USAID
FROM THE AMERICAN PEOPLE

ALTERNATIVES TO CHARCOAL (A2C)
BASELINE REPORT

February, 2023

This document was produced for review by USAID/Zambia by Tetra Tech for the Alternatives to Charcoal Activity **through USAID Contract No. 72061121C00001.**

This document was produced for review by the United States Agency for International Development. It was prepared by Tetra Tech under the USAID Zambia Alternatives to Charcoal contract (No. 72061121C00001).

Cover photo: Actress Wanga Zulu promoting alternative cooking technologies.
Credit: USAID Alternatives to Charcoal (A2C)

This report was prepared by:

Tetra Tech
159 Bank Street, Suite 300
Burlington, Vermont 05401 USA
Telephone: (802) 485-0282
Email: international.development@tetratech.com

Contacts:
Dr. Catherine Picard, Chief of Party Email: Catherine.Picard@tetratech.com
Jason Girard, Project Manager Email: Jason.Girard@tetratech.com

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

A2C	Alternatives to Charcoal
ATF(s)	Alternative Technologies and/or Fuels
CEADIR	Climate Economic Analysis for Development, Investment, and Resilience
CIFOR	Center for International Forestry Research
CO_2	Carbon dioxide
COVID-19	Coronavirus disease
CSAs	Census Supervisory Areas
CSPro	Computer Assisted Program Interview
EA	Enumeration Areas
EG	Economic Growth
FNRB	Fraction of non-renewable biomass
GHG	Greenhouse Gas
HH	Household
IAPRI	Indaba Agricultural Policy Research Institute
IoT	Internet of Things
kg	Kilogram
kWh	Kilowatt hour
LPG	Liquefied Petroleum Gas
MEL	Monitoring, Evaluation and Learning
ODK	Open Data Kit
PAYGO	Pay-As-You-Go
PPES	Probability Proportional to Estimated Size
QC	Quality Controller
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USG	United States Government
Zamstats	Zambia Statistics Agency
ZESCO	Zambia Electricity Supply Corporation
ZRA	Zambia Revenue Authority
ZMW	Zambian Kwacha

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Zambia's deforestation rate is among the highest in the world, with an estimated 250,000 to 300,000 hectares cleared annually. Deforestation in Zambia is responsible for greenhouse gas (GHG) emissions and driving contributions to climate change and other environmental degradation such as soil erosion, reduced ecosystem functions of forests, and decreased water and air quality. Charcoal is a primary driver of deforestation and forest degradation in Zambia due to its dominant role in household cooking, and as a backup or secondary fuel (known as fuel stacking).

A range of innovative technologies are also available to make alternative technologies and fuels (ATFs) more affordable and accessible, such as pay-as-you-go (PayGo) gas release nozzles and Internet of Things (IoT) appliances which supply real time user data. However, the widespread adoption of each of these technologies in Zambia is currently hindered by poor enabling conditions and inefficiencies that keep costs prohibitively high and limit access, while specific social and cultural barriers for different consumer segments limit their cultural acceptability as an alternative to charcoal

The Alternatives to Charcoal Activity (A2C) is a five-year activity funded by the United States Agency for International Development (USAID) and implemented by Tetra Tech ARD Inc. A2C collected data to inform the Monitoring, Evaluation and Learning (MEL) baseline and feed into project activities that will: reduce charcoal energy consumption by 25% in urban and peri-urban areas of Zambia (inclusive of Lusaka); and catalyze a 38% increase in the use of private sector led low emission charcoal ATFs in order to reduce national deforestation and forest degradation, directly attributable to reduced charcoal production, by approximately 7% and reduce, sequester or avoid 735,100 metric tons of GHG emissions.

In October 2021, The Indaba Agricultural Policy Research Institute (IAPRI) was subcontracted in conduct a baseline survey to inform the project's MEL indicators, including data related to household charcoal energy consumption and types of household cooking technologies in use, and to serve as the basis to calculate change (%) in deforestation directly attributable to charcoal and greenhouse gas emissions reduced, sequestered, or avoided through A2C interventions, among other indicators. In June 2022, a second annual household survey was conducted by IAPRI to determine the progress on the project's indicators. After consultations with USAID, it was resolved that the second annual survey be adopted as the baseline to provide a benchmark for measuring progress towards the project's MEL indicators and that data will be collected at the same time throughout the life of project. This decision was made to ensure that A2C collects data regarding charcoal and ATF usage during a peak charcoal consumption period. The second annual survey conducted in June/July 2022 is deemed as a "truer" baseline in the sense that data were collected shortly before the roll out of A2C activities (e.g. grants program, SBCC activities, incubator program, investment for private sector partners etc.) Collecting data in June/July annually and reporting in October will ensure that more current data is collected for annual reporting. The first annual household survey has since become a pilot study for the project.

IAPRI designed the survey instrument and prepared a detailed data collection plan which was reviewed and adapted by A2C. Data collection employed quantitative research techniques using Open Data kit (ODK) tablet-based data capture tools (KOBO Collect) which were developed and discussed with all stakeholders before finalization for implementation. Just like the pilot study, the sampling procedure was aligned with the United Nations Framework Convention on Climate Change (UNFCCC) standard for

sampling and surveys for Clean Development Mechanism project activities. The survey was conducted in a total of 2,440 households in as follows: 840 households from Lusaka, 800 households from Ndola, and 800 households Solwezi.

Table 1 below summarizes the baseline values for the six A2C indicators measured under this baseline survey. Baseline charcoal consumption in Lusaka stands at 689 Kg/year (indictor 1), while baseline charcoal consumption in Solwezi and Ndola was recorded at 783Kg/year (indicator 2). The baseline use of low emission ATFs in Lusaka and other urban areas was estimated to be 27.4% (indicator 3) based on the amount of cooking/heating events carried out on ATFs. Baseline GHG emissions for cooking with charcoal and ATFs stands at 4,434,130tons/year (indicator 4), while cooking with charcoal contributes to 30,020hectares of deforestation and degradation (indicator 5). Finally, it has been estimated that 309,411 households in the three urban areas are currently cooking with ATFs (indicator 9).

Table 1: Summary of A2C baseline indicators

#	Indicator Name	Baseline	Unit
1	Change (%) in charcoal consumption in Lusaka	689	Kg/HH/Year
2	Change (%) in charcoal consumption in select urban areas outside of Lusaka	783	Kg/HH/Year
3	Change (%) in use of low emission ATFs in Lusaka and select urban areas	27.4	% Use
4	Greenhouse gas (GHG) emissions, estimated in metric tons of CO2 equivalent, reduced, sequestered, or avoided through sustainable landscapes activities supported by USG assistance (EG.13-6)	4,434,130	Tons/year
5	Percent change in deforestation directly attributable to charcoal production	31,785	Hectares/year
9	Number of Zambian Households Using ATFs	309,411	# Households

Results indicate charcoal is the predominant (94%) energy source for cooking and heating when averaged across all three districts, with fuel stacking being practiced by 95% of households (the combination of charcoal/electricity and charcoal/fuelwood being the most dominant). Not surprisingly, price is a direct driver of charcoal consumption (the lower the price, the higher the amount of charcoal consumed). However, charcoal consumption and expenditure are uniform regardless of income earned. Respondents spend, on average, 211 Zambian Kwacha per month on charcoal with the 25 kg bag with 1 ball pen head being the most commonly purchased unit.

After charcoal, electricity is the second most common energy use (45.4%). In third place was firewood with an overall percentage of 11 and in fourth place was LPG, with about 4.5% of the surveyed households using this energy source. Interestingly, on average, 85% of all households enumerated were connected to the main electricity grid, and 53% of those households use electricity for cooking and heating

A significant finding was that the presence of an ATF in a household did not have much impact on the amount of charcoal consumed, unless it was used for four or more heating events per day (which reduced charcoal consumption by 27%). Even households which use charcoal for all six daily heating events still used, on average 31 kgs of charcoal per month. It's not clear where this residual charcoal is used but it could be in combination with ATFs to cook certain dishes (e.g. beans). This has implications for A2C's theory of change which presumes if a household adopts an ATF then there will be a reduction in charcoal use.

INTRODUCTION

Zambia's deforestation rate is among the highest in the world, with an estimated 250,000 to 300,000 hectares cleared annually. Deforestation in Zambia is responsible for greenhouse gas (GHG) emissions and driving contributions to climate change and other environmental degradation such as soil erosion, reduced ecosystem functions of forests, and decreased water and air quality. Charcoal is a primary driver of deforestation and forest degradation in Zambia due to its dominant role in household cooking, and as a backup or secondary fuel (known as fuel stacking). Charcoal is widely available, affordable, culturally acceptable, and is the first choice for domestic cooking needs for more than 75% of peri and urban Zambians, regardless of income. The inconsistent supply of electricity, increases in energy tariffs, recent currency depreciation and inflation, coupled with concerns related to affordability and accessibility to alternative energy sources all contribute to persistent and ongoing demand for charcoal. Alternatives to charcoal do exist. Stoves powered by electricity, liquid petroleum gas (LPG), processed biomass (e.g., pellets), gel fuel, bio-ethanol and biogas as well as more efficient (improved) charcoal cookstoves are available.

A range of innovative technologies are also available to make alternative technologies and fuels (ATFs) more affordable and accessible, such as pay-as-you-go (PayGo) gas release nozzles and Internet of Things (IoT) appliances which supply real time user data. However, the widespread adoption of each of these technologies in Zambia is currently hindered by poor enabling conditions and inefficiencies that keep costs prohibitively high and limit access, while specific social and cultural barriers for different consumer segments limit their cultural acceptability as an alternative to charcoal. These challenges must be addressed if ATFs are to replace charcoal as the household energy of choice in Zambia, and ultimately contribute to significant reductions in deforestation and GHG emissions.

SURVEY RATIONALE

The Alternatives to Charcoal Activity (A2C) is a five-year activity funded by the United States Agency for International Development (USAID) and implemented by Tetra Tech/ARD Inc. A2C collected data to inform the Monitoring, Evaluation and Learning (MEL) baseline and feed into project activities that will: reduce charcoal energy consumption by 25% in urban and peri-urban areas of Zambia (inclusive of Lusaka); and catalyze a 38% increase in the use of private sector led low emission charcoal ATFs in order to reduce national deforestation and forest degradation, directly attributable to reduced charcoal production, by approximately 7% and reduce, sequester or avoid 735,100 metric tons of GHG emissions

STUDY OBJECTIVES

The objective of this survey was to establish a baseline for the following project performance indicators:

- Percent change (%) in charcoal energy consumption by households in Lusaka;
- Percent change (%) in charcoal energy consumption by households in Ndola and Solwezi (combined);
- Percent change (%) in use of ATFs by households in Lusaka, Ndola and Solwezi.
- Number of households using ATFs in Lusaka, Ndola and Solwezi

Baseline results from the first two indicators above will in turn be used to calculate the following indicators:

- Number of metric tons of GHG emissions reduced, sequestered, or avoided through sustainable landscapes activities supported by USG assistance.
- Change (%) in deforestation directly attributable to charcoal production.

The specific objectives of the baseline study were to:

- Establish a baseline in three selected locations (Lusaka, Ndola and Solwezi) to capture household- level charcoal energy consumption, household size, the average quantity of charcoal purchased by household per month, frequency of purchase, average cost and average distance to purchase.
- Establish a baseline in Lusaka, Ndola and Solwezi to capture the types of household-level cooking fuels and technologies in use. The baseline captured: household size, the types of fuels used, average cost of fuels, frequency of fuels purchases, average time spent using each fuel type, the cost of the cooking appliances used, and the "average life" of the cooking appliances.

SURVEY DESIGN

The Indaba Agricultural Policy Research Institute (IAPRI) was subcontracted in October 2021 to implement the pilotsurvey and in August of 2022 to implement the baseline. IAPRI designed the survey instrument and prepared a detailed data collection plan which was reviewed and adapted by A2C. Data collection employed quantitative research techniques using KoboCollect tablet-based data capture tools which were developed and discussed with all stakeholders before finalization for implementation. IAPRI staff also comprehensively trained a group of enumerators and field supervisors who were responsible for the collection of data and data quality control in the study districts.

SAMPLE SIZE AND DISTRIBUTION

The sampling procedure for the Enumeration Areas (EAs) was aligned with the United Nations Framework Convention on Climate Change (UNFCCC) standard for sampling and surveys for Clean Development Mechanism project activities. The survey was conducted in three districts, Lusaka, Ndola and Solwezi (see Figure 1 below).

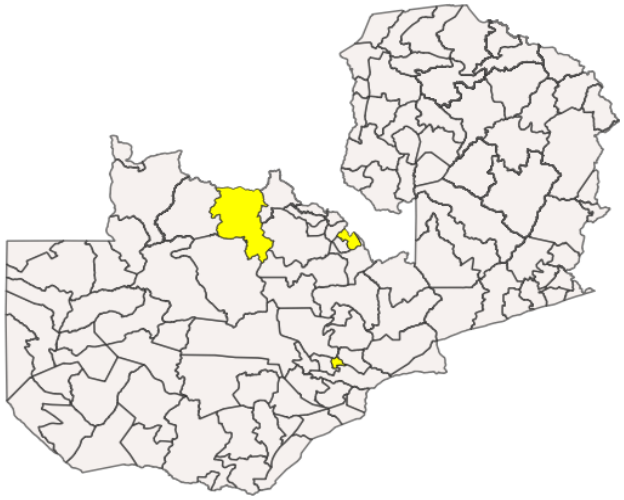


Figure 1: Survey district work areas

The 2022 Household Survey for the Alternatives to Charcoal Baseline Survey used the most current EA sampling frame obtained from the Zambia Statistics Agency (ZamStats) 2010 census mapping. Due to COVID-19 the 2020 census was not undertaken, so no updated EA sampling frame was available. The mapping delineates Wards into Census Supervisory Areas (CSAs) which are subsequently subdivided into Enumeration Areas (EAs). An EA is a subdivision of a CSA reflecting the smallest geographical area allocated to an individual enumerator for purposes of data collection. It contains information on the demographic characteristics of the given population. The EAs are further classified as either rural or urban, have information on number of households and the population size. The EAs are also classified into High, Medium and Low population density areas. The national frame has an updated list of 25,631 EAs and 2,815, 897 households.

Probability sampling procedures through the use of a two-stage stratified cluster sample design was used for sampling. However, before selection, the EAs were classified into strata as high, medium and low density. These housing density classifications can be used as a proxy for income levels, with high-density

areas having the lowest incomes and low-density areas having the highest incomes. In the first stage, EAs were selected using the Probability Proportional to Estimated Size (PPES) procedure within the respective strata.

The EA sample size was determined using the following parameters and formula.

P =Indicator level = 50

e = desired margin of error = 5%

Z =Statistic for a level of confidence = 1.96 (95%)

$\boldsymbol{n}$ = Population for domain of interest = 1,745,332 in the case of Lusaka)

$DEFF$ =Design effect = 1.5

$$\boldsymbol{n} = DEFF * \frac{Z^2 * P(1-P) * N}{e^2 + Z^2 P(1-P)}$$

This formula gave a sample size of 42 EAs for Lusaka and 40 EAs each for Ndola and Solwezi with a total of 122 EAs. A total of 2,440 households in the 122 EAs (see Appendix 1) were sampled as follows: 840 households from Lusaka, 800 households from Ndola, and 800 households Solwezi. The distribution of the EAs to be listed per population density in each district was a 2:1:1 ratio, signifying high density, medium density and low density respectively. The distribution per district is shown in Table 2.

Table 2: Distribution of enumeration areas by population density

District	Population Density	Number of EAs
Lusaka	High density areas	26
	Medium density areas	8
	Low density areas	8
Ndola	High density areas	22
	Medium density areas	8
	Low density areas	10
Solwezi	High density areas	20
	Medium density areas	8
	Low density areas	12

All the households in the 122 selected EAs were listed. Only households with responsible adult members of the household (above 18) and domiciled in the targeted EAs were included in this survey. A total of twenty (20) households were surveyed in each EA.

The square root proportional allocation method was used to allocate the sample to each stratum i.e. low, medium and high density as below:

$$a_h = \frac{\sqrt{Y_n}}{\sum_{h=1}^{L} \sqrt{Y_h}}$$

Where:

$\mathbf{a_h}$ =ratio of the square root of the measure of size of the stratum to the sum of the square root of the measure of size of all strata

$\sqrt{Y_n}$ = Square root of the measure of size of the stratum

$\sum_{h=1}^{L} \sqrt{Y_h}$ = Sum of the square root of the measure of size of all strata

Sampling weights were also applied to compensate for unequal selection probabilities, non-coverage, non-response, and for known differences between the sample and the reference population.

SURVEY METHODOLOGY

Training for the A2C baseline survey was conducted at the Confucius Institute at the University of Zambia Great East Road campus from Monday, 15th November to Friday, 19th November 2021. A total of 49 (31F/18M) enumerators and 12 (All male) supervisors participated in the five-day training. The training was conducted by 5 (five) master trainers from IAPRI for the various sessions that were held. On the final day of training, a pre-test was conducted in three areas within Lusaka district, namely; BChawama representing a high density area, Kabwata representing a medium density area, and Presidential Housing Initiative (PHI) representing a low density area. The trainees were divided into pairs to have the opportunity to observe and conduct interviews. Feedback was given on the survey instrument and comments were addressed before deployment.

There were four data collection (enumeration) teams each in Ndola and Solwezi, while Lusaka had 5 enumeration teams , each team comprised of 1 supervisor and 4 Enumerators[1].. Each district had one Quality Controller (QC) who ensured adherence to data collection protocols, spot checked interviews and questionnaires and responded to any arising issues and challenges during data collection. The QC was also the only person responsible for assigning Enumeration Areas (EA) to be listed and household sampling. This was to ensure adherence to the set sampling protocols.

Households were listed through a form in KoboCollect using a tablet. To list, the survey teams identified the boundaries of a given EA by using a map programmed in Maps.me based on the ZamStats 2010 Census mapping. The survey team in each EA were then divided into two teams listing household from one random starting area in the EA but going into opposite directions. The listing information collected included; residential area, population density, the household serial number (assigned to each listing team by the supervisor), the name of the household head, household size, connection to the electricity grid, and main cooking fuel or energy source.

Once the forms were verified and uploaded by the listing teams, the QC downloaded this data from the server and selected households using circular systematic sampling from the frame created in Microsoft Excel. The sampling was sequential based on the interval obtained by dividing the total number of households in the area by 20. Twenty-five households were sampled from which the first 20 were given to the supervisor for enumeration while 5 were withheld as potential replacements. Households were replaced under two circumstances – if the household refused to take part in the survey and if the household had been visited three times and there was no responsible adult available to respond to the questionnaire on three separate days.

[1] One team in Lusaka had five enumerators to cater for the larger sample in the district.

Data were collected using ODK KoboCollect, in which the questionnaire was programmed. During interviews, enumerators used flash cards to help respondents identify appliances used for the different energy sources as well as identify the different units in which charcoal is sold. This was to ensure respondents were referring to the correct appliances and charcoal units.

CHARCOAL WEIGHING METHODOLOGY

One of the key variables required to estimate the charcoal contribution to deforestation and GHG emissions was the weight of commonly purchased charcoal bags. This is due to the fact that the commonly used names for charcoal bags, for example 25Kg bag, do not represent the actual weight of charcoal they contain.

The data on charcoal weights collected during the pilot study was used for the baseline. Data on charcoal bag weights was collected early 2022 by the A2C Monitoring, Evaluation and Learning (MEL) staff from three markets in Lusaka District, which were purposively selected based on the main entry points of charcoal in the city of Lusaka; namely, Bauleni, Mandevu and Kanyama, located Southeast, North and Southwest of Lusaka respectively. A comprehensive list of 16 different charcoal bags by weight was used, drawn from the commonly purchased charcoal units as administered in the baseline questionnaire. A digital scale was calibrated and used to measure the weight of each charcoal bag using Kilogram as the unit of measurement.

In each of the three market, 5 bags of each charcoal unit type were weighed. Given there were 16 types of charcoal units, this represented 240 bags in total (3 markets * 16 charcoal units * 5 measurement of each unit). The weights were averaged for each of charcoal bag types to determine actual average weight (Kg). Average charcoal prices for each bag type available were also collected for comparing the stated monthly costs spent of charcoal and prices of charcoal on the urban market (See appendix 1 for a summary table of charcoal weights and prices).

SURVEY FINDINGS

DEMOGRAPHIC CHARACTERISTICS

This chapter presents key results from the study focusing on the demographic characteristics of the households interviewed. We present sample area profiles, the characteristics of the household heads and respondents, the demographic characteristics of the household in general and conclude with the income of the households.

AREA PROFILES

Lusaka District: Households in Lusaka district had an average household size of 5, with an average monthly household income of Zambian Kwacha (ZMW) 4,543.12. Findings show that 89% of all households enumerated were connected to the main electricity grid. Fuel stacking is dominant in that 91% of the households reported using traditional charcoal as an energy source for cooking and heating, while 45% reported using electricity as an energy source for cooking and heating, indicating that some households used both traditional charcoal and electricity. In contrast, Liquid Petroleum Gas (LPG) was only used by 6%, firewood by 4%, and less than 1% each for pellets and sawdust. None of the enumerated households reporting using paraffin or ethanol. Overall, in Lusaka, more households used electricity for cooking breakfast and snacks (37% and 35% respectively), than they did to cook lunch and supper (24% and 25% respectively). Traditional charcoal was used by 60% of the households to cook breakfast, 73% for cooking lunch, 71% for cooking dinner and 62% for cooking snacks. Traditional charcoal was used in more households (70%) for heating water than electricity (26%).

Ndola and Solwezi: An average household in Ndola and Solwezi was comprised of 5.3 people, with an average monthly household income of ZMW 4,300.47. Over four-fifths (84%) of the households interviewed in Ndola and Solwezi were connected to the main electricity grid, with 46% using electricity as their cooking and heating energy. Traditional charcoal was used by 95% of the households as their cooking and heating energy while only 3.7% used LPG, 14% used firewood, 1.7% used sawdust/agricultural residue, and 0.7% used pellets. None of the households enumerated in Ndola and Solwezi reported using ethanol and paraffin. Like Lusaka, more households used electricity to cook their breakfast and snacks (34% and 37% respectively) compared to 16% and 21% for lunch and supper respectively. Traditional charcoal use for cooking followed a similar trend as that in Lusaka with less households (62%) using it to cook breakfast, but more at 81% of the households using the energy source to cook lunch, 75% to cook dinner, and 60% to cook snacks. Likewise, more households (70%) used traditional charcoal for water heating compared to 19% using electricity.

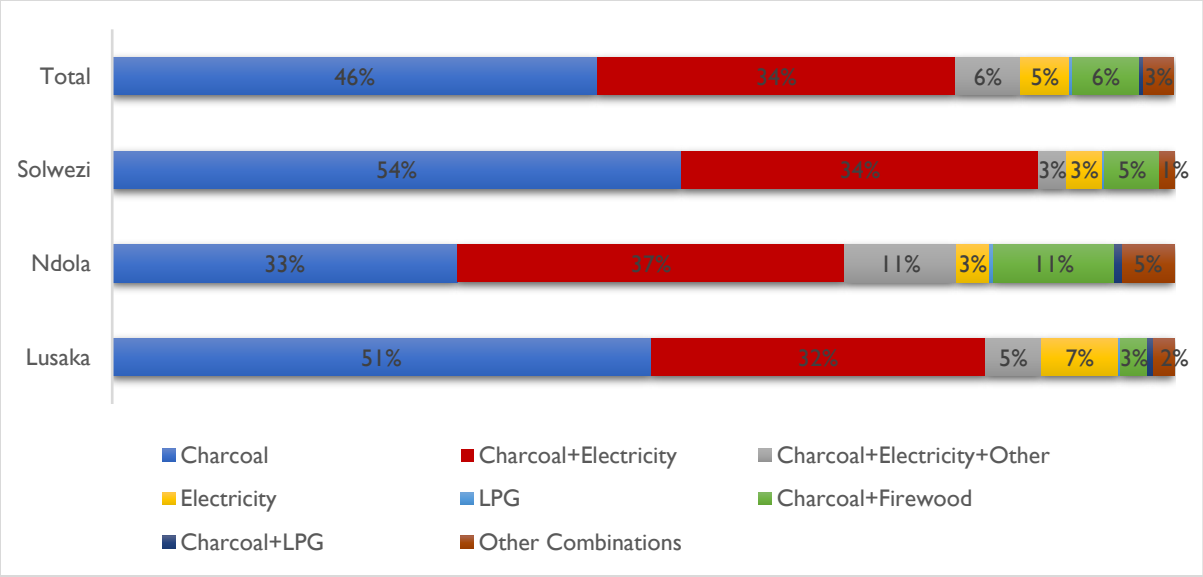


Figure 2: Fuel Stacking by Urban Area

Low-Density Areas: Low-density areas had an average household size of 5.0 and a monthly household income of ZMW 8,240.90. Data shows that 96% of the households were connected to the main electricity grid and that 78% of households used electricity as their source of energy for cooking and heating. Traditional charcoal was used by 84% of the households while 12% used LPG and 7% used firewood. Similar to the trend at district level, none of the households used ethanol and paraffin and ethanol, although 0.8% used sawdust/agricultural residue. Electricity was the energy of choice for cooking breakfast and snacks for 66% and 68% of the households respectively. This dropped to 42% of households for lunch, and 49% of the households for dinner. Traditional charcoal was used by 27% of the households for cooking breakfast, 25% for cooking snacks, 52% for cooking lunch, and 43% for cooking dinner.

Medium-Density Areas: In medium-density areas, average household size was 5.3. The average monthly income was ZMW 4,879.36. Ninety-one per cent (91%) of the households were connected to the main electricity grid. Unlike the low-density areas, 60% used electricity as their source of energy for cooking while households using traditional charcoal was 93%, 3% for LPG, and 7% for firewood. None used paraffin and ethanol, while only 1% used pellets and 0.3% used sawdust/agricultural residue. The percentage of households using electricity for cooking breakfast and snacks was also lower compared to the low-density areas at 48% and 51% correspondingly. A quarter (25%) of the households used electricity to cook lunch, with the percentage rising to 31% for dinner. Households cooking with traditional charcoal use was relatively high at 50%, 73%, 66% and 43% for breakfast, lunch, dinner and snacks respectively. Traditional charcoal was used for water heating by 68% of the households while only 28% used electricity.

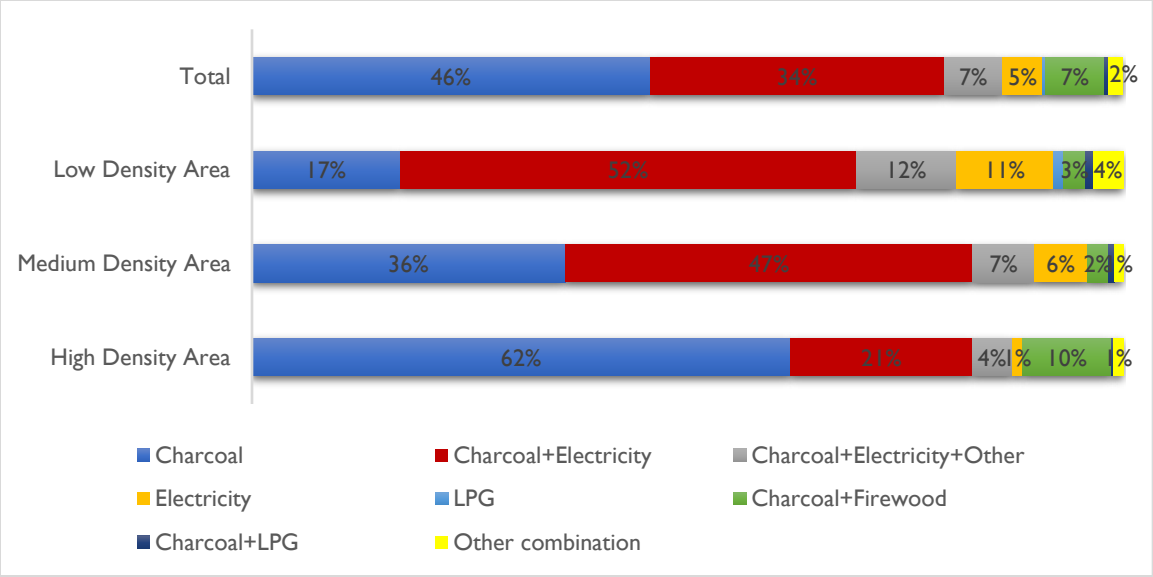


Figure 3: Fuel Stacking by Population density areas

High-Density Areas: The average household size in high-density areas was 5.3 and average monthly income was at ZMW 2,563.32. Households connected to the main electricity grid stood at 79%, with 26% of the households using electricity as a source of cooking energy. Traditional charcoal as a source of energy was reported by 98% of the households, compared to 14% for firewood and 2% for LPG. None of the households used paraffin and ethanol, while 2% used sawdust and 0.2% used pellets. In comparison to both low and medium density areas, only 17% of the households used electricity for cooking breakfast, 6% for lunch, 7% for dinner and 16% for snacks. High-density areas had the highest traditional charcoal usage among all the density types, with 80% and 81% of the households using it to cook breakfast and snacks correspondingly. The percentage rose to 92% for lunch and 90% for dinner. Only 10% used electricity for water heating in comparison to 80% who used traditional charcoal.

HOUSEHOLD CHARACTERISTICS

Data show that 75% of the survey respondents were female and 25% were male. Of these, 39% are the household heads (Table 3). Most of the surveyed households were male headed (71%), while 29% were female headed. The average age of the household head is 43.5 years and that of all respondents is 36.7 years. The average household size was 5.2 individuals. Household composition is mostly adults (2.9), followed by members aged 6 to 17 years (1.5) and then children below five years (0.8). On house ownership, over half (55.3%) of the respondents live in rented houses and 44.7% own the houses they live in.

In terms of education attained, most of the household heads had secondary and tertiary level education at 45.5% and 33.2% respectively. Fewer than 2% of the heads had preschool level education, had never been to school or did not know their level of education. Overall, 74.8% of the respondents who were not household heads had attained secondary level and tertiary education.

Table 3: Characteristics of households and household head

Characteristic	Average
Proportion of household head respondent	39%
Proportion of male respondent	25%
Age of household head	43.5
Age of Respondents (All)	36.7
Household size	5.2
Number of adults (18 years and above)	2.9
Number of children aged 6 to 17 years	1.5
Number of children aged 0 to 5 years	0.8
House Ownership	**Percent**
Own House	44.7
Rent	55.3
Highest level of education by HH head	
Never been to school	0.9
Preschool	0.4
Primary	18.7
Secondary	45.5
Tertiary	33.3
I don't know	1.3
Total	**100**

Data shows occupation of owned or rented houses for households connected to the main electricity grid bore no major differences in use of energy (Table 2Table 4). The exception was that those living in their own houses used more firewood with the trend holding true for households not connected to the main electricity grid. Both monthly expenditure for electricity and charcoal was higher for those that lived in their own houses compared those that did not. However, only 82.8% of the households that lived in their own houses were connected to the main electricity grid compared to 87.3% for those living in rented homes. This could perhaps be as a result of some homeowners opting to install solar rather than electricity.

Table 4: House ownership status and energy use for cooking

Variable	Connected to Grid		Not Grid Connected	
	Own House	Rented	Own House	Rented
Electricity connection (%)	82.8	87.3	0	0
Electricity (%)	44.1	46.4	0	0
LPG (%)	5.0	4.2	1.1	0.6
Ethanol (%)	0	0	0	0
Traditional Charcoal (%)	94.7	91.9	97.3	98.2
Firewood (%)	13.8	3.9	30.5	19.3
Pellets (%)	0.99	0.59	0	0
Paraffin (%)	0	0	0	0
Saw dust (%)	1.54	0.51	4.3	0

Other (%)	0.08	0	0	0
Expenditure on electricity (ZMW/month)*	362	242	0	0
Expenditure on charcoal (ZMW/month)	238	201	196	198

*Expenditure on electricity is for all uses, including but not limited to, cooking.

Application for electricity connection in Zambia is on the rise with the Zambia Electricity Supply Corporation (ZESCO) currently inundated with applications. We analyzed the data to estimate the percent of non-connected households that have applied for connection. Out of the 358 households that did not have electricity connection, the majority indicated not having applied for connection. There were only 13.4% that indicated that they had applied for connection, while 86.6% reported not to have applied. (Figure 4).

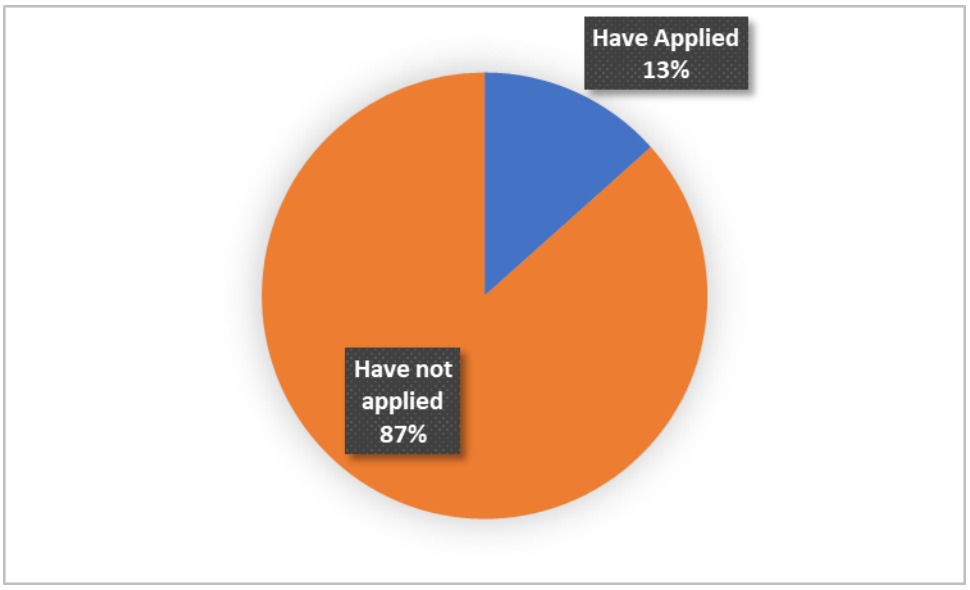


Figure 4: Percent of households that applied for electricity connection among those not connected

Figure 5 shows the percent of households that rent a house and whether they share the electricity meter with the landlord or not. Over half (52%) of the households indicated that they do not share the meter with their landlord, while 48% indicated sharing the meter with the landlord.

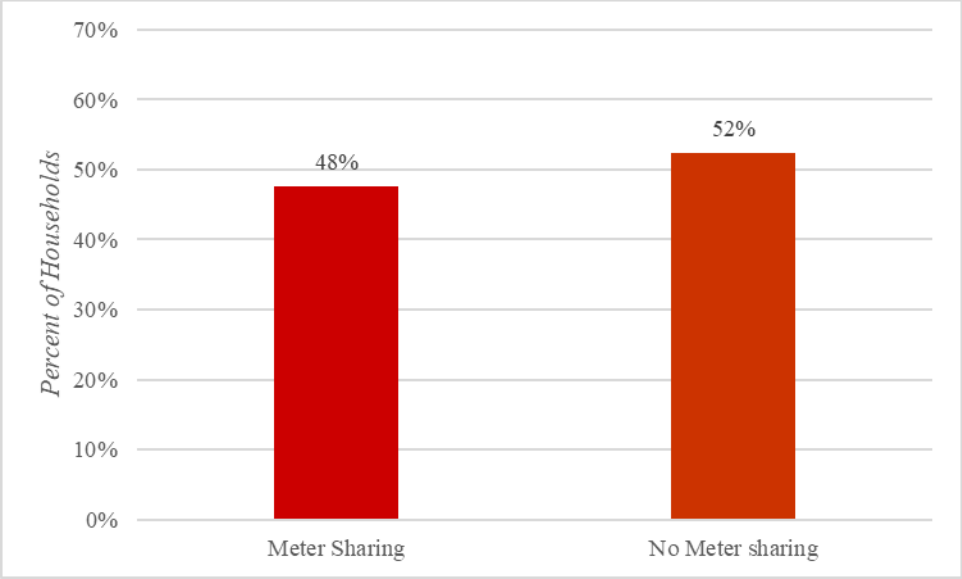


Figure 5: Distribution of households that share the electricity meter with the landlord

It is not uncommon to find cases where the landlord, if sharing the electricity meter with the tenant, imposes restrictions on how electricity is used for cooking. Common restrictions include not cooking food stuffs that take long to cook such as dried beans and fish among others. An analysis of the prevalence of this phenomenon showed that the practice of landlords restricting usage of electricity for cooking was quite rampant among those that share the meter with the landlord. Figure 6 shows that 59.9% of households that rent a house and share the meter with the landlord had restrictions imposed on the usage of electricity for cooking, while 40.1% said they had not restrictions. However, to place this in context, overall, it is estimated that approximately 13.7% of urban households have electric cooking restrictions in place due to sharing an electricity meter with their landlord.

Further analysis to examine the correlation between restrictions on electricity use and charcoal expenditure showed that those that had restrictions spent more on charcoal per month (ZMW 241) versus ZMW 188 per month than those that had no restrictions. This perhaps points to households tending to use more charcoal when they have restrictions on electricity usage.

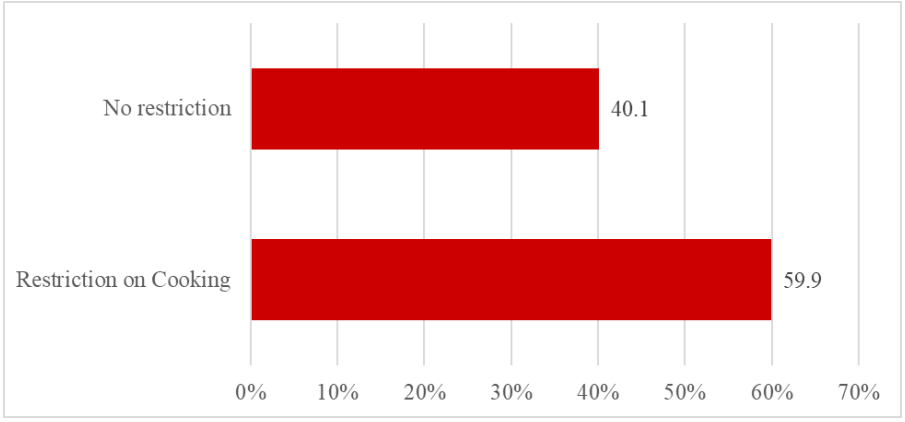


Figure 6: Percentage of households that share a meter with the landlord and have cooking restrictions on electricity imposed by the landlord

HOUSEHOLD INCOME

Figure 7 presents a summary of the main sources of employment among the surveyed households across the three districts and encompassing all three income levels. The three main sources of income for the surveyed households are formal employment (39.0%), own business (29.6%) and informal employment (19.2%).

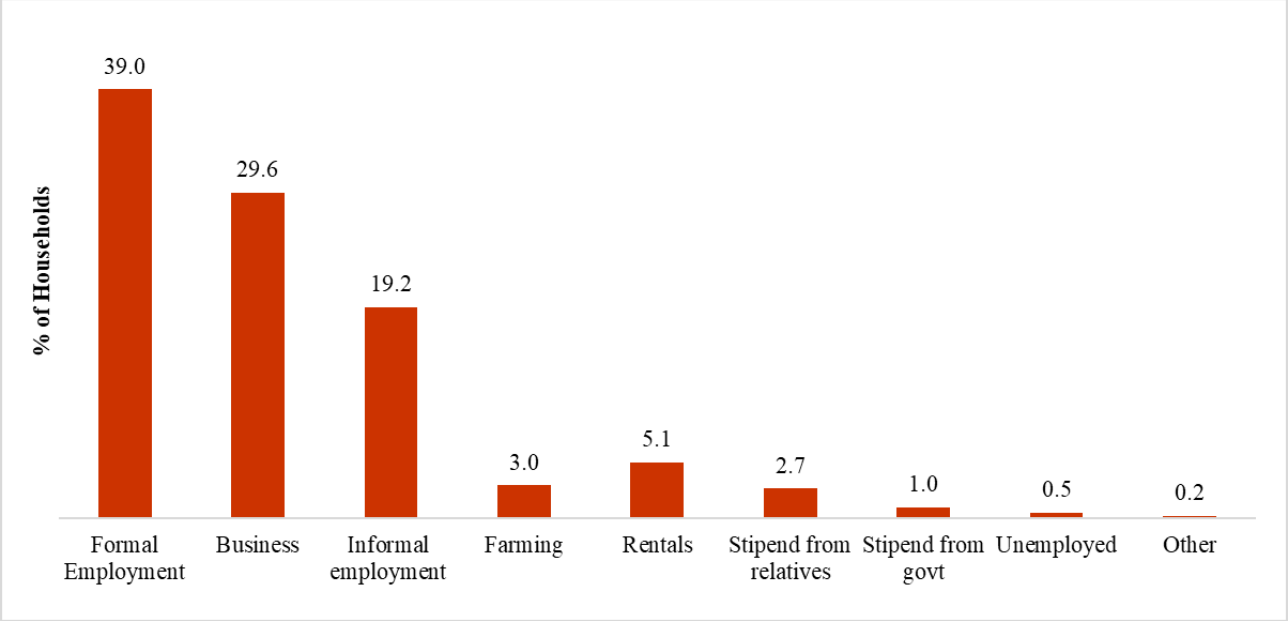


Figure 7: Household main source of income

The average monthly income for all households is summarized in Figure 8. Out of the 2,439 households sampled, 1,855 households, representing 76%, provided information on the exact monthly income for the household. The average household income among these households was ZMW 4,373. When disaggregated by residential area type (based on population density), results show that the low-density residential areas have the highest average monthly income of ZMW 8,241 (which is higher than the overall average), followed by the medium-density residential areas with ZMW 4,879 and lastly the high density residential areas with ZMW 2,563. Low-density residential areas are associated with high income earning households, followed by medium and lastly high-density areas. Thus, population density of the residential area can be used as a proxy for socio-economic status.

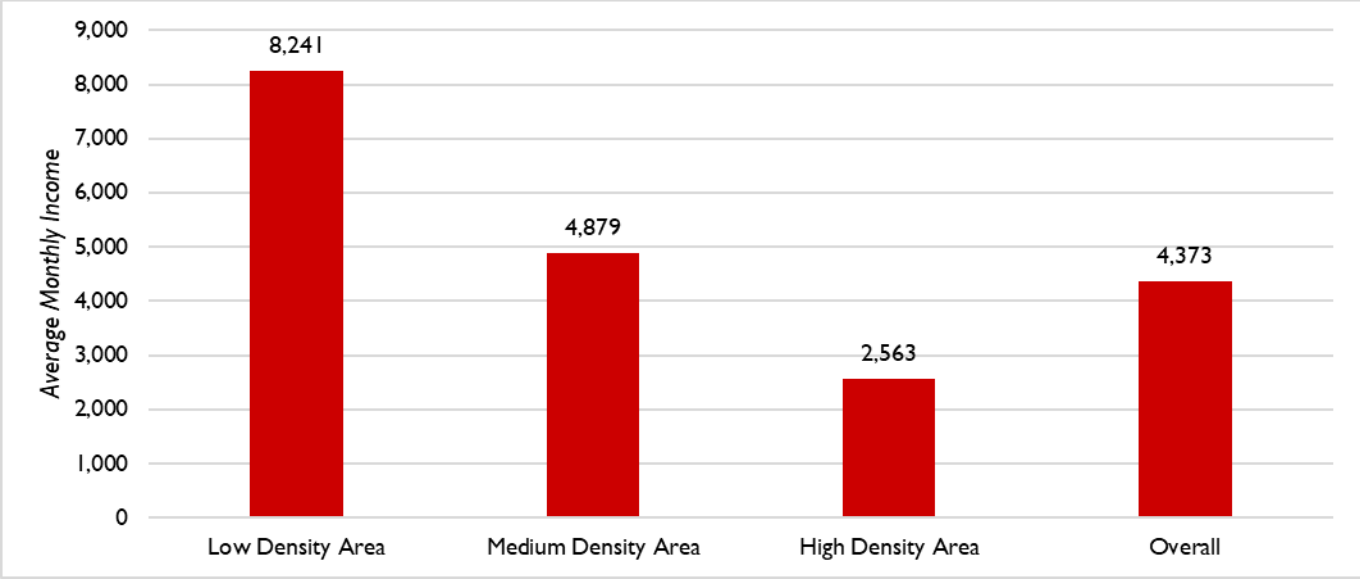


Figure 8: Monthly income by population density of residential area

From figure X below, the results revealed that when disaggregated by district, Lusaka had the highest average monthly income of ZMW 6,188 (which had also higher average income by residential areas except in high-density areas), followed by Ndola with ZMW 4,956 and lastly the high density residential areas with ZMW 4,926.

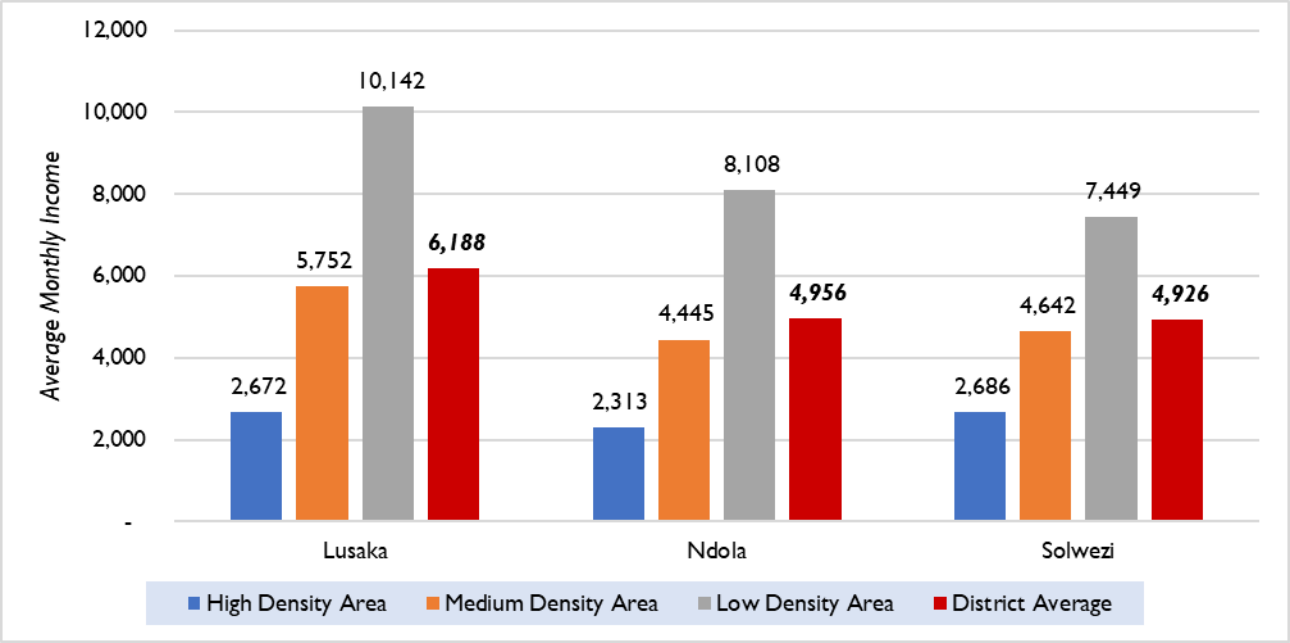


Figure X: Average Monthly income by population density of residential area and district.

Cognizant of the possibility that some households would be uncomfortable to provide information about their exact monthly income, the survey created income ranges to allow households to indicate the range in which their monthly income falls. As expected, some of the households surveyed did not give an exact

figure of monthly income but opted to give a range. A total of 584, representing 23.9%, opted to indicate the income range. The distribution of these ranges is summarized in Figure 9.

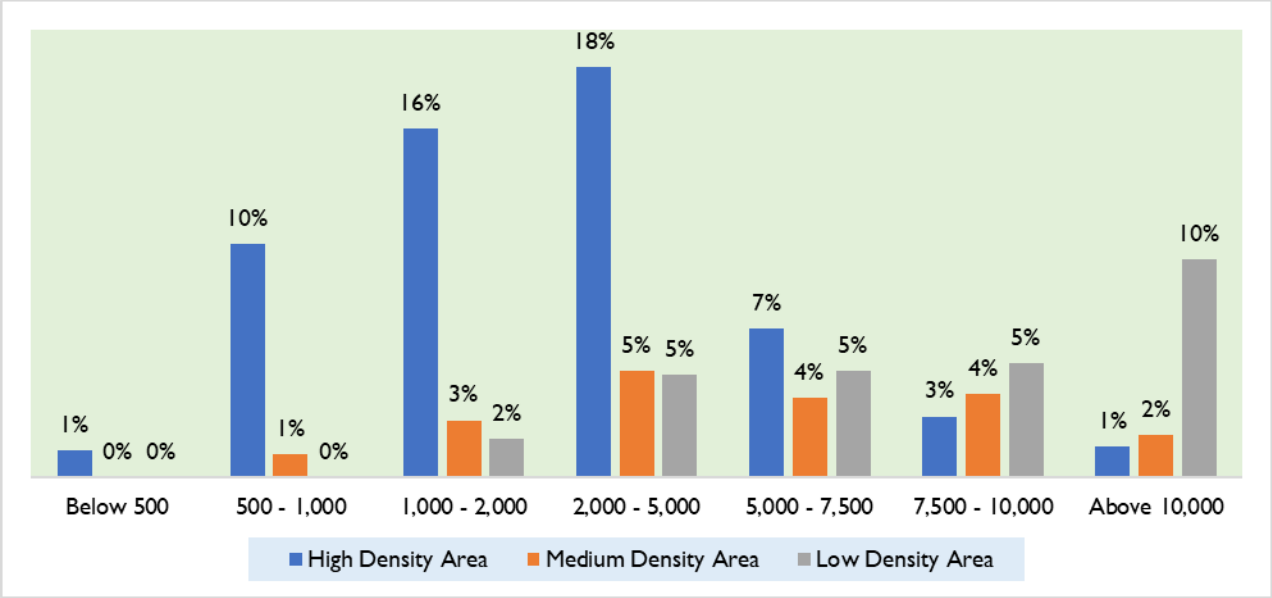


Figure 9: Average monthly income range

A look at the average monthly income range shows that the highest proportion of households (28%) fall in the ZMW 2,000 to ZMW 5,000 income range. About 32% 10% of the households earn between ZMW 500 and 2000 and those between ZMW 7,500 to 10, 000 (12%) and above ZMW 10,000 (13%). A total of 16.3% of the respondents refused to give information about their monthly average income.

BASELINE INDICATORS

INDICATORS 1 AND 2

Indicators 1 and 2 calculate the percentage change in charcoal consumption in Lusaka (Indicator 1) and in select urban areas outside of Lusaka (Indicator 2); with select urban areas being identified as Ndola and Solwezi. Table 5 below presents the baseline values, with households in Lusaka consuming on average 689 Kg a year (Indicator 1), while households in Ndola and Solwezi are consuming a combined average of 783 Kg of charcoal per year (Indicator 2). It is clear from these headline values that charcoal consumption in Lusaka is lower than the other urban areas.

Table 5: Baseline values for charcoal energy consumption in Lusaka and selected urban areas

#	Indicator Name	Kg/HH/year
1	Change (%) in charcoal energy consumption in Lusaka	689
2	Change (%) in charcoal energy consumption in select urban areas outside of Lusaka	783

Table 6 further breaks down charcoal consumption figures by urban location, showing that households in Lusaka consume the least amount of charcoal (689 Kgs / year) while households in Ndola consume more at 711 Kgs / year, and households in Solwezi consume the most (855 Kgs / year). Interestingly, while households in Lusaka consume the least amount of charcoal, they spend the most (ZMW 2,939 / year) and households in Solwezi who consume the most charcoal spend the least (ZMW 1,872 / year).

Clearly, charcoal prices are lower in urban areas outside of Lusaka and price is a direct driver of charcoal consumption (the lower the price, the higher the amount of charcoal consumed).

Table 6: Household charcoal consumption by urban district

Urban Location	Quantity (Kg)		Expenditure (ZMW)	
	Monthly	Annual	Monthly	Annual
Lusaka	57	689	245	2,939
Ndola	59	711	187	2,250
Solwezi	71	855	156	1,872
Average	**63**	**751**	**196**	**2,354**

Table 7 explores how charcoal consumption changes based on the type of housing area (low, medium, high density) which is directly related to income levels, with low-density areas having the highest incomes and high-density areas having the lowest incomes. The result indicated that even as income levels rise, charcoal usage remains steady. Charcoal consumption and expenditure decreased from high density areas to low-density areas, with high-density areas consuming 804 Kgs annually and low-density areas consuming 650 Kgs annually.

Table 7: Household charcoal consumption by Population-density areas

Housing Area	Quantity (Kg)		Expenditure (ZMW/year)	
	Monthly	Annual	Monthly	Annual
High Density	67	804	218	2,622
Medium Density	60	722	195	2,345
Low Density	54	650	149	1,789

Table 8 assesses the impact ATF adoption has on charcoal consumption by comparing households that practice at least some of their cooking on an ATF, with households that exclusively use charcoal. Surprisingly, the adoption of an ATF, such as electricity, does not significantly reduce the amount of charcoal consumed by a household. Users of ATFs consume approximately 5Kg of charcoal less per month than households that exclusively cook on charcoal. However, this metric does not take account of the amount of cooking undertaken on an ATF.

Table 8: Household charcoal consumption of ATF and Non-ATF users

Users	Charcoal (Kg/Month)	Charcoal (ZMW/Month)
ATF Users	65	191
Non ATF Users	70	226

Table 9 below illustrates how charcoal consumption changes as the amount of cooking on an ATF increases/decreases. Households who exclusively cook on charcoal consume on average 64Kg per month. If a household conducts 6 heating events (breakfast, lunch, dinner, snack, water heating and space heating) with an ATF per day they still consume 31Kg of charcoal per month; it is not clear how this residual charcoal is used. Interestingly, households who have low levels of ATF adoption seem to consume more charcoal than those that are exclusively cooking with charcoal. Overall, switching from

exclusive charcoal use to using an ATF 6 times a day reduces charcoal consumption by 56%, while using an ATF 5 times per day and ATF 4 times reduce charcoal consumption by 46% and 27% respectively.

Table 9: Household charcoal consumption and expenditure against ATF use

ATF Cooking Events	Monthly	
	Char Purchase (kg)	Charcoal Exp (ZMW)
6	31	120
5	38	124
4	52	160
3	66	197
2	84	234
1	81	233
0	71	228

INDICATOR 3

Indicator 3 of the A2C project measures the percent change in use of ATFs in Lusaka and select urban areas outside of Lusaka. ATF use was calculated as the number of times a household used any supported ATF (electricity, LPG, ethanol, pellets, paraffin, biogas or saw dust/agricultural residues) for preparing meals (breakfast, lunch, dinner, and snacks), as well as water or home heating. Table 10 below presents the Indicator 3 baseline value of 27.4%, demonstrating that close to a quarter of household cooking and heating events are carried out on ATFs.

Table 10: Use of ATFs in Lusaka and selected urban areas

#	Indicator Name	Baseline
3	Change (%) in use of low emission ATFs in Lusaka and select urban areas	27.4%

To calculate the percent of ATF use, the number of times an ATF was used by a household for the 6 different uses was calculated. For example, if a household used LPG for breakfast, lunch, and dinner (3 events) and used charcoal for snack, water heating and home heating, then the total share of cooking or heating events using an ATF is 3; the percent ATF use was then calculated as follows:

*Percent ATF Use = (number of times ATF was used by a HH / 6) *100*

Then, an average was computed for all sampled households which was disaggregated by district and residential areas, as shown in Table 11. The results on percent ATF use indicate that Lusaka District had the highest ATF usage at 30.8%, followed by Ndola with 29.3% and lastly Solwezi with 22.0%. The ATF use percent for Ndola and Solwezi combined was 25.6%, 5.2 percentage points less than Lusaka.

Table 11: ATF Use by district and Residential Areas

Residential Area	*Lusaka*	*Ndola*	*Solwezi*	*Overall Average*
High-Density Areas	11.7%	13.3%	8.0%	11.1%
Medium-Density Areas	47.4%	33.4%	27.6%	36.1%
Low-Density Areas	76.2%	61.1%	41.5%	57.3%
Overall Average	30.8%	29.3%	22.0%	27.4%

The findings also revealed that ATF use was highest in low-density areas at 57.3%, with high-density areas conducting 11.1% of heating/cooking events on ATFs. The disparity in ATF use is mainly attributed to different income levels which is key in determining the ability and willingness to pay for ATFs at the household level.

INDICATOR 4

Indicator 4 measures the amount of greenhouse gas (GHG) emissions, estimated in metric tons of CO_2 equivalent, reduced, sequestered, or avoided through sustainable landscapes activities supported by USG assistance. The primary source of GHG reductions will come from reduced consumption of charcoal in urban areas through promotion of ATFs. This indicator also accounts for emissions from ATFs – i.e. it is a net change value where some portion of the decreased emissions from charcoal are offset by an increase in emissions from ATFs.

Taking a "demand-side" approach for this indicator – i.e. one that focuses on the end use of charcoal – avoids issues of leakage that would occur with an indicator that was based on forest cover monitoring (the supply side). Focusing solely on fuel-switching by end users also avoids the risk of double-counting that would arise if the indicator added together the impact of fuel-switching with the impact of project activities focusing on reducing charcoal production.

To calculate this indicator, we surveyed households' usage of all energy sources for cooking: this was primarily charcoal, fuelwood, electricity, and LPG, but also included more infrequently-seen sources such as paraffin and pellets.

To calculate the total emissions from cooking fuels, we relied heavily on values from the USAID-funded CEADIR report (2021) that was completed in Zambia.[2] This gave us emissions factors for LPG, electricity, and other fuel / energy sources. For charcoal emissions, we used global default value of 0.3 for the fraction of non-renewable biomass (fNRB). This essentially means that we assumed 70% of the charcoal used was renewable and that only 30% was beyond the renewable fraction and would therefore be counted towards our baseline emissions.

Using these approaches, baseline emissions for indicator 4 are 4,434,130 metric tons CO_2 equivalent.

Table 12: Baseline value for Greenhouse gas (GHG) emissions

#	Indicator Name	Baseline emissions (tons CO_2e)
4	Greenhouse gas (GHG) emissions, estimated in metric tons of CO2 equivalent, reduced, sequestered, or avoided through sustainable landscapes activities supported by USG assistance (EG.13-6)	4,434,130

Breaking down by each urban area, we can see that Lusaka is the source of about 73.9% of the emissions from the three centers with 3,275,230 metric tons CO_2e produced from cooking. Solwezi and Ndola follow with 819,231 and 340,669 tons, respectively.

Table 13: Greenhouse gas (GHG) emissions by urban district

[2] Torres, Pablo; Eric Hyman; and Leah Quin. 2021. *Final Report: Climate Economic Analysis for Development, Investment, and Resilience (CEADIR) Activity.* Washington, DC: Crown Agents USA and Abt Associates, Prepared for USAID.

Urban Area	Baseline Emissions (tons CO_2e)
Lusaka	3,275,230
Solwezi	340,669
Ndola	818,231
Total emissions	4,434,130

INDICATOR 5

Forest clearing, or deforestation, has many causes including charcoal production, agriculture, grazing, mining, or expansion of settlements. A2C estimates that charcoal production (and the clearing of trees for the fuel source) contributes to approximately 25% of annual deforestation. In order to estimate forest clearing that can be attributed to charcoal use, A2C uses a bottom-up approach that starts with the amount of charcoal used by each household. We then calculate an estimate of forest clearing induced by that charcoal use using the relationship between charcoal volume and forest biomass (and hectares) required to estimate hectares of avoided deforestation.

As the basis of our calculation for indicator 5, we use the estimate for CO_2 emissions from charcoal that were already calculated for indicator 4. This already accounts for the fraction of non-renewable biomass (fNRB) in the charcoal production – *i.e.* the portion of charcoal production that can be deemed to be sustainable. From the estimate of CO_2 emissions, we convert to area of forest loss by assuming 61.7 tons of biomass per hectare of miombo forest (using values from Kutsch *et al.* (2011)[3], or 30.9 tons carbon per hectare. This is a calculated metric that does not differentiate between forest degradation and deforestation: for example, two hectares that lost 50% of their biomass through forest degradation would be counted the same as one hectare losing 100% of its biomass through deforestation.

Accordingly, we calculate the baseline value for deforestation directly attributable to charcoal production is 31,785 hectares.

Table 14: Baseline value for deforestation rate attributable to charcoal production

#	Indicator Name	Baseline (ha)
5	Percent change in deforestation directly attributable to charcoal production	31,785

INDICATOR 9

Indicator 9 of the A2C project estimates the number of Zambian households newly using, or increasing their use of, using low emissions charcoal alternative technologies and/or fuels (ATFs). To calculate the number of households using ATFs, households that used at least one ATF (electricity, LPG, ethanol, pellets, paraffin or saw dust/agricultural residues) for any cooking event (breakfast, lunch, dinner, and snacks), or water heating and home heating were included. As illustrated by table 15 below, the baseline figure for the project is 309,411 households using an ATF at least once.

Table 15: Baseline value for Number of households using ATFs

#	Indicator Name	Baseline

[3] Kutsch et al. 2011. *The charcoal trap: Miombo forests and the energy needs of people* | Carbon Balance and Management | Full Text (biomedcentral.com)

9	Number of Zambian Households Using ATFs	309,411

Overall, the findings revealed that the percentage of households who used at least one ATF for one heating event across the three urban districts is 45%. Ndola District had the highest at 50%, followed by Lusaka with 44% and lastly Solwezi with 41%. The findings also revealed that 80% of households in low-density areas are using at least one ATF, with medium-density and high-density areas accounting for 60% and 25% respectively.

Table 16: Percent of households using at least one ATF Use by District and Residential Area

HHs using at least one ATF energy source			
High Density Area	25%	Lusaka	44%
Medium Density Area	60%	Ndola	50%
Low Density Area	80%	Solwezi	41%

Bringing more affordable, accessible, and acceptable fuel options to lower-income households and increasing middle- and higher-income households' use of ATFs sets the framework for an overall decrease in urban charcoal consumption. In terms of number of households using at least one ATF, the study estimated that approximately 309,411 households are currently using at least one ATF in the three districts, with Lusaka accounting for 228,761 households.

Table 17: Number of households using at least one ATF Use by District

District	Population	Number of HHs	HHs using at least one ATF energy Source	Number of HHs Using ATF
Lusaka	2,567,096	513,419	44%	228,761
Ndola	612,104	122,421	50%	61,552
Solwezi	229,187	45,837	41%	19,097
TOTAL	**3,408,387**	**681,677**	**45%**	**309,411**

In the subsequent years after this baseline, A2C as part of its annual surveys, will measure the number of households that have either used an ATF for the first time (new ATF users) over the previous 12 months or have reported increase in existing ATF use over the previous 12 months (increased user).

ENERGY SOURCES AND USE

This section discusses electricity access and energy sources used by the households as well as alternative technologies and fuels to charcoal. The energy sources that are used to cook breakfast, lunch, snacks and dinner, and the most used energy source for heating water and home heating during the cold season are also discussed.

ENERGY SOURCES FOR COOKING, WATER AND HOME HEATING

Table 18: Distribution of household energy sources by district**Error! Reference source not found.** provides a summary of the distribution of energy sources used for cooking, water, and home heating among the surveyed households, by district and overall. Generally, charcoal stood out as the most used energy source overall and across all three districts. A large majority (94%) of surveyed households indicated using charcoal for cooking, water heating or home heating. A similar pattern was observed at

district level, where at least 90% of households in each of the districts indicated using charcoal. Solwezi was the highest at 96%, followed by Ndola at 95% and lastly Lusaka with 91%. In second place was electricity with an overall percentage of 45%. Ndola had the highest percent of household who indicated using electricity (51%), followed by Lusaka (45%) and lastly Solwezi (40%). In third place was firewood with an overall percentage of 11%, with Ndola being the highest at 20% followed by Solwezi with 8% of households using firewood, while Lusaka had only 4%.

In fourth place was LPG, with about 5% of the surveyed households indicating using this energy source. Among the three districts, Lusaka and Ndola were leading with 6% each, and Solwezi reported about 1% use of LPG. None of the households in any of the three districts reported using ethanol and paraffin. However, about 1% used pellets and sawdust/agricultural residue.

Table 18: Distribution of household energy sources by district

Energy source for cooking, water, or home heating	Lusaka		Ndola		Solwezi		Overall	
	Freq.	*Percent*	*Freq.*	*Percent*	*Freq.*	*Percent*	***Freq.***	***Percent***
Charcoal	763	90.8%	762	95.3%	764	95.5%	**2289**	**93.8%**
Firewood	37	4.4%	163	20.4%	61	7.6%	**261**	**10.7%**
Electricity	379	45.2%	407	50.9%	321	40.1%	**1107**	**45.4%**
LPG	51	6.1%	48	6.0%	11	1.4%	**110**	**4.5%**
Ethanol	0	0.0%	0	0.0%	0	0.0%	**0**	**0.0%**
Pellets	6	0.7%	9	1.1%	2	0.3%	**17**	**0.7%**
Paraffin/Kerosene	0	0.0%	0	0.0%	0	0.0%	**0**	**0.0%**
Saw dust/Ag residue	1	0.1%	25	3.1%	2	0.3%	**28**	**1.1%**

Error! Reference source not found. shows the different energy sources used based on whether the household is connected to the electricity grid. A total of 53% of the surveyed households that are connected to the electricity grid use it for cooking and heating. Generally, households connected to the electricity grid use more LPG (5%) than households that aren't connected. Most of the households, regardless of grid connection status, use traditional charcoal for cooking and heating, with 93% being those connected to the grid and a higher proportion of 98% being those not connected to the grid. A significantly higher proportion of households not connected to the grid use firewood for cooking and heating at 25%.

Table 19: Energy source for cooking and heating and electricity grid connection

Energy used for cooking, water, or home heating	Connected to electricity grid	
	No	*Yes*
Charcoal	97.8%	93.1%
Firewood	25.1%	8.2%
Electricity	0.0%	53.1%
LPG	0.8%	5.1%
Ethanol	0.0%	0.0%

Pellets	0.3%	0.8%
Paraffin/Kerosene	0.0%	0.0%
Saw dust/Ag residue	2.2%	1.0%

Error! Reference source not found.Error! Reference source not found. shows the distribution of household use of different energy sources for meal preparation, water, and home heating among the surveyed households. Results show that charcoal dominates across all 6 uses, with the highest being for home heating with 85% of households indicating using this source for the purpose of heating the home, and the lowest was for breakfast and snacks preparation (61% each). In second place is electricity, commonly used to prepare breakfast (36%) and snacks (36%). This finding is consistent with the Consumer Preference Survey Report (USAID A2C 2021)[4] and Tembo *et al.* (2015)[5]. Only 22% and 13% of the households use it to heat water or house heating respectively. Less than 4% of the households use any of the other five ATFs to prepare any meals or heat their homes or water, except firewood used 7% of the households to heat water.

Table 20: Energy Source by Meal Preparation and Other Uses

	Meal/Purpose					
Energy source	*Breakfast*	*Lunch*	*Dinner*	*Snacks*	*Water Heating*	*Home Heating*
Charcoal	61.0%	78.2%	73.9%	60.5%	69.7%	85.0%
Electricity	35.5%	18.4%	22.1%	36.0%	21.7%	12.7%
LPG	2.3%	2.0%	2.6%	2.6%	1.0%	0.5%
Firewood	0.9%	1.1%	1.0%	0.8%	7.0%	1.6%
Pellets	0.3%	0.3%	0.3%	0.2%	0.3%	0.0%
Sawdust/Agri. Residue	0.0%	0.0%	0.0%	0.0%	0.3%	0.1%
Solar Energy	0.0%	0.0%	0.0%	0.0%	0.04%	0.0%

Distribution of energy sources vary across residential area type, mostly driven by income levels and socio-economic status. Typically, households in low density areas (high income areas) tend to use less of

[4] Tetra Tech. 2021. *USAID Alternatives to Charcoal Consumer Preferences Survey Report*. USAID/Zambia, Lusaka, Zambia
[5] Tembo, S.T, B. P. Mulenga, and N. Sitko. 2015. "*Cooking Fuel Choice in Urban Zambia: Implications on Forest Cover*." Working Paper No. 94. IAPRI Working Paper series, Lusaka, Zambia.

biomass based fuels or energy sources, compared with those in the medium and high density areas.

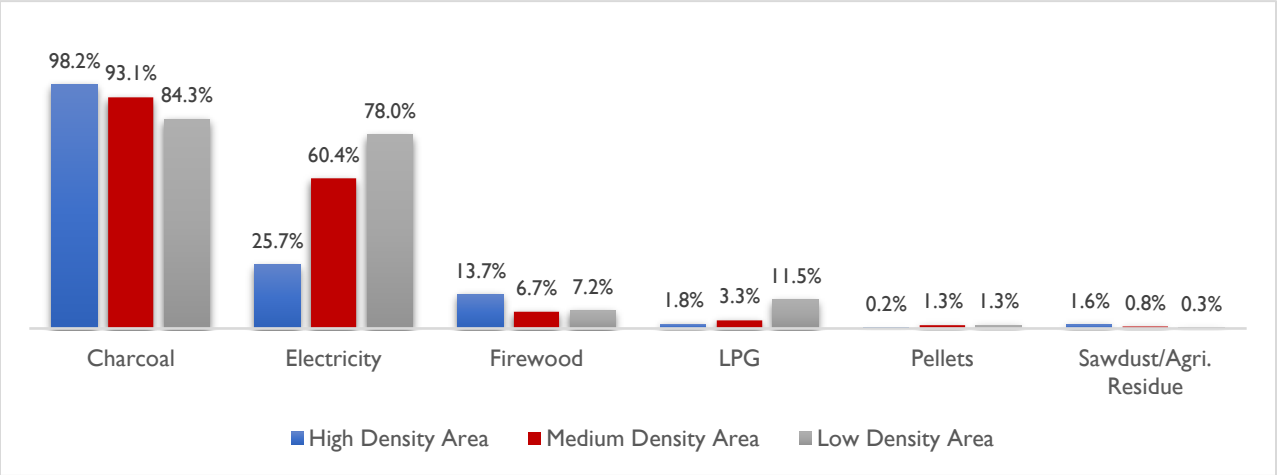


Figure 10 shows the distribution of household energy sources across the three residential area types. As expected, the percentage of households using electricity was highest in low density areas and lowest in high density areas. Slightly above three quarters (78%) of low-density households indicated using electricity for cooking, followed by medium-density (60%) and in third place was high density households at 26%. A similar pattern was observed with regards to LPG, where low-density areas had a relatively higher percent of households (12%) using LPG, followed by medium-density (3%) and lastly high-density (~2%).

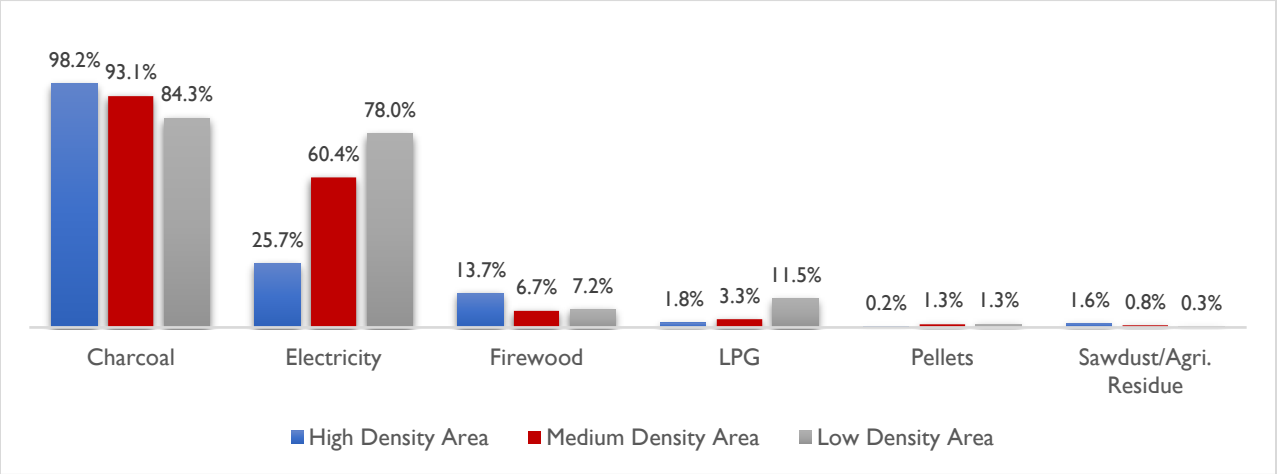


Figure 10: Energy source by residential area type by density of population

The pattern changes significantly for traditional charcoal. A relatively higher percentage of high-density area households reported using charcoal (98%) followed by medium-density (93%) and lastly low-density households (84%). It is important to note that traditional charcoal remains the most commonly used energy source across all three residential areas, with not less than 84% using the energy source. The widespread use of charcoal regardless of residential area is consistent with other studies (Tetra Tech,

2021; Tembo et al., 2015[6]; Kabisa et al., 2020[7]). It was interesting to note that firewood had a somewhat different pattern from charcoal, with the low-density and medium-density areas having relatively same percent (7%) of households using the source in comparison. Atteridge *et al.* (2013)[8] found that households in urban areas that used firewood were able to collect it on their own, including from trees within their yards. This could perhaps explain this observation, and also based on observation, firewood bundles are typically sold in the low-density areas in the survey areas.

Pellet efficient stove at a respondent's house in Solwezi (Credit: A2C)

A respondent showing the pellets used in a pellet stove (Credit: A2C)

Households also use energy sources for businesses they may be operating such as restaurants, selling cold drinks, making fritters etc. Such in-house businesses tend to share the same energy sources used for household purposes. An estimated 5% of the interviewed households had an in-house business. We analyzed the data to estimate the percent of distribution of energy sources used for in-house businesses. The total percent across energy sources exceeds 100% as a household may use multiple energy sources for the same business or may own multiple business, hence using multiple energy sources. **Error! Reference source not found.** shows that traditional charcoal is the most used energy source for in-house businesses, used by 99% of households that own an in-house business. This was followed by electricity reported by 49% of households that own an in-house business. In third was firewood reported by 28% of households, while the rest of the energy sources were reported by less than 5%, with ethanol and paraffin not reported by any household.

[6] Tembo, S.T, B. P. Mulenga, and N. Sitko. 2015. "*Cooking Fuel Choice in Urban Zambia: Implications on Forest Cover*." Working Paper No. 94. IAPRI Working Paper series, Lusaka, Zambia.
[7] Kabisa, M**.** B.P. Mulenga, H. Ngoma, and M.M. Kandulu. 2019. "*The Role of Policy and Institutions in Greening the Charcoal Value Chain in Zambia*". Working Paper No. 151. IAPRI Working Paper series, Lusaka, Zambia.
[8] Atteridge, A., Heneen, M. and J. Senyagwa. 2013. *Transforming household energy practices among charcoal users in Lusaka, Zambia: A user-centred approach*. Stockholm Environment Institute.

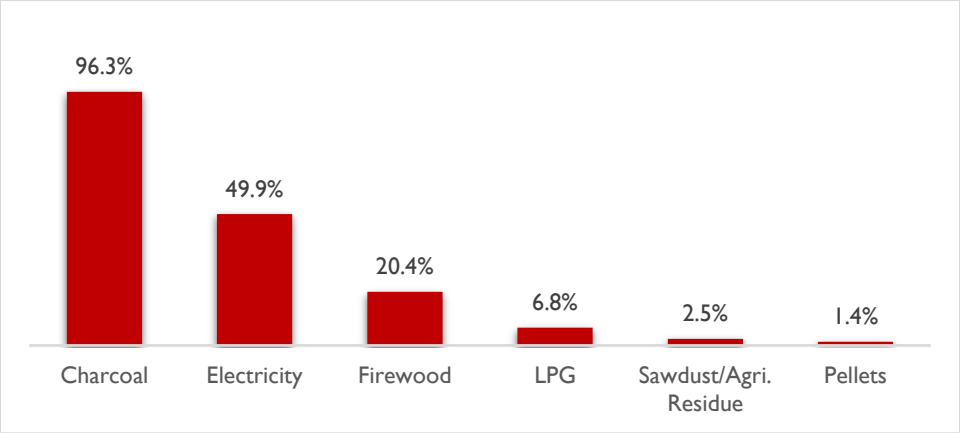


Figure 11: Percent distribution of energy sources used for in-house businesses

ALTERNATIVE TECHNOLOGY AND FUEL ADOPTION

Error! Reference source not found. presents a summary of the distribution of households who adopted an ATF and added to their energy mix for the first time in last 12 months. Therefore, a household is considered to have adopted an ATF if they adopted it for the first time in the last 12 months. Results show that Solwezi had the highest percentage of electricity adopters in the past year (0.75%), followed by Ndola at 0.38% and lastly Lusaka at 0.24%. Overall, there were 0.45% of households that adopted electricity for the first time in the last 12 months. With regards to LPG adoption in the past year, results show a relatively higher percentage for Lusaka (0.71%) followed by Ndola (0.63%) and in last place was Solwezi at 0.13%. Overall, LPG adoption was at 0.49% of the households in the three urban areas. For pellets, there were no new reported new adopters in Solwezi, while Ndola and Lusaka reported 0.75% and 0.24% respectively. Another ATF that was reported to have been adopted first time in the last 12 months was saw dust/agricultural residue, which was only reported in Ndola, with 0.13% of the households in the districts. Generally, LPG was the highest adopted ATF at 0.49%, followed by electricity at 0.45%, and in third place were pellets at 0.33%.

Table 21: Adoption of Alternative Technology and Fuels

	Fuel adopted in previous 12 months				Appliance used more than in previous year			
Fuel	Lusaka	Ndola	Solwezi	**Overall**	Lusaka	Ndola	Solwezi	**Overall**
Electricity	0.24%	0.38%	0.75%	**0.45%**	14.76%	15.88%	10.50%	**13.73%**
LPG	0.71%	0.63%	0.13%	**0.49%**	1.07%	0.88%	0.13%	**0.70%**
Pellets	0.24%	0.75%	0.00%	**0.33%**	0.24%	0.88%	0.00%	**0.37%**
Saw dust/Ag residue	0.00%	0.13%	0.00%	**0.04%**	0.12%	0.13%	0.13%	**0.12%**

ATF FUEL USE PERCENT

A higher proportion of the households in the low-density residential areas use electricity to prepare all their meals, heating water and home heating than those in the medium and high-density areas. The high-density areas have the least proportion of households using ATFs for any meals or heating purposes. LPG is the second most used ATF for these purposes, albeit very distant from first place electricity.

Table 22: Energy source use by cooking and heating event and by population density

Population Density	Energy source	Meal/Purpose					
		Breakfast	*Lunch*	*Dinner*	*Snack*	*Water heating*	*Home heating*
Low density	Electricity	66.1%	41.6%	48.7%	67.8%	43.1%	36.6%
	Charcoal	27.2%	51.7%	43.1%	25.1%	48.7%	60.0%
	LPG	6.0%	6.2%	7.5%	6.7%	3.5%	2.1%
	Firewood	0.3%	0.3%	0.3%	0.2%	4.0%	1.3%
	Pellets	0.3%	0.2%	0.3%	0.2%	0.3%	0.0%
	Paraffin	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
	Solar Energy	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
Medium density	Charcoal	49.5%	73.1%	66.2%	46.4%	67.8%	85.3%
	Electricity	48.2%	24.6%	31.1%	50.6%	28.0%	14.5%
	LPG	1.7%	1.0%	1.7%	2.6%	0.4%	0.0%
	Pellets	0.6%	1.3%	1.0%	0.4%	0.4%	0.0%
	Firewood	0.0%	0.0%	0.0%	0.0%	3.3%	0.3%
High density	Charcoal	80.1%	91.7%	90.2%	81.4%	79.6%	94.5%
	Electricity	17.3%	6.0%	7.3%	16.4%	9.9%	3.1%
	Firewood	1.6%	1.8%	1.6%	1.3%	9.6%	2.2%
	LPG	0.9%	0.5%	0.8%	0.8%	0.1%	0.0%
	Pellets	0.1%	0.0%	0.1%	0.1%	0.2%	0.0%
	Sawdust/Agri. Residue	0.0%	0.0%	0.0%	0.0%	0.5%	0.2%

LIQUID PETROLEUM GAS

The second most commonly used ATF is LPG, utilized by 4.5% of all households surveyed. Various quantities of LPG cylinders are used by households and data show that the 9 kg cylinder is the most commonly purchased unit reported by 19% of households (Figure 13: Commonly purchased LPG unitsFigure 13). This is followed by the 6 kg (15%), 3 kg (13%) and 5 kg (12%) cylinders. The 45 kg and 48 kg cylinders are the least commonly purchased units with less than 2% of the households using them. In addition, none of the households enumerated had the 38 kg and 35 kg cylinder.

Figure 12 LPG cylinder secured in a concrete block housing at a respondent's house

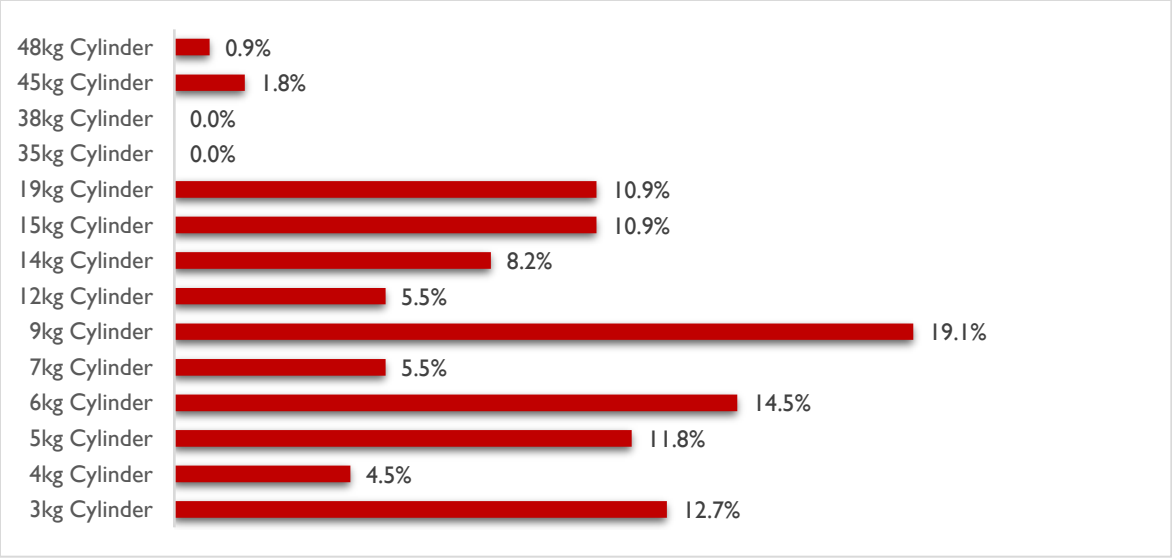


Figure 13: Commonly purchased LPG units

Households that used LPG were asked how long the cylinder(s) they use last in weeks (**Error! Reference source not found.**). Households using any cylinder size except the 14kg mostly reported the cylinder lasting for 4 weeks. Only the 14kg was reported to have lasted 8 weeks, by 44% of households who used it. The top 3 commonly purchased cylinders were equally reported to mostly have last 4 weeks, as follow; 9kg (24%), 6kg (38%), and 3kg (36%).

Table 23: LPG Cylinder size by number of weeks the cylinder lasts

Number of weeks cylinder lasts	Size of Cylinder											
	3Kg	4kg	5Kg	6Kg	7Kg	9Kg	12Kg	14Kg	15Kg	19Kg	45Kg	48Kg
Less than 1 week												
1 week												
2 Weeks	7.1%	20.0%	7.7%	18.8%								
3 Weeks	21.4%		15.4%			14.3%						
4 Weeks	35.7%	40.0%	38.5%	37.5%	50.0%	23.8%	83.3%	33.3%	41.7%	50.0%	50.0%	
5 Weeks				18.8%		9.5%		11.1%				
6 Weeks		20.0%	7.7%	12.5%	16.7%		16.7%	11.1%	8.3%	16.7%		
8 Weeks	14.3%		7.7%	6.3%		19.0%		44.4%	25.0%	16.7%		
9 Weeks			7.7%		16.7%				8.3%			
10 Weeks						4.8%					50.0%	
11 Weeks												
12 Weeks	7.1%		15.4%			23.8%			16.7%	16.7%		
13 Weeks												
14 Weeks												
15 Weeks												
16 weeks					16.7%	4.8%						
17 weeks												
18 Weeks	7.1%											
19 Weeks												
20 Weeks		20.0%										100.0%
24 Weeks				6.3%								
First time purchasing gas	7.1%											
Total Number (N)	**14**	**5**	**13**	**16**	**6**	**21**	**6**	**9**	**12**	**12**	**2**	**1**

CHARCOAL

Overall, 99.6% of all households interviewed in reported purchasing charcoal. The proportion of households purchasing charcoal was almost uniform across the three urban areas (Figure 15). Less than 1% of the respondents used charcoal but did not purchase it. For the very few households that did not purchase charcoal, slightly above half of them made their own charcoal, and the remainder were given by family/friends/neighbors.

Figure 14 Efficient charcoal stove

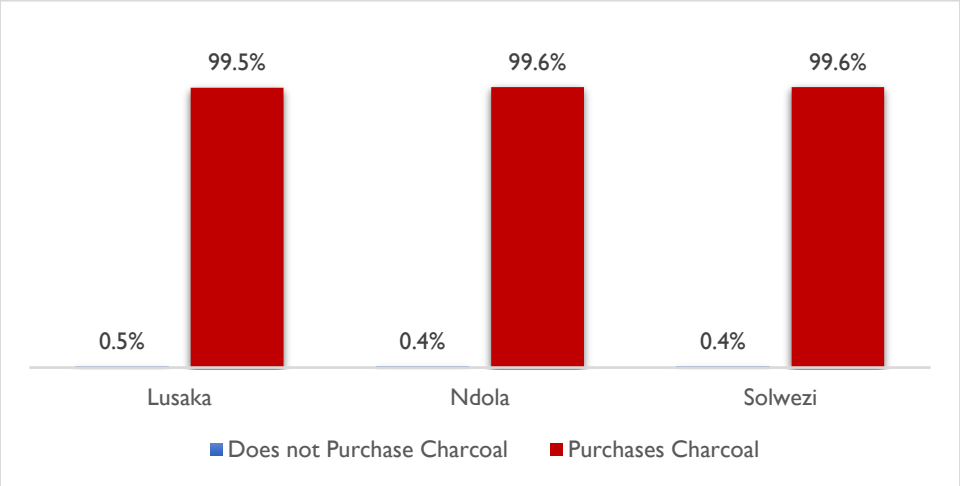


Figure 15: Charcoal purchases by district

The most commonly purchased quantity of charcoal across all the survey districts is the 25 kg bag with 1 ball pen head (39%) and a distant second, the 50 kg 2 ball pen, at 8% (Figure 17: Most commonly purchased charcoal unit by residential area typeFigure 16). All other charcoal unit types are commonly bought by less than 7% of the households, with the 10 kg half ball pen being the least commonly purchased at 1%.

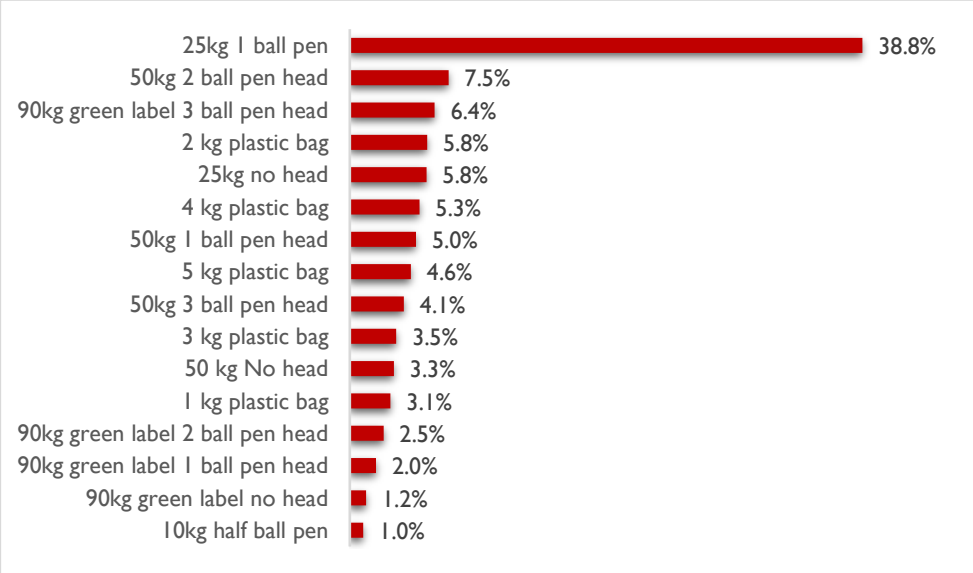
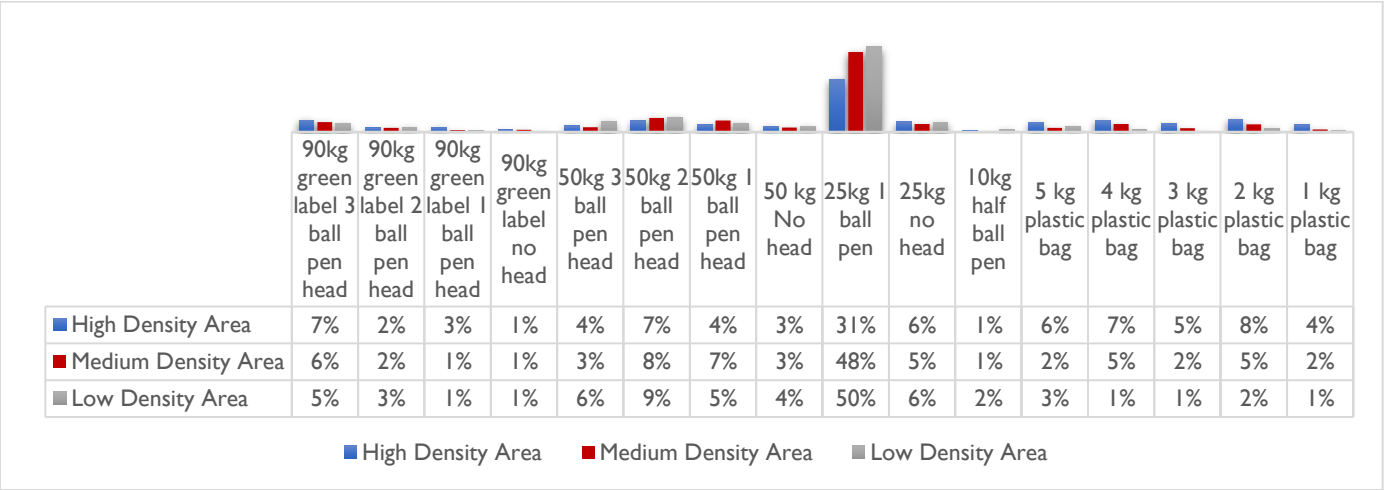


Figure 16: Commonly purchased charcoal units

When disaggregated by residential area type, the 25 kg bag with 1 ball pen head still stood out as the most commonly purchased unit across all three residential categories (Figure 17). This unit was highest among the low-density household (50%) closely followed by medium-density (48%) and in distant third place the high-density area (31%). This may be explained by the fact that the lower the unit of charcoal purchased, the higher the price paid for each kilogram than for bigger bags[9]. Decisions to purchase bigger units may thus be based on cost saving. Generally, the pattern shows relatively more high-density area households purchasing smaller units compared to the low and medium-density households. These range from 1 kg plastic bag to 5 kg plastic bag. Units greater than these appear to be more common among the low and medium-density households. This perhaps can be explained by the income level disparities, where high density areas could easily afford more of smaller units due to low income, whereas low density and medium density have relatively higher incomes are able to afford larger units. This finding is similar to Atteridge *et al.* (2013) and Gumbo *et al.* (2013)[10] that show that unit size purchase decisions are based on the buying power of the household.



	90kg green label 3 ball pen head	90kg green label 2 ball pen head	90kg green label 1 ball pen head	90kg green label no head	50kg 3 ball pen head	50kg 2 ball pen head	50kg 1 ball pen head	50 kg No head	25kg 1 ball pen	25kg no head	10kg half ball pen	5 kg plastic bag	4 kg plastic bag	3 kg plastic bag	2 kg plastic bag	1 kg plastic bag
High Density Area	7%	2%	3%	1%	4%	7%	4%	3%	31%	6%	1%	6%	7%	5%	8%	4%
Medium Density Area	6%	2%	1%	1%	3%	8%	7%	3%	48%	5%	1%	2%	5%	2%	5%	2%
Low Density Area	5%	3%	1%	1%	6%	9%	5%	4%	50%	6%	2%	3%	1%	1%	2%	1%

High Density Area Medium Density Area Low Density Area

Figure 17: Most commonly purchased charcoal unit by residential area type

[9] Atteridge, A., Heneen, M. and Senyagwa, J., 2013. *Transforming household energy practices among charcoal users in Lusaka, Zambia: A user-centred approach*. Stockholm Environment Institute.

[10] Gumbo, D. J., Moombe, K. B., Kandulu, M. M., Kabwe, G., Ojanen, M., Ndhlovu, E. and Sunderland, T.C.H. 2013. *Dynamics of the charcoal and indigenous timber trade in Zambia: A scoping study in Eastern, Northern and Northwestern provinces*. Occasional Paper 86. CIFOR, Bogor, Indonesia.

Table *24* shows the summary of the analysis of the number of weeks a unit of charcoal most commonly purchased by a household lasts. For the 3 most commonly purchased units across all residential area types (25kg with 1 ball pen head, 50kg with 2 ball pen head and 90 kg with 3 ball pen heads), results show that 41% of those that most commonly purchased 25kg with 1 ball pen head reported that the unit lasts for two weeks on average, and 30% said the unit lasts 1 week. For the 50kg bag with 2 ball pen head, 38% said the unit lasts 4 weeks, while 33% said 2 weeks. For the 90kg bag with 3 ball pen, 57% said the unit lasts 4 weeks, followed by 10% who indicated 8 weeks.

The smallest unit, the 1kg plastic bag was reported to last less than 1 week by 94% of those who used it. Further results show that 90kg bags do not last for a week or less – but more.

Table 24: Most commonly purchased charcoal units by the number of weeks the unit lasts

Number of weeks a unit lasts	1 kg plastic bag	2 kg plastic bag	3 kg plastic bag	4 kg plastic bag	5 kg plastic bag	10kg half ball pen	25kg no head	25kg 1 ball pen	50 kg No head	50kg 1 ball pen head	50kg 2 ball pen head	50kg 3 ball pen head	90kg green label no head	90kg green label 1 ball pen head	90kg green label 2 ball pen head	90kg green label 3 ball pen head
Less than a week	94.3%	95.5%	95.0%	96.7%	87.6%	4.3%	1.5%	4.9%			2.9%	1.1%				
1 Week		1.5%	1.3%	2.5%	6.7%	34.8%	27.3%	30.2%	10.5%	3.5%	7.6%	4.3%				
2 Weeks	2.9%	2.3%	2.5%		1.9%	26.1%	34.8%	40.9%	32.9%	35.1%	33.5%	20.4%		8.9%	10.3%	8.2%
3 Weeks					1.0%		7.6%	2.5%	7.9%	6.1%	1.8%	7.5%	10.7%	8.9%	1.7%	6.2%
4 Weeks	1.4%		1.3%	0.8%	1.0%	34.8%	20.5%	17.8%	40.8%	48.2%	38.2%	47.3%	57.1%	55.6%	62.1%	56.8%
5 Weeks							0.8%	0.1%		3.5%	0.6%	4.3%	10.7%	2.2%	6.9%	4.1%
6 Weeks							0.8%	0.3%		0.9%	1.2%			4.4%	1.7%	6.2%
7 Weeks								0.1%			0.6%	1.1%			1.7%	1.4%
8 Weeks		0.8%			1.0%		3.0%	1.8%	5.3%	1.8%	8.8%	12.9%	17.9%	15.6%	10.3%	9.6%
9 Weeks																0.7%
10 Weeks																0.7%
11 Weeks								0.2%						2.2%		
12 Weeks					1.0%		0.8%	0.6%	1.3%	0.9%	2.9%	1.1%	3.6%	2.2%		4.1%
13 Weeks											0.6%					0.7%
14 Weeks															1.7%	
15 Weeks								0.1%			0.6%					
16 Weeks																
17 Weeks																
18 Weeks																
19 Weeks																
20 Weeks																

More than 20 Weeks	1.4%						3.0%	0.5%	1.3%		0.6%				3.4%	1.4%

HOUSEHOLD CHARACTERISTICS BY MAIN ENERGY SOURCE

In this section, characteristics of households who used charcoal, electricity and LPG are compared against those that did not use these sources. The three energy sources were selected as they are the most commonly used sources for cooking and heating.

First, characteristics of charcoal users and non-charcoal users were examined and compared. Non-charcoal users are defined as households that indicated not using charcoal for cooking, water heating or home heating. Charcoal users have a higher household size of 5.3 in comparison to 3.6 for non-charcoal users, and they have a lower average monthly income of ZMW 4,086.32 whereas non-charcoal users have ZMW 8,599.07 (Table 25). Seeing that charcoal users have a bigger household size than non-charcoal users, the age group proportions of household members also follows the same pattern for whichever age group. In addition, results show that there were three times more charcoal users who were not connected to electricity (15%) than non-charcoal users were equally not connected (5%). This may suggest that households not connected to electricity as more likely to use charcoal as a source of energy.

Table 25: Socio-demographic characteristics of charcoal versus non-charcoal users

Characteristic	Charcoal users	Non charcoal users
Average household size	5.3	3.6
Average number of adults (18 years and above)	2.9	2.3
Average number of children (5 years and below)	0.8	0.5
Average number of children (6 - 17 years)	1.6	0.9
Average household monthly income (ZMW)	4,086.32	8,599.07
Not connected to electricity (%)	15.3%	5.3%

A summary of the differences in the demographic characteristics of households that use electricity for cooking and heating, and those that don't is given in Table 26. It is important to note that electricity users do not imply those that use electricity exclusively, but includes those that use other sources in addition to electricity. The household sizes are almost identical at 5.1 for electricity users and 5.3 for non-electricity users. There is a distinct difference in average monthly income, with households using electricity unsurprisingly having a higher average income at ZMW 7,216.86 and non-electricity users having an average monthly income of ZMW 2,324.98.

Table 26: Socio-demographic characteristics of households that use electricity for cooking and heating versus non-users

Characteristic	Electricity users	Non electricity users
Average household size	5.1	5.3
Average number of adults (18 years and above)	3.0	2.8
Average number of children (5 years and below)	0.7	0.9
Average number of children (6 - 17 years)	1.5	1.6
Average household monthly income (ZMW)	7,216.86	2,324.98

The demographic characteristics for LPG and non-LPG users are summarized in Table 27. Households that use LPG have a slightly smaller household size (4.9) in comparison to non-LPG users at 5.2. LPG-using households have almost the same distribution of household members across the specified age groups with non-LPG users. As expected, LPG user households have a higher income of ZMW 12,154.86 in comparison to non-LPG users with an average monthly income of ZMW 4,107.96. Further, households that used LPG and were not connected to the electricity was only 3%, while those not using LPG and also not connected to the electricity was almost five times more (15%). This suggests that household that use LPG are more likely to be connected to the electricity grid – as indicated by 97.3% of LPG users who were connected to the grid.

Table 27: Socio-demographic characteristics of households that use LPG for cooking and heating versus non-users

Characteristic	LPG users	Non LPG users
Average household size	4.9	5.2
Average number of adults (18 years and above)	2.9	2.9
Average number of children (5 years and below)	0.6	0.8
Average number of children (6 - 17 years)	1.5	1.6
Average household monthly income (ZMW)	12,154.86	4,107.96
Not connected to electricity (%)	2.7%	15.2%

MONTHLY EXPENDITURE ON COOKING ENERGY

The highest average monthly expenditure spent by a household on an energy source was LPG at ZMW 359.90 and electricity at ZMW 302.10, however, electricity expenditure includes all uses, not simply cooking (Figure 18). Sawdust/agricultural residue had the least amount of money spent on (ZMW 50), although with regards to ATFs, pellets had the least monthly average expenditure (ZMW 142.14).

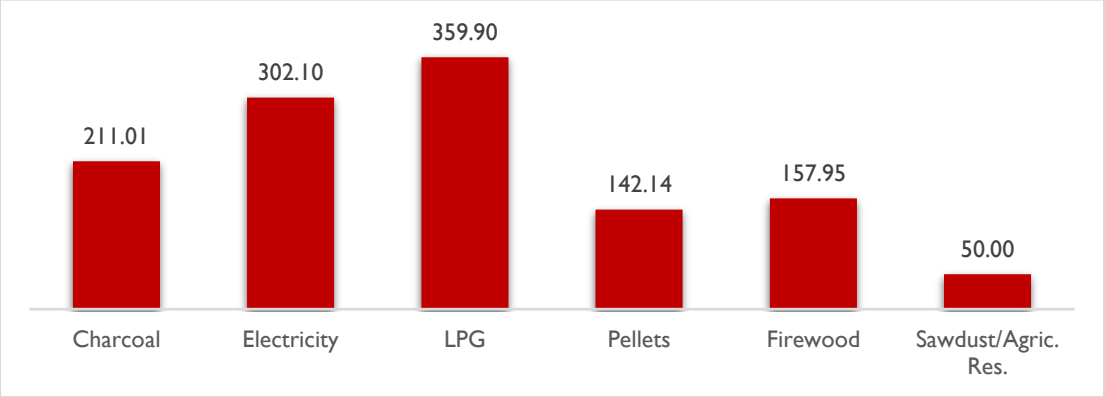


Figure 18: Average monthly expenditure on energy source Monthly expenditure on charcoal

Given that charcoal is the most commonly used energy source, further analysis was conducted to examine the variation in household monthly expenditure on charcoal by unit size most commonly purchased. Figure 19 shows the summary of the analysis. Results show that households that purchase the 90 kg bags (the 1 to 3 ball pen head) spent the highest on charcoal per month relative to those who purchased other units. The bigger the size of the 90kg bag quantity the higher the monthly expenditure (the range was ZMW 282.51 – ZMW 334.43). It was interesting to note that households that purchased

a 10kg bag with half ball pen head spent the least per month, yet the unit was the least commonly purchased by households. Households that purchase the 10kg half ball pen unit spent ZMW 104.78 per month compared with ZMW 204.03 per month among households that purchase the 1 kg plastic bag – which was the smallest bag. Household that purchase the most commonly purchased unit, the 25kg bag with 1 ball ben head, spent ZMW 177.35 per month on charcoal, ZMW 26.68 less than those purchasing 1 kg but ZMW 72.57 higher than those purchasing the least costly 10 kg bag.

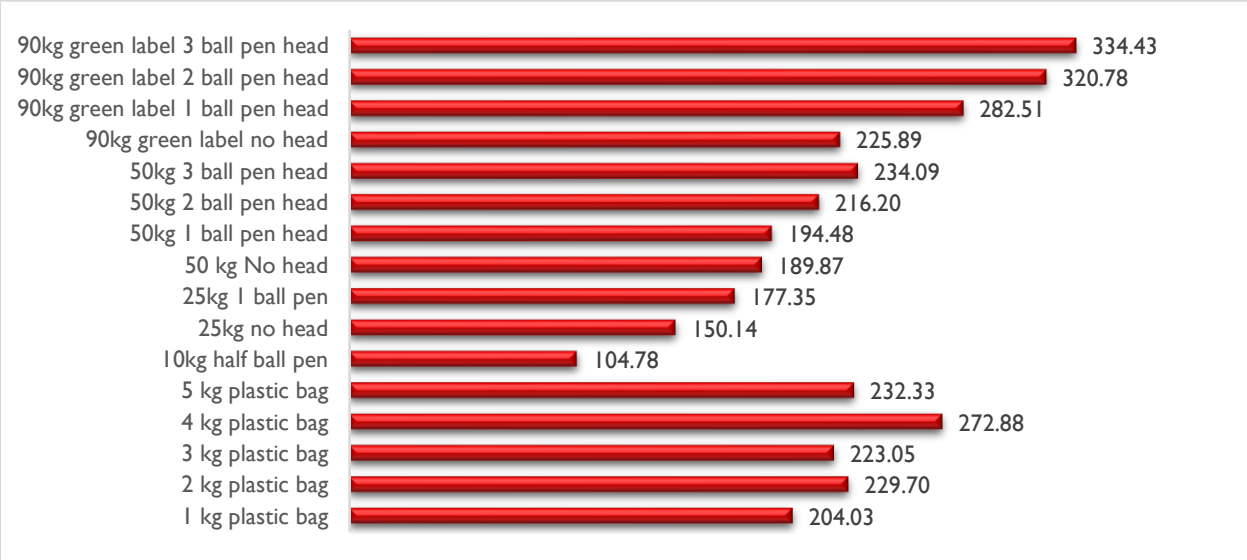


Figure 19: Average monthly expenditure (ZMW) on charcoal by unit size

APPLIANCE USE

This chapter discusses the appliances used by the households for the different energy sources that they use. The frequency of the different appliances used by energy source and district are summarized in this section.

ATF APPLIANCE USAGE

The most commonly used electric appliances are shown in Table 28. The four-plate electric cooker with an oven (32%) and electric kettle the (27%) are the two most commonly used appliances across all the districts. There are slightly more households in Ndola district using the electric kettle (30%) and four-plate electric stove with an oven (38%) for cooking and heating water in comparison to the other two districts. It can be noted that the Induction is not a commonly used cooking electric appliance, as barely any household used it, and the Electric Pressure Cooker has higher usage (2%) even though it is still lower than the Double Electric Plate (6%).

Table 28: Electric appliance usage by district

	Lusaka		Ndola		Solwezi		Overall	
Type of electric appliance	*Freq.*	*Percent*	*Freq.*	*Percent*	*Freq.*	*Percent*	***Freq.***	***Percent***
Single electric plate	14	1.7%	6	0.8%	3	0.4%	**23**	**0.9%**
Double electric plate	46	5.5%	54	6.8%	44	5.5%	**144**	**5.9%**
4 plate electric cooker(with oven)	248	29.5%	307	38.4%	215	26.9%	**770**	**31.6%**
Rice Cooker	22	2.6%	27	3.4%	15	1.9%	**64**	**2.6%**

Microwave	87	10.4%	104	13.0%	67	8.4%	**258**	**10.6%**
Two plate electric with oven	23	2.7%	23	2.9%	19	2.4%	**65**	**2.7%**
Electric kettle plate	219	26.1%	239	29.9%	204	25.5%	**662**	**27.1%**
Electric Pressure Cooker	16	1.9%	24	3.0%	11	1.4%	**51**	**2.1%**
Single Electric Fryer	22	2.6%	18	2.3%	14	1.8%	**54**	**2.2%**
Induction Cooker	1	0.1%	0	0.0%	0	0.0%	**1**	**0.0%**
Toaster	59	7.0%	87	10.9%	50	6.3%	**196**	**8.0%**
Sandwich Maker	37	4.4%	43	5.4%	28	3.5%	**108**	**4.4%**
Geyser	49	5.8%	40	5.0%	37	4.6%	**126**	**5.2%**
Blender	59	7.0%	61	7.6%	38	4.8%	**158**	**6.5%**
Single Oven	1	0.1%	2	0.3%	0	0.0%	**3**	**0.1%**
Heating Element	16	1.9%	3	0.4%	2	0.3%	**21**	**0.9%**
Coffee Maker	1	0.1%	16	2.0%	9	1.1%	**26**	**1.1%**
3 Plate Cooker with Oven	1	0.1%	1	0.1%	0	0.0%	**2**	**0.1%**
Airfryer	0	0.0%	1	0.1%	0	0.0%	**1**	**0.0%**
Other appliances	18	2.1%	21	2.6%	12	1.5%	**51**	**2.1%**

The most commonly used LPG appliance across the three districts is the two burner (2%), followed by the cylinder with one burner (1.4%), and the 4-burner cooker with an oven (1%) (.

Table 29). Disaggregating the findings by district, there are more households in Lusaka (3%) and Ndola (2%) districts using the two-burner stove. There were slightly more households in Lusaka using the cooker with four burners with an oven and the one burner.

Table 29: LPG appliance usage by district

	Lusaka		Ndola		Solwezi		Overall	
Type of LPG Appliance	*Freq.*	*Percent*	*Freq.*	*Percent*	*Freq.*	*Percent*	***Freq.***	***Percent***
LPG Cooker (5 Burner with Oven)	1	0.12%	0	0.0%	0	0.0%	**1**	**0.0%**
LPG Cooker (4 Burner with Oven)	12	1.4%	9	1.1%	2	0.3%	**23**	**1.0%**
LPG Cylinder Burner (1 Plate Stove)	11	1.3%	21	2.6%	2	0.3%	**34**	**1.4%**
LPG 2 Burner	27	3.2%	16	2.0%	7	0.9%	**50**	**2.1%**
LPG 3 burner	0	0.0%	2	0.3%	0	0.0%	**2**	**0.1%**
Other LPG appliances	1	0.12%	0	0.0%	0	0.0%	**1**	**0.0%**

NON-ATF APPLIANCE USAGE

The most commonly used charcoal appliances are summarized in

Table 30. The Mbaula is used by 86% of the surveyed households in the three districts, an unsurprising result.[11],[12] The distant second most commonly used charcoal appliance is the improved charcoal stove used by 10% of the households. The drum or barbeque/braai stand is the third most commonly used appliance at 3%. There were more households in Solwezi and Ndola districts using a Mbaula at 93% and 92% respectively, higher than the overall percent across the three districts. For the improved charcoal stove, a higher proportion of the users were from Lusaka district (21%).

Table 30: Charcoal appliance usage by district

	Lusaka		Ndola		Solwezi		Overall	
Type of Charcoal Appliance	*Freq.*	*Percent*	*Freq.*	*Percent*	*Freq.*	*Percent*	***Freq.***	***Percent***
Mbaula	629	74.9%	732	91.5%	747	93.4%	2108	86.4%
Drum or Barbeque/Braai stand	17	2.0%	35	4.4%	15	1.9%	67	2.8%
Improved Charcoal Stove	175	20.8%	59	7.4%	17	2.1%	251	10.3%
Efficient Charcoal Stoves	12	1.4%	7	0.9%	11	1.4%	30	1.2%
Other charcoal based appliances	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Table 31 shows the appliances used for the firewood energy source. The vast majority of the households use the three stone (10%). There were more households in Ndola and Solwezi districts using a three-stone than Lusaka (20% and 7% respectively). The second most used firewood appliance was the Efficient Wood Stove (0.2%) – although most users were from Lusaka (0.4%) than Solwezi (0.1%) and Ndola (0.1%).

Table 31: Firewood appliance usage by district

	Lusaka		Ndola		Solwezi		Overall	
Type of Firewood Appliance	*Freq.*	*Percent*	*Freq.*	*Percent*	*Freq.*	*Percent*	***Freq.***	***Percent***
Three Stone Stove	35	4.2%	161	20.1%	58	7.3%	**254**	**10.4%**
Mud Stove	0	0.0%	1	0.1%	2	3.3%	**3**	**0.1%**
Improved Wood Stove	0	0.0%	0	0.0%	0	0.0%	**0**	**0.0%**
Efficient Wood Stove	3	0.4%	1	0.1%	1	0.1%	**5**	**0.2%**
Other Firewood based stove	0	0.0%	0	0.0%	0	0.0%	**0**	**0.0%**

[11] Atteridge, A., Heneen, M. and Senyagwa, J., 2013. *Transforming household energy practices among charcoal users in Lusaka, Zambia: A user-centred approach*. Stockholm Environment Institute.
[12] Hibajene, S.H. and Kalumiana, O.S., 2003. *Manual for charcoal production in earth kilns in Zambia*. Stockholm Institute of Energy/Department of Energy.

APPENDIX I: CHARCOAL MARKET WEIGHTS

Bag Description	Market 1 Name: Katambala, Bauleni							Market 2 Name: Lupili, Mandevu							Market 3 Name: Mbasela/Bus-stop, Kanyama							Adjusted Weight (Interpolation)
	Measured Weights					Average Weight	Price (ZMW)	Measured Weights					Average Weight	Price (ZMW)	Measured Weights					Average Weight	Price (ZMW)	
	1	2	3	4	5			1	2	3	4	5			1	2	3	4	5			
1 kg Smallest Plastic bag	0.5	0.5	0.6	0.5	0.4	0.5	-	0.5	0.4	0.4	0.4	0.4	0.4	1	0.5	0.4	0.4	0.5	0.3	0.4	1	0.45
2Kg Plastic bag	0.6	0.5	0.6	0.6	0.6	0.6	3	1.1	1.0	1.0	1.0	1.1	1.0	2	0.7	0.7	0.7	0.7	0.7	0.7	2	0.77
3kg Plastic bag	1.4	1.1	1.1	1.3	1.2	1.2	-	1.3	1.4	1.4	1.3	1.4	1.4	3	1.2	1.2	1.2	1.3	1.3	1.2	3	1.27
4kg Plastic bag	1.2	1.3	1.2	1.2	1.2	1.2	5	1.6	1.6	1.7	1.5	1.7	1.6	5	1.6	1.6	1.7	1.7	1.6	1.6	5	1.49
5kg Large Plastic bag	3.2	3.1	2.9	3.2	3.1	3.1	10	3.4	3.6	2.6	3.1	3.0	3.1	10	2.7	2.7	3.0	3.0	2.7	2.8	10	3.02
10kg half ball pen	11.7	11.9	12.3	11.5	12.8	12.0	40	11.6	12.8	12.0	11.6	10.5	11.7	50	11.6	12.5	11.8	12.1	12.5	12.1	50	11.95
25kg No head	22.7	22.9	22.1	21.3	21.5	22.1	70	23.1	22.3	23.4	20.8	24.2	22.8	70	26.3	21.6	24.0	29.3	22.6	24.8	70	15.97
25 kg 1 ball pen head	23.2	22.3	22.8	32.1	23.0	24.7	60	19.9	19.0	16.4	12.4	13.3	16.2	50	17.9	19.3	16.4	18.3	23.6	19.1	100	19.99
50kg No head	25.8	29.9	32.9	23.3	26.3	27.6	100	32.7	41.5	41.3	37.4	43.0	39.2	100	49.4	50.5	53.4	36.4	51.5	48.2	150	38.35
50kg 1 ball pen head	48.4	44.9	44.8	39.8	50.5	45.7	100	33.2	41.1	38.1	52.0	33.1	39.5	110	45.3	38.5	46.2	43.7	39.1	42.6	150	42.58
50kg 2 ball pen head	64.3	60.1	59.3	44.8	46.0	54.9	150	62.1	49.1	50.8	60.6	55.5	55.6	150	67.3	58.4	58.1	69.9	59.2	62.6	200	57.70
50kg 3 ball pen head	69.6	102.8	81.2	94.0	87.8	87.1	150	72.1	70.6	56.8	48.0	56.8	60.9	200	65.4	97.0	92.9	92.3	96.3	88.8	250	78.91
90kg green label No head	68.0	79.1	86.9	78.8	72.9	76.7	180	77.7	82.8	85.0	96.0	84.0	85.1	280	91.3	98.7	77.7	74.5	85.5	85.5	260	82.43
90kg green label 1 ball pen head	74.7	88.4	67.0	65.4	100.8	79.3	150	81.6	86.7	57.8	61.7	71.9	71.9	280	65.4	61.4	58.1	61.3	73.6	64.0	250	102.34
90kg green label 2 ball pen head	111.4	122.0	135.1	123.7	131.7	124.8	250	135.9	133.0	124.7	95.0	128.8	123.5	350	110.8	100.0	144.5	115.5	121.7	118.5	280	122.25
90kg green label 3 ball pen head	131.8	124.6	158.6	102.8	145.5	132.7	360	166.8	167.5	131.5	117.6	125.6	141.8	350	148.5	160.6	158.6	155.6	170.4	158.7	400	144.40

APPENDIX II: SAMPLED ENUMERATION AREAS

1.1 COPPERBELT

Cluster	prov_name	dist_name	classcode	const_name	ward_name	region	csa	sea	geoid	hh	pop	sea_code
001	Copperbelt	Ndola	High Density- Urban	Bwana Mkumbwa	Munkulungwe	Urban	1	1	20210033122011	120	478	210033122011
002	Copperbelt	Ndola	High Density- Urban	Bwana Mkumbwa	Munkulungwe	Urban	9	2	20210033122092	304	964	210033122092
003	Copperbelt	Ndola	High Density- Urban	Bwana Mkumbwa	Twashuka	Urban	5	2	20210033132052	131	32	210033132052
004	Copperbelt	Ndola	High Density- Urban	Bwana Mkumbwa	Mushili	Urban	5	3	20210033152053	161	836	210033152053
005	Copperbelt	Ndola	High Density- Urban	Bwana Mkumbwa	Mushili	Urban	11	2	20210033152112	176	1,006	210033152112
006	Copperbelt	Ndola	High Density- Urban	Bwana Mkumbwa	Kantolomba	Urban	3	2	20210033172032	193	859	210033172032
007	Copperbelt	Ndola	High Density- Urban	Chifubu	Pamodzi	Urban	9	3	20210034012093	167	699	210034012093
008	Copperbelt	Ndola	High Density- Urban	Chifubu	Kawama	Urban	2	1	20210034022021	181	1,009	210034022021
009	Copperbelt	Ndola	High Density- Urban	Chifubu	Fibobe	Urban	1	3	20210034032013	150	783	210034032013
010	Copperbelt	Ndola	High Density- Urban	Chifubu	Chifubu	Urban	2	4	20210034042024	246	1,300	210034042024
011	Copperbelt	Ndola	High Density- Urban	Chifubu	Kamba	Urban	6	2	20210034052062	152	764	210034052062
012	Copperbelt	Ndola	High Density- Urban	Kabushi	Lubuto	Urban	7	2	20210035182072	113	621	210035182072
013	Copperbelt	Ndola	High Density- Urban	Kabushi	Toka	Urban	2	3	20210035202023	191	990	210035202023
014	Copperbelt	Ndola	High Density- Urban	Kabushi	Kabushi	Urban	2	3	20210035222023	120	683	210035222023
015	Copperbelt	Ndola	High Density- Urban	Kabushi	Skyways	Urban	1	3	20210035242013	211	1,108	210035242013
016	Copperbelt	Ndola	High Density- Urban	Kabushi	Masala	Urban	4	1	20210035252041	116	568	210035252041
017	Copperbelt	Ndola	High Density- Urban	Ndola	Nkwazi	Urban	5	3	20210036072053	191	896	210036072053
018	Copperbelt	Ndola	High Density- Urban	Ndola	Chipulukusu	Urban	3	4	20210036092034	118	615	210036092034
019	Copperbelt	Ndola	High Density- Urban	Ndola	Chipulukusu	Urban	9	3	20210036092093	175	848	210036092093
020	Copperbelt	Ndola	High Density- Urban	Ndola	Kanini	Urban	6	2	20210036102062	134	399	210036102062
021	Copperbelt	Ndola	High Density- Urban	Ndola	Twapia	Urban	7	1	20210036262071	206	1,087	210036262071
022	Copperbelt	Ndola	High Density- Urban	Ndola	Dag Hammerskjoe	Urban	1	2	20210036271012	65	265	210036271012
023	Copperbelt	Ndola	Medium Density- Urban	Bwana Mkumbwa	Mushili	Urban	2	1	20210033152021	133	518	210033152021
024	Copperbelt	Ndola	Medium Density- Urban	Bwana Mkumbwa	Mushili	Urban	3	2	20210033152032	165	1,071	210033152032
025	Copperbelt	Ndola	Medium Density- Urban	Bwana Mkumbwa	Mushili	Urban	6	2	20210033152062	110	509	210033152062
026	Copperbelt	Ndola	Medium Density- Urban	Bwana Mkumbwa	Mushili	Urban	9	1	20210033152091	132	709	210033152091
027	Copperbelt	Ndola	Medium Density- Urban	Chifubu	Pamodzi	Urban	1	2	20210034012012	166	908	210034012012
028	Copperbelt	Ndola	Medium Density- Urban	Chifubu	Pamodzi	Urban	5	1	20210034012051	184	929	210034012051
029	Copperbelt	Ndola	Medium Density- Urban	Chifubu	Pamodzi	Urban	8	3	20210034012083	199	1,025	210034012083
030	Copperbelt	Ndola	Medium Density- Urban	Ndola	Kanini	Urban	5	2	20210036102052	184	814	210036102052

031	Copperbelt	Ndola	Low Density - Urban	Bwana Mkumbwa	Itawa	Urban	3	1	20210033112031	161	750	210033112031
032	Copperbelt	Ndola	Low Density - Urban	Bwana Mkumbwa	Itawa	Urban	7	2	20210033112072	175	903	210033112072
033	Copperbelt	Ndola	Low Density - Urban	Bwana Mkumbwa	Itawa	Urban	9	1	20210033112091	171	961	210033112091
034	Copperbelt	Ndola	Low Density - Urban	Ndola	Kansenshi	Urban	2	1	20210036062021	109	457	210036062021
035	Copperbelt	Ndola	Low Density - Urban	Ndola	Kansenshi	Urban	4	2	20210036062042	155	594	210036062042
036	Copperbelt	Ndola	Low Density - Urban	Ndola	Yengwe	Urban	2	1	20210036082021	120	443	210036082021
037	Copperbelt	Ndola	Low Density - Urban	Ndola	Yengwe	Urban	5	1	20210036082051	140	645	210036082051
038	Copperbelt	Ndola	Low Density - Urban	Ndola	Yengwe	Urban	8	1	20210036082081	141	527	210036082081
039	Copperbelt	Ndola	Low Density - Urban	Ndola	Kanini	Urban	2	1	20210036102021	170	439	210036102021
040	Copperbelt	Ndola	Low Density - Urban	Ndola	Kanini	Urban	5	1	20210036102051	185	953	210036102051

1.2 LUSAKA

cluster	prov_name	dist_name	classcode	const_name	ward_name	region	csa	sea	geoid	hh	pop	sea_code
041	Lusaka	Lusaka	High Density- Urban	Chawama	Nkoloma	Urban	11	4	50504075012114	126	593	504075012114
042	Lusaka	Lusaka	High Density- Urban	Chawama	Chawama	Urban	6	3	50504075022063	149	621	504075022063
043	Lusaka	Lusaka	High Density- Urban	Chawama	Chawama	Urban	25	4	50504075022254	164	752	504075022254
044	Lusaka	Lusaka	High Density- Urban	Kabwata	Kamwala	Urban	8	3	50504076052083	131	559	504076052083
045	Lusaka	Lusaka	High Density- Urban	Kabwata	Kamulanga	Urban	10	1	50504076092101	139	528	504076092101
046	Lusaka	Lusaka	High Density- Urban	Kanyama	Kanyama	Urban	15	3	50504077102153	133	627	504077102153
047	Lusaka	Lusaka	High Density- Urban	Kanyama	Kanyama	Urban	33	4	50504077102334	196	887	504077102334
048	Lusaka	Lusaka	High Density- Urban	Kanyama	Kanyama	Urban	49	4	50504077102494	127	580	504077102494
049	Lusaka	Lusaka	High Density- Urban	Kanyama	Harry Mwaanga N	Urban	9	3	50504077112093	148	629	504077112093
050	Lusaka	Lusaka	High Density- Urban	Kanyama	Harry Mwaanga N	Urban	25	1	50504077112251	191	884	504077112251
051	Lusaka	Lusaka	High Density- Urban	Kanyama	Harry Mwaanga N	Urban	41	1	50504077112411	180	792	504077112411
052	Lusaka	Lusaka	High Density- Urban	Kanyama	Munkolo	Urban	13	3	50504077122133	204	955	504077122133
053	Lusaka	Lusaka	High Density- Urban	Mandevu	Roma	Urban	8	2	50504079172082	232	989	504079172082
054	Lusaka	Lusaka	High Density- Urban	Mandevu	Ngwerere	Urban	2	5	50504079192025	132	537	504079192025
055	Lusaka	Lusaka	High Density- Urban	Mandevu	Ngwerere	Urban	15	3	50504079192153	193	850	504079192153
056	Lusaka	Lusaka	High Density- Urban	Mandevu	Justine Kabwe	Urban	8	2	50504079212082	180	921	504079212082
057	Lusaka	Lusaka	High Density- Urban	Mandevu	Raphael Chota	Urban	13	2	50504079222132	138	587	504079222132
058	Lusaka	Lusaka	High Density- Urban	Mandevu	Mpulungu	Urban	1	2	50504079232012	271	1,241	504079232012
059	Lusaka	Lusaka	High Density- Urban	Mandevu	Mpulungu	Urban	22	3	50504079232223	144	609	504079232223
060	Lusaka	Lusaka	High Density- Urban	Matero	Kapwepwe	Urban	10	3	50504080252103	210	1,078	504080252103
061	Lusaka	Lusaka	High Density- Urban	Matero	Lima	Urban	9	4	50504080262094	143	652	504080262094

062	Lusaka	Lusaka	High Density- Urban	Matero	Mwembeshi	Urban	7	2	50504080272072	212	1,020	504080272072
063	Lusaka	Lusaka	High Density- Urban	Munali	Chainda	Urban	10	3	50504081292103	121	492	504081292103
064	Lusaka	Lusaka	High Density- Urban	Munali	Mtendere	Urban	14	3	50504081302143	95	443	504081302143
065	Lusaka	Lusaka	High Density- Urban	Munali	Mtendere	Urban	31	2	50504081302312	128	594	504081302312
066	Lusaka	Lusaka	High Density- Urban	Munali	Munali	Urban	8	3	50504081332083	143	679	504081332083
067	Lusaka	Lusaka	Medium Density- Urban	Chawama	Chawama	Urban	3	3	50504075022033	121	616	504075022033
068	Lusaka	Lusaka	Medium Density- Urban	Kabwata	Kamwala	Urban	5	5	50504076052055	215	796	504076052055
069	Lusaka	Lusaka	Medium Density- Urban	Kabwata	Libala	Urban	1	1	50504076072011	123	389	504076072011
070	Lusaka	Lusaka	Medium Density- Urban	Kabwata	Chilenje	Urban	12	2	50504076082122	119	665	504076082122
071	Lusaka	Lusaka	Medium Density- Urban	Kabwata	Chilenje	Urban	25	1	50504076082251	101	360	504076082251
072	Lusaka	Lusaka	Medium Density- Urban	Matero	Muchinga	Urban	10	1	50504080242101	151	615	504080242101
073	Lusaka	Lusaka	Medium Density- Urban	Matero	Matero	Urban	6	2	50504080282062	161	906	504080282062
074	Lusaka	Lusaka	Medium Density- Urban	Munali	Chakunkula	Urban	2	4	50504081322024	122	631	504081322024
075	Lusaka	Lusaka	Low Density - Urban	Kanyama	Munkolo	Urban	4	2	50504077122042	177	583	504077122042
076	Lusaka	Lusaka	Low Density - Urban	Lusaka Centra	Independence	Urban	2	2	50504078142022	184	461	504078142022
077	Lusaka	Lusaka	Low Density - Urban	Lusaka Centra	Independence	Urban	7	5	50504078142075	177	586	504078142075
078	Lusaka	Lusaka	Low Density - Urban	Lusaka Centra	Lubwa	Urban	20	2	50504078152202	114	491	504078152202
079	Lusaka	Lusaka	Low Density - Urban	Mandevu	Roma	Urban	1	2	50504079172012	93	345	504079172012
080	Lusaka	Lusaka	Low Density - Urban	Mandevu	Mulungushi	Urban	7	2	50504079182072	189	574	504079182072
081	Lusaka	Lusaka	Low Density - Urban	Munali	Chainda	Urban	4	2	50504081292042	140	619	504081292042
082	Lusaka	Lusaka	Low Density - Urban	Munali	Munali	Urban	15	2	50504081332152	101	375	504081332152

1.3 SOLWEZI

cluster	prov_name	dist_name	classcode	const_name	ward_name	region	csa	sea	geoid	hh	pop	sea_code
083	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kapijimpanga	Urban	15	1	80807110081151	122	592	807110081151
084	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	2	1	80807110112021	165	879	807110112021
085	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	3	3	80807110112033	124	698	807110112033
086	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	4	2	80807110112042	271	1,548	807110112042
087	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	5	3	80807110112053	360	1,997	807110112053
088	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	7	2	80807110112072	185	1,037	807110112072
089	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	9	1	80807110112091	209	1,112	807110112091
090	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	10	2	80807110112102	105	492	807110112102
091	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	11	3	80807110112113	160	783	807110112113

092	North wes	Solwezi	High Density- Urban	Solwezi Centr	Tuvwanganai	Urban	15	1	80807110112151	399	2,160	807110112151
093	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	3	1	80807110122031	193	921	807110122031
094	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	5	1	80807110122051	95	442	807110122051
095	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	7	1	80807110122071	147	713	807110122071
096	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	9	1	80807110122091	54	282	807110122091
097	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	11	1	80807110122111	173	978	807110122111
098	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	12	2	80807110122122	167	873	807110122122
099	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	14	1	80807110122141	209	1,069	807110122141
100	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	15	3	80807110122153	77	448	807110122153
101	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	16	3	80807110122163	171	847	807110122163
102	North wes	Solwezi	High Density- Urban	Solwezi Centr	Kimasala	Urban	18	1	80807110122181	211	1,084	807110122181
103	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Tuvwanganai	Urban	5	1	80807110112051	311	1,799	807110112051
104	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Tuvwanganai	Urban	5	2	80807110112052	226	1,260	807110112052
105	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Tuvwanganai	Urban	6	1	80807110112061	320	1,899	807110112061
106	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Tuvwanganai	Urban	6	2	80807110112062	246	1,312	807110112062
107	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Tuvwanganai	Urban	12	3	80807110112123	150	842	807110112123
108	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Tuvwanganai	Urban	13	2	80807110112132	87	480	807110112132
109	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Kimasala	Urban	2	2	80807110122022	112	515	807110122022
110	North wes	Solwezi	Medium Density- Urban	Solwezi Centr	Kimasala	Urban	4	3	80807110122043	91	462	807110122043
111	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	1	2	80807110102012	112	596	807110102012
112	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	2	1	80807110102021	213	984	807110102021
113	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	3	1	80807110102031	101	439	807110102031
114	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	3	3	80807110102033	122	627	807110102033
115	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	4	2	80807110102042	146	606	807110102042
116	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	5	2	80807110102052	73	180	807110102052
117	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	6	1	80807110102061	163	843	807110102061
118	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kamalamba	Urban	6	2	80807110102062	229	1,289	807110102062
119	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Tuvwanganai	Urban	14	2	80807110112142	169	880	807110112142
120	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Tuvwanganai	Urban	15	2	80807110112152	393	2,078	807110112152
121	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kimasala	Urban	1	3	80807110122013	158	678	807110122013
122	North wes	Solwezi	Low Density - Urban	Solwezi Centr	Kimasala	Urban	4	1	80807110122041	188	900	807110122041

HOUSEHOLD SURVEY QUESTIONNAIRE

CONSENT TO PARTICPATE
Instructions: *Before beginning the interview, it is necessary to provide an overview of the study to the respondents and obtain their consent to participate. Participation is completely voluntary. Please read the following statement in the language of the interview and then ask the primary participants/respondents knowledgeable about energy sources for cooking, cooking appliances and energy purchases, if they consent to participate in the study.*
Thank you for the opportunity to speak with you. We are a team from a USAID funded project that is conducting a survey on urban household cooking energy and fuel sources. We are conducting this study to learn about how people are using different fuels and appliances to cook. Your household has been randomly selected to participate in this study, which includes questions on topics such as energy sources for cooking, cooking appliances and energy purchases, because your household is in [name of community] where the project is working. For us to collect meaningful information, we would like to interview the person(s) who is/are the most knowledgeable about the household's energy sources for cooking, cooking appliances and energy purchases. These questions in total will take approximately 30 minutes to complete and your participation is entirely voluntary. If you agree to participate, you can choose to stop at any time or to skip any questions you do not want to answer. Information you share shall be treated with confidentiality; we will not share information that identifies you with anyone. There are no risks anticipated with your participating in this study. Again, your participation is entirely voluntary. While you will not be compensated, your participation will help us to inform decisions to promote clean cooking in Zambia.
1.1 Are you willing to participate? Yes ☐ No ☐ *(End of interview)* *Kindly thank the person you talked to and proceed to the next household)* *(Mandatory)*

SECTION A: QUESTIONNAIRE DETAILS	
Survey start time: *Automated time*	
Interview date: *Automated Date*	
Enumerator Name: (*Selected from the Drop-down List)*	
Supervisor name: *(Selected from the Drop-down List)*	
GPS coordinates of Household's residence	
Residential Area Type:	1= Low density Area
	2= Medium Density Area
	3= High Density Area
Standard Enumeration Area (SEA) #:	
District	1= Lusaka
	2= Ndola
	3= Solwezi

SECTION B HOUSEHOLD HEAD/RESPONDENT		
	RESPONSES	**SKIP**
HD1.Sex of respondent	1= Female	
	2= Male	
HD2. Is the respondent the head of the household?	1= Yes	*If yes, Skip to HD8*
	2= No	
HD3. What is the relationship of the respondent to the household head?	1= Spouse 2= Child 3= Son-In-Law or Daughter-In-Law 4= Grandchild 5= Parent 6= Parent-In-Law 7= Brother or Sister 8= Other Relative 9 = Not Related 99= Don't Know	
HD4. Age of the respondent *(Year of birth)*	…… 999 = refusal	
HD5. What is your marital status?	1= Never married	
	2= Married	
	3= Living together/ Cohabiting	
	4= Separated	
	5= Divorced	
	6= Widowed	
HD6. What is the highest level of education attained by respondent	1= Never been to school	
	2= Preschool	
	3= Primary	
	4= Secondary	
	5= Tertiary	
	99= I don't know	
HD7. What is the sex of the head of the household?	1= Female	
	2= Male	
HD8. What is the age of the head of the household? *(Year of birth)*	…… 999 = refusal	
HD9. What is the marital status of the head of the household?	1= Never married	
	2= Married or living together	
	3 = Living together/ Cohabiting	
	4= Separated	

	5= Divorced	
	6= Widowed	
HD10. What is the highest level of education attained by the head of the household?	1= Never been to school	
	2= Preschool	
	3= Primary	
	4= Secondary	
	5= Tertiary	
	99= I don't know	
SECTION C: DEMOGRAPHICS		
DE1. How many people live in the household (i.e. eat from the same pot and sleep under the same roof)?	…….. People	
DE2. How many are adult in the HH (18 years and above)	……. Adult	
DE3. How many young children are in the HH (0 – 5 years)	……. Children	
DE4. How many other children are in the HH (6 – 17 years)	……. Children	
DE5. ***Do you rent or own the house you are living in?***	1= Rent 2= Own house	
SECTION D: SOURCE OF INCOME		
IN1. What is the main source of income for the household?	1= Formal Employment 2= Business 3= Rentals 4= Farming 5= Unemployed 6= Receive a stipend from gov't 7= Receive stipend from relatives 8 = Informal employment (casual work/piecework) 9= Other (Specify)_____	
IN2. What is the monthly average household income? *(Include the total income from those working in the household and business ventures)*	ZMW: ……. *Enter* ***98*** *if the respondent refuses to give the amount or seems unsure skip to IN3.*	

IN3 (*If not willing to state the actual household income)* **Which range is your monthly average household income?**	1= Below 500 2= 500 – 1,000 3= 1,000 – 2,000 3= 2,000 – 5,000 4= 5,000 – 7,500 5= 7,500 – 10,000 6= Above 10,000	

SECTION E: ELECTRICITY ACCESS AND ENERGY SOURCES

ELECTRICITY ACCESS	
ES 0: Are you connected to the electricity grid?	1= Yes (*if yes, skip to ESOc*) 2= No
EA0b: If not connected to the electricity grid, have you applied for connection?	1= Yes 2=No 99 = Don't know
ES0c: If you rent the property, do you share the electricity meter with your landlord	1 = Yes 2 = No (Skip to ES0e)
ES0d: If you rent the property and share the electricity meter with our landlord, does your landlord have any restriction on electricity usage for cooking? (*This question will only be available if the property is rented and connected to electricity)*	1 = Yes 2 = No
ES0e: Do you have solar power system to generate electricity?	1= Yes 2 = No
ES0f: Do you have a functional genset?	1 = yes 2 = No

ENERGY SOURCES			
Energy Source *(Allow for multiple responses)*	**ES1. Which of the following energy sources do you use for cooking, heating water or heating the home?**	**ES2. Do you have an in-home business that uses this type of energy source?**	**ES3. Did you use this type of energy source for the first time in the last 12 months?**
Electricity	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes, *If yes, then go to Section G* 2= No
Liquefied Petroleum Gas (LPG)	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes, *If yes, then go to Section G* 2= No
Ethanol-based fuels	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes, *If yes, then go to Section G* 2= No
Traditional charcoal	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes 2= No
Firewood	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes 2= No
Pellets	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes, *If yes, then go to Section G* 2= No
Paraffin/Kerosene	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes, *If yes, then go to Section G* 2= No
Sawdust/Agricultural Residue	1= Yes 2= No *Skip to next energy source*	1= Yes 2= No	1= Yes, *If yes, then go to Section G* 2= No
Other type(specify)	1= Yes 2= No	1= Yes 2= No	1= Yes 2= No

SECTION F: ENERGY USE	**Instruction:** *(Compulsory section for all households)*	
QUESTION CODE	**QUESTION**	**RESPONSE (S)**
EU1	**What type of fuel or energy source does this household use most of the time for cooking breakfast?** *(Select the primary source)*	1= Electricity
		2= Liquefied Petroleum Gas (LPG)
		3= Ethanol-based fuels
		4= Traditional charcoal
		5= Firewood
		6= Pellets
		7= Paraffin/Kerosene
		8= Sawdust/Agricultural Residue
		98 = Other (specify)
EU2	**What type of fuel or energy source does this household use most of the time for cooking lunch?** *(Select the primary source)*	1= Electricity
		2= Liquefied Petroleum Gas (LPG)
		3= Ethanol-based fuels
		4= Traditional charcoal
		5= Firewood
		6= Pellets
		7= Paraffin/Kerosene
		8= Sawdust/Agricultural Residue
		98 = Other (specify)
EU3	**What type of fuel or energy source does this household use most of the time for cooking dinner?** *(Select the primary source)*	1= Electricity
		2= Liquefied Petroleum Gas (LPG)
		3= Ethanol-based fuels
		4= Traditional charcoal
		5= Firewood
		6= Pellets
		7= Paraffin/Kerosene
		8= Sawdust/Agricultural Residue
		98 = Other (specify)
EU4	**What type of fuel or energy source does this household use most of the time in the preparation of a snack?** *(Select the primary source)*	1= Electricity
		2= Liquefied Petroleum Gas (LPG)
		3= Ethanol-based fuels
		4= Traditional charcoal
		5= Firewood
		6= Pellets
		7= Paraffin/Kerosene

		8= Sawdust/Agricultural Residue
		98 = Other (specify)
EU5	**What type of fuel or energy source does this household use most of the time for heating water?** *(Select the primary source)*	1= Electricity
		2= Liquefied Petroleum Gas (LPG)
		3= Ethanol-based fuels
		4= Traditional charcoal
		5= Firewood
		6= Pellets
		7= Paraffin/Kerosene
		8= Sawdust/Agricultural Residue
		98 = Other (specify)
EU6	**What type of fuel or energy source does this household use most of the time for heating in the cold season?** *(Select the primary source)*	1= Electricity
		2= Liquefied Petroleum Gas (LPG)
		3= Ethanol-based fuels
		4= Traditional charcoal
		5= Firewood
		6= Pellets
		7= Paraffin/Kerosene
		8= Sawdust/Agricultural Residue
		98 = Other (specify)

SECTION G: APPLIANCE USAGE

ELECTRICITY – APPLIANCE USAGE		
EL1. For cooking and heating water, what appliance(s) do you use? *(Allow for multiple responses)*	**EL2. Have you adopted this appliance for <u>the first time</u> in the last 12 months?**	**EL3. Are you using the appliance more, less or the same as last year?**
Single electric plate 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Double electric plate 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
4 plate electric cooker (with oven) 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Rice cooker 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Microwave 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
2 plate electric with oven 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Electric Kettle 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Electric pressure cooker 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Electric fryer 1= Yes 2= No	1= Yes *if yes, then go to EL4* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Induction cooker 1= Yes 2= No	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Other (Specify)	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Toaster 1=Yes	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same

2=No		3= Less
Sandwich maker 1=Yes 2=No	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Geyser 1=Yes 2=No	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Blender 1=Yes 2=No	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
Single oven 1=Yes 2=No	1= Yes *if yes, then go to EL6* 2= No, *if no, go to EL3*	1= More 2= Same 3= Less
ELECTRICITY PURCHASES		
QUESTION CODE	**QUESTION**	
EL4	**How much did you spend on electricity last month?** ZMW: ……. *Enter **98** if the respondent refuses to give the amount.*	
EL5	**How much did you spend as a HH on electricity the month before last?** **ZMW……** *Enter **98** if the respondent refuses to give the amount*	

LPG – APPLIANCE USAGE		
LP1. For cooking and heating water, what stove or appliance(s) do you use? *(Allow for multiple responses)*	**LP2. Have you adopted this appliance for the first time in the last 12 months?**	**LP3. Are you using the appliance more, less or the same as last year?**
LPG cooker (5 burner with oven) 1= Yes 2= No	1= Yes, *if yes, then go to LP4* 2= No, *if no, then go to LP3*	1= More 2= Same 3= Less
LPG cooker (4 burner with oven) 1= Yes	1= Yes, *if yes, then go to LP4* 2= No, *if no, then go to LP3*	1= More 2= Same

2= No		3= Less
LPG cylinder burner (1 plate stove) 1= Yes 2= No	1= Yes, *if yes, then go to LP4* 2= No, *if no, then go to LP3*	1= More 2= Same 3= Less
LPG 2 burner 1= Yes 2= No	1= Yes, *if yes, then go to LP4* 2= No, *if no, then go to LP3*	1= More 2= Same 3= Less
Other (specify) 1= Yes 2= No	1= Yes, *if yes, then go to LP4* 2= No, *if no, then go to LP3*	1= More 2= Same 3= Less
LPG burner 6 cooker with oven 1= Yes 2= No	1= Yes, *if yes, then go to LP4* 2= No, *if no, then go to LP3*	1= More 2= Same 3= Less

LPG PURCHASES

QUESTION CODE	QUESTION
LP4	**What size of cylinder (s) do you buy?** *(Could show picture examples of different cylinder sizes for respondents to choose from) (Allow for multiple responses)* 1= 3Kg 2= 4Kg 3= 5Kg 4= 6Kg 5= 7Kg 6= 9Kg 7= 12Kg 8= 14Kg 9= 15Kg 10= 19Kg 11= 35Kg 12= 38Kg 13= 45Kg 14= 48Kg 15= Other *(Specify)*……. Kgs
LP5	**How long does your cylinder(s) last in weeks on average?** *(Specify the duration for each cylinder mentioned in LP6)* 1= Less than a week

	2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= 6 Weeks 8= 7 Weeks 9= 8 Weeks 10= 9 Weeks 11 = 10 Weeks 12 = 11 Weeks 13 = 12 Weeks 14= 13 Weeks 15 = 14 Weeks 16 = 15 Weeks 17 = 16 weeks 18= 17 Weeks 19 = 18 Weeks 20 = 19 Weeks 21 = 20 Weeks
LP6	**How much did you spend as household the last time you bought LPG?** ZMW: …….

ETHANOL-BASED APPLIANCE USAGE		
ET1. For cooking and heating water, what stove or appliance(s) do you use?	**ET2. Have you adopted this appliance for the first time in the last 12 months?**	**ET3. Are you using the appliance more, less or the same as last year?**
Single Bio-ethanol gel stove 1= Yes 2= No	1= Yes, *if yes, then go to ET4* 2= No	1= More 2= Same 3= Less
Double Bio-ethanol gel stove 1= Yes 2= No	1= Yes, *if yes, then go to ET4* 2= No	1= More 2= Same 3= Less
Single liquid bio-ethanol stoves 1= Yes 2= No	1= Yes, *if yes, then go to ET4* 2= No	1= More 2= Same 3= Less
Double liquid bio-ethanol stoves 1= Yes	1= Yes, *if yes, then go to ET4* 2= No	1= More 2= Same

2= No		3= Less
5=Other (Specify)	1= Yes 2= No	1= More 2= Same 3= Less
ETHANOL PURCHASES (BOTH LIQUID AND GEL ETHNAOL)		
QUESTION CODE	**QUESTION**	
ET4	**What size of bottle do you buy?** ……. Millilitres	
ET5	**How long does one bottle last in weeks?** 1= Less than a week 2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= Other (specify)_____	
ET6	**How much did you spend as household on Ethanol-based fuel last month or the last time your bought?** ZMW: …….	

CHARCOAL-BASED APPLIANCE USAGE	
CH1. For cooking and heating water, what stove or appliance(s) do you use?	**CH2. Have you adopted this appliance for the first time in the last 12 months?**
Mbaula 1= Yes 2= No	1= Yes 2= No
Drum or Barbeque/Braai stand 1= Yes 2= No	1= Yes 2= No
Improved charcoal stove 1= Yes 2= No	1= Yes 2= No
Efficient charcoal stoves 1= Yes 2= No	1= Yes 2= No
Other (specify)	1= Yes 2= No
CHARCOAL PURCHASES	

QUESTION CODE	QUESTION
CH3	Do you buy charcoal? 1= Yes *Skip to CH6* 2= No
CH4	How do you have access to charcoal? 1= Household makes charcoal 2= Given by family/friends/neighbors/others *(Skip to CH5)* 3= Other (specify) *(Skip to CH5)*
CH5	If household makes charcoal, how many standard 50Kg bags do you produce per month on average?
CH6	**What is the unit of charcoal that you most COMMONLY buy?** 1= 1 kg plastic bag 2= 2 kg plastic bag 3= 3 kg plastic bag 4= 4 kg plastic bag 5= 5 kg plastic bag 6= 10kg half ball pen 7= 25kg no head 8= 25kg 1 ball pen 9= 50 kg No head 10= 50kg 1 ball pen head 11= 50kg 2 ball pen head 12= 50kg 3 ball pen head 13= 90kg green label no head 14= 90kg green label 1 ball pen head 15= 90kg green label 2 ball pen head 16= 90kg green label 3 ball pen head
CH6A	**How often do you buy the above stated unit?** 1= every meal 2= Daily 3= every 2 days 4= every 3 days 5= every 4 days 6= every 5 days 7= every 6 days 8= every week 9= every 2 weeks 10= every month 11= every 2 months

	12= every 3 months 13= every 6 months
CH7	**How long does one unit last on average in weeks?** 1= Less than a week 2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= 6 Weeks 8= 7 Weeks 9= 8 Weeks 10= 9 Weeks 11 = 10 Weeks 12= 11 weeks 13= 12 weeks 14= 13 weeks 15= 14 weeks 16= 15 weeks 17= 16 weeks 18= 17 weeks 19 =18 weeks 20= 19 weeks 21= 20 weeks
CH8	**How much do you spend as a Household on charcoal in a month on average?** ZMW: ……..

FIREWOOD-BASED APPLIANCE USAGE	
FW1. For cooking and heating water, what stove or appliance(s) do you use?	**FW2. Have you adopted this appliance for the first time in the last 12 months?**
Three stone 1= Yes 2= No	1= Yes 2= No
Mud stove 1= Yes 2= No	1= Yes 2= No
Improved wood stove 1= Yes	1= Yes 2= No

2= No	
Efficient wood stove 1= Yes 2= No	1= Yes 2= No
Other *(specify)*	1= Yes 2= No
FIREWOOD-BASED APPLIANCE USAGE	
QUESTION CODE	**QUESTION**
FW3	**Do you buy firewood?** 1=Yes *Skip to FW5* 2= No
FW4	**How do you have access to firewood?** 1= Households collects 2= Given by a neighbor/relative/friend 3= Other (specify)
FW5	**What is the unit of firewood that you most commonly buy?** …… Kg/bundle
FW6	**How long does one unit last in weeks?** 1= Less than a week 2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= 6 Weeks 8= 7 Weeks 9= 8 Weeks 10= 9 Weeks 11 = 10 Weeks 12= Other, (specify)_____
FW7	**How much do you spend as Household on firewood in a month?** ZMW: ……..

PELLETS-BASED APPLIANCE USAGE		
PT1. For cooking and heating water, what stove or appliance(s) do you use?	**PT2. Have you adopted this appliance for the first time in the last 12 months?**	**PT3. Are you using the appliance more, less or the same as last year?**

1. Pellet stove/Gasifier 1= Yes 2= No 2. Other (specify)	1= Yes, *if yes, then got to PT4* 2= No, *if no, then go to PT3*	1= More 2= Same 3= Less

PELLETS PURCHASES

QUESTION CODE	QUESTION
PT4	**What is the unit of Pellets that you most commonly buy?** 1= 5 kg 2= 20kg 3= 50kg 4= Other (specify)
PT5	**How long does one unit of Pellets last in weeks?** 1= Less than a week 2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= 6 Weeks 8= 7 Weeks 9= 8 Weeks 10= 9 Weeks 11 = 10 Weeks 12= 11 weeks 13= 12 weeks 14= 13 weeks 15= 14 weeks 16= 15 weeks 17= 16 weeks 18= 17 weeks 19= 18 weeks 20= 19 weeks 21= 20 weeks _____
PT6	**How much do you spend as Household on Pellets last month or the last time you purchased pellets?** ZMW: ……

PARAFFIN/KEROSENE-BASED APPLIANCE USAGE		
PK1. For cooking and heating water, what stove or appliance(s) do you use?	**PK2. Have you adopted this appliance for the first time in the last 12 months?**	**PK3. Are you using the appliance more, less or the same as last year?**
1. Paraffin/Kerosene stove 1= Yes 2= No 2. Other (specify)	1= Yes, *if yes, then got to PK4* 2= No, *if no, then go to PK3*	1= More 2= Same 3= Less

PARAFFIN/KEROSENE PURCHASES	
QUESTION CODE	**QUESTION**
PK4	**What is the unit of Kerosene/Paraffin that you most commonly buy?** …… Liters
PK5	**How long does one unit of Kerosene/ Paraffin last in weeks?** 1= Less than a week 2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= 6 Weeks 8= 7 Weeks 9= 8 Weeks 10= 9 Weeks 11 = 10 Weeks 12= Other (specify)_____
PK6	**How much do you spend as Household on Kerosene/Paraffin in a month or the last time you bought Kerosene/Paraffin?** ZMW: ……..

SAW DUST AND AGRICULTURAL RESIDUE-BASED APPLIANCE		
SA1. For cooking and heating water, what stove or appliance(s) do you use?	**SA2. Have you adopted this appliance for the first time in the last 12 months?**	**SA3. Are you using the appliance more, less or the same as last year?**
Three stone 1= Yes	1= Yes, *if yes, then got to SA4* 2= No, *if no, then go to SA3*	1= More 2= Same

2= No		3= Less
Mud stove 1= Yes 2= No	1= Yes, *if yes, then got to SA4* 2= No, *if no, then go to SA3*	1= More 2= Same 3= Less
Improved stove 1= Yes 2= No	1= Yes, *if yes, then got to SA4* 2= No, *if no, then go to SA3*	1= More 2= Same 3= Less
Efficient stove 1= Yes 2= No	1= Yes, *if yes, then got to SA4* 2= No, *if no, then go to SA3*	1= More 2= Same 3= Less
Other (specify)	1= Yes, *if yes, then got to SA6* 2= No, *if no, then go to SA3*	1= More 2= Same 3= Less

SAW DUST AND AGRICULTURAL RESIDUE- PURCHASES

QUESTION CODE	QUESTION
SA4	**Do you buy Sawdust or Agricultural residue?** 1=Yes 2= No, *End of Survey*
SA5	**What is the unit of saw dust or agricultural residues that you most commonly buy?** …… Kg/bundle
SA6	**How long does one unit last in weeks?** 1= Less than a week 2= 1 Week 3= 2 Weeks 4= 3 Weeks 5= 4 Weeks 6= 5 Weeks 7= 6 Weeks 8= 7 Weeks 9= 8 Weeks 10= 9 Weeks 11 = 10 Weeks 12= Other (specify)_____
SA7	**How much do you spend as Household on saw dust or agricultural residue in a month or last time you bought saw dust or agricultural residues?** ZMW: ……..

SOCIAL BEHAVIOUR CHANGE AND CAMPAIGNS		
SB01. Have read or heard any messages or information about promoting clean cooking technologies or alternatives to charcoal? *(Probe)*	1= Yes 2= No	
SB02. Are you aware of the cleaning cooking hotline (3838)	1= Yes 2= No	
SB03. Have you read or heard any messages about clean cooking technologies or alternatives to charcoal from the following media platforms or persons (Ask for each)		
a. TV program or advert	1= Yes 2= No	
b. Radio program or advert	1= Yes 2= No	
c. Local Newspaper	1= Yes 2= No	
d. Social Media (Facebook or Twitter)	1= Yes 2= No	
e. Message on a Billboard	1= Yes 2= No	
f. Message on a bus (Sticker)	1= Yes 2= No	
g. Demonstration event or exhibition	1= Yes 2= No	
h. Community leader or influencer	1= Yes 2= No	
i. Religious leader or church member	1= Yes 2= No	
j. Community meeting or focus group discussion	1= Yes 2= No	
k. Public service announcement or roadshow	1= Yes 2= No	
SB04. Was the message clear enough for you to understand	1 = Yes 2 = No	
SB05. Have the message or information received helped you to make a decision on the use or adoption of alternative technology or fuel	1= Yes 2= No, *End of interview*	
SB05. What decision or action have you taken on the use or adoption of alternatives to charcoal	1= started using clean cooking technologies/fuel 2= Increased use of a clean cooking fuel 3= Reduce on the use of charcoal technology 4= Planning to purchase a clean	

	cooking technology	