# Discrete Choice Modelling Survey, Ghana

*Authors N Scott, S Batchelor, S Bawakyillenuo, T Jones*

*Gamos, Loughborough University, University of Ghana.*

*Draft Analysis for Comment, September 2019*

*This is the data and analysis report, intended to inform work strategies in Ghana.*

*It is a precursor to public promotional material and academic papers.*

## Contents


1 Introduction .... 4
2 Overview of data .... 5
2.1 Geographical locations .... 5
2.2 Respondent characteristics .... 6
2.2.1 Personal characteristics .... 6
2.2.2 Personal use of technology .... 7
2.2.3 Household characteristics .... 9
3 Characteristics of cooking practice .... 11
3.1 Meals and timing .... 11
3.2 Cooking fuels .... 14
3.3 Cooking devices .... 16
4 Fuel consumptions and costs .... 17
4.1 Electricity .... 17
4.2 LPG .... 19
4.3 Charcoal .... 21
4.4 Wood .... 24
4.5 Energy consumptions .... 25
4.6 Total expenditure on cooking fuels .... 28
4.7 Cooking times .... 28
5 Characteristics of household electricity supply .... 29
5.1 Sources of electricity .... 29
5.2 Household electrical appliances .... 29
5.3 Quality of supply .... 30
6 Beliefs and attitudes .... 32
6.1 Perceptions on fuels .... 32
6.2 Purchasing preferences .... 35
6.3 Cooking device preferences .... 36
7 Choices .... 37
7.1 Methodology .... 37
7.2 Discrete choice modelling results .... 38
7.2.1 Cooking processes .... 38
7.2.2 Stove .... 40
7.2.3 Device Functionality .... 41
7.3 Disaggregating choices .... 43

7.3.1 Cooking Processes ........................................................................................ 43
7.3.2 Stove Design ................................................................................................. 45
7.3.3 Device Functionality ...................................................................................... 47

# 1 Introduction

The primary purpose of the Discrete Choice Modelling surveys was to explore people's preferences regarding various aspects of the design and functionality of cooking devices. The survey has also been used to gather valuable data on cooking practices (e.g. the mix of fuels used and the timing of meals), and the quality of electricity supplies. Data on expenditure on cooking fuels is especially useful as this represents disposable income that can be substituted for modern fuel devices.

Discrete choice modelling was proposed as the theoretical construct to be used in these surveys, to identify the key characteristics (or parameters) that each product should have in order to find ready acceptance with consumers. The methodology has considerable advantages over stated preference, particularly in this case of exploring a market for a future product, as it is difficult for a consumer to state what they would like about a product if they do not yet have exposure to the product. Choice models are set up using choice cards, based on the key parameters identified, each of which has a limited number of 'levels'. The respondent must then choose one of the two cards presented. Discrete choice models predict the probability that an individual will choose an option, based on the levels of each parameter given in the option.

Parameters were divided into three sections covering cooking processes (e.g. speed of cooking), stove design (e.g. smoke emissions), and functionality (e.g. financing plans). Each section was assigned four or five parameters, each parameter having between 2 and 4 levels. Each section included a cost parameter (the capital cost of the device), which was considered to be a continuous variable. This enables willingness to pay figures to be calculated for different features of a cooking device. The analysis used binary logistic regression to fit predictive models to the data for each section. The results provide an understanding of the strength of preference for each attribute, reflecting how important it is in decision making.

Descriptor data was also gathered from respondents, such as age, gender, level of education and so on. Two composite descriptor variables have been calculated representing characteristics of households that might be expected to influence attitudes towards, and eventual adoption of, modern energy cooking devices. A poverty index has been calculated from five variables including the level of education of the respondent and the quality of the dwelling. A technological aptitude index has been calculated from variables representing personal use of media, phones and the internet services. Preferences have then been disaggregated by descriptors and indices to highlight particular aspects that may be more important to specific customer segments.

The surveys were carried out by a team of enumerators as face to face interviews and responses were recorded using the Kobo Collect Android application on a tablet.

# 2 Overview of data

## 2.1 Geographical locations

The sample of 252 was drawn from urban areas around Accra – see Table 1 and Figure 1. All respondents considered themselves to be living in an urban area.

*Table 1 Settlements and type of settlement*

| Town name | Frequency | Percent |
|---|---|---|
| Abokobi | 12 | 4.8 |
| Agbogba | 7 | 2.8 |
| Akweley - Kasoa | 21 | 8.3 |
| Ashongman | 9 | 3.6 |
| Colomba - Kasoa | 21 | 8.3 |
| Dome | 30 | 11.9 |
| Haatso | 26 | 10.3 |
| Kasoa | 84 | 33.3 |
| Kwabenya | 21 | 8.3 |
| Taifa | 21 | 8.3 |
| Total | 252 | 100.0 |

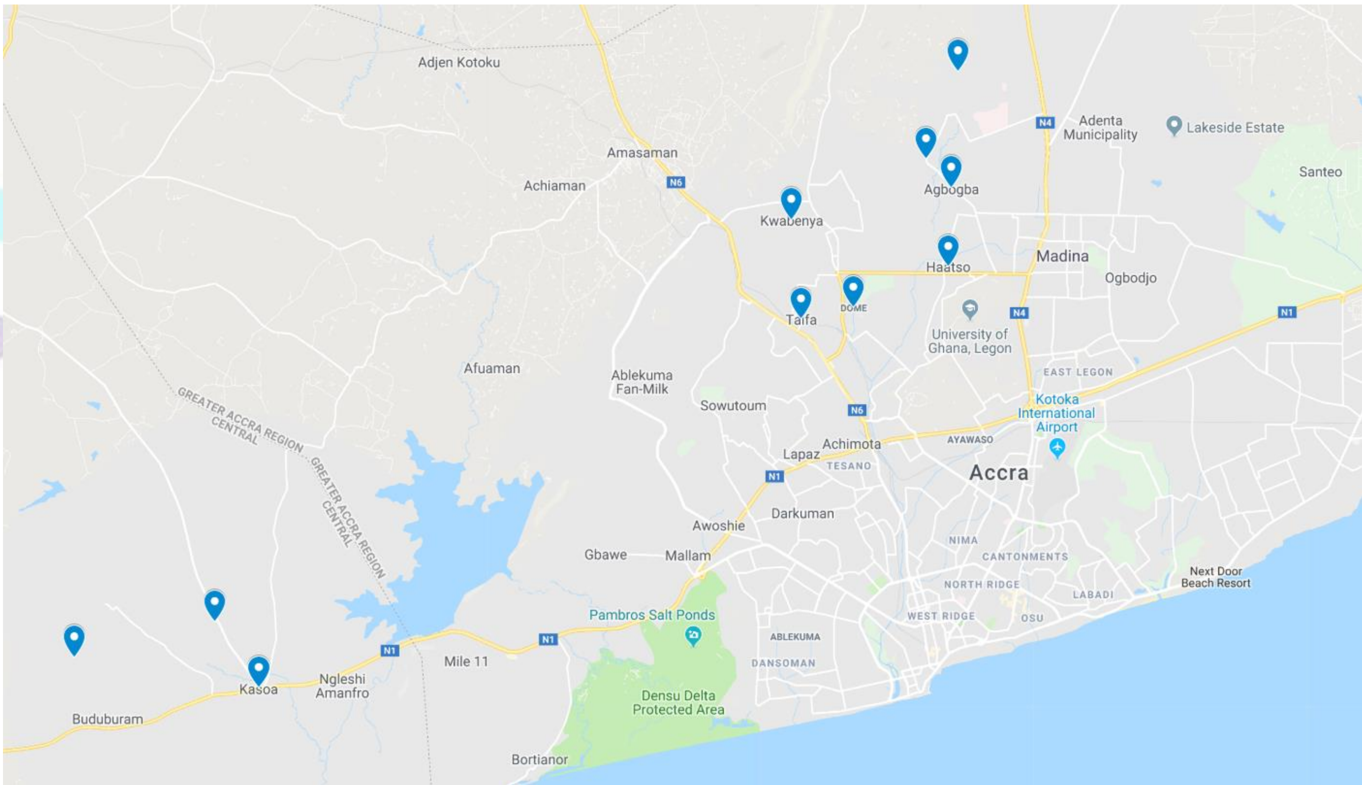



*Figure 1 Geographical spread of survey*

Table 2 shows that, despite living in urban settlements, households are still far from commercial centres. The average time taken to travel to the nearest market is around 30 minutes with 90% of respondents being within an hour's walk.

*Table 2 Remoteness - time taken to walk to nearest marketplace (minutes)*

| | |
|---|---|
| Mean | 33 |
| Median | 25 |
| Mode | 30 |
| Std. Deviation | 30 |

## 2.2 Respondent characteristics

### 2.2.1 Personal characteristics

The sample was evenly split – 50.4: 49.6 (male: female). 81.3% of respondents were either the head of household or the spouse of the head of household. The mean age of respondents was 36.4 years, but the sample included respondents of a wide age range – see Figure 2. The sample has a high educational status, given that over half of respondents had finished secondary school and almost one quarter had some form of post-secondary education (see Table 3).

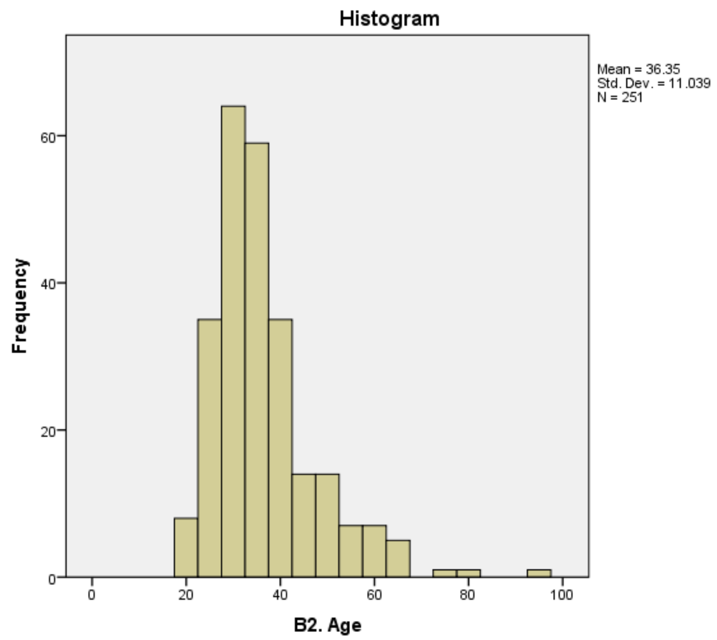



*Figure 2 Age distribution of respondents*

*Table 3 Highest level of education attained*

| | Frequency | Percent |
|---|---|---|
| none | 12 | 4.8 |
| incomplete primary | 14 | 5.6 |
| completed primary | 10 | 4.0 |
| incomplete secondary | 71 | 28.2 |

| | | |
|---|---|---|
| completed secondary | 85 | 33.7 |
| higher than secondary | 60 | 23.8 |
| Total | 252 | 100.0 |

## 2.2.2 Personal use of technology

Most respondents watch TV daily, more than listen to the radio daily (Table 4). Among respondents who access both media, use correlates positively, indicating that people who consume more media, consume more of both radio and TV ($r_s = 0.257$, $p<0.001$) i.e. they do not substitute for one another. 2% (n=6) were isolated in not accessing either of these types of broadcast media.

*Table 4 Frequency of use of broadcast media*

| | Radio | | TV | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| not at all | 23 | 9.1 | 18 | 7.1 |
| less than once a week | 25 | 9.9 | 13 | 5.2 |
| at least once a week | 55 | 21.8 | 39 | 15.5 |
| daily | 149 | 59.1 | 182 | 72.2 |
| Total | 252 | 100.0 | 252 | 100.0 |

Patterns of mobile phone use can serve as a proxy for technical proficiency and ability to adapt to technological innovations. 96.8% of respondents owned a mobile phone (or SIM card), and most of these were smartphones (Table 5). Nearly all respondents used a phone several times a day with only one respondent not using a phone at all (Table 6).

Literacy clearly acts as a barrier to fully exploiting the potential of mobile phones, but only 11% of respondents were not able to read SMS texts for themselves (n=28). However, 93% of these say they use a phone several times a day, indicating that literacy does not necessarily prevent people taking advantage of the phone.

*Table 5 Type of phone most commonly used*

| | | Frequency | Percent |
|---|---|---|---|
| | Basic phone | 63 | 25.0 |
| | Feature phone | 19 | 7.5 |
| | Smart phone | 169 | 67.1 |
| | Total | 251 | 99.6 |
| Missing | System | 1 | .4 |
| Total | | 252 | 100.0 |

*Table 6 Frequency of use of mobile phone (in last month)*

| | | Frequency | Percent |
|---|---|---|---|
| | not used | 1 | .4 |
| | weekly | 3 | 1.2 |
| | once or twice a day | 11 | 4.4 |

| | | | |
|---|---|---|---|
| | several times a day | 236 | 93.7 |
| | Total | 251 | 99.6 |
| Missing | System | 1 | .4 |
| Total | | 252 | 100.0 |

In terms of innovative services, Table 7 and Table 8 show that 68.2% of respondents used the internet yet 77.4% used social media services (e.g. Facebook, WhatsApp). This indicates that some social media users do not recognise this as use of the internet. Table 9 shows that those who access social media use it quite intensively with 66.2% using it several times a day. Table 10 indicates that the penetration of mobile money services is high (94.8% of respondents used).

*Table 7 Frequency of use of internet (in last month)*

| | | Frequency | Percent |
|---|---|---|---|
| Valid | not aware of internet | 6 | 2.4 |
| | not used | 74 | 29.4 |
| | weekly | 14 | 5.6 |
| | once or twice a day | 24 | 9.5 |
| | several times a day | 133 | 52.8 |
| | Total | 251 | 99.6 |
| Missing | System | 1 | .4 |
| Total | | 252 | 100.0 |

*Table 8 Use of social media (at all in the past)*

| | | Frequency | Percent |
|---|---|---|---|
| Valid | not aware of Facebook/WhatsApp | 3 | 1.2 |
| | No | 53 | 21.0 |
| | Yes | 195 | 77.4 |
| | Total | 251 | 99.6 |
| Missing | System | 1 | .4 |
| Total | | 252 | 100.0 |

*Table 9 Frequency of use of social media (among users)*

| | | Frequency | Valid Percent |
|---|---|---|---|
| Valid | no longer used | 30 | 15.4 |
| | weekly | 11 | 5.6 |
| | once or twice a day | 25 | 12.8 |
| | several times a day | 129 | 66.2 |
| | Total | 195 | 100.0 |
| Missing | System | 57 | |
| Total | | 252 | |

*Table 10 Frequency of use of MTN Mobile Money (or other)*

| | | Frequency | Percent |
|---|---|---|---|
| Valid | not used | 13 | 5.2 |
| | 1 or 2 times a month | 104 | 41.3 |
| | 3 - 10 times a month | 125 | 49.6 |

| | | | |
|---|---|---|---|
| | daily | 10 | 4.0 |
| | Total | 252 | 100.0 |

A factor analysis has been conducted on the following variables, which show a good deal of internal consistency (Cronbach alpha = 0.670):

- Frequency of use of mobile phone
- Type of phone used (including none)
- Ability to read SMS
- use of internet
- use of social media
- use of mobile money services

The factor analysis highlighted two distinct factors, one representing use of more advanced technology such as the internet, social media and high-end handsets, and the other representing everyday technologies, including use of mobile money and frequency of use of a phone. The sample has then been split into two roughly equal parts on the basis of the sum of these factor scores (see Table 11).

*Table 11 Composite technical proficiency classification*

| | | Frequency | Percent |
|---|---|---|---|
| Valid | low | 111 | 44.0 |
| | high | 138 | 54.8 |
| | Total | 249 | 98.8 |
| Missing | System | 3 | 1.2 |
| Total | | 252 | 100.0 |

## 2.2.3 Household characteristics

The mean household size was 4.35 (including children). The distribution of household sizes is presented in Figure 3. 44% of households had at least one child under the age of 5 years.

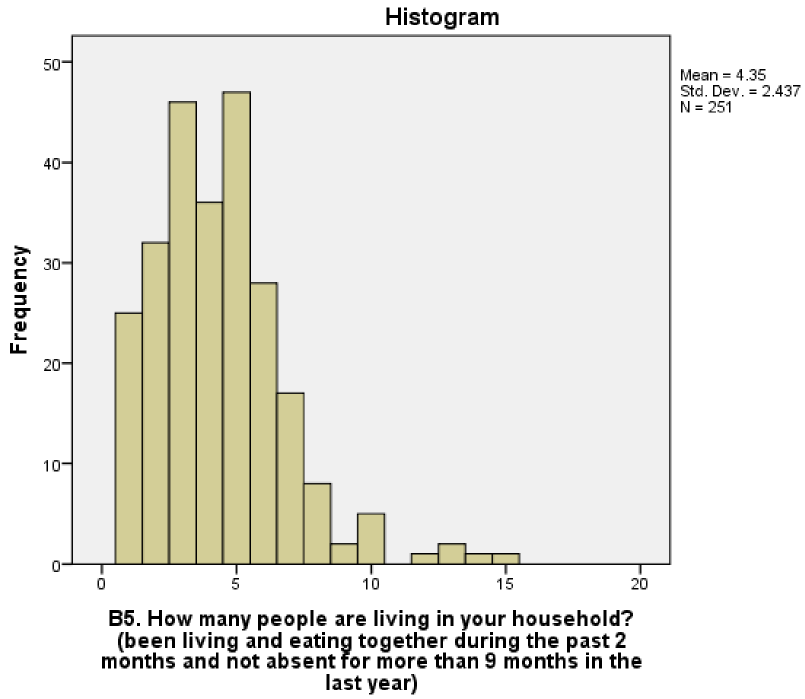



*Figure 3 Distribution of household size (adults + children)*

Details of dwelling constructions are presented in Table 12 to Table 14. The households' main sources of drinking water are presented in Table 15.

*Table 12 Dwelling construction – floor*

| | | Deprived | Frequency | Percent |
|---|---|---|---|---|
| Valid | Cement screed | | 151 | 59.9 |
| | Tiles | | 99 | 39.3 |
| | Other | X | 2 | .8 |
| | Total | | 252 | 100.0 |

*Table 13 Dwelling construction – walls*

| | | Deprived | Frequency | Percent |
|---|---|---|---|---|
| Valid | Wood / mud / thatch | X | 1 | .4 |
| | Mud bricks (traditional) | X | 1 | .4 |
| | Corrugated iron sheet | X | 1 | .4 |
| | cement block (plastered or unplastered) | | 248 | 98.4 |
| | Bricks (burnt) | | 1 | .4 |
| | Total | | 252 | 100.0 |

*Table 14 Dwelling construction – roof*

| | | Deprived | Frequency | Percent |
|---|---|---|---|---|
| Valid | Wood | X | 1 | .4 |
| | Corrugated iron / cement sheet | | 244 | 96.8 |
| | Cement | | 6 | 2.4 |
| | Tiles | | 1 | .4 |

| | | | | |
|---|---|---|---|---|
| | Total | | 252 | 100.0 |

*Table 15 Main source of drinking water*

| | | Deprived | Frequency | Percent |
|---|---|---|---|---|
| Valid | Piped into dwelling | | 3 | 1.2 |
| | Piped into yard | | 3 | 1.2 |
| | Public standpipe | | 8 | 3.2 |
| | Unprotected dug well | X | 1 | .4 |
| | Bottled water | | 7 | 2.8 |
| | Sachet | | 228 | 90.5 |
| | other | X | 2 | .8 |
| | Total | | 252 | 100.0 |

A poverty index has been created based on the following five variables:

- Level of education of respondent
- Dwelling construction materials (floor, walls and roof)
- Main source of drinking water.

Households have been classified as deprived as indicated in Table 12 to Table 15. They have been classified as deprived on the education indicator if the respondent had no education or primary education only. These five dichotomous indicators show no internal consistency, which is due to the high degree of homogeneity in dwelling characteristics (only two or three households use 'deprived' materials or have unprotected water supplies), and few respondents had low levels of education (Table 3). Nevertheless, a composite poverty index has been created by summing the number of aspects in which the household is deprived – see Table 16. For the purposes of the analysis, the sample has been split into two parts: 83% non-deprived, and 17% that are deprived in at least one indicator.

*Table 16 Composite Poverty index (max 5)*

| | Frequency | Percent |
|---|---|---|
| Non deprived | 210 | 83.3 |
| Deprived (at least one indicator) | 39 | 15.5 |
| Total | 252 | 100.0 |

# 3 Characteristics of cooking practice

## 3.1 Meals and timing

On average, households cooked 2.1 meals/day (mean). Households most commonly cooked two meals per day (median) (see Table 17).

*Table 17 Number of meals cooked per day*

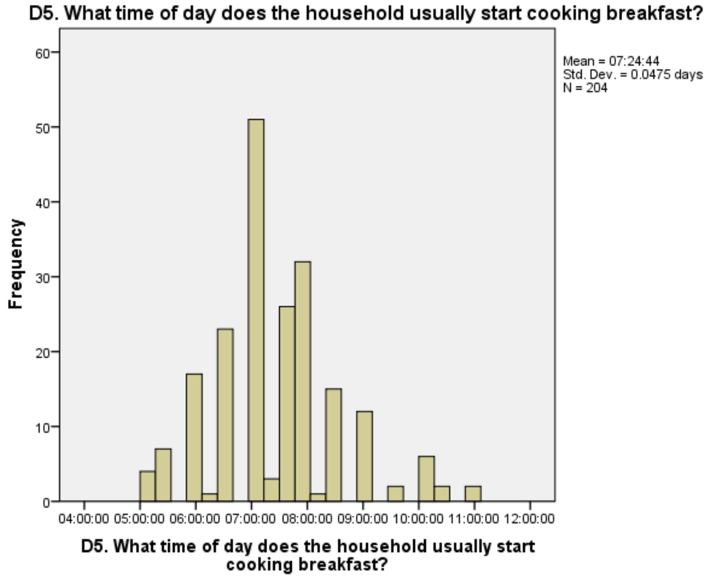
| Number of meals | Frequency | Percent |
|---|---|---|
| 1 | 54 | 21.4 |
| 2 | 120 | 47.6 |
| 3 | 74 | 29.4 |
| Total | 248 | 98.4 |
| Missing | 4 | 1.6 |
| Total | 252 | 100.0 |

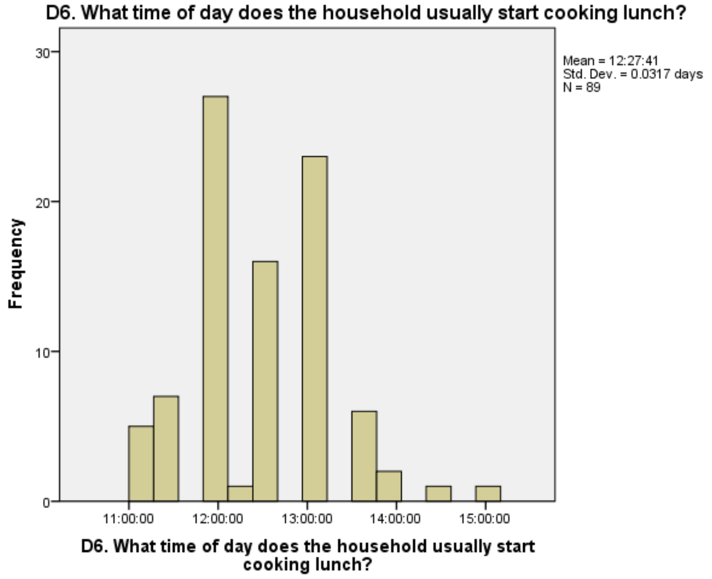
The most common times to start cooking meals (modes) were:

- Breakfast: 7.00
- Lunch: 12.00
- Dinner: 17.00

The distributions of starting times are presented in Figure 4 and show that 90% of households start cooking:

- breakfast between 6.00 and 9.30
- lunch between 11.30 and 13.30
- dinner between 15.00 and 18.30



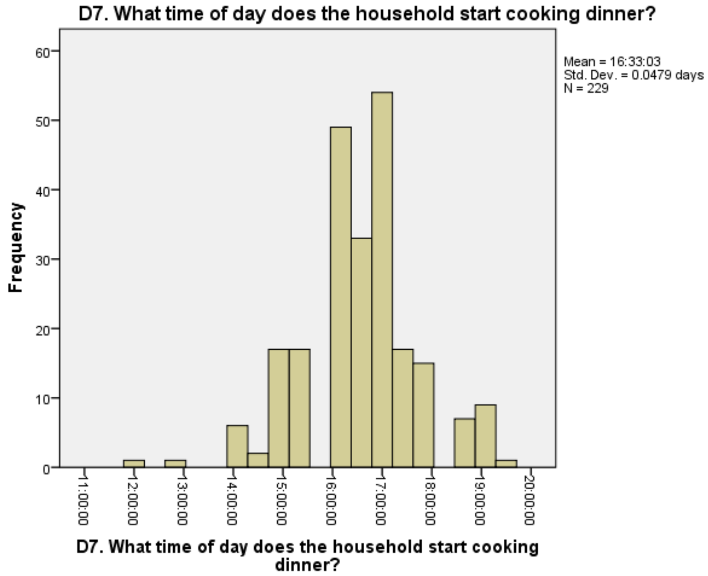



*Figure 4   Distribution of times for starting to prepare meals*

Households spend an average of 2.7 hours/day cooking (median = 2.5 hours/day). **Figure 5** shows that the mode is 2 hours/day. As might be expected, there is a strong correlation between time spent cooking and the number of meals cooked per day ($r = 0.688$, $p < 0.001$).

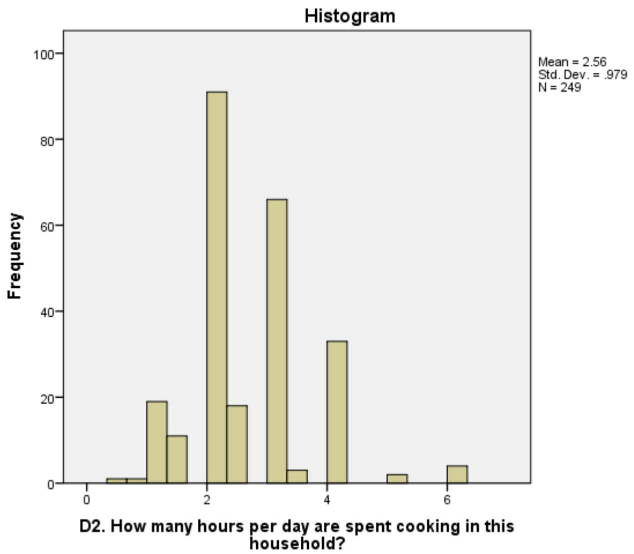



*Figure 5   Distribution of time spent cooking (hours/day)*

It appears that dinner is the most commonly cooked meal. When asked what time they start cooking breakfast, 81% of respondents gave an answer, 35% gave an answer for lunch and 91% for dinner. Note that the number of responses for these timings does not correspond with the number of meals typically cooked e.g. people who tend to cook only one meal per day may have given timings for two or three meals – it may not necessarily be the same meal that they cook each day, and there will be days in which they cook more than one meal.

In 87% of households, it was a woman who did most of the cooking, and in 10% of households a man did most of the cooking; only in 3% did men and women share cooking. The norm was for a female spouse of the head of the household to do the majority of the cooking (see Table 18).

*Table 18 Gender of persons who do the majority of cooking in the household[1]*

| Description | Gender | | | Total | Percent |
|---|---|---|---|---|---|
| | Male | Female | Both | | (n=248) |
| Head of household | 20 | 33 | 4 | 57 | 9% |
| Spouse of head | 1 | 151 | 7 | 159 | 64% |
| Other family member | 5 | 47 | 2 | 54 | 17% |
| Maid / cook | 0 | 4 | 0 | 69 | 28% |
| Other | 0 | 2 | 0 | 2 | 1% |

## 3.2 Cooking fuels

LPG and Charcoal were the most commonly used fuels for cooking (Table 19). Most households (71%) use more than one fuel for cooking (Table 20). Of the 58% of respondents who do not use electricity for cooking, 44% had some prior experience of cooking with electricity, suggesting that people are reasonably aware of how to cook with electricity.

Among households using only a single cooking fuel, a majority used charcoal – see Table 21. The combinations of cooking fuels among those households using multiple cooking fuels is presented in Table 22, along with the split of fuels regarded as the main cooking fuel. This shows that:

- Most people cooking with two fuels used LPG as one of the fuels. LPG was usually the main fuel.
- Charcoal was the only fuel used in conjunction with every other fuel.
- Where electricity was used for cooking, it was almost always used as a backup fuel.

*Table 19 Cooking fuels*

| Fuel | Fuels used[2] | | MAIN cooking fuel | |
|---|---|---|---|---|
| | Frequency | Percent (n=252) | Frequency | Percent (n=252) |
| Electricity | 105 | 42% | 2 | 1% |
| LPG | 188 | 75% | 154 | 61% |
| Charcoal | 189 | 75% | 95 | 38% |
| Wood | 6 | 2% | 0 | 0% |
| No food cooked | 1 | 0% | 1 | 0% |
| Other | 0 | 0% | 0 | 0% |
| Total | | | 252 | 100.0 |

*Table 20 Number of cooking fuels used*

| | Frequency | Percent |
|---|---|---|
| 1 | 73 | 29% |
| 2 | 121 | 48% |
| 3 | 58 | 23% |
| Total | 252 | 100% |

[1] This was asked as multiple response question, so totals add up to more than 100%.
[2] N.B. multiple response.

*Table 21 Cooking fuel used - household uses single fuel only*

| | Frequency | Percent |
|---|---|---|
| Electricity | 1 | 1% |
| Cylinder gas | 27 | 37% |
| Kerosene | 0 | 0% |
| Charcoal | 44 | 61% |
| Wood | 0 | 0% |
| No food cooked | 1 | 1% |
| Other | 0 | 0% |
| Total | 73 | 100.0 |

*Table 22 Combinations of fuels used for cooking (and MAIN cooking fuel)*

| | Number of people using fuel combination | Percent | Main cooking fuel breakdown | | |
|---|---|---|---|---|---|
| | | | Electricity | LPG | Charcoal |
| Electricity | 1 | 0.4% | 1 | - | - |
| LPG | 27 | 10.7% | - | 27 | - |
| Charcoal | 44 | 17.5% | - | - | 44 |
| Electricity & LPG | 34 | 13.5% | 1 | 33 | - |
| Electricity & charcoal | 13 | 5.2% | 0 | - | 13 |
| LPG & charcoal | 69 | 27.4% | - | 46 | 23 |
| Charcoal & wood | 5 | 2.0% | - | - | 5 |
| Electricity, LPG & charcoal | 57 | 22.6% | 0 | 48 | 9 |
| LPG, charcoal & wood | 1 | 0.4% | - | 0 | 1 |
| No cooking | 1 | 0.4% | - | - | - |
| Total | 252 | 100% | 2 | 154 | 95 |

Households tended to cook either indoors or both indoors and outdoors (Table 23) – fewer households cooked outdoors. Breaking location down by main cooking fuel shows that only charcoal is commonly used outdoors (Table 24). Note that 16% of households using charcoal as their main cooking fuel still cook indoors.

*Table 23 Cooking location (within the household)*

| | | Frequency | Valid Percent |
|---|---|---|---|
| Valid | Indoors | 114 | 45.6 |
| | Outdoors | 39 | 15.6 |
| | Both | 97 | 38.8 |
| | Total | 250 | 100.0 |
| Missing | System | 2 | |
| Total | | 252 | |

*Table 24 Cooking location broken down by main cooking fuels*

| Main cooking fuel | Cooking location | | | Total |
|---|---|---|---|---|
| | Indoors | Outdoors | Both | |
| Electricity | 2 | 0 | 0 | 2 |
| Cylinder gas | 97 | 3 | 54 | 154 |
| Charcoal | 15 | 36 | 43 | 94 |
| Total | 114 | 39 | 97 | 250 |

## 3.3 Cooking devices

*Among households in the sample, basic stoves are the most commonly used cooking device (Table 25), however the total number of biomass stoves (basic and improved) is approximately the same as the total number of gas devices (single / double burners and gas cooker). There is a wide variation in the number of cooking devices owned by households, with 78% owning more than one device (Table 26). Households owning 1 device were less likely to have gas or electric cookers and more likely to have basic stoves instead (*

Table 27).

*Table 25 Number of households owning cooking devices*

| Device | Frequency | Percent |
|---|---|---|
| 3 stone fire | 6 | 2% |
| Basic stove (wood, charcoal, dung etc.) | 143 | 57% |
| Improved biomass cookstove | 70 | 28% |
| use kerosene to light biomass stove | 0 | 0% |
| single kerosene burner | 0 | 0% |
| double kerosene burner | 0 | 0% |
| Gas burner (portable) - single | 70 | 28% |
| Gas burner (portable) - double | 54 | 21% |
| Gas cooker (rings and oven) | 88 | 35% |
| Gas oven | 2 | 1% |
| Electric hotplate - 1 hob | 3 | 1% |
| Electric hotplate - 2 hob | 0 | 0% |
| Electric hotplate - more than 2 hob | 0 | 0% |
| Electric Cooker (rings and oven) | 2 | 1% |
| Electric oven | 2 | 1% |
| Electric water heater | 39 | 11% |
| Microwave | 45 | 15% |
| Toaster | 25 | 10% |
| Rice cooker | 66 | 26% |
| Electric slow/multicooker (pressure cooker) | 2 | 1% |
| Other | 90 | 36% |

*Table 26 Number of cooking devices in the household*

| Number of cooking devices | Frequency | Valid Percent |
|---|---|---|

| | | |
|---|---|---|
| 0 | 1 | 0.4 |
| 1 | 55 | 21.8 |
| 2 | 83 | 32.9 |
| 3 | 47 | 18.7 |
| 4 | 21 | 8.3 |
| 5 | 21 | 8.3 |
| 6 | 14 | 5.6 |
| 7 | 8 | 3.2 |
| 8 | 2 | 0.8 |
| Total | 252 | 100.0 |

*Table 27 Number of households owning cooking devices – households with single device*

| Device | Frequency | Percent (n=55) |
|---|---|---|
| 3 stone fire | 0 | 0% |
| Basic stove (wood, charcoal, dung etc.) | 34 | 62% |
| Improved biomass cookstove | 5 | 9% |
| Gas burner (portable) - single | 6 | 11% |
| Gas burner (portable) - double | 9 | 16% |
| Gas cooker (rings and oven) | 1 | 2% |
| Total | 55 | 100% |

The survey also asked about non-cooking electrical appliances; among those households that cook with electricity (n=105), 92 households had fridges, and 93 had freezers (all of those with fridges also had freezers, so these probably represent fridge-freezers) i.e. 93 (89%) of households using electricity to cook had either a refrigerator or fridge-freezer.

# 4 Fuel consumptions and costs

## 4.1 Electricity

Nearly all households were connected to the national grid (Table 28). 23% of households have more than one source of electricity (Table 29). These are mostly national grid backed up with electric generators and rechargeable batteries. This leaves 2% with no electricity.

*Table 28 Sources of electricity*

| Source of electricity | Frequency | Percent (n=252) |
|---|---|---|
| National grid | 246 | 97% |
| Local mini-grid | 1 | 0% |
| Electric generator | 17 | 7% |
| Solar home system | 1 | 0% |
| Solar lantern / lighting | 10 | 4% |
| Rechargeable battery | 39 | 15% |
| No electricity | 4 | 2% |

*Table 29 Number of sources of electricity*

| | Frequency | Valid Percent |
|---|---|---|

| | | |
|---|---|---|
| 0 | 4 | 2 |
| 1 | 190 | 76 |
| 2 | 47 | 19 |
| 3 | 10 | 4 |
| Total | 251 | 100.0 |

*Table 30 Sources of electricity – households with 2 sources of electricity*

| Source of electricity | Frequency | Percent (n=47) |
|---|---|---|
| National grid | 47 | 100% |
| Local mini-grid | 1 | 2% |
| Electric generator | 10 | 21% |
| Solar home system | 0 | 0% |
| Solar lantern / lighting | 7 | 15% |
| Rechargeable battery | 29 | 62% |

Respondents were asked for their monthly expenditure on electricity and how many units they used each month. The mean average paid by national grid users was 94.5 GHS/month (USD 17.3/month[3]). The distribution presented in Figure 6 shows a broad range of monthly costs.

Respondents' estimates of energy consumptions (units used per month) were checked against consumption figures calculated from the monthly costs, which are likely to be recalled more reliably. Calculated consumptions were based on the following tariff structure[4]:

- 0-50 kWh 0.31 GHS/kWh
- 51-300 kWh 0.61 GHS/kWh
- 301-600 kWh 0.80 GHS/kWh
- > 601 kWh 0.89 GHS/kWh

The calculated consumptions correlated strongly with respondents' estimates ($r = 0.987$, $p < 0.001$), indicating that the estimates are reliable. Expenditure and unit consumption figures have been used to calculate the average equivalent unit price of electricity; the mode is 0.42 GHS/kWh, which in between the first two tariffs published by the Public Utilities Regulatory Commission.

[3] Exchange rate 5.57 GHS/USD.
[4] http://purc.com.gh/purc/sites/default/files/purc_approved_2019-2020_electricity__tariffs.pdf

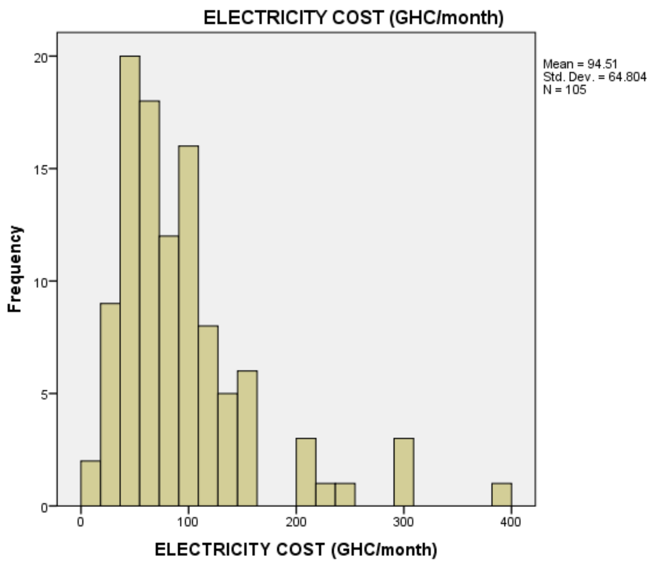



*Figure 6 Monthly expenditure on electricity (GHS/month) – National grid users*

## 4.2 LPG

Respondents appeared to use a wide range of refill sizes (

Table 31). The most common sizes were 4kg, 5kg and 10kg. 6 kg cylinders are commonly available, although larger cylinders can are available e.g. 12 kg[5], 15 kg, 35 kg and 45 kg[6] cylinders. The field survey team noted that people can ask for a cylinder to be partially refilled, depending on how much cash they have to spend. This explains why refill sizes do not necessarily correspond with standard cylinder sizes.

Respondents all paid different costs for their refills; however, these prices correlate well with refill size ($r = 0.994$, $p < 0.001$), indicating that data on refill sizes is reliable. The median calculated price is 7.5 GHS/kg and the range is relatively small.

Almost three quarters of respondents say their refill lasts less than two months (see Table 32). The mean monthly expenditure on LPG was 37 GHS/month (

[5] http://www.sigmagroupgh.com/products.html
[6] https://www.made-in-china.com/products-search/hot-china-products/Ghana_Lpg_Cylinder_Price.html

Table 33**Error! Reference source not found.** and Figure 7).

*Table 31 Size of LPG cylinder refills*

| Size (kg) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 3 | 18 | 9.7 | 9.7 |
| 4 | 29 | 15.7 | 25.4 |
| 5 | 29 | 15.7 | 41.1 |
| 6 | 5 | 2.7 | 43.8 |
| 7 | 14 | 7.6 | 51.4 |
| 8 | 11 | 5.9 | 57.3 |
| 9 | 15 | 8.1 | 65.4 |
| 10 | 35 | 18.9 | 84.3 |
| 11 | 8 | 4.3 | 88.6 |
| 12 | 5 | 2.7 | 91.4 |
| 13 | 12 | 6.5 | 97.8 |
| 14 | 1 | .5 | 98.4 |
| 15 | 1 | .5 | 98.9 |
| 16 | 1 | .5 | 99.5 |
| 17 | 1 | .5 | 100.0 |
| Total | 185 | 100.0 | |

*Table 32 Period of time that LPG cylinder lasts for (weeks)*

| How long a cylinder lasts (weeks) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 1 | 2 | 1.1 | 1.1 |
| 2 | 11 | 5.9 | 7.0 |
| 3 | 25 | 13.5 | 20.5 |
| 4 | 29 | 15.7 | 36.2 |
| 5 | 11 | 5.9 | 42.2 |
| 6 | 18 | 9.7 | 51.9 |
| 7 | 3 | 1.6 | 53.5 |
| 8 | 33 | 17.8 | 71.4 |
| 9 | 2 | 1.1 | 72.4 |
| 10 | 9 | 4.9 | 77.3 |
| 11 | 1 | .5 | 77.8 |
| 12 | 18 | 9.7 | 87.6 |
| 13 | 1 | .5 | 88.1 |
| 14 | 4 | 2.2 | 90.3 |
| 15 | 1 | .5 | 90.8 |
| 16 | 4 | 2.2 | 93.0 |
| 18 | 1 | .5 | 93.5 |
| 24 | 1 | .5 | 94.1 |
| 28 | 1 | .5 | 94.6 |
| 30 | 7 | 3.8 | 98.4 |
| 32 | 1 | .5 | 98.9 |
| 60 | 2 | 1.1 | 100.0 |
| Total | 185 | 100.0 | |

*Table 33 Monthly expenditure on LPG (GHS/month)*

| | |
|---|---|
| N | 185 |
| Mean | 37.19 |
| Median | 33.33 |
| Mode | 40 |
| Std. Deviation | 20.652 |
| 25th Percentile | 23.67 |
| 75th Percentile | 46.67 |

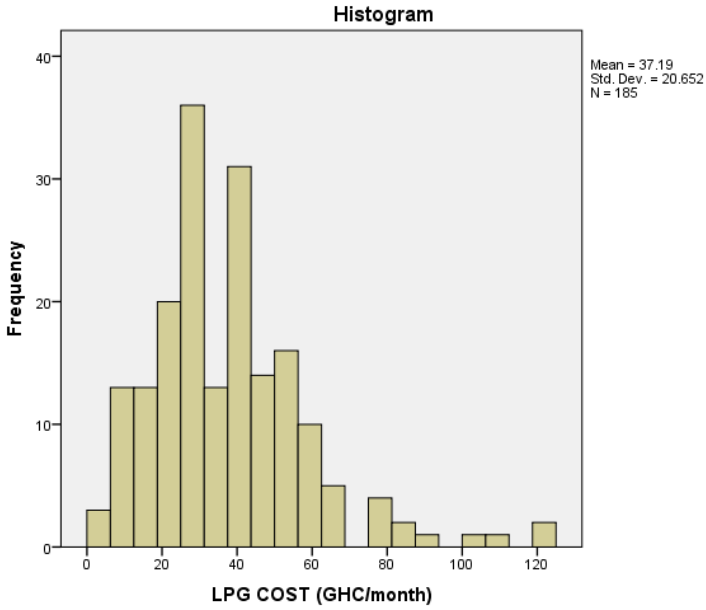



*Figure 7 Monthly expenditure on LPG (GHS/month)*

## 4.3 Charcoal

Only those respondents who used charcoal for cooking were asked for details of their consumption of charcoal. Charcoal consumption is difficult to assess because people usually buy it in a wide variety of measures e.g. tin, mini/maxi bag. However, the enumerators were able to calculate the amount of charcoal purchased in kg, based on the following capacities:

- Maxi bag (60kg)
- Mini bag (30kg)
- 1 tin (1kg)

Charcoal is most commonly bought in small quantities, between 1kg and 3kg – 71% of households buy 5 kg or charcoal or less (Table 34). Mini bags (30 kg) are bought more commonly than the maxi bag (60 kg). Among all charcoal users, there is a strong relationship between the price paid and the amount bought ($r = -0.379$, $p < 0.001$), confirming that those who buy in small quantities pay a premium. The median calculated price is 1.0 GHS/kg and the range of estimated unit prices paid is presented in Table 35.

Table 36 shows that 60% of respondents buy charcoal either every day or every two days. About 6% of respondents buy charcoal on a monthly basis and another 7% bimonthly.

The mean monthly expenditure on charcoal was 47 GHS/month (Table 37 and Figure 8).

*Table 34 Amounts of charcoal was bought (kg)*

| How much charcoal (kg) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 1 | 24 | 12.7 | 12.7 |
| 2 | 67 | 35.4 | 48.1 |
| 3 | 16 | 8.5 | 56.6 |
| 4 | 7 | 3.7 | 60.3 |
| 5 | 20 | 10.6 | 70.9 |
| 10 | 2 | 1.1 | 72.0 |
| 15 | 6 | 3.2 | 75.1 |
| 20 | 2 | 1.1 | 76.2 |
| 30 | 26 | 13.8 | 89.9 |
| 40 | 2 | 1.1 | 91.0 |
| 60 | 16 | 8.5 | 99.5 |
| 90 | 1 | .5 | 100.0 |
| Total | 189 | 100.0 | |
| Missing | 63 | | |
| Total | 252 | | |

*Table 35 Calculated price of charcoal (GHS/kg)*

| Calculated unit price (GHS/kg) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 0.70 | 5 | 2.6 | 2.6 |
| 0.72 | 1 | .5 | 3.2 |
| 0.75 | 4 | 2.1 | 5.3 |
| 0.78 | 5 | 2.6 | 7.9 |
| 0.83 | 1 | .5 | 8.5 |
| 1.00 | 144 | 76.2 | 84.7 |
| 1.03 | 7 | 3.7 | 88.4 |
| 1.07 | 15 | 7.9 | 96.3 |
| 1.17 | 5 | 2.6 | 98.9 |
| 1.33 | 2 | 1.1 | 100.0 |
| Total | 189 | 100.0 | |
| Missing | 63 | | |
| Total | 252 | | |

*Table 36 Period of time that charcoal lasts for (days)*

| How long a charcoal lasts (days) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 1 | 72 | 38.1 | 38.1 |
| 2 | 42 | 22.2 | 60.3 |
| 3 | 15 | 7.9 | 68.3 |
| 4 | 1 | .5 | 68.8 |
| 5 | 2 | 1.1 | 69.8 |
| 6 | 2 | 1.1 | 70.9 |
| 7 | 2 | 1.1 | 72.0 |
| 8 | 1 | .5 | 72.5 |
| 12 | 1 | .5 | 73.0 |
| 14 | 3 | 1.6 | 74.6 |
| 15 | 2 | 1.1 | 75.7 |
| 20 | 3 | 1.6 | 77.2 |
| 21 | 2 | 1.1 | 78.3 |
| 25 | 1 | .5 | 78.8 |
| 30 | 12 | 6.3 | 85.2 |
| 35 | 1 | .5 | 85.7 |
| 37 | 1 | .5 | 86.2 |
| 40 | 5 | 2.6 | 88.9 |
| 45 | 3 | 1.6 | 90.5 |
| 60 | 13 | 6.9 | 97.4 |
| 61 | 1 | .5 | 97.9 |
| 80 | 1 | .5 | 98.4 |
| 100 | 1 | .5 | 98.9 |
| 120 | 1 | .5 | 99.5 |
| 365 | 1 | .5 | 100.0 |
| Total | 189 | 100.0 | |
| Missing | 63 | | |
| Total | 252 | | |

*Table 37 Monthly expenditure on charcoal (GHS/month)*

| | |
|---|---|
| Valid | 189 |
| Missing | 63 |
| Mean | 46.75 |
| Median | 32 |
| Mode | 30 |
| Std. Deviation | 32.168 |
| 25th Percentile | 30.00 |
| 75th Percentile | 60.00 |

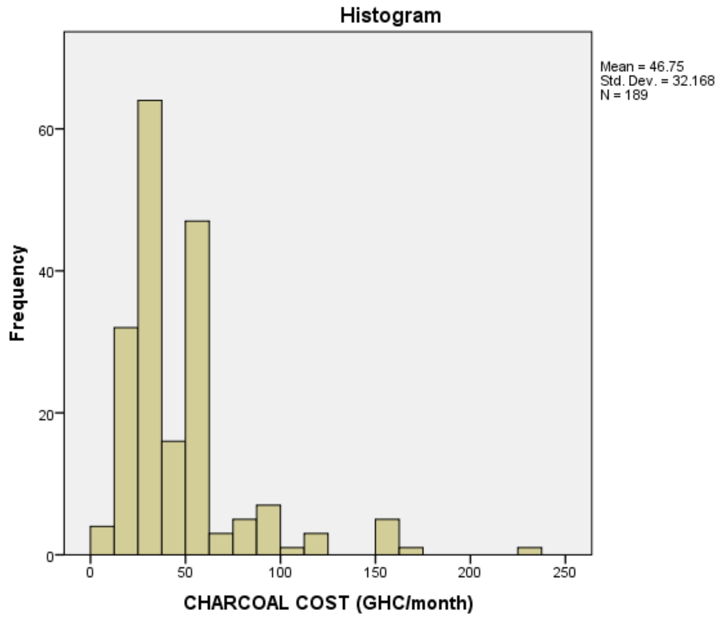



*Figure 8 Monthly expenditure on charcoal (GHS/month)*

## 4.4 Wood

Respondents who said they use wood for cooking were asked for details of their consumption of wood. Too few respondents use wood as their cooking fuel to make any clear observations about the buying habits and use of wood. Having said that, it is worth noting that 5 of the 6 respondents get through their wood supply within a week (Table 40), the unit price of wood is around 0.25 GHS/kg (

Table 39), and people tend to buy in smaller quantities (e.g. 12 kg, see Table 38). Furthermore, 4 say that collecting wood is a burden to the family.

The mean monthly expenditure on wood was 61 GHS/month (Table 41).

*Table 38 Amounts of wood purchased (kg)*

| How much wood (kg) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 12 | 3 | 50.0 | 50.0 |
| 37 | 1 | 16.7 | 66.7 |
| 61 | 1 | 16.7 | 83.3 |
| 74 | 1 | 16.7 | 100.0 |
| Total | 6 | 100.0 | |
| Missing | 246 | | |
| Total | 252 | | |

*Table 39 Calculated price of wood (GHS/kg)*

| Calculated unit price (GHS/kg) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 0.16 | 1 | 16.7 | 16.7 |
| 0.20 | 1 | 16.7 | 33.3 |
| 0.21 | 1 | 16.7 | 50.0 |
| 0.24 | 2 | 33.3 | 83.3 |
| 0.33 | 1 | 16.7 | 100.0 |
| Total | 6 | 100.0 | |
| Missing | 246 | | |
| Total | 252 | | |

*Table 40 Period of time that wood lasts for (days)*

| How long a wood lasts (weeks) | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| 1 | 2 | 33.3 | 33.3 |
| 3 | 1 | 16.7 | 50.0 |
| 4 | 1 | 16.7 | 66.7 |
| 7 | 1 | 16.7 | 83.3 |
| 10 | 1 | 16.7 | 100.0 |
| Total | 6 | 100.0 | |
| Missing | 246 | | |
| Total | 252 | | |

*Table 41 Monthly expenditure on wood (GHS/month)*

| | |
|---|---|
| Valid | 6 |
| Missing | 246 |
| Mean | 61 |
| Median | 55 |
| Mode | 90 |
| Std. Deviation | 24 |
| 25th Percentile | 40 |
| 75th Percentile | 90 |

## 4.5 Energy consumptions

Energy consumptions have been based on the calorific values given in Table 42.

*Table 42 Calorific values and conversion efficiencies[7]*

| **Fuel** | **Calorific value** |
|---|---|
| Electricity | 3.6 MJ/kWh |
| LPG | 44.8 MJ/kg |
| Charcoal | 29.9 MJ/kg |
| Wood | 15.9 MJ/kg |

[7] Source: World Bank (BLG14 Cooking Costs by Fuel Type.xlsx)

Figure 9 presents the total energy consumed in a month by all respondents. This clearly shows that shows that despite there being almost as many respondents using LPG as those using charcoal, a lot more energy is released through the burning of charcoal than LPG. Note that these fuels will be used for a range of uses other than cooking, and these are explored in Table 44.

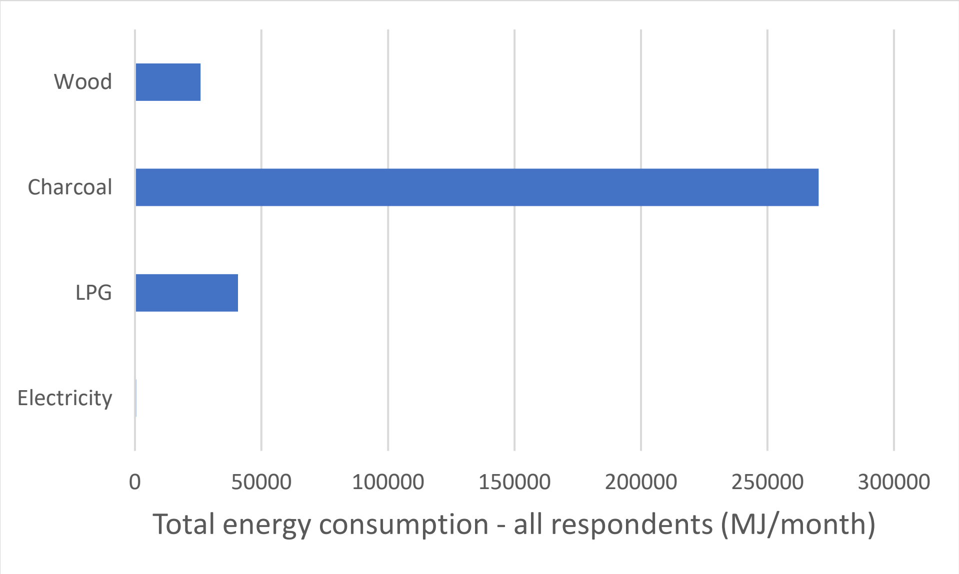



*Figure 9 Energy consumptions (totals)*

Energy consumptions have been divided by the number of household members to arrive at estimates of per capita energy consumptions for each fuel. Results in Figure 10 shows that, among respondents who use these fuels for cooking, the specific consumption of electricity is very low. While this graph simply considers the differences between different fuels, and takes no account of fuel stacking, when compared to Table 22 and Table 25. The low specific consumption of electricity confirms its role as a backup or supplementary fuel and the use of secondary appliances like rice cookers and toasters.

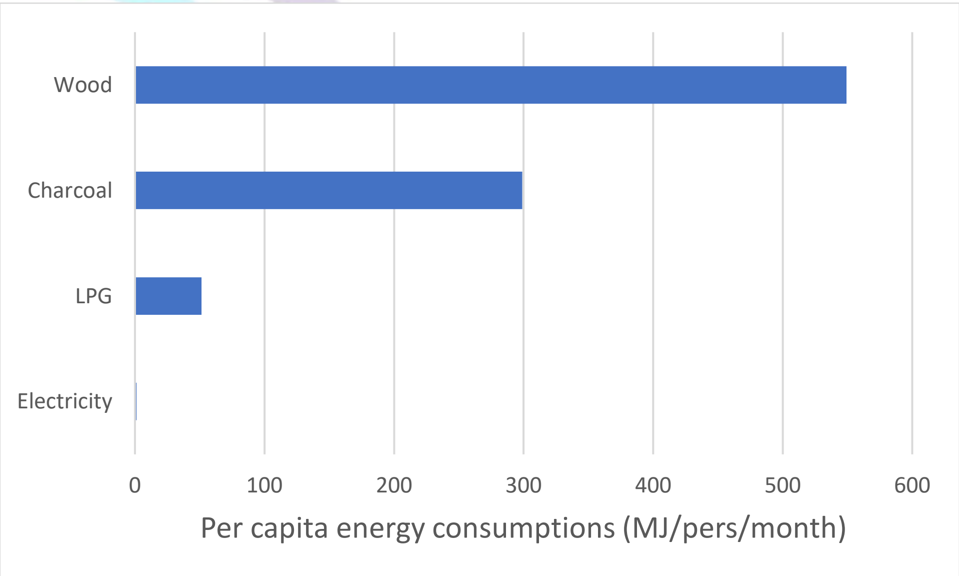



*Figure 10 Per capita energy consumptions (valid users)*

Table 43 shows how much energy it takes cook one meal for one person using LPG or charcoal. Only LPG and charcoal are compared as only 2 respondents use electricity as their main cooking fuel. These figures indicate that that cooking with charcoal uses six times as much energy as cooking with LPG.

*Table 43 LPG and charcoal energy consumption per capita per meal (MJ/person/month) – users of single fuel only*

| | LPG energy consumption per capita per meal (MJ/person/month) | Charcoal energy consumption per capita per meal (MJ/pers/month) |
|---|---|---|
| Valid | 27 | 44 |
| Mean | 50.2 | 317.5 |
| Median | 39.8 | 240.3 |
| Mode | 26.5 | 149.5 |
| Std. Deviation | 32.7 | 312.4 |
| 25 Percentile | 28.0 | 149.5 |
| 75 Percentile | 67.2 | 426.1 |

Charcoal and LPG are the most commonly used cooking fuels (Table 19), each used by 75% of households. The survey went on to explore additional uses of fuels that were used for cooking. Interestingly, of the 181 of LPG users and 176 of charcoal users who went on to answer the 'other uses' question, the percentage of respondent using the fuels for "water heating", "space heating" and "other" were the same. Further analysis showed that of the 99% of respondents who used either charcoal or LPG for cooking, 50% used both. Note that all fuels were widely used for heating water. Note that no data was gathered on what water was heated for (e.g. bathing, tea, purifying water), or what the associated energy consumption might be. A substantial minority of households used each of these fuels for 'other' purposes not specifically addressed in Table 44; further research is required to explore what these uses include.

*Table 44 Cooking fuels and non-cooking uses*

| | Used as cooking fuel | | Non-cooking uses of fuel | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Percent | Lighting | Refrigeration | Water heating | Space heating | Space cooling | Other |
| Electricity | 105 | 42% | 99% | 92% | 65% | 32% | n/a | 29% |
| LPG | 188 | 75% | 1% | 1% | 97% | 0% | n/a | 14% |
| Charcoal | 189 | 75% | n/a | n/a | 97% | 0% | n/a | 14% |
| Wood | 6 | 2% | n/a | n/a | 100% | 0% | n/a | 0% |

Table 44 shows that the respondents using LPG and charcoal for cooking also use them for water heating and a minority for 'other' uses. On the contrary, electricity is used as a fuel for cooking, for lighting, refrigeration, water heating and space heating. However, energy use of lighting and refrigeration will be minimal compared to that of water heating and space heating (thermal loads).

## 4.6 Total expenditure on cooking fuels

The purpose of this section is to calculate the disposable income that households spend on cooking fuels in a month. Expenditure figures include the cost of any non-cooking uses of cooking fuels. This is justified as follows:

- water is likely to be heated on the same device that food is cooked on, and water is most commonly heated for hot drinks that can be considered to be part of a meal.
- Non-thermal loads will be an order of magnitude lower than thermal loads (cooking and water heating).

Figure 11 shows that about 50% of households spend more than 70 GHS/month (13 USD/month). Note that this figure does not include households that cook with electricity and also use electricity for space heating.

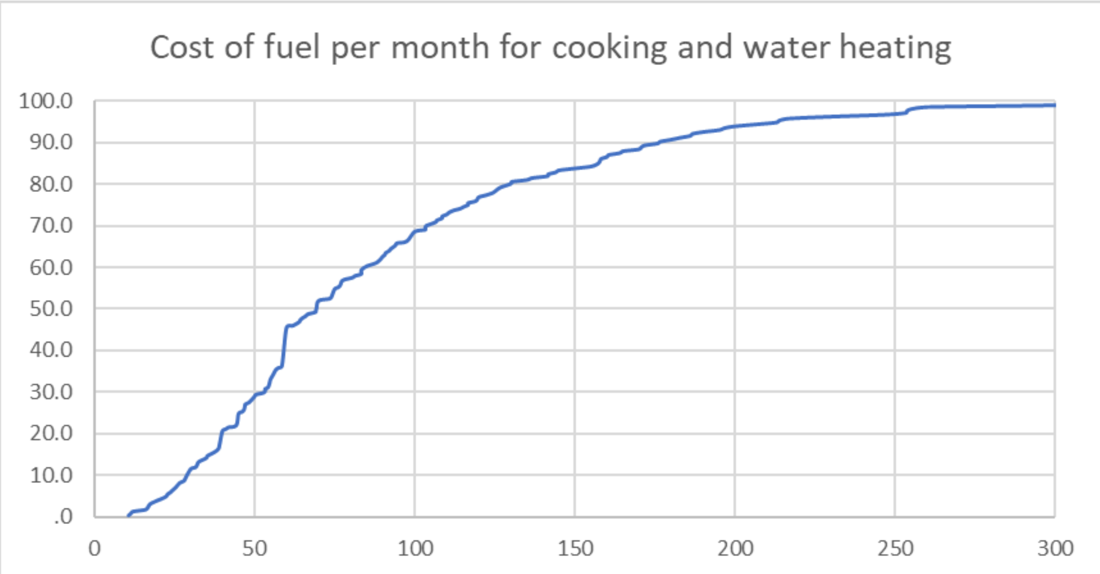



*Figure 11 Monthly expenditure - cumulative distribution*

## 4.7 Cooking times

Results in Table 45 suggests that there is no significant difference in the time take to cook using LPG compared to charcoal. The time spent cooking correlates strongly with the number of meals always cooked ($r = 0.705$, $p < 0.001$), suggesting that the time spent cooking depends on the demand for meals rather than the fuel used. A regression analysis confirms that time spent cooking depends mostly on number of meals cooked, but also on choice of fuel. However, the difference between LPG and charcoal are not significant.

*Table 45 Time spent cooking by choice of main cooking fuel*

| Main cooking fuel? | LPG (n) | Charcoal (n) | KW test (p value) |
|---|---|---|---|
| Time spent cooking (hour/day) | 2.61 (153) | 2.51 (94) | 0.64 |
| Number of people in household | 4.09 (153) | 4.84 (95) | 0.48 |
| Number of meals always cooked | 2.12 (153) | 2.04 (93) | 0.43 |

# 5 Characteristics of household electricity supply

## 5.1 Sources of electricity

1.6% of respondents had no electricity (n=4). Most respondents had a single source of electricity, but 23% had multiple sources (Table 46); all of these had a national grid connection and every other type of electricity source is accounted for aside from one rechargeable battery owner. This means that this rechargeable battery owner is the only person without a national grid connection other than the 4 respondents with no electricity.

*Table 46 Number of sources of electricity (excluding rechargeable and dry cell batteries)*

| | Frequency | Valid Percent |
|---|---|---|
| 0 | 4 | 1.6 |
| 1 | 190 | 75.7 |
| 2 | 47 | 18.7 |
| 3 | 10 | 4.0 |
| Total | 251 | 100.0 |
| Missing | 1 | |
| | 252 | |

*Table 47 Sources of electricity*

| Source | Frequency | Valid Percent |
|---|---|---|
| Grid connection | 246 | 98 |
| Local mini grid | 1 | 0.4 |
| Electric generator | 17 | 6.8 |
| Solar home system | 1 | 0.4 |
| Solar lantern | 10 | 4 |
| Rechargeable batteries | 39 | 15.5 |
| No electricity | 4 | 1.6 |

Respondents with connections to the national grid or to any type of mini grid were asked to give details of the type of connection; results in Table 48 show that nearly all respondents had a direct connection to the national grid supply.

*Table 48 Type of connections*

| **Source** | Connection is informal | Direct connection from provider | Total |
|---|---|---|---|
| Grid connection | 7 | 239 | 246 |
| Local mini grid | 0 | 1 | 1 |

## 5.2 Household electrical appliances

Only those respondents who said they had electricity were asked which appliances they had – see Table 49.

*Table 49 Household ownership of electrical appliances*

| Appliance | Frequency | Valid percent |
|---|---|---|
| Radio (battery powered) | 107 | 43.3 |
| Music system (mains powered) | 172 | 69.6 |
| Mobile phone | 243 | 98.4 |
| Non mobile phone | 1 | 0.4 |
| Television | 232 | 93.9 |
| refrigerator | 197 | 79.8 |
| Electric kettle | 98 | 39.7 |
| Electric water heater | 42 | 17 |
| fan | 236 | 95.5 |
| Air conditioner | 35 | 14.2 |
| Electric lights | 239 | 96.8 |

## 5.3 Quality of supply

Respondents who accessed electricity via the national grid or any type of mini grid (see Table 50) were asked a series of questions relating to quality of supply. Note that the 1 respondent with a mini grid connection also has a national grid connection so has been classified under 'national grid'.

*Table 50 Respondents accessing electricity from a grid*[8]

| | Frequency | Percent |
|---|---|---|
| No | 6 | 2.4 |
| National grid | 246 | 97.6 |
| Total | 252 | 100.0 |

Table 51 shows that only 3.6% of respondents connected to the national grid say they do not experience blackouts. There is a slight seasonal trend in which respondents say that they experience more blackout in summer: there are 12% more blackouts in summer than winter.

In Table 52, 28% of respondents will experience blackouts twice a month or less, 22% once a week and 24% twice a week. About 50% of these blackouts last less than 2 hours and 11% last an entire day (Table 53).

[8] N.B. household having access to both national and mini grids have been classified as 'National grid' on the basis that they are likely to source most of their energy from the national grid.

*Table 51 Months in which load shedding is experienced (National grid users)*

| | Frequency | Valid percent (n=245) |
|---|---|---|
| Jan | 149 | 60.6% |
| Feb | 160 | 65% |
| Mar | 162 | 65.9% |
| Apr | 170 | 69.1% |
| May | 171 | 69.5% |
| Jun | 174 | 70.7% |
| Jul | 178 | 72.4% |
| Aug | 173 | 70.3% |
| Sep | 166 | 67.5% |
| Oct | 169 | 68.7% |
| Nov | 162 | 65.9% |
| Dec | 158 | 64.2% |
| No Blackouts | 9 | 3.6% |

*Table 52 Frequency of blackouts (National grid users)*

| | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| once a month | 25 | 10.2 | 10.2 |
| twice a month | 44 | 17.9 | 28.0 |
| once a week | 54 | 22.0 | 50.0 |
| twice a week | 60 | 24.4 | 74.4 |
| every other day | 51 | 20.7 | 95.1 |
| every day | 3 | 1.2 | 96.3 |
| twice a day | 2 | .8 | 97.2 |
| many times, a day | 3 | 1.2 | 98.4 |
| No blackouts | 4 | 1.6 | 100.0 |
| Total | 246 | 100.0 | |

*Table 53 Duration of blackouts (National grid users)*

| | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| under 5 minutes | 1 | 0.4 | .4 |
| 10 mins | 13 | 5.3 | 5.7 |
| 30 mins | 43 | 17.5 | 23.2 |
| 1 hour | 33 | 13.4 | 36.6 |
| 2 hours | 44 | 17.9 | 54.5 |
| 4 hours | 39 | 15.9 | 70.3 |
| 8 hours | 41 | 16.7 | 87.0 |
| 1 day | 28 | 11.4 | 98.4 |
| No blackouts | 4 | 1.6 | 100.0 |
| Total | 246 | 100.0 | |

Among national grid users, 25% had received some kind of information about a schedule for load shedding (Table 54). Among those who did receive information, most got this information via the radio or from social networks (neighbours) (Table 55).

*Table 54 Received information on load shedding schedule (National grid users who have experienced load shedding)*

| Load shedding information | Frequency | Percent |
|---|---|---|
| Yes | 19 | 7.7 |
| Sometimes | 42 | 17.1 |
| No | 185 | 75.2 |
| Total | 246 | 100.0 |

*Table 55 Sources of information on load shedding schedules*

| | Frequency | Valid percent[9] (n=61) |
|---|---|---|
| radio | 52 | 85.2 |
| Printed notice | 0 | 0 |
| newspapers | 9 | 14.7 |
| internet | 10 | 16.4 |
| SMS | 0 | 0 |
| neighbours | 26 | 42.6 |
| other | 0 | 0 |

# 6 Beliefs and attitudes

## 6.1 Perceptions on fuels

Figure 12 and Figure 13 indicate that respondents regard charcoal and LPG as being easy to access, but only charcoal was generally regarded as safe (N.B. electricity was not included in these questions). It is interesting to note that LPG was regarded as the least safe fuel overall, reflecting some kind of negative experiences to date. Over half of respondents said that firewood is either difficult to access or they had no opinion, which most likely reflects that all respondent live in an urban area, remote from wood sources.

A further set of questions on various aspects of different fuels provide further insights (see Figure 14):

- At face value, there was no consensus on smoke being a health problem or whether smoke repels insects. However, charcoal wasn't regarded as being harmful to health, but wood was.
- Charcoal appears to be more convenient that firewood (N.B. these two questions were asked in opposite senses), with the minority of wood users agreeing it is a burden to collect.
- There was greatest agreement that electricity is expensive for cooking, less so for LPG, and wood appears to be regarded as the cheapest fuel (out of these three only).

[9] Questions were asked of those receiving information.

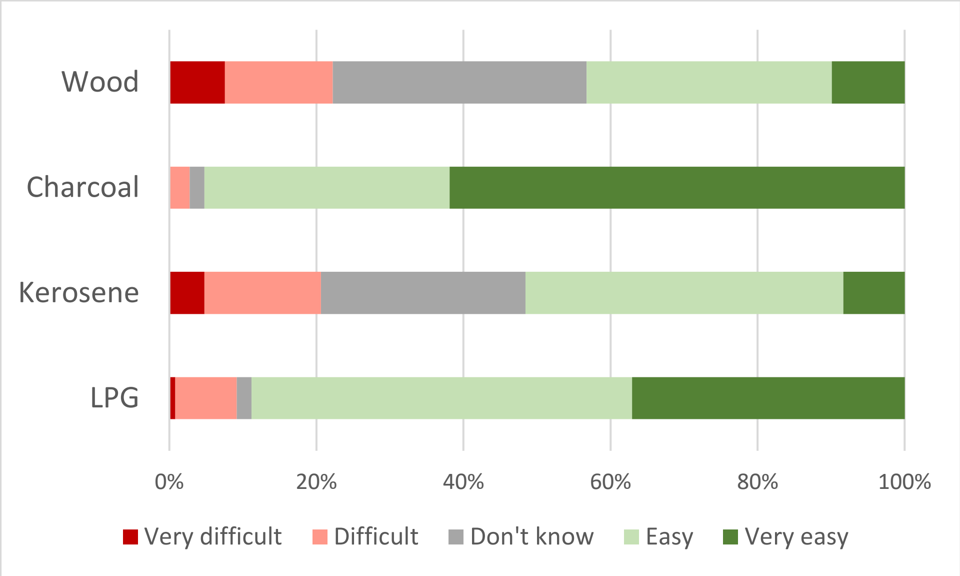



*Figure 12 Ease of access to fuels*

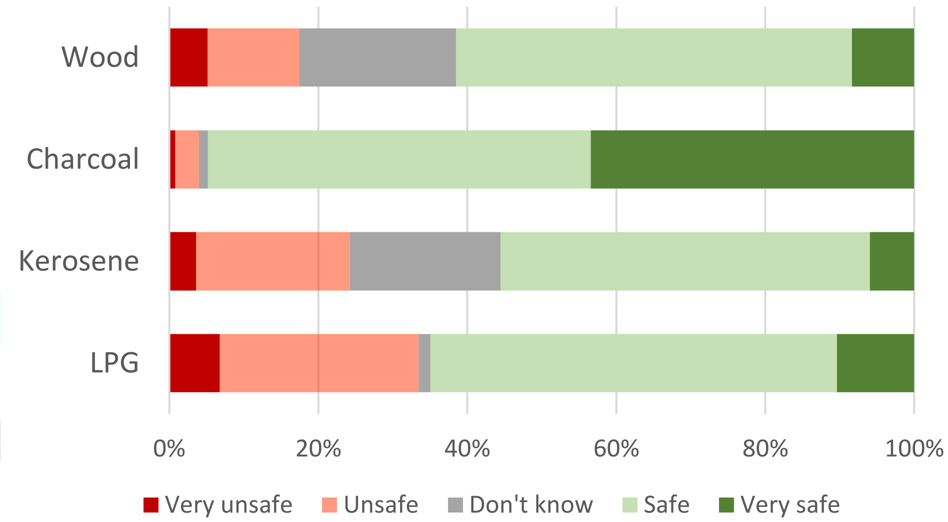



*Figure 13 Safety of fuels*

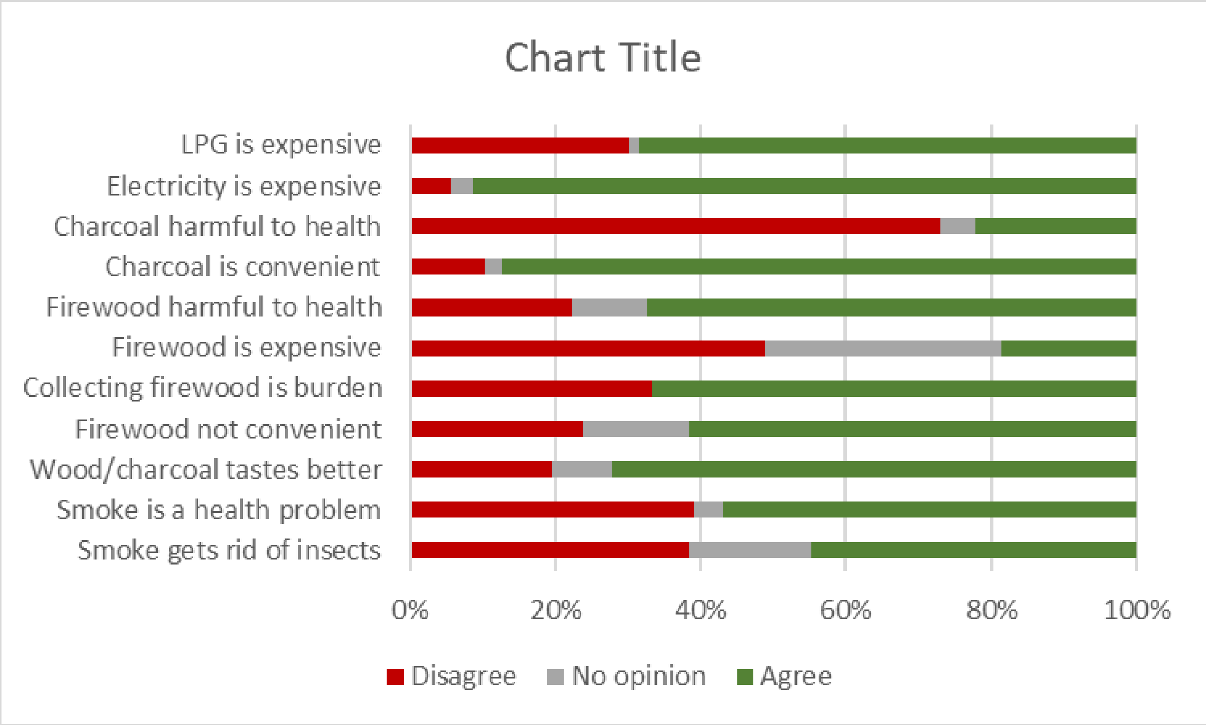



*Figure 14 Perceptions of fuels*

Mean attitude scores have been calculated for groups of respondents that use either LPG or charcoal as their main cooking fuel (Table 56). Electricity and wood were not included in this table as there was only 1 respondent who used electricity as their main cooking fuel and none who use wood. The following relationships can be seen:

- LPG users tend to regard it as a safe fuel, unlike charcoal users, suggesting that negative perceptions on safety act as a barrier to use of LPG.
- Both LPG and charcoal users did not think cooking with charcoal presents health risks but cooking with wood does.
- People who use charcoal consider it significantly more convenient to use charcoal compared to LPG users.
- The respondents seem to think firewood is not expensive meaning they are choosing not to use it as a cooking fuel for other reasons, perhaps health concerns or because they do not view it as convenient.
- Both groups agree that electricity is expensive.

*Table 56 Attitudes by choice of main cooking fuel (mean values)*

| | Range | What is your MAIN cooking fuel? | | M-W P value |
|---|---|---|---|---|
| N | | LPG (154) | Charcoal (95) | |
| How easy is it to access LPG? | -2 to +2 | 1.25 | 0.98 | .001 |
| How easy is it to access kerosene? | -2 to +2 | 0.25 | 0.47 | .038 |
| How easy is it to access charcoal? | -2 to +2 | 1.44 | 1.73 | .001 |
| How easy is it to access wood? | -2 to +2 | 0.06 | 0.48 | .002 |
| How safe is LPG? | -2 to +2 | 0.69 | -0.20 | .000 |
| How safe is kerosene? | -2 to +2 | 0.29 | 0.39 | .548 |
| How safe is charcoal? | -2 to +2 | 1.22 | 1.52 | .002 |
| How safe is wood? | -2 to +2 | 0.38 | 0.60 | .145 |
| Smoke from stove is good at chasing insects away. | -1 to +1 | -0.01 | 0.18 | .117 |
| Smoke from cooking fuels is a big health problem. | -1 to +1 | 0.20 | 0.14 | .632 |
| food tastes better when cooked with charcoal/wood | -1 to +1 | 0.60 | 0.42 | .080 |
| Cooking with firewood is not convenient. | -1 to +1 | 0.36 | 0.43 | .575 |
| Firewood is expensive for cooking. | -1 to +1 | -0.29 | -0.32 | .838 |
| Cooking with firewood is harmful to health. | -1 to +1 | 0.45 | 0.45 | .990 |
| Charcoal is convenient to use for cooking. | -1 to +1 | 0.70 | 0.88 | .020 |
| Cooking with charcoal is harmful to health. | -1 to +1 | -0.45 | -0.60 | .144 |
| Electricity is expensive for cooking. | -1 to +1 | 0.83 | 0.89 | .760 |
| LPG is expensive for cooking. | -1 to +1 | 0.33 | 0.46 | .328 |

## 6.2 Purchasing preferences

When it comes to purchasing substantial household items, women are highly likely to be involved in purchasing a cooker (in 69% of cases the female head of household would be involved), but it was men who were more likely to be involved in purchasing a solar panel (men would be involved in 80% of cases, compared with involvement of women in 37% of cases) (Table 57).

*Table 57 Main decision maker for hypothetical household purchases*

| | Cooking device | | Solar panel | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| male head of house | 67 | 26.6 | 151 | 59.9 |
| female head of house | 101 | 40.1 | 44 | 17.5 |
| joint decision | 73 | 29.0 | 50 | 19.8 |
| another relative | 8 | 3.2 | 6 | 2.4 |
| Total | 249 | | 251 | |

A clear majority of respondents felt that people would be opposed to renting equipment rather than buying it – see Table 58. However, 74% of respondents would prefer to pay for high value purchases (not specified) by monthly instalments rather than paying the total cost up front, implying the issue is with renting the equipment (not owning it) rather than not wanting to pay in instalments. The vast majority of respondents (82%), if paying in instalments, would prefer to make monthly payments rather than weekly or quarterly payments (every 3 months).

*Table 58 How would people in your neighbourhood feel about the idea of renting equipment?*

| | Frequency | Percent |
|---|---|---|
| Very opposed | 40 | 15.9 |
| Opposed | 122 | 48.4 |
| No opinion | 43 | 17.1 |
| Positive | 42 | 16.7 |
| Very positive | 5 | 2.0 |
| Total | 252 | 100.0 |

## 6.3 Cooking device preferences

Overall, there appears to be a strong appetite from respondents for cooking with some form of modern energy if the cost were the same as the cost of using their current fuels (see Table 59).

*Table 59 How many people would switch to modern energy (gas/electric) if fuels cost were the same*

| | Frequency | Percent |
|---|---|---|
| none | 1 | .4 |
| a few people | 18 | 7.1 |
| some people | 48 | 19.0 |
| many people | 177 | 70.2 |
| Don't know | 8 | 3.2 |
| Total | 252 | 100.0 |

On details of any proposed design, 83% of respondents felt there was a need for a device to accommodate very large pots as well as medium sized ones. There was a preference for a square and circular designs (41% voted for design A, 36% for design B, and 23% for design C in Figure 15). There was mixed support (46% positive and 46% negative with 8% neutral) for the idea of using cooking appliances being provided by the electricity utility company (see Table 60).

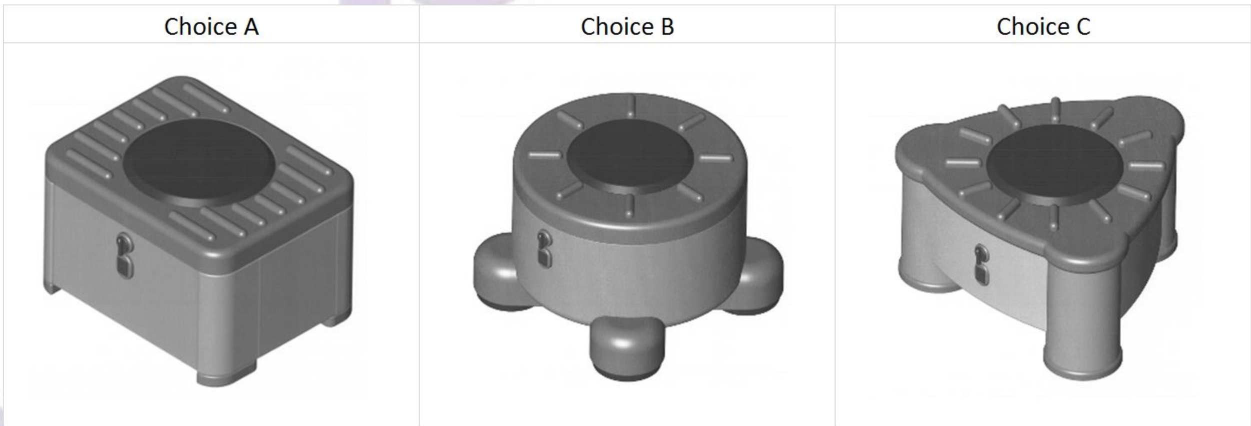



*Figure 15 Hypothetical cooking device design options*

*Table 60 How would you feel about using cooking appliances provided by the electricity utility?*

| | Frequency | Percent |
|---|---|---|
| Very opposed | 38 | 15.1 |
| Opposed | 78 | 31.0 |
| No opinion | 19 | 7.5 |
| Positive | 112 | 44.4 |
| Very positive | 5 | 2.0 |
| Total | 252 | 100.0 |

# 7 Choices

## 7.1 Methodology

Discrete choice modelling was used as a means of exploring the key characteristics (or parameters) that cooking devices should have in order to find ready acceptance with consumers. Choice models are set up using choice cards, based on the key parameters identified, each of which has a limited number of 'levels'. The respondent must then choose one of the two cards presented. Discrete choice models predict the probability that an individual will choose an option, based on the levels of each parameter given in the option.

Three sets of choices were posed to respondents, representing different aspects of cooking device design:

- Cooking processes – boiling and frying, speed (power), use of lid, number of hobs
- Stove – capacity, smoke emissions, portability and looks
- Additional functionality – lights, mobile phone charging, TV, financing options, ability to clean.

Fractional orthogonal design[10] was used to limit the number of choices to 16 choice cards per design aspect (Mangham, Hanson, & McPake, 2009). A simple constant comparator approach was used (De Bekker-Grob et al., 2010), in which one of the 16 choice cards was used as a 'reference'[11], and the 15 resulting pairs presented respondents with a choice between this comparator and each of the other choice cards. The literature suggests that respondents get fatigued when presented with too many choices, and a review suggested studies rarely used more than 16 choices (De Bekker-Grob, Ryan, & Gerard, 2012). For each technology the choice cards were therefore split in two sets (with 7 & 8 pairs in each), included in a Questionnaire A and Questionnaire B. Previous experience suggests that respondents can then successfully move on to further sets of 7 or 8 pairs of choices.

The analysis used binary logistic regression to fit predictive models to the data for each technology because the dependent variable was a dichotomous categorical variable (representing whether the choice card was chosen or not). All of the parameters were entered into the model, which calculated regression coefficients for each, along with p values indicating whether the parameter was significant in the model. The modelling was done using SPSS, and the output tables are presented

[10] Using SPSS software.

[11] The constant comparator choice card was selected on the basis that the mix of levels represented a mid-level of attractiveness, so one would expect the number of times the comparator was chosen and reject to be roughly balanced.

in Section 7.2. The two main figures to look for in these tables are the beta coefficients (B), which reflect the strength of preference for each attribute, and whether each coefficient is significant in the model (Sig). If a variable is significant (Sig<0.05), then the larger the B value (positive or negative), the more important it is in the making a choice. Other statistics presented include the standard error (S.E.), which is a measure of how precise the beta value is likely to be – a large standard error means that that the actual beta value may lie within a wider range. The odds ratio (Exp(B)) is the change in odds resulting from a unit change in the predictor variable, and is another measure of the influence the variable has on people's choice, as is the Wald statistic. As all variables have been separated out into dichotomous dummy variables, the degrees of freedom (df) for all variables is 1.

Where the cost variable is significant in a model, a measure of willingness to pay (also known as implicit price) can be derived for each attribute from the ratio of the coefficients (Hanley, Mourato, & Wright, 2001):

$$WTP = \frac{-\beta_x}{\beta_c}$$

where:

$\beta_x$ = coefficient of any parameter

$\beta_c$ = coefficient of cost parameter

## 7.2 Discrete choice modelling results

### 7.2.1 Cooking processes

The variables used in the analysis are:

CPCooking:
- 0 = boil only
- 1 = boil & fry

CPSpeedMed
- 0 = slow
- 1 = normal

CPSpeedfast
- 0 = slow
- 1 = fast

CPFlavour
- 0 = no smoky flavour
- 1 = smoky flavour

CPPotlid
- 0 = no lid
- 1 = pot with lid

CPPot sealed
- 0 = no lid
- 1 = sealed pot

CP2hob:
- 0 = 1 hob

1 = 2 hob

CP4hob:

0 = 1 hob

1 = 4 hob

Results from the binary logistic regression are presented in Table 61.

*Table 61 Binary logistic regression – cooking processes*

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 1[a] | CPCooking(1) | 1.268 | .124 | 104.076 | 1 | .000 | 3.553 |
| | CPSpeedMed(1) | .525 | .146 | 12.856 | 1 | .000 | 1.690 |
| | CPSpeedFast(1) | .238 | .156 | 2.328 | 1 | .127 | 1.269 |
| | CPFlavour(1) | -.807 | .140 | 33.447 | 1 | .000 | .446 |
| | CPPotLid(1) | 1.362 | .178 | 58.204 | 1 | .000 | 3.903 |
| | CPPotSealed(1) | -.203 | .164 | 1.531 | 1 | .216 | .816 |
| | CP2hob(1) | 1.120 | .135 | 68.955 | 1 | .000 | 3.066 |
| | CP4hob(1) | .340 | .175 | 3.768 | 1 | .052 | 1.405 |
| | CPCOSTC | -.937 | .211 | 19.771 | 1 | .000 | .392 |
| | Constant | -1.779 | .193 | 85.219 | 1 | .000 | .169 |

Note: Compared against a constant only model, the model was significant ($\chi^2$ = 1502, $p < 0.001$, with df = 9); Nagelkerke $R^2$ = 0.437. Prediction success = 79.9%.

Those design features that appear to be most important to consumers are (see Table 62 for estimates of willingness to pay):

- Cooking – prefer to be able to both boil and fry
- Lid – people have a strong preference for a lid, but not for a sealed pot
- Hobs – people prefer double hobs, but interestingly people did not appear to have much of a preference for 4 hobs over a single hob.
- Taste – there was a clear preference for a device that does not make food taste smoky.
- Cost – preference for low cost device.

*Table 62 Willingness to pay for priority characteristics - cooking process*

| Feature | WTP (GHS) |
|---|---|
| Pot with Lid | 145 |
| Boil and fry | 135 |
| 2 hobs | 120 |
| No smoky flavour | 86 |
| Medium cooking speed | 56 |

### 7.2.2 Stove

The variables used in the analysis are:

STPeople6:
- 0 = cooks for 4 people
- 1 = cooks for 6 people

STPeople8:
- 0 = cooks for 4 people
- 1 = cooks for 8 people

STSomeCooking
- 0 = always need to use with another stove
- 1 = sometimes need to use with another stove

STAllCooking
- 0 = always need to use with another stove
- 1 = you can do all your cooking on it

STWoodSmoke
- 0 = no smoke
- 1 = gives same smoke as wood fire

STCharcoalSmoke
- 0 = no smoke
- 1 = gives same smoke as charcoal fire

STPortable
- 0 = cannot be moved (too heavy)
- 1 = can be carried in/out of the house

STLooks
- 0 = looks plain
- 1 = Looks good

Results from the binary logistic regression are presented in Table 63.

*Table 63 Binary logistic regression – stove design*

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 1[a] | STPeople6(1) | .620 | .138 | 20.325 | 1 | .000 | 1.860 |
| | STPeople8(1) | .981 | .114 | 73.645 | 1 | .000 | 2.668 |
| | STSomeCooking(1) | -.389 | .137 | 8.104 | 1 | .004 | .678 |
| | STAllCooking(1) | -.067 | .150 | .200 | 1 | .655 | .935 |
| | STWoodSmoke(1) | -1.742 | .135 | 166.667 | 1 | .000 | .175 |
| | STCharcoalSmoke(1) | -.407 | .129 | 9.972 | 1 | .002 | .666 |
| | STPortable(1) | 1.381 | .111 | 155.640 | 1 | .000 | 3.978 |
| | STLooks(1) | .212 | .102 | 4.286 | 1 | .038 | 1.236 |
| | STCOSTC | -1.083 | .180 | 36.231 | 1 | .000 | .339 |
| | Constant | -.270 | .201 | 1.801 | 1 | .180 | .763 |

Note: Compared against a constant only model, the model was significant ($\chi^2$ = 1010, $p < 0.001$, with df = 9); Nagelkerke $R^2$ = 0.313. Prediction success = 72.2%.

Those design features that appear to be most important to consumers are (see Table 64 for estimates of willingness to pay):

- Smoke – people would prefer a device that avoids generating any kind of smoke especially wood smoke.
- Portable – people would like a device that can be carried in/out of the house
- Cost – preference for low cost device.
- Capacity – people want to be able to cook for larger numbers of people (8 people).
- Capacity – people would prefer to use the device in conjunction with another stove.

*Table 64 Willingness to pay for priority characteristics – stove design*

| Feature | WTP (GHS) |
|---|---|
| No wood smoke | 161 |
| Portable | 128 |
| Cater for 8 people | 91 |
| Cater for 6 people | 57 |
| No charcoal smoke | 38 |
| Always use with other cooking device | 36 |
| Looks good | 20 |

### 7.2.3 Device Functionality

The variables used in the analysis are:

FULED
0 = 2 hobs
1 = 2 hobs + 3 LED lights
FUMob
0 = 2 hobs
1 = 2 hobs + charge mobile phone
FUTV
0 = 2 hobs
1 = 2 hobs + television
FUAvailable
0 = only works on sunny days
1 = works on sunny and rainy days
FU6yr
0 = pay each month (utility)
1 = lease over 6 years
FU3yr
0 = pay each month (utility)
1 = lease over 3 years
FUCleaning
0 = awkward to clean
1 = easy to clean

Results from the binary logistic regression are presented in Table 65.

*Table 65 Binary logistic regression – device functionality*

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|---|
| Step 1[a] | FULED(1) | .791 | .139 | 32.173 | 1 | .000 | 2.206 |
| | FUMob(1) | 1.118 | .155 | 51.805 | 1 | .000 | 3.060 |
| | FUTV(1) | 1.289 | .146 | 77.737 | 1 | .000 | 3.630 |
| | FUAvailable(1) | .983 | .099 | 98.910 | 1 | .000 | 2.674 |
| | FU6yr(1) | 1.031 | .139 | 54.796 | 1 | .000 | 2.804 |
| | FU3yr(1) | .322 | .111 | 8.444 | 1 | .004 | 1.380 |
| | FUCleaning(1) | .499 | .103 | 23.653 | 1 | .000 | 1.646 |
| | FUCOSTC | -2.058 | .165 | 156.372 | 1 | .000 | .128 |
| | Constant | -.517 | .175 | 8.718 | 1 | .003 | .596 |

Note: Compared against a constant only model, the model was significant ($\chi^2 = 538$, $p < 0.001$, with df = 8); Nagelkerke $R^2 = 0.188$. Prediction success = 65%.

Those design features that appear to be most important to consumers are (see Table 66 for estimates of willingness to pay):

- Cost – preference for low cost device.
- Accessories – people would like a system that provides additional services; the strongest preference was for a system can power a TV, then for a system that can charge a mobile phone, then for LED lights.
- Availability – people had a strong preference for a system that could cook reliably regardless of the weather.
- Finance – people have a strong preference for leasing models over simply making regular monthly payments (for as long as they used the system). There was a preference for a 6 year lease period over a 3 year period. These findings are potentially difficult to interpret, as people were not given any detail on the relative magnitudes of payments.
- Cleaning – preference of a device that was easy to clean.

*Table 66 Willingness to pay for priority characteristics – device functionality*

| Feature | WTP (GHS) |
|---|---|
| Can power TV | 63 |
| Provided phone charger | 54 |
| 6 year lease | 50 |
| Not weather dependent | 48 |
| Provided socket for 3 LED's | 38 |
| Easy to clean | 24 |
| 3 year lease | 16 |

## 7.3 Disaggregating choices

Further analysis was conducted to explore differences in preferences between different groups of respondents. The effects of five demographic variables were investigated:

- Gender
- Choice of main cooking fuel
- Size of household
- Age of respondent
- Technical proficiency
- Poverty status

This analysis simply looked for relationships between these variables and each of the modelling variables among the cards that were chosen by respondents i.e. those sets of choice parameters that were 'preferred' by respondents.

### 7.3.1 Cooking Processes

Results in Table 67 show no significant difference in choices between men and women.

*Table 67 Cooking variables disaggregated by gender*

| Variable | Male (n=952) | Female (n=936) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| PRCooking(1) | 92% | 92% | 0.981 |
| PRSpeedMed(1) | 8.3% | 7.1% | 0.309 |
| PRSpeedFast(1) | 8.6% | 7.9% | 0.577 |
| PRFlavour(1) | 8.9% | 6.3% | 0.32 |
| PRPotLid(1) | 84.2% | 86.2% | 0.227 |
| PRPotSealed(1) | 8.1% | 8.8% | 0.599 |
| PR2hob(1) | 85.5% | 87.9% | 0.121 |
| PR4hob(1) | 6.2% | 4.5% | 0.099 |
| Continuous variables (means) | | | MW U-test p value |
| PRCOST | 77.6 GHS | 77.9 GHS | 0.719 |

Comparing choices made by respondents using different fuels as their main cooking fuel suggests that people using LPG expressed a stronger preference for 4 hobs whereas charcoal users had a stronger preference for 2 hobs (Table 68). This comparison also found that charcoal users were willing to pay more for a stove.

*Table 68 Cooking variables disaggregated by main cooking fuel*

| Variable | LPG (n=1140) | Charcoal (n=726) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| Cooking(1) | 91.6% | 92.8% | 0.327 |
| SpeedMed(1) | 7.9% | 7.4% | 0.719 |
| SpeedFast(1) | 8.9% | 7.3% | 0.233 |
| Flavour(1) | 8.0% | 6.9% | 0.383 |
| PotLid(1) | 84.6% | 86.8% | 0.186 |
| PotSealed(1) | 7.9% | 9.2% | 0.312 |
| 2hob(1) | 85.7% | 88.8% | **0.050** |
| 4hob(1) | 6.6% | 3.2% | **0.001** |
| Continuous variables (means) | | | KW test p value |
| COST | 77.0 | 79.1 | **0.007** |

The size of the household was found to have no effect on stove preferences. On the other hand, choices appear to be highly sensitive to age. Choices made by respondents with a higher mean age indicated that they would prefer a 2 hob stove that can boil and fry with a non-sealing lid (Table 69). Non smoky flavour tended to be preferred by older respondents.

*Table 69 Cooking variables disaggregated by age*

| Age of respondent (mean) | Response to parameter variable | | |
|---|---|---|---|
| | 0 | 1 | MW U-test p value |
| Cooking(1) | 34 | 37 | **< 0.001** |
| SpeedMed(1) | 37 | 34 | **0.002** |
| SpeedFast(1) | 37 | 34 | **< 0.001** |
| Flavour(1) | 36 | 35 | **0.009** |
| PotLid(1) | 34 | 37 | **< 0.001** |
| PotSealed(1) | 37 | 34 | **< 0.001** |
| 2hob(1) | 35 | 37 | **0.001** |
| 4hob(1) | 36 | 35 | 0.583 |

Respondents classified as more technically proficient seem to prefer faster stoves (Table 70). They are less likely to prefer multiple hobs, or to want a device that both boils and fries, which may reflect access to multiple cooking devices in the household. They are also less opposed to devices that have sealing lids. This suggests that they may have had some experience with products like this, such as rice/ pressure/ slow cookers.

Preferences did not appear to depend on a respondent's poverty status.

*Table 70 Cooking variables disaggregated by technical proficiency*

| Variable | Low technical proficiency (n=836) | High technical proficiency (n=1031) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| Cooking(1) | 94.0% | 90.5% | **0.005** |
| SpeedMed(1) | 5.7% | 9.0% | **0.008** |
| SpeedFast(1) | 6.1% | 10.0% | **0.002** |
| Flavour(1) | 6.5% | 8.4% | 0.108 |
| PotLid(1) | 88.6% | 83.2% | **0.003** |
| PotSealed(1) | 6.0% | 10.2% | **0.001** |
| 2hob(1) | 89.6% | 84.7% | **0.002** |
| 4hob(1) | 4.7% | 5.6% | 0.352 |
| Continuous variables (means) | | | KW test p value |
| COST | 77.7 | 78.0 | 0.696 |

## 7.3.2 Stove Design

Results in Table 71 show no significant difference in choices between men and women.

*Table 71 Stove design variables disaggregated by gender*

| Variable | Male (n=953) | Female (n=935) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| People6(1) | 9.3% | 9.5% | 0.894 |
| People8(1) | 77.8% | 76.3% | 0.439 |
| SomeCooking(1) | 7.0% | 7.1% | 0.981 |
| AllCooking(1) | 9.8% | 10.5% | 0.603 |
| WoodSmoke(1) | 9.8% | 10.5% | 0.603 |
| CharcoalSmoke(1) | 76.4% | 76% | 0.859 |
| Portable(1) | 89.5% | 89.5% | 0.993 |
| Looks(1) | 18.5% | 19.1% | 0.707 |
| Continuous variables (means) | | | MW U-test p value |
| COST | 74.2 | 74.1 | 0.918 |

Table 72 shows that charcoal users would prefer a stove that can cook an entire meal on it, suggesting that charcoal users may be used to only cooking on one stove already. LPG users are willing to pay more for a device.

*Table 72 Stove design variables disaggregated by main cooking fuel*

| Variable | LPG (n=1047) | Charcoal (n=629) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| People6(1) | 9.3% | 9.6% | 0.817 |
| People8(1) | 77.4% | 76.1% | 0.513 |
| SomeCooking(1) | 7.4% | 6.5% | 0.474 |
| AllCooking(1) | 8.8% | 12.5% | **0.010** |
| WoodSmoke(1) | 10.5% | 9.5% | 0.482 |
| CharcoalSmoke(1) | 76.2% | 76.1% | 0.985 |
| Portable(1) | 89.1% | 89.9% | 0.595 |
| Looks(1) | 19.7% | 17.4% | 0.213 |
| Continuous variables (means) | | | KW test p value |
| COST | 76 GHS | 71 GHS | **< 0.001** |

The size of the household was found to have no effect on stove preferences. Table 73 shows that respondents who preferred a stove that can cook for 8 people, and a device that is portable tended to be older. People who preferred no wood smoke tended to be older, yet people who preferred no charcoal smoke tended to be younger. Respondents who preferred a better-looking stove or one that sometimes needs to be used in conjunction with another stove (as opposed to always needing to use another stove) tended to be younger.

*Table 73 Stove design variables disaggregated by age*

| Age of respondent (mean) | Response to parameter variable | | |
|---|---|---|---|
| | 0 | 1 | MW U-test p value |
| People6(1) | 37 | 35 | **0.008** |
| People8(1) | 35 | 37 | **0.006** |
| SomeCooking(1) | 37 | 34 | **0.005** |
| AllCooking(1) | 36 | 35 | 0.073 |
| WoodSmoke(1) | 37 | 34 | **0.014** |
| CharcoalSmoke(1) | 35 | 37 | **0.002** |
| Portable(1) | 34 | 37 | **0.003** |
| Looks(1) | 37 | 35 | **0.015** |

Preferences relating to stove design parameters did not appear to depend on the poverty status. Technical proficiency only effected portability preferences; respondents with low technical proficiency preferred a portable stove (Chi-Square p=0.003). This may be because they are used to using stoves that produce smoke and so like to cook outside.

### 7.3.3 Device Functionality

Results in Table 74 show no significant difference in choices between men and women.

*Table 74 Device functionality variables disaggregated by gender*

| Variable | Male (n=951) | Female (n=938) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| LED | 50.4% | 53.4% | 0.186 |
| Mobile | 17.9% | 16.7% | 0.513 |
| TV | 18.7% | 18.8% | 0.979 |
| works on sunny and rainy days | 38.8% | 36.2% | 0.252 |
| lease over 6 years | 20.1% | 18.4% | 0.366 |
| lease over 3 years | 31.1% | 30.3% | 0.690 |
| easy to clean | 69.5% | 71.2% | 0.416 |
| Continuous variables (means) | | | MW U-test p value |
| PRCOST | 48.3 GHS | 49.6 GHS | 0.719 |

Table 75 shows that charcoal users would prefer a system that provides a mobile phone charger and that can be leased over 6 years. LPG users would prefer a system that can power LED's. LPG users are willing to pay more for a device.

*Table 75 Device functionality variables disaggregated by main cooking fuel*

| Variable | LPG (n=1139) | Charcoal (n=728) | |
|---|---|---|---|
| Dichotomous variables | | | Chi-square p value |
| LED | 54.2% | 47.7% | **0.006** |
| Mobile | 15.4% | 20.5% | **0.005** |
| TV | 17.8% | 20.5% | 0.154 |
| works on sunny and rainy days | 37.7% | 38.0% | 0.867 |
| lease over 6 years | 16.7% | 23.6% | **<0.001** |
| lease over 3 years | 29.6% | 33.0% | 0.123 |
| easy to clean | 70.7% | 69.5% | 0.590 |
| Continuous variables (means) | | | KW test p value |
| COST | 50.1 | 47.0 | **0.003** |

Preferences relating to device functionality parameters did not appear to depend the size of a household, age of the respondent or poverty status. Technical proficiency only effected the price respondents are willing to pay, with more proficient respondents willing to pay more (Mann-Whitney p=0.038).