
Total	40 100.0%	178 100.0%	103 100.0%	626 100.0%

3.5 Cooking and access to electricity

Nearly all exclusive charcoal users (93%) have access to electricity but do not use it for cooking. Electrification rates among urban households cooking exclusively with purchased wood is 87%. Households that have a grid connection yet choose to cook exclusively with a biomass fuel obtained their connection relatively recently. This suggests that it takes time to acquire the electrical devices to meet all cooking requirements (e.g. kettle, microwave), and to gain the confidence and skills to cook with electricity.

Over one half of households (62%) were connected to the national grid and a further 12% relied on some kind of solar powered installation (Table 12). Grid connection rates among rural households were much lower at 17%, compared with 95% among urban households. It can be assumed that it is not possible to use electric cooking appliances with solar systems.

Table 12 Main source of electricity.

	Frequency	Valid Percent
national grid connection	2695	62.4
local mini grid connection	22	0.5
electric generator	7	0.2
solar home system	157	3.6
solar lantern/lighting system	352	8.2
rechargeable battery	6	0.1
dry-cell battery	647	15.0
no electricity	418	9.7
Total	4304	99.7
Missing	13	0.3

Figure 12 Injera, the local staple, is difficult to cook with electricity, although agencies have tried to produce appliances.

Details of the electricity source can give another perspective into how a household functions day to day as well as which households may be able to switch over to cooking with electricity.

Nearly all exclusive charcoal users (93%) have access to electricity but do not use it for cooking (Table 13). Around two thirds of households who cook exclusively with bought wood (67%) are connected to the grid. However, electrification rates among urban households cooking exclusively with purchased wood is 87% (and 46% among rural households). These households are particularly interesting, and Section 4 explores what might lie behind their choice not to use electricity for cooking.

Among households that make exclusive use of biomass for cooking and are not connected to the national grid, then main reason is simply proximity (Table 14). However, a further 20% of those who exclusively use wood for cooking find the administrative process too complicated**, suggesting that lower levels of education (Table 7) present a barrier to access to electricity.**

Table 13 Main source of electricity – by exclusive cooking fuel

	Electricity	Charcoal	Wood purchased	Wood collected	Total
n	117	370	152	751	
national grid connection	117 100.0%	344 93.0%	102 67.1%	90 12.0%	653 47.0%
solar home system	0 0.0%	2 0.5%	10 6.6%	68 9.1%	80 5.8%
solar lantern/lighting system	0 0.0%	3 0.8%	6 3.9%	116 15.4%	125 9.0%

Table 14 Reasons for not being connected to the grid

	Charcoal	Wood purchased	Wood collected	Total
Grid is too far from household/not available	14 51.9%	34 68.0%	355 53.7%	404 54.6%
Cost of initial connection is too expensive	3 11.1%	0 0.0%	26 3.9%	29 3.9%
Monthly fee is too expensive	1 3.7%	0 0.0%	2 0.3%	3 0.4%
Renting, landlord decision	2 7.4%	1 2.0%	7 1.1%	11 1.5%
Administrative procedure is too complicated	2 7.4%	10 20.0%	137 20.7%	149 20.1%
Submitted application and waiting for connection	2 7.4%	4 8.0%	66 10.0%	72 9.7%
Company refused to connect the household	2 7.4%	1 2.0%	45 6.8%	48 6.5%
Other	0 0.0%	0 0.0%	5 0.8%	5 0.7%
Total	27 100.0%	50 100.0%	661 100.0%	740 100.0%

Households that have a grid connection yet choose to cook exclusively with a biomass fuel obtained their connection relatively recently. Table 15 shows that households that cook exclusively with electricity have been connected to the grid for longest. This suggests that it takes time to acquire the electrical devices to meet all cooking requirements (e.g. kettle, microwave), and to gain the confidence and skills to cook with electricity.

Table 15 Period of time household has been connected to grid (years)

	N	Mean	Median
Electricity	114	18.3	15
Charcoal	308	14.8	11.5
Wood purchased	98	7.0	3.5
Wood collected	88	2.9	2
Total	608	12.5	7

3.6 Influence of attitudes

All groups, including wood users, concede that using wood is not convenient. Awareness of the harm caused by charcoal smoke is highest among people who cook exclusively with electricity. People who cook exclusively with electricity feel quite strongly that it is not expensive. The aspiration to cook with LPG as a modern fuel is strongest among people who use purchased wood.

The questionnaire asked a series of questions relating to attitudes towards the main cooking fuels. The mean scores presented in Table 16 highlight some of the key attitudes that appear to act as barrier to and drivers of cooking fuel choices:

Figure 13 Photo - Beyebo Eresado and a fellow villager describe how their community in southern Ethiopia stopped female genital mutilation. Image by Amy Yee. Ethiopia, 2016.

- **All groups, including wood users, concede that using wood is not convenient.**
- There is consensus that cooking with firewood is harmful, which ca be assumed to be a recognition of the impact of wood smoke. The levels of agreement that cooking with charcoal is also harmful are lower, but still quite consistent. **Awareness of the harm caused by charcoal smoke is highest among people who cook exclusively with electricity.**
- Among all groups (except those who collect firewood) there is a consistent ranking of firewood as most expensive, followed by LPG, but attitudes towards the expense of electricity are neutral. Interestingly, it is **people who cook exclusively with electricity who feel quite strongly that it is not expensive.**
- Attitudes regarding the taste of cooking with biomass are neutral among wood users, and both electricity and charcoal users disagree that biomass makes food taste better.
- **Aspiration to cook with LPG as a modern fuel is strongest among people who use purchased wood.** However, charcoal and people using collected wood have neutral attitudes.

This suggests that features of cooking with electricity that appeal to consumers are reduced health risk, convenience (both use and access to fuel), low cost.

Table 16 Attitudes relating to cooking fuels – single cooking fuels[2]

	Cooking fuel				K-W P-value
	Electricity	Charcoal	Wood purchased	Wood collected	
Smoke from stove is good at chasing insects away.	0.1681	0.073	0.3158	0.3822	<0.001
Smoke from cooking fuels is a big health problem in my family.	0.6891	0.6892	1.0395	0.8349	<0.001
Cooking with firewood is not very convenient.	0.8571	0.8757	0.8618	0.7577	0.086
Firewood is expensive for cooking.	0.8319	0.5162	0.9079	0.1252	<0.001
Modern or wealthy families use LPG/cooking gas to cook.	0.2101	0.0541	0.4868	-0.0559	<0.001
Charcoal is convenient to use for cooking.	-0.3109	0.3	0.4342	0.2876	<0.001
Cooking with charcoal is harmful to a person's health.	0.7479	0.4541	0.6053	0.4208	0.003
Cooking with firewood is harmful to a person's health.	0.8067	0.9162	0.8882	0.8602	0.566
Electricity is expensive for cooking.	-0.3697	0.0243	0.0263	-0.1651	<0.001
Firewood is hard to obtain.	0.7479	0.3189	0.6776	0.0386	<0.001
LPG is expensive for cooking household meals.	0.6807	0.373	0.625	0.5486	<0.001
Certain food tastes better when cooked with biomass compared to gas or electricity.	-0.2101	-0.2919	0.0789	-0.0999	0.001
Charcoal is hard to obtain in the market.	0.1345	-0.1135	0.5789	0.2184	<0.001
I prefer to use "Three/five Stone" as the firewood stove at home.	-0.6723	-0.6216	-0.0789	-0.0186	<0.001
Collecting and preparing firewood is a burden for my family.	0.3866	0.3892	0.8421	0.7031	<0.001

[2] Scores -2 (strongly disagree) to +2 (strongly agree).

4 Household electric cooking choices

- *57% of households have access to at least one source of electricity: 33.1% of households have access through the grid, and 23.9% have access through off-grid solutions.*
- *Of these 57% of households, only 77.7% –or 44.3% of all Ethiopian households– have access to at least basic electricity supply. The remaining 55.7% have no access to any electricity source, rely on dry-cell batteries, or have a grid or off-grid electricity supply*
- *that does not provide basic energy service (ability to light the house and charge phones and available for at least 4 hours a day, including 1 hour in the evening).*
- *38.1% of unelectrified households are within 7 kilometers of the national grid and report administrative barriers or delay or refusal in being connected as the main reason for not having a grid connection.*
- *Half of the electrified households receive service at least 8 hours a day. A fifth of households have electricity available 23 hours a day, 7 days a week.*
- *5.2% of electrified households receive less than 4 hours of service per day.*
- *57.6% of grid-connected households face 4 -14 disruptions a week, and 2.8% of households face more than 14 disruptions a week.*
- *15.8% of households face voltage issues –which can damage appliances and limit their use.*
- *Electricity is affordable for the majority of households: 99.5% of households spending is less than 5% of their total household expenditure for basic grid electricity service.*
- *On average, electrified households have been connected to the grid for 11 years and consume 120.7 kWh of electricity per month. Most households that use an off-grid solar device bought their first solar product within the last three years.*
- *Only 29.8% of grid-connected households have medium- or high-load appliances, such as a refrigerator or washing machine.*
- *96.1% of households are willing to pay for a grid connection, and 79.8% of households are willing to pay for a solar home system capable of powering a television, either up-front or with a payment plan.*

Executive summary highlights on electricity access, Padam et al 2018

4.1 Quality of supply and single cooking fuels

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. Households exclusively using wood (both purchased and collected), have bad quality connections. Households exclusively using charcoal have better quality of supply, but the quality of supply among households exclusively using electricity is substantially better still. This confirms that quality of supply is a predictor of whether a household uses electricity as their only cooking fuel.

Figure 10 is the key graphic for the tier approach to electricity access, illustrating how the availability, reliability and quality of the supply are key pillars of the Tier system.

ATTRIBUTES		TIER 0	TIER 1	TIER 2	TIER 3[b]	TIER 4	TIER 5
Capacity	Power capacity ratings (W or daily Wh)	Less than 3 W	At least 3 W	At least 50 W	At least 200 W	At least 800 W	At least 2 kW
		Less than 12 Wh	At least 12 Wh	At least 200 Wh	At least 1 kWh	At least 3.4 kWh	At least 8.2 kWh
	Services		Lighting of 1,000 lmhr per day	Electrical lighting, air circulation, television, and phone charging are possible			
Availability[a]	Daily Availability	Less than 4 hours	At least 4 hours		At least 8 hours	At least 16 hours	At least 23 hours
	Evening Availability	Less than 1 hour	At least 1 hour	At least 2 hours	At least 3 hours	At least 4 hours	
Reliability		More than 14 disruptions per week			At most 14 disruptions per week or At most 3 disruptions per week with total duration of more than 2 hours"	(> 3 to 14 disruptions / week) or ≤ 3 disruptions / week with > 2 hours of outage	At most 3 disruptions per week with total duration of less than 2 hours
Quality		Household experiences voltage problems that damage appliances				Voltage problems do not affect the use of desired appliances	
Affordability		Cost of a standard consumption package of 365 kWh per year is more than 5% of household income			Cost of a standard consumption package of 365 kWh per year is less than 5% of household income		
Formality		No bill payments made for the use of electricity				Bill is paid to the utility, prepaid card seller, or authorized representative	
Health and Safety		Serious or fatal accidents due to electricity connection				Absence of past accidents	

Figure 14 Multi-Tier Framework for measuring access to electricity (Padam et al 2018)

One hypothesis here is that poor quality of supply acts as a barrier preventing people from cooking electricity. In the absence of a single measure of quality of supply, this section outlines a methodology used to create a composite variable used to represent overall quality of supply. A factor analysis was run on the following variables that relate to voltage volatility and connection reliability:

- Availability of electricity in the evening on a good day
- Availability of electricity in the evening on a bad day
- Frequency of blackouts during the best week
- Frequency 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 in the evening, 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.** Table 17 shows the relationship between quality of electricity supply and choice of cooking fuels (single fuels only). This shows that, overall, households using wood (both purchased and collected), have bad quality connections. Households exclusively

using charcoal have better quality of supply, but the quality of supply among households exclusively using electricity is substantially better still (Chi square, p <0.001). This confirms that quality of supply is a predictor of whether a household uses electricity as their only cooking fuel.

Table 17 Quality of grid connection by single cooking fuels

	Electricity	Charcoal	Wood purchased	Wood collected	Total
Mean scores	2.07	2.42	2.67	2.68	
Very Good (1)	45 38.8%	90 26.3%	17 17.0%	12 14.3%	164 25.5%
Good (2)	33 28.4%	95 27.8%	22 22.0%	27 32.1%	177 27.6%
Bad (3)	23 19.8%	79 23.1%	38 38.0%	21 25.0%	161 25.1%
Very Bad (4)	15 12.9%	78 22.8%	23 23.0%	24 28.6%	140 21.8%
Total	116 100.0%	342 100.0%	100 100.0%	84 100.0%	642 100.0%

4.2 Quality of supply and fuel stacking

There is no significant difference in connection quality between those using electricity for cooking stacked with other fuels and those who do not cook with electricity at all. However, the quality of supply is significantly better among households who exclusively using electricity for cooking. The quality of a grid connection only acts as a barrier for the exclusive use of electricity for cooking, it does not hinder use of electricity for cooking in households who are prepared to stack fuels.

This section goes on to consider all households with a grid connection. This sub-set is divided between those that cook exclusively with electricity (n=119), those that stack electricity with other fuels for cooking (n=1,020), and those that have electricity yet choose not to use at for cooking at all (1,156)[3]. 99% of all households cooking with electricity live in an urban settlement, but most connected households choosing not to cook with electricity (81%) also live in urban settlements. In terms of key demographics (education, financial inclusion, and income), households that cook with electricity are broadly similar and households that do not cook with electricity tend to be of lower socio-economic status (this is presented in more detail in Section 4.4).

The composite quality of supply indicator is presented for each category of household connected to the grid in Table 18. Interestingly, **there is no significant difference in connection quality between those using electricity for cooking stacked with other fuels and those who do not cook with electricity at all** (Mann Whitney p value

[3] Only 85% of those with a grid connection (n=2697) indicated that they used electricity in the section on Household Fuel Consumptions.

=0.446). However, **the quality of supply is significantly better among households who exclusively using electricity for cooking** (Kruskal Wallis p value <0.001).

So, while the quality of a household's grid connection may prevent them from exclusively using electricity for cooking, it does not stop a household from using electrical cooking appliances altogether. Or in other words, **the quality of a grid connection only acts as a barrier for the exclusive use of electricity for cooking, it does not hinder use of electricity for cooking in households who are prepared to stack fuels.** This could be because they only want to use electricity for certain kitchen appliances (e.g. kettle, rice cooker etc.) or because they would prefer to exclusively use electricity but when the electricity goes off, they have to switch to a more reliable fuel.

Table 18 Quality of supply by categories of electricity user

	Cooks exclusively with electricity	Stacks electricity with other cooking fuels	Has other uses for electricity	Total
Mean scores	2.07	2.57	2.53	
Very Good (1)	45 38.8%	230 23.0%	270 24.0%	545 24.3%
Good (2)	33 28.4%	246 24.6%	279 24.8%	558 24.9%
Bad (3)	23 19.8%	252 25.2%	288 25.6%	563 25.1%
Very Bad (4)	15 12.9%	273 27.3%	290 25.7%	578 25.8%
Total	116 100.0%	1001 100.0%	1127 100.0%	2244 100.0%

4.3 Quality of supply and appliances

An alternative approach taken by the World Bank is to Indirectly assess the quality of a household's electricity supply according to the electrical appliances owned by the household. The two quality of supply indicators do not correlate with one another. It is possible that the appliances a household owns is more of a reflection of household wealth rather than the capacity of a household's electricity supply and, indeed, tier capacity ratings correlate with monthly income levels. Financial constraints and skills may not be involved in making the transition to cook exclusively with electricity.

An alternative method of indirectly assessing the quality of a household's electricity supply (as well as their purchasing habits) is to categorise the capacity of the connection according to the electrical appliances owned by the household. The 5 tiers outlined in the ESMAPS multi-tier framework report were used to classify the households in this way.

The tier capacity ratings of supplies to households that use electricity exclusively or partly for cooking are similar (Table 19) (Mann Whitney =0.191). However, the tier capacity ratings are significantly lower among households who never cook with electricity (Kruskal Wallis <0.001). This follows a different pattern to the composite indicator presented in Table 17 and the two indicators do not correlate with one another. It is likely that the appliances a household owns is more of a reflection of household wealth rather than the capacity of a

household's electricity supply and, indeed, tier capacity ratings correlate with monthly income levels ($r = 0.37$, $p < 0.001$).

Table 19 Tier capacity of households who do and do not cooking with electricity

	Cooks exclusively with electricity	Stacks electricity with other cooking fuels	Has other uses for electricity	Total
Mean Tier level	2.8	2.9	2.2	2.6
Tier 1 (3-49W)	1 0.8%	5 0.5%	13 1.1%	19 0.8%
Tier 2 (50-199W)	50 42.4%	395 38.8%	913 79.5%	1358 59.5%
Tier 3 (200-799W)	49 41.5%	395 38.8%	188 16.4%	632 27.7%
Tier 4 (800-1999W)	6 5.1%	97 9.5%	22 1.9%	125 5.5%
Tier 5 (>2000W)	12 10.2%	126 12.4%	12 1.0%	150 6.6%
Total	118 100.0%	1018 100.0%	1148 100.0%	2284 100.0%

Households that use electricity for cooking have been connected to their supply for longer than households that do not cook with electricity (Table 20). This may suggest that it takes time to acquire electrical cooking appliances and to gain the confidence and skills to cook with electricity. If so, then financial constraints and skills are not involved in making the transition to cook exclusively with electricity.

Table 20 Period of time household has been connected to grid (years)

	N	Mean	Median
Cooks exclusively with electricity	114	18.3	15
Stacks electricity with other cooking fuels	985	19.6	18
Has other uses for electricity	1055	12.4	8
Total	2154	16.0	12

4.4 Household demographics and electric cooking choices

Financial capacity does not appear to lie behind the choice to cook exclusively with electricity, but it may present a barrier to cooking with electricity.

Households that use electricity for cooking have higher incomes than those that do not cook with electricity at all (Table 21). This suggests that the cost of electric appliances may present a barrier to cooking with electricity. Although households that cook with electricity in combination with other fuels have the highest income

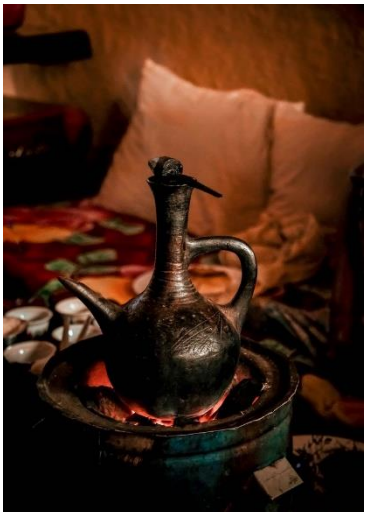


Figure 15Traditional coffee pot - which the locally made electric cooker is designed to fit.

levels, households that exclusively cook with electricity are smaller, so there is little difference in per capita income levels of these two groups. Financial capacity does not, therefore, appear to lie behind the choice to cook exclusively with electricity but it may present a barrier to cooking with electricity.

Table 21 Income and electricity costs

		Total monthly income	Monthly expenditure on electricity	Total monthly expenditure (all fuels)	Household size	Per capita Total monthly expenditure (all fuels)
Cooks exclusively with electricity	N	119	81	85	119	85
	Mean	3554.8	84.0	96.7	3.5	31.5
	Median	2800	57	80	3	22
Stacks electricity with other cooking fuels	N	1019	792	1005	1020	1005
	Mean	4269.1	103.4	334.5	4.5	88.1
	Median	3000	76	292	4	68
Has other uses for electricity	N	1156	965	1143	1156	1143
	Mean	2498.4	44.9	326.4	4.0	97.8
	Median	2000	20	280	4	74
Total	N	2294	1838	2233	2295	2233
	Mean	3339.7	71.8	321.3	4.2	90.9
	Median	2500	40	280	4	68.3

There is also a clear difference in the highest level of education achieved within a household between households that do and don't use electricity for cooking (Table 22). This suggests that low levels of education act as a barrier to including electricity as one of their cooking fuels.

Table 22 Education

	Mean	N	Std. Deviation
Cooks exclusively with electricity	12.3	116	2.989
Stacks electricity with other cooking fuels	12.2	973	3.508
Has other uses for electricity	9.8	1129	4.101
Total	11.0	2218	3.981

4.5 Mechanisms of payment

Households who cook with electricity most often have an electric meter and pay EEPCO on a post-paid bill. Most households who do not have an electric meter and have a fixed monthly fee do not cook with electricity.

As seen in Figure 17, there are a wide variety of ways households in Ethiopia can pay for their electricity bill. Households who cook with electricity most often have an electric meter and pay EEPCO on a post-paid bill. Whether the meter is shared does not seem to be an indicator of using electricity for cooking, however almost all households with a prepaid meter do cook with electricity.

Figure 16 Ethiopian Electric Power Company EEPCO logo

On the other hand, most households who do not have an electric meter and have a fixed monthly fee do not cook with electricity. It is a lot more common for these households to be billed informally through a landlord or neighbour, however many do still pay EEPCO. It is not clear that the ability to cook is constrained in non-metered supplies, as the difference in the composite quality of supply indicator between metered and non-metered households is not significant. It may be that households with non-metered supplies are prohibited or discouraged from cooking and, indeed, Table 23 shows that most non-metered supplies are provided by landlords and neighbours.

Table 23 Electricity supplier by metered / non-metered connection

Who receives payment for electricity	Metered	Non-metered	Total
eepco/ post paid	1547	147	1694
pre-paid meter card seller	81	6	87
community/village/municipality	14	18	32
relative	1	10	11
neighbour	6	279	285
landlord	56	294	350
other	2	4	6
not paid yet	6	0	6
rented the house. do not pay electric bill.	5	12	17
Total	1718	770	2488

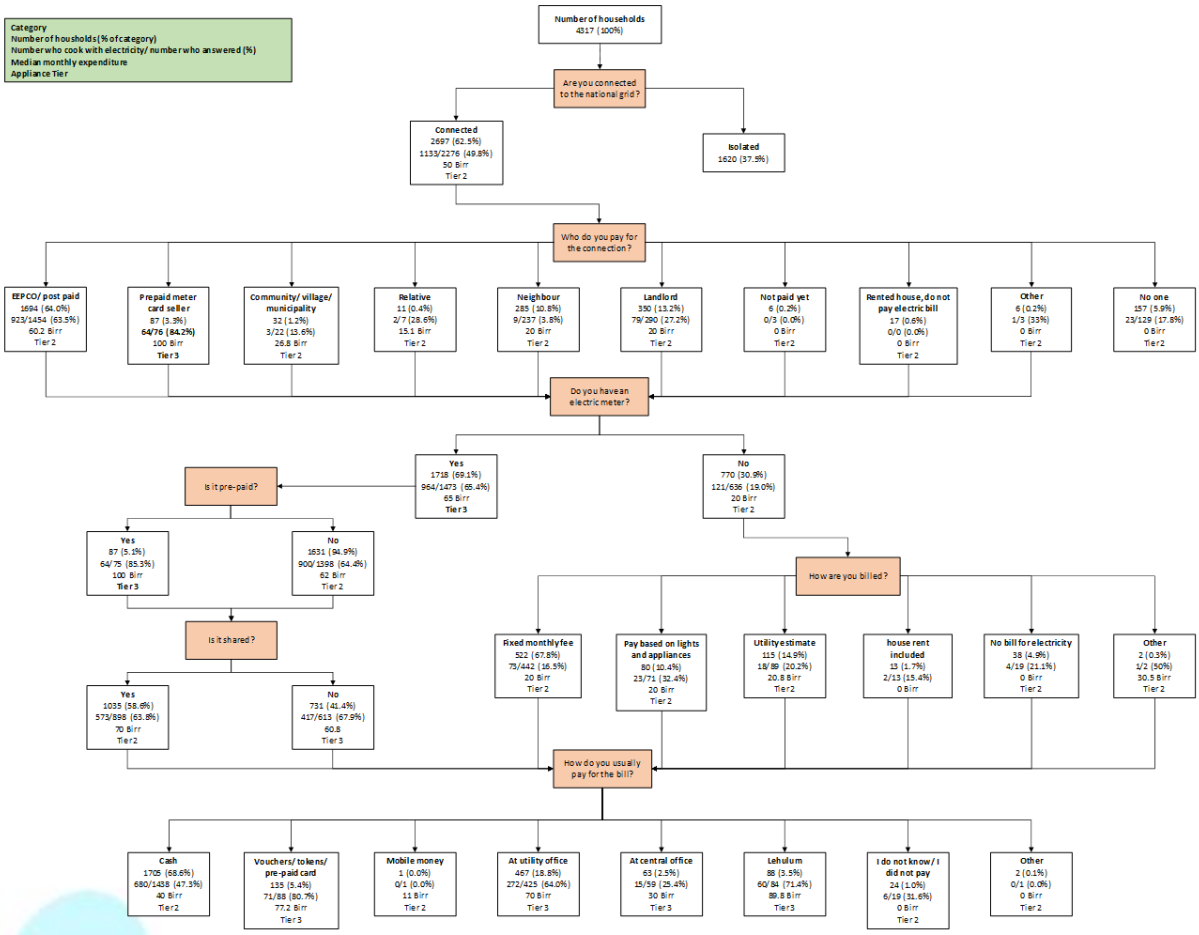


Figure 17 Type of grid connection and use of electricity for cooking

4.6 Influence of attitudes

The decision not to cook exclusively with electricity is not driven by beliefs regarding fuels. People who cook with electricity are more concerned about the inconvenience of cooking with charcoal and firewood. Those who cook with electricity are more concerned about the health implications of smoke. Those who cook with electricity are more likely to believe that firewood is expensive. Those who do some cooking with electricity have a neutral attitude towards the cost of cooking with electricity, but those who cook exclusively with electricity believe it to be cheap. Satisfaction with the electricity service is lower among those who cook partially with electricity.

Figure 18 Health, convenience and expense

When comparing attitudes of those who have electricity but do not use it for cooking with those who use electricity for some of their cooking (Table 24), the issues that are linked to the choice to cook with electricity include:

- **Convenience – people who cook with electricity are more concerned about the inconvenience of cooking with charcoal and firewood, including access, collection, and preparation of firewood (access to charcoal is not a factor).**
- **Health – those who cook with electricity are more concerned about the health implications of smoke from both charcoal and wood.**
- **Cost – those who cook with electricity are more likely to believe that firewood is expensive, but perceptions regarding the cost of cooking with electricity are not a factor.**

Table 24 Attitudes relating to cooking fuels – no cooking and some cooking with electricity[4]

	Stacks electricity with other cooking fuels	Has other uses for electricity	M-W P value
Smoke from stove is good at chasing insects away.	0.05	0.26	<0.001
Smoke from cooking fuels is a big health problem in my family.	0.88	0.83	0.036
Cooking with firewood is not very convenient.	0.92	0.79	<0.001

[4] Scores -2 (strongly disagree) to +2 (strongly agree).

Firewood is expensive for cooking.	0.98	0.74	<0.001
Modern or wealthy families use LPG/cooking gas to cook.	0.20	0.28	0.321
Charcoal is convenient to use for cooking.	-0.11	0.11	<0.001
Cooking with charcoal is harmful to a person's health.	0.82	0.66	<0.001
Cooking with firewood is harmful to a person's health.	1.05	0.98	0.005
Electricity is expensive for cooking.	-0.05	-0.01	0.361
Firewood is hard to obtain.	0.59	0.40	<0.001
LPG is expensive for cooking household meals.	0.82	0.58	<0.001
Certain food tastes better when cooked with biomass	-0.20	-0.19	0.806
Charcoal is hard to obtain in the market.	0.14	0.09	0.314
I prefer to use "Three/five Stone" as the firewood stove	-0.76	-0.38	<0.001
Collecting and preparing firewood is a burden for my family.	0.81	0.65	<0.001
Are you satisfied with the service from your main source of electricity?	0.76	0.63	<0.001
The monthly electric bill is or would be a financial burden for my family.	0.11	-0.11	<0.001

Overall, there is a good degree of similarity in attitudinal variables among those who cook with electricity, both those that cook exclusively and those that cook only partially with electricity (Table 25). This indicates **the decision not to cook exclusively with electricity is not driven by beliefs regarding fuels.** For example, people who cook only partially with electricity believe just as strongly that biomass fuels pose a health hazard, in fact they are even more likely to believe that cooking with firewood is harmful to health. Neither are they any more likely to believe that biomass fuels are more convenient. This suggests there exists a latent demand for an alternative to biomass fuels that are stacked with electricity.

So what are the factors that enable people to make this substitution and cook exclusively with electricity? Issues linked to the choice to move to cooking exclusively with electricity (Table 25) include;

- Perception of cost – those who do some cooking with electricity have a neutral attitude towards the cost of cooking with electricity, but those who cook exclusively with electricity believe it to be cheap. There is an overall trend for those who cook partially with electricity to believe more strongly that the cost of cooking is high for all fuels e.g. firewood, electricity, and LPG (although the difference is not significant) indicating that this group is more price sensitive despite being of a similar socio-economic status (see Section 4.4).

- Quality of supply – satisfaction with the electricity service is lower among those who cook partially with electricity. This is consistent with scores for the composite quality of supply indicator (see Table 18).

Table 25 Attitudes relating to cooking fuels – some cooking and exclusive cooking with electricity[5]

	Cooks exclusively with electricity	Stacks electricity with other cooking fuels	M-W P value
Smoke from stove is good at chasing insects away.	0.17	0.05	0.353
Smoke from cooking fuels is a big health problem in my family.	0.69	0.88	0.052
Cooking with firewood is not very convenient.	0.86	0.92	0.612
Firewood is expensive for cooking.	0.83	0.98	0.038
Modern or wealthy families use LPG/cooking gas to cook.	0.21	0.20	0.98
Charcoal is convenient to use for cooking.	-0.31	-0.11	0.1
Cooking with charcoal is harmful to a person's health.	0.75	0.82	0.404
Cooking with firewood is harmful to a person's health.	0.81	1.05	0.029
Electricity is expensive for cooking.	-0.37	-0.05	0.006
Firewood is hard to obtain.	0.75	0.59	0.247
LPG is expensive for cooking household meals.	0.68	0.82	0.107
Certain food tastes better when cooked with biomass	-0.21	-0.20	0.808
Charcoal is hard to obtain in the market.	0.13	0.14	0.902
I prefer to use "Three/five Stone" as the firewood stove	-0.67	-0.76	0.54
Collecting and preparing firewood is a burden for my family.	0.39	0.81	<0.001
Are you satisfied with the service from your main source of electricity?	1.12	0.76	<0.001
The monthly electric bill is or would be a financial burden for my family.	0.06	0.11	0.62

[5] Scores -2 (strongly disagree) to +2 (strongly agree).

5 Decision makers

- 18.9% of *households are headed by women.*
- *47% of female-headed households are in the bottom two spending quintiles, compared with 38.4% of male-headed households.*
- *39.6% of households in urban areas are headed by women, compared with 12% of households in rural areas.*
- *58.8% of female-headed households are connected to the grid, compared with 27.1% of male-headed households. This is mostly due to a higher concentration of female-headed households in electrified urban areas. The gender gap disappears when female- and male-headed households are compared in urban and rural areas separately.*
- *37.1% of female-headed households use a solar home system or solar lighting system, compared with 46.5% of male-headed households.*
- *Among unconnected households, 37.5% of female-headed households are willing to pay full price upfront for a connection to the grid, compared with 60.1% of male-headed households.*
- *28.4% of female-headed households are willing to pay full price upfront for an off-grid solar device that allows the household to use lighting service and watch television, compared with 47.5% of male-headed households.*
- *33.9% of female-headed households and 14.6% of male-headed households use a manufactured biomass stove, while 8.3% of female-headed households and 3.2% of male-headed households use a clean fuel stove.*
- *61.3% of female-headed households and 62.4% of male-headed households are willing to pay full price* upfront for an improved biomass stove.
  Executive summary highlights on gender, Padam et al 2018

5.1 Gender within the household

Responses from three variables have been combined to give a composite gender empowerment indicator relating to mobility. Another indicator of independence is the ability to be in control of your own finances.

Figure 19 Photo from USAID illustrating gender equality and women's empowerment

Before looking at 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. For example, the extent to which women need permission to engage with their community impacts their ability to generate an income and what they are influenced by when making decisions. In most households, women can carry out everyday activities themselves, however about 30% of the time they will need permission (Table 26). Valid responses from these three variables (only records with valid scores for all three variables) have been combined to give a composite gender empowerment indicator relating to mobility (scores range from 0 to 3)[6] (see Table 27).

Another indicator of independence is the ability to be in control of your own finances, Table 28 shows that in about 30% of households, the female head/ spouse owns their own bank account. This is about two thirds of the number of households who have at least one person with bank account residing in them (46%) which is quite a large proportion. We also see in Table 28 that women are more likely to own their own bank account if they are not in a relationship.

[6] A score of 1 has been allocated for each component if the woman can do the activity herself, and 0 if she can only do it with either her husband or others. A combined score of 0 represents a woman who needs to be accompanied for all three activities, and a score of 3 represents a woman who can do all three activities by herself.

Table 26 Permission required for everyday activities

	Visit relatives/ friends		Go to markets/ town		Go outside the village	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Can do herself (1)	2673	76.6	2435	69.4	2226	63.5
Can do with husband (2)	762	21.8	952	27.1	1075	30.6
Can do with others (3)	45	1.3	113	3.2	197	5.6
Does not know	4	0.1	8	0.2	10	0.3
Other	7	0.2	0	0	0	0
Total	3491	100	3508	100	3508	100

Table 27 Composite Gender empowerment indicator - mobility

		Frequency	Percent
Valid	0	567	13.1
	1	253	5.9
	2	411	9.5
	3	1971	45.7
	Total	3202	74.2
Missing	System	1115	25.8
Total		4317	100.0

Table 28 Female bank account ownership

Female marital status	No account	Own account	Joint account (with spouse)	Joint account (with group)	Do not know	Total
With partner	1637 65.6%	672 26.9%	110 4.4%	5 0.2%	70 2.8%	2494 100%
Single	493 61.7%	299 37.4%	1 0.1%	4 0.5%	2 0.3%	799 100%

Of the households surveyed, 71% of household heads were male, and 21% were female headed. Females heads of household were much more likely to be single than male heads of household – 84% compared with 10%.

Of the heads of households and spouses that are women, half are unemployed, and a further 15% do not work for other reasons such as old age or because they are on job seekers (Table 29). On the other hand, less than 10% of men (heads of households or spouses) either do not work or are unable to work.

Table 29 Occupations of household heads and spouses

	Male		Female		Total	
Wage employee, non-farm	738	22.5%	395	9.9%	1133	15.6%
Wage employee, farm	250	7.6%	107	2.7%	357	4.9%
Self-employed, non-farm-business enterprise	382	11.7%	347	8.7%	729	10.0%
Self-employed, non-farm-independent professional	143	4.4%	48	1.2%	191	2.6%
Self-employed, crop production	1081	33.0%	151	3.8%	1232	16.9%
Self-employed, livestock	107	3.3%	41	1.0%	148	2.0%
Assistance in family enterprise	7	0.2%	78	1.9%	85	1.2%
Casual/ day labourer	167	5.1%	84	2.1%	251	3.4%
Intern/ free labour/ voluntary work	1	0.0%	3	0.1%	4	0.1%
Student	32	1.0%	52	1.3%	84	1.2%
Retired/pensioner	179	5.5%	117	2.9%	296	4.1%
Too old to work	87	2.7%	190	4.7%	277	3.8%
Disabled	12	0.4%	16	0.4%	28	0.4%
Job seeker	28	0.9%	242	6.0%	270	3.7%
Unemployed	55	1.7%	2020	50.5%	2075	28.5%
Housewife	0	0.0%	99	2.5%	99	1.4%
Traditional medicine/healer	1	0.0%	0	0.0%	1	0.0%
Other	6	0.2%	13	0.3%	19	0.3%
Total	3276	100%	4003	100%	7279	100%

5.2 Burden of cooking

On average, women spend over 2 hours a day preparing fuel and cooking food, whereas men will not spend over 30 minutes. 67% of households get girls to spend an average of 26 minutes/day, and 64% of households get boys to spend an average of 12 minutes/day on the three meal related tasks. Women who have a bank account spend less time cooking than women with no access to formal banking, however empowered women (able to go out on their own) spend more time cooking.

When it comes to cooking, the time burden of preparing meals clearly falls to women. The questionnaire asks about the total time spent on different activities by all adult men in the household (aged over 15 years), all adult women, all male children, and all female children. The total minutes presented in Table 30 may, therefore, represent the combined labour of more than one adult man or woman, and the men and women spending time on these activities may not be the head of household or spouse. The table shows that, **on average, women spend over 2 hours a day preparing fuel and cooking food, whereas men will not spend over 30 minutes**.

Children are also commonly involved in meal preparation, but spend less time than adults. **67% of households get girls to spend an average of 26 minutes/day, and 64% of households get boys to spend an average of 12 minutes/day on the three meal related tasks.**

Table 30 Average time spent by men and women over 15 on cooking related tasks (mins/day)

	Gathering/ purchasing fuel		Preparing fuel		Cooking/ boiling		Total preparation time	
	Men	Women	Men	Women	Men	Women	Men	Women
N	3201	4005	3351	3775	2988	4177	3417	4193
Mean	13	38	10	14	5	85	26	133
Median	0	30	0	0	0	60	0	105
Mode	0	0	0	0	0	60	0	60
Std. Deviation	38.6	53.2	24.6	22.2	18.4	82.0	55.1	108.2

Disaggregating the total cooking time burden by gender related indicators shows that women who have a bank account spend less time cooking than women with no access to formal banking. Table 31 shows this effect among female spouses of household heads. There is an interesting anomaly that spouses who share an account with their partner experience the greatest time burden. The time burden is less on women spouses who are engaged in some kind of income generating activities (Table 32). On the other hand, Table 33 shows that empowered women (able to go out on their own) spend more time cooking.

Table 31 Total meal preparation time by gender financial inclusion – female spouses only

GENDER EMPOWERMENT - FINANCIAL INCLUSION (ordinal)	Mean	N	Std. Deviation
No account	161	1539	117.99572
Group account	208	5	85.48392
Joint account (with spouse)	189	102	122.25001
Own account	115	551	89.54140
Total	151	2197	113.73406

Table 32 Total meal preparation time by income generating status – female spouses only

LABOUR STATUS OF SPOUSE OF HEAD OF HOUSEHOLD	Mean	N	Std. Deviation
non-earner	151	2084	107.67368
earner	125	636	102.83789
Total	145	2720	107.12543

Table 33 Total meal preparation time by gender empowerment (mobility) (mins/day) – female spouses only

GENDER EMPOWERMENT - MOBILITY 3 vars (max 3)	Mean	N	Std. Deviation
0	116	492	75.38262
1	132	200	91.94907
2	169	321	134.30829
3	164	1057	120.42233
Total	150	2070	113.24153

5.3 Purchasing electrical appliances

There is slightly greater agreement that men make decisions relating to energy related purchases in particular. Women are involved in almost two thirds of decisions concerning the purchase of an electrical appliance. In fact, when comparing decisions made solely by men or women, women tended to be responsible for more decisions than men.

The MTF questionnaire includes several questions related to decision making within the household. The results presented in Table 34 shows that overall, respondents believe that men usually make these types of decisions. **There is slightly greater agreement that men make decisions relating to energy related purchases in particular**; although the difference is marginal, it is significant (t test, $p < 0.001$).

The questionnaire asks about ownership of a range of electrical appliances, including light bulbs, fans, irons, TVs etc. It also asks who decided to purchase each appliance. These responses have been matched up with details of the respondent to extract the gender of the decision maker. For each household, sums have been created of the number of appliances for which the purchasing decision was made by a male, by a female, and by both, where decisions were made jointly. These sums have then been summed across all households in the sample to give the figures presented in Table 35. This shows **that women are involved in almost two thirds of decisions concerning the purchase of an electrical appliance.** In fact, when comparing decisions made solely by men or women, women tended to be responsible for more decisions than men.

Figure 20 shows the gender breakdown of decision makers for the purchase of a sub-set of electrical appliances. **The only appliance that was chosen most frequently by men was a rechargeable torch – an 'outdoor' tool. Cheaper household items such as light bulbs and phone chargers were chosen by women. Purchasing more expensive items like washing machines and air conditioners was usually a joint decision.**

Table 34 Opinions on gender within budgeting

	"Men usually make decisions on the distribution of family budget"		"Men usually make decisions on purchasing of energy and energy-consuming devices"	
	Frequency	Valid Percent	Frequency	Valid Percent
Strongly agree	514	11.9	608	14.1
Agree	2432	56.4	2388	55.4
No opinion	96	2.2	142	3.3
Disagree	1130	26.2	1062	24.6
Strongly disagree	141	3.3	113	2.6
Total	4313	100	4313	100

Table 35 Decision makers in household electrical appliance purchases

	Male	Female	Both	Other	Total
Total number of appliance-decisions	3520 27.2%	4770 36.8%	3583 27.6%	1088 8.4%	12961 100%

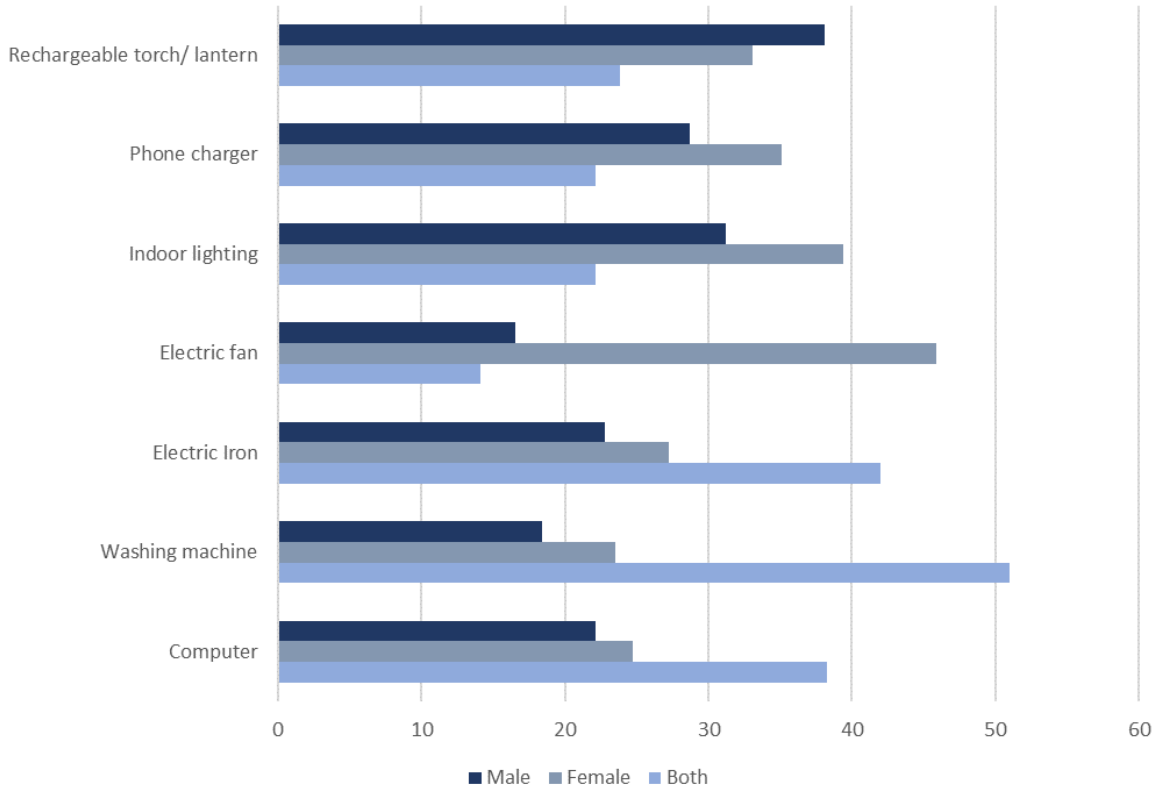


Figure 20 Gender dominating specific appliance purchases

5.4 Purchasing a cookstove

Men are more involved in purchasing electric cookstoves, which is consistent with them being more expensive. Nevertheless, women are the dominant decision maker. Electric cookstoves tend to be bought by people who are older and better educated. Men who purchase electric cookstoves are more likely to be income generators than men who purchase charcoal cookstoves. Women who purchase cookstoves are clearly the main cook, whereas men who make these purchasing decisions rarely, if ever, cook.

The previous section showed that women are involved in household decision making (purchasing electrical appliances). In order to explore the implications of gender in purchasing a cookstove we compared households who have obtained manufactured cookstoves where the main fuel used on it was either electricity or charcoal. For each stove, the questionnaire asked which household member decided to purchase the cookstove. The personal details of this household member have been extracted and are presented in Table 36 to Table 38 (N.B. this methodology prohibits any response representing joint decision making). The following trends are evident from these tables:

- **Men are more involved in purchasing electric cookstoves (Table 36), which is consistent with them being more expensive. Nevertheless, women are the dominant decision maker.**
- **Electric cookstoves tend to be bought by people who are older and better educated (Table 37).**
- **Men who purchase electric cookstoves are more likely to be income generators than men who purchase charcoal cookstoves (Table 38) (the effect is marginal among female decision makers).**

Table 36 Gender of electric stove decision maker

	Electric		Charcoal	
	Frequency	Percent	Frequency	Percent
Male	109	24.4	139	12.2
Female	337	75.6	1002	87.8
Total	446	100	1141	100

Table 37 Age and education of electric stove decision maker

	Electricity		Charcoal	
	Age	Education	Age	Education
N	446	446	1141	1141
Mean	42.7	8.6	38.8	6.1
Median	40	9	35	6
Mode	35	0	40	0
Std. Deviation	15.1	5.5	15.8	5.4

Table 38 Occupation of stove decision maker (main categories)

	Electric		Charcoal	
	Male	Female	Male	Female
Wage employee, non-farm	40 37%	74 22%	40 29%	137 14%
Self-employed, non-farm-business enterprise	22 20%	37 11%	23 17%	147 15%
Self-employed, non-farm-independent professional	6 6%	3 1%	7 5%	21 2%
Retired/ pensioner	14 13%	26 8%	13 9%	30 3%
Too old to work	5 5%	19 6%	4 3%	53 5%
Unemployed	2 2%	98 29%	5 4%	395 39%
Housewife	0 0%	27 8%	0 0%	22 2%

Table 39 shows that **women who purchase cookstoves are clearly the main cook, whereas men who make these purchasing decisions rarely, if ever, cook.** This pattern is consistent for the purchase of both electric and charcoal cookstoves.

An inspection of the 14 men who cook every day and bought an electric cookstoves reveals that most are single. Most of these men are either well educated on good salaries, or less well educated, self employed, and earning lower incomes.

Table 39 How often stove decision maker cooks

	Electric		Charcoal	
	Male	Female	Male	Female
Everyday	14 13%	285 85%	21 15%	913 91%
A few times in a week	14 13%	31 9%	15 11%	53 5%
Once a week	4 4%	1 0%	1 1%	1 0%
A few times in a month	5 5%	6 2%	3 2%	9 1%
Once a month	1 1%	1 0%	0 0%	0 0%
Never	68 62%	12 4%	89 64%	17 2%
Total	109 100%	337 100%	139 100%	1002 100%

6 Learning points from Ethiopia

6.1 Fuel choices

Choice of exclusively cooking fuels follows a classic energy ladder pattern – collected wood is the choice of less well off, rural households and electricity is the choice of well educated urban elites. Ethiopia is unusual in having low electricity tariffs, so households using exclusively electricity spend less on cooking fuels (than households exclusively using other fuels). It is interesting to note that charcoal users are similar to electricity users in many ways. Use of electricity as a cooking fuel appears to be driven by issues of:

- **health** (a recognition of the harmful effects of charcoal smoke)
- **convenience** – charcoal is regarded as inconvenient (compared to electricity). The time spent purchasing charcoal is less than time spent purchasing wood, illustrating the relative ease of access to charcoal. Attitudes confirm that firewood is difficult to access, and it involves the greatest amount of time spent collecting (both collected and purchased wood).
- **cost** - it is regarded as a cheap fuel for cooking.
- **quality of electricity supply**.

Cooking with electricity requires a change in cooking practices, and it can take time to acquire both the electrical devices to meet all cooking requirements (e.g. kettle, microwave), and to gain the confidence and skills to cook with electricity.

6.2 Cooking with electricity

Households that have a grid electricity supply yet chose not to cook with it are of particular interest. The overriding narrative is that barriers of education and income appear to prevent people cooking with electricity, but factors associated with quality of supply prevent people from cooking exclusively with electricity.

Levels of education and per capita income are similar among households using electricity for cooking (both exclusively and partially), but lower among households that do not cook with electricity. While the quality of a household's grid connection may prevent them from exclusively using electricity for cooking, it does not stop a household from using electrical cooking appliances altogether.

Households that cook with electricity have been connected to the grid for longer than households that do not cook with electricity, suggesting that it takes time (and money) to acquire electrical cooking appliances and to gain the confidence and skills to cook with electricity. This also implies financial constraints and skills are not involved in making the transition to cook exclusively with electricity.

The convenience of cooking with electricity (at least partly) appears to be an effective driver, which is consistent with the expectations of households of higher socio-economic status. Similarly, the health hazards of cooking with biomass fuels are more strongly felt by people cooking with electricity, which is consistent with higher levels of education.

Stated beliefs confirm that poor quality of supply acts as a barrier to people transitioning to cooking exclusively with electricity. Perceptions of cost do appear to play at least some role in this transition, as people yet to make the change are less likely to believe that cooking with electricity is cheap. People stacking electricity with other

fuels appear just as concerned about health hazards and convenience, suggesting there exists a latent demand for a clean alternative to biomass fuels. While the study has highlighted quality of supply as one barrier, there may be others associated with cooking practices, for example (e.g. the high temperature of charcoal may be needed for frying; large pots may not fit on electric hobs). The electrical tier capacity[7] appears to reflect the spending power of the household rather than the quality of supply.

The type of supply is important. It appears that households with non-metered supplies, most of which are provided by landlords and neighbours, are prohibited or discouraged from cooking. These may represent informal connections of poor quality that could pose a hazard if subject to heavy cooking loads, or it may simply be that landlords want to minimise their electricity bills, especially if electricity is included in the rent.

6.3 Gender implications

It is clear that the burden of cooking falls to women. However, interaction with female empowerment indicators is more complex. On the one hand, empowered women (able to go out on their own) tend to spend more time cooking, but on the other hand financially empowered women (income earners and bank account holders) spend less time cooking. There are myriad of intra-household gender dynamics involved in this relationship so it is not clear which is cause and effect. Nevertheless, the finding that women who cook exclusively with electricity are most likely to be engaged in some kind of income generation suggests that cooking exclusively with electricity liberates time for women to engage in income generating activities.

Purchasing decisions for high cost household items tend to be made jointly between men and women (household head and spouse), although women are the dominant decision maker when it comes to electric cookstoves.

7 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 Ethiopia 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.

7.1 References

Padam G, Rysankova D, Portale E, Bonsuk Koo B, Keller S, Fleurantin G, 2018 ETHIOPIA Energy Access Diagnostic Report Based on the Multi-Tier Framework, The World Bank (ESMAP) with external contributions SE4All, SREP.

[7] MTF methodology for assessing the quality of a connection according to the capacity of electrical appliances owned by the household.