AN ENERGY AUDIT EXPERIMENT TO PROMOTE RENEWABLE ENERGY IN LARGE INSTITUTIONS AND HOUSEHOLDS

DRAFT REPORT

SUBMITTED TO

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I List of Abbreviations

Abbreviation	Abbreviation in Full
CCTs	Controlled Cooking Tests
COVID 19	CoronaVirus Disease of 2019
CSOs	Civil Society Organisations
DCDO	District Community Development Officer
ERA	Electricity Regulatory Authority
GDP	Gross Domestic Product
FGDs	Focus Group Discussions
IEA	International Energy Agency
IGAs	Income Generating Activities
KPT	Kitchen Performance test
MEMD	Ministry of Energy and Mineral Development
PPA	Power Purchase Agreement
REEP	Renewable Energy and Energy Efficiency Programs
RETs	Renewable Energy Technologies
UBOS	Uganda Bureau of Statistics
UPDF	Uganda Peoples Defense Forces
UNDP	United Nations Development Program
USD	United States Dollars
WHO	World Health Organisations

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II Executive Summary

Following the formation and launch of the Worlds' largest network by UNDP in 2019 to tackle development challenges, and the formation of a cohort of 10 accelerator labs based in 10 countries, UNDP conducted an energy audit in Uganda, whose purpose was to inform the promotion of renewable energy uptake in large institutions and households in the country. The study focused on the performance, availability, affordability and accessibility of fuels and technologies for both households and institutions from across the 4 regions of Uganda, in the districts of Kampala, Wakiso, Mukono, Mubende, Masaka, Jinja, Mbale, Sororti, Mbarara, Bushenyi, Gulu, and Lira.

The study specifically intended to; Analyze the renewable energy land scape in Uganda and determine the performance, availability, affordability and access to fuels of energy efficient solutions, analyze the rate of biomass consumption by large institutions and households, and perform a cost benefit analysis through a kitchen laboratory test on large institution and households to determine the difference in expenditures of alternative energy. The study utilized a mixed participatory approach using both quantitative and qualitative methods and engaged a total 789 respondents including 237 (30%) institutions and 552 (70%) households.

Findings of the study have revealed that both households and institutions were generally aware of almost all existing fuels used for cooking in Uganda, with charcoal being more popular, followed by firewood, biogas, hydropower electricity; solar power and others. The level of awareness for nonrenewable fuels from oil such as LPG and Kerosene was low but positive. The level of awareness however varies significantly for those located in the urban and rural areas with more positive awareness among urban households. The same trends apply for awareness of the dangers of using traditional fuels in traditional stoves. The major source of fuels was from markets both for households and institutions, and fuels were generally available within a five-kilometer radius. The study also revealed a growing demand for charcoal both in urban and rural areas and the increasing demand is met with increased supply. The study revealed that Firewood remains the cheapest fuel for both households and institutions, explaining why wood still remains the mostly widely used fuel in the country.

When it comes to utilization of fuels and technologies however, majority of respondents were utilizing traditional technologies and fuels, with a very low rate of adoption of the improved stoves. This confirms that accessibility alone does not necessarily lead to adoption of the improved technologies and fuels, but socio-cultural and economic factors played a significant role in influencing adoption of fuels and technologies especially at the household level, as cooking is a culture specific and, in some cases, still governed by social beliefs and practices. The Controlled Cooking Tests (CCTs) performed during the study revealed that Briquettes was the cheapest option followed by Charcoal. The test also revealed that the average percentage difference in fuel efficiency/saving between using traditional stoves vis-à-vis the improved stoves was average 51.12, showing that the adoption of the improved stoves and clean fuels have a potential to reduce the rate of deforestation that is caused by a search for firewood by 51.12 percent. The study recommends that interventions to channel fuel consumption to clean fuels would be a great stride

1.0 Introduction and Background Information

1.1 Introduction

The energy audit was conducted to inform the promotion of renewable energy uptake in large institutions and households in Uganda. It was conducted following the launch of the Worlds' largest network by UNDP in 2019 to tackle development challenges in an effort to reimagine development for the 21st century. At the heart of this network is a cohort of 10 accelerator labs based in 10 countries. The Uganda accelerator lab identified deforestation as a frontier issue to tackle for the 1st cycle among other prevailing development challenges. Over the years Uganda's forests have faced severe pressures mainly from Agriculture conversion as a result of population increase, urban demand for charcoal and wood fuel, overgrazing, uncontrolled timber harvesting and policy failures. As a result, the rate of deforestation is on the rise leading to air pollution increasing levels of poisonous gases and environmental heat, and climate change felt now more than ever before. Uganda has a unique potential of alternative renewable energy resources including hydropower, solar, geothermal, wind and biomass. In the last 10 years, Uganda has focused her energy sector investment on increasing energy access by increasing energy supply. In light of this, UNDP accelerator lab conducted an energy audit experiment on available energy efficient solutions in Uganda focusing on their performance, availability, affordability and access to fuels. This study unveils the rate of biomass consumption and cost benefit analysis by large institutions and households which guided a recommendation of the choice of an appropriate technology to install when the institutions and households are making decisions on energy and technologies to install.

1.2 The Study Goal & Objectives

The overall goal of the assignment was to carry out an energy audit experiment to promote renewable energy uptake in large institutions and Households. Specifically, the following objectives guided the study;

1. Analyzed the renewable energy land scape in Uganda and determine the performance, availability. Affordability and access to fuels of energy efficient solutions in Uganda.
2. Analyzed the rate of biomass consumption by large institutions which would guide the choice of an appropriate technology to install when the institutions and households are making a decision.
3. Performed a cost benefit analysis through a kitchen laboratory test on large institution and households to determine the difference in expenditures of alternative energy.

Specifically, the audit experiment carried out 5 key activities;

1) Analyzed the performance, availability, affordability and access of renewable energy technologies including electricity that can be used in institutions and households.

2) Conducted a cost benefit analysis on the choice of efficient technology including electricity by large institutions and households
3) Profiled key factors that influence institutional culture and foster behavior change in energy adoption and use.
4) Analysed the demand and supply of renewable energy alternatives and cooking technologies utilized by the different segments of the institutions and households.
5) Made a recommendation on the appropriate technology to install at large institutions and households in rural and urban setting.

1.4 Approaches and Methodology Used

The study utilized a mixed participatory approach following methodological paradigm triangulation and attained a blend of quantitative and qualitative methods. The quantitative methods fragmented and delimited energy concepts into measurable through a structured questionnaire that were applied to all of the sampled institutions and households. A total 789 respondents were reached of which 237 (30%) were institutions and 552 (70%) were households drawn from across the 4 regions of Uganda. These were selected from the districts of Kampala, Wakiso, Mukono, Mubende, Masaka, Jinja, Mbale, Sororti, Mbarara, Bushenyi, Gulu, and Lira. Majority of the institutions (84%) were drawn from urban and peri urban setting. The households survey sampled 47.2% from rural and 52.8% from urban and per urban setting. The institutions that participated include; bakery (7%; 17), brewery (2%; 5), hospitals (13%; 31), Hotel (59%; 140), security agencies (4%; 9), and schools (15%; 36).

The qualitative research design obtained in depth responses about the energy and cooking technologies utilized by institutions and households. This also helped to breakdown complex concepts and relationships with adoption, accessibility, performance and access to fuels that were not captured by the standardized measures. A total of 5 FGDs were conducted 3 of which were from institutional participants while 2 were from household participants.

The Controlled Cooking Tests (CCTs) were conducted in partnership with Centre for Integrated Research and Community Development Uganda and in accordance with the set of guidelines, data sheets, and evaluation procedures as established under the Controlled Cooking Test Protocol v.2.0. The CCTs focused on determining Specific fuel consumption and cooking time comparing the improved cooking technologies and clean fuels with the baseline stoves and fuels. CCT tests were conducted for 6 stove models and designed to assess the performance of the improved stove relative to the common or traditional. Under the CCT v2.0; each stove sample was tested three times by two cooks and thus a total of 36 tests in total for all the stove models. A three-stone-fire and a metallic charcoal stove were used as baseline stoves.

The tools used in the study were purely electronic (on Tablets) and this reduced direct contact between the researchers and the study participants. Other approaches included phone calls, email, test messages, WhatsApp tests were also used to harness information from key informants and other respondents. Focus Group Discussions for representatives from some institutions and some households in urban areas were held on ZOOM platform to allow for social distancing. In rural areas where technologies were inaccessible, the FGDs were held while upholding social distancing rules and having a maximum of ten (10) participants per session.

1.4.1 Data Collection

Data collection was conducted by teams of experienced local researchers who administered the household questionnaire under the direct supervision of the consulting team. Key informant interviews and FGDs were directly executed by the consulting team under the supervision of the team leader. This followed quality standards and quality assurance measures set by this study). The teaming of researchers was informed by experience in the respective districts, language proficiency, and gender considerations and this explains the good quality data that was collected from the participants. Data collection took 15 days and was carried out from 1st August to 15th August 2020 and teams started at the same period across the districts.

1.4.2 Ethical Considerations during Data Collection

The study heeded to the principles of informed consent, confidentiality, privacy, protection from potential damage or threat, and scientific validity.

1.4.3 Data Management and Analysis

Quantitative data extracted from the server were exported to STATA 16 for further cleaning and analysis. Qualitative data collected through key informant interviews and Focus Group Discussion was analyzed thematically. The data was transcribed, coded with Atlas ti, and later on analyzed using thematic procedures where codes were merged and developed into themes. Participants in focus group discussions were assigned numbers and captured verbatim and individual responses were coded by each particular item and related to the Subject matter and theme in the interview schedule.

Analysis of data from documents focused on identifying voices and language expressions to inform context analysis within themes. This provided a triangulation experience for the study as data contained in themes and content also compared to what was contained in the reviewed documents before conclusions were drawn from the fresh voices of the study and silent voices contained in the documents. This helped to enhance the credibility of findings.

1.4.4 Limitations of the Study

The study was conducted during the period when Uganda was under partial lockdown to stop the spread of COVID 19. This prolonged the period in which data was collected. However, this never compromised the quality assurance measures instituted and quality data was collected. In as much as possible the team of researchers and consultants practiced all of the Ministry of Health guidelines including keeping social distance, wearing face masks, regular sanitizing and taking temperature readings before interaction with the study participants.

1.5 Demographic Characteristics of the Study Participants

The distribution of the demographic characteristics indicates that there was no significant variations across the regions ($p<0.05$) implying that the sample is representative in the same way across the regions and therefore regional based estimates are possible with this data. At 5% confidence level, accurate conclusions on statistical significance of estimates can be relied on and appropriate conclusions about energy consumption and utilisation of cooking technologies are possible. A similar study done in the same location would yield similar results with minimum error of five percent (5%).

characteristic	**category**	**Residence**		
		Rural: n[%]	**Urban: n[%]**	**Overall: n [%]**
sex	Female	74.1	73.1	73.6
	Male	25.9	26.9	26.4
Age*	18-24	19.9	17.1	18.6
	25-29	12.5	21.2	16.6
	30-39	26.4	31.6	28.9
	40-49	19.0	11.9	15.7
	50+	22.2	18.1	20.3
Type of household	Male Headed Household	74.1	77.2	75.6
	Female Headed Household	25.9	22.8	24.5
Household size				
Males	< 2 People	19.2	26.3	22.5
	2 to 3	47.2	51.1	49.0
	4 to 6	27.6	18.4	23.3
	7+	6.1	4.2	5.2
Females	< 2 People	17.2	19.9	18.5
	2 to 3	46.1	48.7	47.3
	4 to 6	34.4	27.8	31.3
	7+	2.3	3.7	3.0
Adults above 18 years	< 2 People	11.7	9.4	10.6
	2 to 3	57.0	66.5	61.5
	4 to 6	23.8	18.3	21.2
	7+	7.5	5.8	6.7
Children below 18 years	< 2 People	23.0	30.3	26.5

	2 to 3	39.7	41.6	40.6
	4 to 6	29.9	24.9	27.5
	7+	7.4	3.2	5.4
Current main source of income*	Casual Worker	9.3	13.0	11.0
	Farmer	59.3	6.7	34.5
	Formal employed	7.9	23.3	15.2
	Trader	12.0	36.8	23.7
	Remittances	0.5	3.1	1.7
	Other	11.1	17.1	13.9
Level of income*	Less than 200,000	61.1	19.7	41.6
	Between 200,000-500,000	28.2	43.5	35.5
	Between 500,000- 1,0000,000	8.3	24.9	16.1
	Between 1,000,000-5,000,000	1.9	10.9	6.1
	Above 5,000,000	0.5	1.0	0.7
INSTITUTIONAL RESPONDENTS				
Age of the institution	<5 Years	26.2		
	5 to 9	18.5		
	10 to 14	15.5		
	15 to 19	11.7		
	20+	28.2		
Number of employees Involved in Cooking				
Males	< 10 People	54.3		
	10 to 19	19.1		
	20 to 49	14.3		
	50+	12.4		
Females	< 10 People	50.5		
	10 to 19	22.9		
	20 to 49	17.1		
	50+	9.5		

2.0 Clean Fuels and Improved Cooking Technologies Land Scape in Uganda

2.1 Introduction

Use of clean fuels and improved technologies has multiple benefits; they reduce heavy reliance on wood fuel as the main source of fuel for cooking hence protecting the environment, has potential to improve the health of the household or institutional kitchen users through reduced exposure to smoke from wood fuels. Multiple alternative energy sources (clean fuels) have been popularized and offer higher energy content (as compared to the traditional) but also offer additional benefits in handling, transportation, storage and ignition. The improved and clean cooking devices offer added advantages of fuel savings, increasing efficiency, stability, durability, improved aeration among others.

According to UBOS 2014 census, majority of households used wood fuel (71%) as the main source for cooking with 85 percent in the rural and 15 percent in the urban areas. This was a decline in the usage of firewood from 82 percent registered in the 2002 UBOS national census. The 2015 National Charcoal survey for Uganda established that a total of 101 tree and shrub species are used for charcoal production, with associated challenges of high labor intensity, wood scarcity and health complications resulting from the charcoal production processes. The study further revealed that there are no dedicated forest plantations for charcoal production and the main source of wood for charcoal production in Uganda is from privately owned forests (43%), followed by central forest reserves (22%), on farm trees (20%) and others (14%). The charcoal and firewood (biomas) utilisation situation in Uganda has continued to deplete and threaten the forest and vegetation cover thus requiring an urgent shift to use of improved cooking technologies and clean fuels. This section of the report presents the situation about awareness, availability, affordability and adoption of clean fuels and improved cooking technologies for institutions and households in Uganda.

2.2 Awareness of Clean Fuels and Improved Cooking Technologies

The study considered awareness of clean fuels and improved technologies in 3 forms; 1) Awareness of the existence of the clean fuels and technologies, 2) awareness of the health and environmental dangers of traditional fuels and cooking technologies 3) Awareness of the ecosystem benefits accrued from using improved cooking technologies and clean fuels. People in urban areas seemed to be more aware generally that their counterparts in rural areas. This could be attributed to media, and general access to information and markets.

2.2.1 Awareness of renewable energy fuels

The sampled households and institutions generally were aware of a bit of every existing fuel used for cooking in Uganda. Specifically, among the Institution, charcoal was the most popular (97.8%), followed by firewood (84.8%); biogas (75.0%);

hydropower electricity (72.8%); solar power (64.1%); briquettes (50.0%); wind energy (10.9%); geothermal (8.7%); bioethanol (4.4%). The level of awareness for nonrenewable fuels from oil was low but positive i.e. LPG; 17.6 %, Kerosene; 18.3 %.

The trend is similar for households save for the fact that awareness about briquettes was lower in households (urban, 25.8%; rural, 18.9%) with a significant variation in the level of awareness for the households in rural and urban areas. The variation was mostly significant for the high end fuels like briquettes, biogas, and bioethanol, biodiesel whose popularity is still limited to urban dwellers. Firewood was the most popular in both urban (89.4%) and rural household 91.6% followed by Charcoal and Electricity. The next sections of this report explores if this awareness of fuels translate into adoption and utilisation.

2.2.2 Awareness of Improved Technologies for Cooking

Majority of the institutions (91.7%) are generally aware of the available improved institutional cook stoves and specifically, 34.5% know about bio digesters, 70.2% are aware of the modern baking ovens that use either charcoal or wood. The level of awareness at household level varies significantly for those located in the urban and rural areas with more positive awareness for urban households. On a good note, an overall big proportion of 93.4% were aware of improved cooking technologies. The energy requirements of people in different geographical settings coupled with the living conditions, access to fuels, and mindset among other factors are the likely contributors to this margin. The revealed variation between rural and urban respondents was only significant between households but not institutions. This is because the energy requirements of an institutions are more dependent on the type of institution and its purpose than it is on its location.

The level of awareness of institution on other stoves that use clean fuels apart from biomass was also generally high; LPG stove was at 61.9% and electric stove at 68.6%. This implies that the efforts by government and development partners to popularize technologies that utilise clean fuels are taking steady strides in the right direction. Households on the hand, LPG was more popular in urban areas (13.5%) than rural areas (0.9%); electricity was also more known to urban households (16.6%) than rural ones (0.5%); which indicates a need for increased publicity for these high end fuels especially in urban areas.

2.2.3 Awareness of dangers of traditional stoves

The use of traditional fuels and devices impacts life in different forms, there are direct effects on nature and the biomass. Traditional fuels used in traditional devices have some dangerous to users` health and 80% of the institutions were aware of this possibility. These stoves also have direct and indirect impacts on the environment like air pollution and 64.8% of the institutions knew the air pollution effect. The sampled institutions expressed concern that using traditional stoves can be time consuming in the whole process of collecting fuels, lighting and cook and use a lot of more fuel (64.8%) than the improved ones (47%).

Households were also generally aware of the dangers of using traditional fuels in traditional stoves. The rural (68.9%) households were more aware of the impact on health by the traditional fuels as compared to urban (59.6%) households. This could be because they use the traditional technologies than those in urban houses; however the variation was not significant. Generally, rural households presented a higher level of awareness on the effects of the traditional technologies on human health and environment and this could be because they use the traditional fuels and technologies than the urban dwellers.

2.2.4 Awareness of the Ecosystem Benefits accrued from using improved cooking technologies and clean fuels

The results revealed that more institutions are aware of the benefits than households. The benefits known to institutions include; clean air 73%, reduced rate of deforestation 57.1%, improved microclimate temperature 38%, cleaner water and general improved ecosystem performance. This increased awareness of these benefits indicates that institutions have a higher potential for adoption as long as other factors other than awareness influencing the uptake are addressed. A big proportion (66.7%) of the institutions were aware that using installation and use of improved cooking stoves improves the kitchen ventilation and consequently air quality of the kitchen. The other added advantages included reduced fuel consumption was different for charcoal fuel users (61.9%) and wood fuel users (50.5%) (Table 13). Their increased awareness on the savings on charcoal than wood could be a result of the observed trend of institutions using more wood than charcoal fuel in cooking which may be arising from the time related energy demands of institutions.

There was a significant difference between the knowledge of these benefits between the rural and urban households. Reduced smokiness in the kitchen was more popular in urban households (59.5%) than rural households; the direct merits of clean air and reduced deforestation and indirect ones like improved fertility, improved micro climate and ecosystem health were in the same range for the rural and urban households. The smoke in the kitchen from traditional stoves is visible and its choke can be felt by mostly rural households who use more of these traditional stoves or fuels.

The rural (57.8%) households revealed a high level of awareness than urban (32.6%) households on the improved kitchen ventilation that comes with using improved cooking technologies. The general observation of the other accrued benefits like improved air quality and reduced cooking time were more popular in rural areas than in urban areas. This could be as a result of the extended exposure by rural households to the negative effects of the traditional stoves over many generations. The general merit of reduced charcoal and/or wood fuel was similarly higher for charcoal than wood like it was for institutions.

2.3 Accessibility and Availability of the Clean Fuels and Cooking Technologies

2.3.1 Sources of the fuels

Institutions and households source fuels from markets but also self-supply or own made/owned source. Owned source include private woodlots, self-made charcoal or briquettes and biogas. The hydroelectricity supply in Uganda is largely on the main grid with scattered off grid distribution. Seventy seven percent (77.1%) of the institutions purchased their fuels from the market, a small fraction owned wood lots (2.9%) from which they could harvest wood or make charcoal or used solar energy harvested from their roof tops (1.9%); 40% that were using electricity were connected to the main grid with 12.4% connect to micro grids.

The largest proportion of households also bought fuels from the market especially those in urban areas (92.2%) and in rural areas up to 77.8%. This trend is un usual since most rural areas have had access to community; forest or public forest reserves; but the trends in land use change coupled with the alarming rate of deforestation have increased stringency of the National Forestry Authority in blocking access by locals to any wood lots. This has left the households in rural areas with no option but buying of the fuels due to the fact that even the private woodlots are guarded enviously by the owners. Generally households obtain their fuels from the market (84.6%) followed by self-supply (15.4%) (private wood lot); and 6.4% obtain their electricity from the main grid with only 0.7% and 0.25% obtaining power from micro grids and solar roof harvest respectively.

According to the National Charcoal survey, 2016; 43% of the charcoal produced in Uganda is from privately owned forests. It is interesting to note that this figure for private woodlot as a source of fuel has drastically reduced to 15.4 % for households and 2.9% for institutions. This implies that the level of depletion of private woodlots is high due to the increasing demand for fuels or lack of alternative sources of fuels. This also implies an increasing market for fuels both in rural and urban areas and this poses an opportunity to market cleaner fuels to the households and institutions since they are used to purchasing the fuels.

2.3.2 Distance of Household or Institution from the Fuel Source

The distance from the household or institution plays a huge role in determining the type of the fuel to be used based on the level of accessibility (convenience) and this can be used to determine the possible fuel for adoption by any target institution or household. Generally most fuels that are used by institutions are within a five kilometer radius; electricity ranked highest at 49.5%, this can be attributed to the huge investment in hydro power generation and distribution by rural electrification program by the government of Uganda. There was also reported growing demand for charcoal both in urban and rural areas and the increasing demand is met with increased supply that makes its readily available at 47.6% in a radius of 5 kilometers. The growing number of petrol stations and their distribution along the developed road infrastructure across the country has opened ways or supplying LPG at 45.7% within a radius of 5 kilometers. Firewood accessibility within 5 km radius was as low as 17.1% which explains the huge loss in forest cover and thereby increasing scarcity in wood, locals and traders travel long distances to obtain firewood. This too poses an opportunity for clean energy alternatives.

Households on the other hand showed a slightly different trend with charcoal ranking closest within the 5 Km radius at 42.8%; electricity accessible within 5 km was at 21.5%; firewood had a similar percentage like for institutions at 17.1 and solar ranked higher at 11.3% higher than LPG at 5.4%. This shows that there is need to put in place measure to increase popularity of the high end fuels to the households.

2.3.3 Distance of Household or Institution from the Technology/device sources

The percentage of cooking devices that were accessed by Institutions within 5 km radius were topped by mobile Charcoal stove at 25.7% followed by Installed Improved cooking stoves at 10.5%. Majority of the institutions had no easy access to institutional cooking devices. They have to travel very long distances to purchase them or get a service provider to install the modern cooking stove.

Households on the other hand that obtained cooking devices with a 5Km radius include; Charcoal stoves ranked highest at 24.5% followed by Kerosene stove at 7.8%, then Installed Improved cooking stoves at 6.9%. Those that obtained their stoves from weekly markets were on average 6.08% a factor attributed to the temporary closure of routine vendor markets in the COVID 19 lockdown

2.3.4 Accessibility to electricity and use in cooking

Access to electricity by institutions was 100% with all the sampled connected to either the main grid or had connections from a micro grid. Surprisingly though is the fact that only 72.2% used it in the cooking process. Households on the other hand had variations along the rural urban divide; only 28.2% rural households had access to electric as compared to 90.2% of the urban ones. The households in urban areas are slowly adopting the use of electricity in cooking and currently, 25.9 % use it in cooking to run different appliances including Percolator, microwaves, electric hot plates, ovens, among others. On a good note also 15% of the households that accessed electricity in the rural areas actually use it for cooking. Though this appear a small fraction, it is a shift from 0.2% reported in the UBOS 2014 census.

Access to electricity	Institution		Household			
	Overall		Rural		Urban	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
	100	0	28.2	71.8	90.2	9.8
Use of electricity in cooking	72.2	27.8	15	85	25.9	74.1

2.3.6 Supplier findings on Availability of the Improved cook Stoves

The charcoal stove supply market is composed of small multiple players many of whom are double as manufacturers and suppliers. There are two leading distributors of mobile charcoal stoves in Uganda i.e. Ugastove and UP Energy. Ugastove doubles as a manufacturer as is dominating in the market in central districts/markets of Uganda while Up energy dominates in the North and Eastern Parts of the Country. The western Uganda markets are dominated by MB Energy and other multiple small suppliers. A market survey of the local markets across the districts confirmed the presence of the improved stoves and people can easily access the products in the nearby retail, wholesale shops and markets. However the retailers have capacity challenges as they can only stock a limited number of improved stoves due to their relatively high cost price and a survey of the markets discovered limited stocks as compared to the expressed demand by the users.

> "*Sometimes we want the improved charcoal stoves but they are not available or some times the size I need is not available. That means I have to book with the retailer and when the suppliers bring, he can keep for me"*

International Lifeline Fund' (ILF) is another big supplier who also doubles as a manufacturer and they use the NGOs as their main distribution channel who take 50% of the stoves made, 40% is distributed by retailors and ILF directly supplies 10% on its own. Some of their biggest consumers are LWF in the west Nile& kyangwali, EcoTrust in western Uganda and Up Energy suppliers to the rest of the regions.

Though the prices of the improved cook stoves appear realistic when compared to the production and distribution costs, an interaction with the retailers reveal that the users find them expensive especially the fact that there is presence of alternative stoves that are over 5 times cheaper.

> *We get many inquiries about our improved stoves across all our outlets however it is only 2 of the 5 who inquire that actually purchase the stoves.* A distributor of the Barkley durfur in Kampala and has retail stalls at Senana supermarket and Acacia mall and other outlets in and around Kampala.

The study profiled the different improved charcoal stoves on the market and they are Summarised in the table as follows;

Stove Name and Image	Description
Burkely Durfur 	Barkely with a mesh is at Ugx150,000 final consumer and Ugx80,000 to retailers Baekely without a mesh is at Ugx120,000 final consumer and Ugx70,000 retailer 50% fuel savings both charcoal and wood Cast iron heavy therefore stove is stable
Smart Home Charcoal Stove(s) 	Smart Home Charcoal stoves (size 2) Retail Ugx12,000/= Customer Ugx15,000/= from the distributor Up Energy Smart home in Kampala Ugx30,000 in Wandegeya Market
EcoSmart Charcoal Stove	EcoSmart Stove (charcoal) Price ranges small Ugx10,000- 14,000:

	Big Ugx50,000 from the ILF manufacturer
EcoSmart for briquettes 	EcoSmart Stove (firewood) Price ranges small Ugx10,000- 14,000: Big Ugx50,000

Okello Kuc Improved stove 	Okello Kuc (charcoal) with a metallic casing Price ranges small Ugx10,000- 14,000: Big Ugx50,000
Improved Ugastove Size 2 (in Lira Market) 	Improved stove in Lira market distributed by a gentleman from Kampala named Senyonga Ugx 12,000

Lorena Improved 	Stationary lorena build on the verander made from mud and brick
Traditional Stoves	
Okello kuc Charcoal and Wood fuel 	Can use both charcoal and Wood stove with a remover liner to switch fuels for use. Price Ugx10.000-15.000

Okello kuc Wood only stove  	Uses on wood and its price ranges from Ugx 10,000 to 15,000
Institutional	
Instituional round stationary wood stove  	Instituional round stationary wood stove

Institutional Charcoal Stove with different cooking pots 	
Institutional LPG gas stove with multiple cook points 	Institutional LPG gas stove with multiple cook points

Institutional Electric Improved Baking oven 	
Institutional Biogas stove 	Institutional Biogas stove stove

2.4 Affordability of Clean Fuels and Improved Cooking Technologies

2.4.1 Costs of Fuels in Uganda

The study profiles the unit prices of the different fuels used in Uganda and the results are presented in the table as follows;

Fuel	Average Prices	Kampala	Central	Northern	Western	Eastern
Charcoal (50kg bag)	52,000	80,000	75,000	25,000	35,000	45,000
Firewood Institutional per tone	88,320	141,000	125,600	62,500	37,500	75,000
Firewood household per/kg	1060	2000	1500	300	500	1000
Briquettes per kg	Institution	1000	1000	1000	1000	1000
	Household	700	700	700	700	700
LPG/KG	Institutional 36kg and above cylinder	6973				
	Household (3, 6 &12kg cylinder)	8824				
Electricity/Unit	Household	882.352 (USD0.235)				
	Business	596.000 (0.162)				
Biogas						

The results indicate that Firewood remains the cheapest fuel for both households and institutions. This explains why wood still remains the mostly widely used fuel in the country. It is also important to note that there is a significant difference in prices for wood sold to institutions and that sold to households. This trend also applies for briquettes, LPG and electricity and this is because institutions benefit from the economies of large scale purchases. Across the regions, Kampala and central region get their fuel at higher prices than all the other regions followed by the eastern region. This is explained by the fact that the forest/vegetation cover in these regions is so low that the households and institutions ferry the fuels from the other regions and this comes at an additional cost.

The survey of the suppliers of biomass fuels reveal numerous small to medium players who trade charcoal and firewood and get a markup of 10 to 20% profit on sales and this caters for profit and cost of sales. The high end fuels have few multinational players and they determine the prices of the fuels. It is not clear from the interviews with these suppliers whether the prices reflect the production because the production chain has many players and the distributors could not know also how the final prices are arrived at.

2.4.2 Rate and Cost of Biomass Consumption in Uganda

An average household of 6 members consumed approximately 5 kg of firewood per day cooking 3 meals. This is equivalent to 150 Kgs of firewood per months and translates into 156,000 Uganda shillings spent on Firewood for cooking. The findings indicate that 50.45% of the households in Uganda exclusively use fire wood for cooking and this translates into 567 tons of fire wood consumed per month across the country which is equivalent to 601,237,699,207 Uganda shillings an equivalent of United States Dollars 167,010,472. (Calculations based on the UBOS census 2014 i.e. using the parameters of household size, population size and population growth rate).

Also an average household of 6 members consumed approximately 2 bags of 50 kgs in a month's when doing 3 meals in a day. This is an equivalent of 104,000 Uganda shillings per months spent on cooking. The findings also indicate that 73.1% of the households across the country use charcoal for cooking. However it was also observed that 49% of the households who use charcoal also use other fuels. It is also observed from data that 29.6% of households actually use fuel exclusively for cooking and this translates into 4,441,608 bags (50kg bag) of charcoal consumed every months equivalent to 230,963,628,486 Uganda shillings an equivalent of 63,277,706 united states dollars. (Calculations based on the UBOS census 2014 i.e. using the parameters of household size, population size and population growth rate).

The study also asked some respondents who exclusively use LPG for cooking and results indicate an average of 19 kgs for a 6 member household. This is also equivalent to 167,656 Uganda shillings. The study could not compare results for Electricity and briquettes since there was no household sampled that exclusively use Electricity and briquettes.

From this finding, it is important to note that the rate of Biomass consumption (firewood and charcoal) is overwhelming/big and requires urgent attention. In order to understand how this rate can be reduced significantly using improved cooking technologies, the study conducted Kitchen tests to determine the rate of energy saving by switching from traditional technologies. This is presented in chapter 4 of this report.

2.4.1 Perceptions about the affordability of fuels and technologies

The cost of the improved technologies varies with the type of consumer, technology and the geographical location where the technologies are being utilized. From the institutions sampled, 19.1% revealed that the improved technologies were very costly; 36.2% found it costly whereas 29.5% reported that the technologies were not costly. Though a big proportion of the institutions find the improved technologies costly, further investigation through qualitative approaches revealed that the cost comes with added benefits. This explains why 13.3% of the institutions were indifferent about the costs of the improved cook stoves.

The households too find the stoves expensive (32%) with a big proportion (40.1%) declining to commit to an answer and preferred to explain that they get more benefits with improved stoves which are way beyond the costs incurred in purchasing the stoves. There was no significant variation between the responses from rural and urban households on the perceptions about the cost of cook stoves.

2.4.2 Cost Drivers/items for improved Technologies

It was report by the household users of improved charcoal stoves that they are durable and require minimal repairs. However, the traditional stoves were reported to have a short lifespan. The biggest cost on improved stoves is the initial purchase cost and a few repairs on movable parts like liners, the insulating case, and metallic rods.

For institutional stoves, maintenance costs on some items included insulation, sealing cracks, replacing broken metallic rods, and labor costs for regular maintenance. Among the institutions, labor costs for regular repairs ranked highest at 31.8% followed by sealing cracks at 23.8% and the least was insulation at 14.3. The households in rural areas reported a 24.9% of the labor costs for maintenance and 16.6% for sealing cracks and other maintenance costs were on average at 57%.The labor that is associated with the use of any given stove ranked highest at 31.8%.

2.4.3 Supplier findings on Affordability

Up energy attributed the fairly affordable cost of their products to their additional business in carbon credits, they started the carbon credit scheme in 2014 which has enabled them to currently sell the smart home Size 2 at charcoal stoves to retailers @ Ugx22,000/= and Customer @ Ugx27,000. CREEC- Center for renewable energy efficiency reported that the price of the common improved stoves is about 20,000UGx which on average is expensive for most locals who are used to purchasing the traditional stoves at 5,000Ugx. International Lifeline Fund (ILF) reported to be the manufacturer with the most affordable stoves on the market and they sell size 2 Charcoal stove between Ugx10,000-16,000/=; size 1 Small at 14,000/= and biggest at 50,000.

Burkely durfur who sell premier cook stoves sold at premium prices and indicated that they guarantee maintenance with any parts being damaged. The Barkely with a mesh costs UGx150,000 final consumer and Ugx 80,000 to retailers; Baekely without a mesh was at Ugx120,000 final consumer and Ugx70,000 to the retailer. They also had other clean energy products like the solar jerry can sold at Ugx120,000 apiece and charcoal lighters where were sold at Ugx2000 apiece and Ugx20,000 a dozen and their briquettes were sold at Ugx70,000 for 50Kgs.

2.5 Adoption of Clean Fuels and Improved Technologies

2.5.1 Adoption of Clean Fuels in Uganda

Uganda has taken huge steps in popularizing clean cooking fuels. The rural electrification program under the clean cooking alliance and other players with support from development partners in the electrification of Uganda continues to take huge strides in this direction. Charcoal and firewood have for a long time been the only available options but this trend has changed in the recent past; now briquettes, LPG, electricity, biogas, biodiesel and bioethanol are taking center stage due to the deliberate efforts by government and development partners to popularize clean renewable energy fuels. Among the sampled institutions, electricity took lead at 68.9% followed by LPG ranked highest at 61.9% and then charcoal at 61%. Institutions adopted more than one fuel in order to benefit from advantages from each option.

This was different for households; rural households adopted firewood most at 74.5% followed by charcoal at 58.3% the rest of the fuels save biogas at 1.9% were below 1%. In urban households, charcoal scored highly over the rest of the fuels at 89.6% followed by charcoal 26.4% followed by electricity at 16.6%, then LPG at 13.5%. This finding is in line with finding of the National Charcoal survey; 65.7% of the urban households use charcoal while 33.4% use firewood for cooking. This finding is also in line with the trend on accessibility and there is a significant relationship between accessibility and adoption. What is surprising though is that the level of accessibility for clean energy options was higher than the rate of adoption implying that there are other factors that influence adoption of clean fuels other than accessibility.

2.5.2 Adoption of Improved Cooking Technologies in Uganda

Amongst the institutions sampled, electric cooking appliances ranked highest at 41.9%; these included hotplate, oven, and microwave, among others used commonly by hotels, bakeries and breweries. This was followed by traditional clay/mud stoves at 39.1% then improved charcoal/wood stoves at 33.3%. Traditional three stone cook stoves were still in use by a good number of institutions represented at 7.7% which implies that institution’s mode of adoption of improved technologies does not necessary translate into relinquishing the old traditional technologies.

Amongst households sampled, 64% were utilizing traditional three stone stove and 41.1% adopted the traditional mud/clay stove. The adoption of improved charcoal stove was at 7.3% while for improved installed firewood stove at 2.3%. There is a very low rate of adoption of the improved stoves at the household level and this finding confirms the fact that accessibility alone does not necessarily influence adoption of the improved technologies.

2.5.4 Challenges faced in utilization improved cook stoves

The challenges expressed about some of the improved stove brands and types included but not limited to; taking long to heat up, making half cooked food, some reported abnormal smokiness, costly to purchase, costly to maintain, unreliable supply of the stoves or the quality of the stove, and the changing market prices of the stoves which frustrate the referrals from pioneer users. Among the institutions sampled, the largest proportion; 51.4% and 58.1 highlight high purchasing price and high maintenance costs of the improved stoves respectively. Avery low percentage ir 3.8% and 8.6% reported challenges of making half cooked food and taking long to heat up amongst the institutions sampled. This seems to suggest that the issues about performance have been greatly improved and cost of the technologies is the leading impediment for the increased adoption of these technologies.

Households in rural areas; 20.7% reported the challenge of taking long to heat while those in urban areas only 8.3% expressed that concern. This could be a result of the variation in quality and type of the improved stoves used in the urban and rural areas. High cost of purchase ranked highest at 47.2% followed by high cost of maintenance at 43% in the rural areas, the same challenges scored less in urban areas at 23.2% and 13.4% respectively. The Lorena made with unburnt bricks was one of the common improved stoves in rural areas of Uganda, this stove cracks often and requires to be sealed often and some of the stoves are built outside on the veranda or in the outer kitchen which in most home steads has no door kitchen. This could be the reason why the stoves take long to heat up and they have high maintenance costs in rural areas than urban areas where the charcoal improved stoves are more popular

2.5.5 Additional challenges faced impending utilization from the supplier's view

Challenge	*Narration*
Negative Mindset	Local in the midst of huge forest reserves and others surrounded by large woodlots can't comprehend the notion of reducing biomass cover. "*Why switch if the stoves we have now have worked for all my past generations"* a respondent in Sororti District
Cultural norms	Some people believe the food cooked on local three stone devices taste better with a better scent and other factors. In many households visited most husbands leave some money for daily use (kameza money) this money varies based on family and this actually determines the fuel, stove type and other cooking choices in a home. It was reported that the purchasers prefer making daily purchases/fuels that can be bought in small quantities so that the flow of the money is sustained.

Lack of standards	The lack of regulations and standards on quality has left some smallholder manufacturers who are profit minded to duplicate the stoves without the appropriate energy savings
Perceptions	The failure of the fake stove to perform creates negative publicity which has corrupted the attitude and perception of the locals hence slowing the uptake of the technology.
Expensive	In comparison to the free three stoves and the traditional local stoves, the improved stoves are relatively expensive and the cost of maintenance and obtaining spare parts or any repairs is high
Awareness	The households know about the technologies but don't actually understand the unique attributes of these stoves and their accrued benefits
Partnerships	Small firms cannot afford the technology investment, raw material bulking for production and distribution independently.
Raw materials	Clay still going high, metal prices high because it is still being imported, technology that locally available not yet as effective yet the better machines are expensive
Technology	Some wood stoves require chipping and sizing, the time, skill and tools to use to accomplish this are limited. Some of the parts to replace some stoves are not available and those available are expensive. Some stoves are designed with pot specific platforms which are not in tandem with the local pots/saucepans available.

2.6 Performance of the Improved Cook Stoves in Uganda

This section presents both the technical performance and the perceptions of the users about the performance of the improved cook stoves.

2.6.1 Level of satisfaction with the fuels

The general level of satisfaction was assessed for the different fuels currently in use across the country, this was done on Likert scale. On a good note, 100% of the institutional users of biogas were satisfied with the fuel, they were few using biogas but the few that have mastered the art of production were very satisfied with the fuel performance. This was followed by LPG at 58.5% for the institutions like hotels that use it in cooking, most of the 'big' restaurants and hotels used LPG as either the main source of energy or the second. Electricity at 47.2 % gave the institutional users satisfaction and it ranked third, charcoal and fire wood followed at 34.4% and 33.3% of the institutions expressing that they are satisfied with the fuels. This trend suggest that the high end clean fuels are highly ranked in their performance in comparison to the traditional fuels.

Households generally derived satisfaction in using biogas at 50%, followed by kerosene at 46.2%, then charcoal at 45.2%; then LPG at 42.9%; briquettes at 40% and firewood at 23.6%. The households that have mastered the dynamics of generating and using biogas though still few still expressed the highest level of satisfaction and this may be similar with kerosene but additionally because kerosene is very easy to ignite and its major challenge is the choking smell when it is switched off. Charcoal at 45.2% ranks very high and on average it is the most commonly used fuel in Uganda, this explains the continued preference of this fuels even amidst the efforts to regulate the charcoal burning with its negative effects on the environment. LPG also ranks in the top four fuels that give satisfaction to the users because it is clean, it is easy to regulate and conserve the fuel and with the increasing awareness efforts for the adoption of this fuel, its uptake will continue to increase.

2.6.2 Supplier Findings on Performance

The suppliers generally boosted of 50% fuel saving on improved charcoal stoves. The additionbal performance attributes reported include; they are stable, they can carry pots of various sizes and weights to cook several meals and that they retain heat and can stay warm for an extended period of time.

Nyabweya Forestry College-Masindi a testing and standardizing government institution on performance of the different technologies reported that, most improved stoves give close to 50% energy savings and 20-30% general performance efficiency. They also heighted that the energy consumption trends are determined by status; where the high end class of society use multiple devices and fuels while the lower end (poor) use on fuel and one device for most of the cooking needs. Their perception on LPG was that it is used for simple meals and charcoal cooks main meals in most urban homes.

The records from the suppliers indicate that the improved wood stoves scores between 25% to 35%% on general efficiency and the charcoal stove is at 35% to 40% and both have up to 50% fuel saving efficiency. The designs are tested and the stove quality greatly optimized to suit final user including: the quality improvements have taken in consideration the size and position of the handles, height of the stove, pot size difference and the fittings with the stoves, coverage and maintenance of the stove, weight and mobility, heat retention, and shape which has been made conical to allow for heat concentration on saucepan. Some stoves such as Barkley durfur have other added advantages of using cast iron heavy which further enhances stove stability.

2.7 Assessment of the Influence of Awareness, Accessibility, Performance and Affordability Criteria on the Adoption of the Clean Fuels and Technologies

In order to understand the level at which the 4 criteria influence the adoption of the improved technologies, the study run a regression analysis of the 4 factors and the adoption of improved fuels and technologies. The analysis produced the P-Values to determine the level of significance and the direction of the relationship between each of the criteria and adoption.

2.7.1 Accessibility, Availability, Performance and Affordability Vs Uptake of Fuels

The study determined a single factor to represent each of the factors and categorized all the fuels into two i.e. Clean fuels and non-clean fuels. Basing on the P-Values, accessibility (P-Value 0.002) of the clean fuels is more likely to influence adoption of the fuels followed by availability (P-Value 0.025). While discussing the factor of accessibility with institutions, it came out that they can only choose from alternatives that they have access to. For instance some institutions had electricity power lines in their compounds but had no electricity installed in their houses due to high installation costs. This implies that there are other socio economic factors that determine accessibility to fuels. This also implies that institutions consider other factors such as affordability and performance as factors that influence accessibility to fuels.

Table showing analysis of Accessibility, Availability, Performance and Affordability Vs Uptake of Fuels

Institutions				
Aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Aware about clean fuels/ energy	No	reference		
	Yes	4	0.4	0.375
Has access to all clean fuels/ energy*	No	reference		
	Yes	7.6	5.0	0.002
Indicates that clean fuels are affordable	No	reference		
	Yes	0.6	2.3	0.406
Availability	No	reference		
	Yes	0.04	0.1	0.025
Performance: clean fuel currently meets/satisfies cooking needs	No	reference		
	Yes	5.5	6.6	0.160

When it comes to households, accessibility still ranked as top on the list with P- value of 0.000 followed by availability at 0.005. These two factors determine to a large extent the adoption of the clean fuels by households. The same discussion came out to explain the factors that determine accessibility and they include both socio economic and cultural factors. The findings also show a more positive relationship between all the factors and adoption of fuels for households. This implies that households are more sensitive to all factors and will base on most of them to make a decision to adopt a fuel or not to adopt the fuel.

Households				
aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Access to electricity*	No	Reference		
	Yes	5.1	2.6	0.002

Aware about clean fuels/ energy	No	reference		
	Yes	1.7	0.7	0.254
Has access to all clean fuels/ energy*	No	reference		
	Yes	6.2	2.9	0.000
Indicates that clean fuels are affordable	Prices are okay	reference		
	Yes	0.3	0.4	0.300
Availability	No	reference		
		0.3	0.1	0.005
Performance: clean fuel currently meets/satisfies cooking needs	No	reference		
	Yes	1.2	0.7	0.714

2.7.2 Accessibility, Availability, Performance and Affordability Vs Uptake of Improved Cooking Technologies

The study determined a single factor to represent each of the factors and categorized all the technologies into two i.e. improved technologies and traditional technologies. Basing on the P-Values, affordability (0.03) of the technologies has a more positive relationship with adoption than with other factors. The other factors influence adoption in more less the same proportion implying that decision to purchase a technology will depend on its pricing. This discussion was validated by market players who indicated that prices determine the choice of the consumers of the improved cook stoves.

Institutions				
Aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Aware about Improved cooking technologies	No	reference		
	Yes	0.7	0.5	0.671
Has access to all Improved cooking technologies	No	reference		
	Yes	2.3	1.6	0.244
Indicates that Improved cooking technologies are affordable	Prices are okay	reference		
	They are expensive	11.1	12.5	0.034
Availability	Bi-Monthly	reference		
	Everyday	0.5	0.4	0.365

Performance: Improved cooking technology currently meets/satisfies cooking needs	No	reference		
	Yes	0.9	6.3	0.351

When it comes to households, accessibility (P-0.000) ranked as a top factor that influence adoption of improved technologies followed by affordability (P-0.02). This implies that households will base their decisions to adopt the technologies based on their prices, if the prices are affordable to them and initial costs are accessible.

***Households**				
Aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Access to electricity*	No	reference		
	Yes	2.1	0.8	0.037
Aware about Improved cooking technologies	No	reference		
	Yes	1.0	0.4	0.914
Has access to all Improved cooking technologies*	No	reference		
	Yes	4.0	1.5	0.000
Indicates that Improved cooking technologies are affordable	No	reference		
	Yes	0.1	0.1	0.021
Availability	Bi-Monthly	reference		
	Everyday	1.0	0.3	0.885
Performance: Improved cooking technology currently meets/satisfies cooking needs	No	reference		
	Yes	3.0	0.56	0.452

Based on this finding, it is important to note that accessibility and affordability play a big role on influencing the decision to adopt clean fuels and improved technologies for both households and institutions. It is therefore important that programs to support the adoption of the same should focus on processes that are efficient and minimize production costs which will later translate into lower retail prices. This in away will improve accessibility which is the high end decision factor. However it is important to note that there are other socio economic and cultural factors that influence accessibility to fuels and technologies and these are discussed in detail in Chapter 3 as follows.

3.0 Social Acceptance, Adoption and Use of Renewable Energy and Improved Technology

3.1 Introduction

The use of energy /fuel especially for cooking is not only influenced by their availability or accessibility. The tradition of cooking is culture specific and is governed by community and social beliefs and practices. Community beliefs and perceptions therefore govern the way people cook and eat and thus their choice of fuel and technologies used. Uganda is a land of social and cultural diversity, with over 54 tribes many of which maintain their traditional practices related to cooking, eating and other related activities that involve the use of energy and fuel. Many of these tribes however have been influenced by various external interactions and such choices have over time changed. The central part of the country has greatly been influenced by western cultures and way of life, but the further one goes from the central part of the country, the stronger traditions and culture is likely to be.

In almost all the communities, women do most of the cooking and many times supported by the children both girls and boys but in some communities, girls are more engaged in cooking than the boys. Cooking is learned by girls from a very young age in all communities in Uganda, where they actively engage and also watch their mothers cooking. The study on renewable energy landscape in Uganda has revealed such and many other social factors that influence people's consumption of various fuel and technology options. Besides gender, other factors include level of income of the household, age, level of education, nature of food, and others.

3.1 Socio-demographic characteristics that influence the use and adoption of clean fuels and improved technology.

3.1.1 Gender

Our statistical results indicate that of those who preferred to use clean fuel, 69% were female and only 31% were males. Those who preferred to use improved technologies, 61.9% were female and 38% were male. Women therefore were more likely to use clean fuel and improved technologies than men. This could be attributed to the fact that the women and girls do most of the cooking and are more likely to be experiencing all the challenges resulting from use of traditional fuel and technology, while the men on the other hand could be hesitant to move to improved technology and fuels for fear of the related financial implications.

During the focus group discussions, women were asked what features they considered important if they were to adopt any new cooking technology. The following features were mentioned more repeatedly during these discussions: (1) the technology must provide space for one to cook more than one dish at a time, (2) must give space or enable one to keep food warm (3) should be able to cook food in the shortest time possible (4) and usable by the children in the house.

Earlier studies have indicated that there are clear gender dimension in the household energy sector. Some scholars have revealed that women and men do not equally bear the burden of environmental and health factors associated with biomass use, since they are responsible for the collection, transportation, processing and storing of fuels, as well as the cooking activities; while men typically make decisions of a financial nature (Choudhuri & Desai, 2020). It is thus possible to deduce that the health burdens associated with traditional biomass cooking are disproportionately felt by women due to the fact that they are more involved in cooking. We recommend therefore that any technology promoted should be checked on how well it meets the expectations of certain categories of people, specifically the women, who are or should be the primary beneficiaries of improved stoves.

3.1.2 Location

74.5% of people using firewood were rural residents, and only 26.4% were urban residents. On the other hand, less than 1% (0.5) of rural residents used electricity, while 16.6% of urban residents used electricity for cooking. Therefore, residing in a rural area was closely associated with use of traditional cooking technology and fuel, while residing in an urban area was more closely associated with use of modern and clean cooking technology and fuel. It is however encouraging that awareness of improved technologies, especially improved cooking stones was almost at the same level in rural (91%) and urban (95%). Since level of awareness of improved fuels are quite high, the low rate of adoption of the same can better be attributed to accessibility, as majority of the respondents in rural areas did not have access to electricity, bio gas or LPG. The high adoption of charcoal in rural areas however (58.3%) is an encouraging trend that should be utilised to further promote improved cooking stoves.

3.1.3 Level of education

Results also indicated that household level of education also influenced whether they would use clean energy and technology or not. Only 3% of respondents who had no formal education used clean energy, while 16% of them used traditional energy. On the other hand, 21% of respondents who had a university degree used clean energy while only 6% of them used traditional energy. This implies that the higher the level of education, the more likelihood for one to use clean energy. This could be attributed to the fact that once one is educated, they are likely to understand both the environmental and health dangers of using traditional energy for cooking and for lighting. This could imply that, beyond making clean technologies available, sensitisation efforts need to be heightened especially in areas where residents have lower education levels.

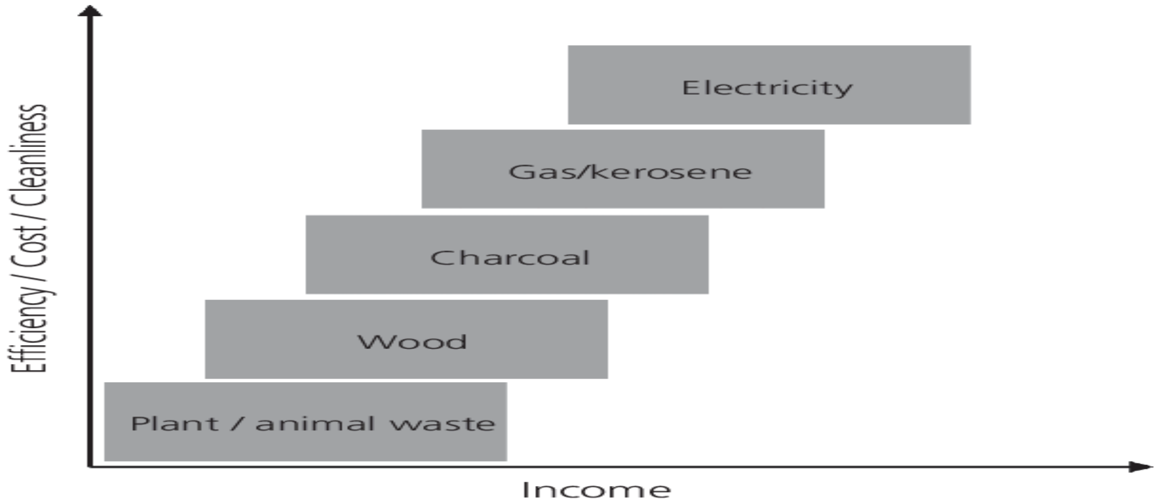
3.1.4 Age of household head

Whereas statistics did not reflect the relationship between the age of the respondent and the adoption of clean cooking technologies and fuels, our interactions and observations with households and institutions reveal that younger people were more flexible and willing to adopt modern cooking technologies and fuels than their older counterparts. During a focus group discussion with women in Bushenyi district, one of the respondents had this to say: "for *me when I am cooking, I prefer to use the charcoal stove. But when mum is around, she wants me to use the stones (referring to the three stones)*". When probed on the reason why the mum prefers the three stones, she noted that mum believes that the stones cook food better than the charcoal stove. Studies have generally indicated that younger people embrace technology much faster than older persons and are willing to adapt to new things faster.

3.2 Socio-economic factors that influence the use and adoption of clean fuels and improved technology.

Level of income. It is generally true that the initial capital cost of renewable energy is relatively higher when compared to conventional sources of energy. The biggest percentage of households on the other hand, especially in the rural areas (61%) earned less than 200.000 shs a month and of those who earned less than 200.000 shs, only 9.5% of them used clean energy while the 47% of them used traditional energy. On the other hand, households that earned between 1-5million shs, mainly used clean energy (20%) and only 3.5% of them used traditional energy. It was thus observed generally that households with higher income levels had a tendency to use more modern and clean cooking fuels and technologies such as gas and electricity. Similarly, a study in Bukinafaso revealed that as household income increased, households' firewood use systematically decreased as well (Ouedraogo, 2013). Campbell and colleagues also established that higher income households in urban Zimbabwe had the tendency to transition to modern cooking fuel sources such as kerosene and electricity, as opposed to using wood fuels as their primary energy source like the majority of lower income residents (Campbell, Vermeulen, Mangono, & Mabugu, 2003). Generally, people with lower incomes generally focus on other priorities such as food, than type of energy used, thus tend to use the cheapest and most available energy options.

The energy ladder model proposed by Barnes and others suggests that as income increase, households adopt more modern cooking fuels. This linear process as illustrated below shows that households cease to use traditional biomass fuels and adopt modern alternatives as their income level increases (Link, Axinn, & Ghimire, 2012).



The model thus proposes income as a determinant factor for fuel choice, and thus the rationale for transitioning up the energy ladder. Furthermore Masera et al. (2000) point out that "the energy ladder assumes that more expensive technologies are locally and internationally perceived to signify higher status, and that families desire to move up the energy ladder not just to achieve greater fuel efficiency or less direct pollutions exposure, but to demonstrate an increase in socio-economic status."

This model however focuses too rigidly on economic processes as determinants of fuel choice; with no concern for certain social, cultural and behavioural processes as determinants of energy choice. From our observation however, firewood/fuel wood was not only restricted to low income households. In fact it seemed to us that as income levels rose, households adopted multiple options of fuel instead of entirely shifting to an improved on.

Earlier studies have provided evidence that multiple fuel use is widespread in other areas. In Guatemala for example, it was estimated that households predominantly rely on both firewood and LPG (26% and 16% respectively), while in rural parts of South Africa 34% of households use both firewood and kerosene for their cooking needs. Similar observations can be found in Botswana (van der Horst & Hovorka, 2008), and in rural India (Joon et al, 2009). Masera et al. (2000) provide an alternate to the energy ladder model´s linear fuel switch process, by introducing the "multiple fuel" model. The model asserts that "rural households do not 'switch fuels', but more generally follow a multiple fuel or 'fuel stacking' strategy by which new cooking technologies and fuels are added, but even the most traditional systems are rarely abandoned.

3.3 Socio-cultural factors that influence the use and adoption of clean fuels and improved technology.

3.3.1 Type of Staple Food

Different ethnic groups in Uganda have different staple foods. It was observed that certain cultures preferred their staple food to be cooked in the most traditional manner and seemed to argue that certain technologies could not be used to cook certain foods. A few people still hold the norm that food prepared with fuelwood tastes better than food prepared with other heat sources The Baganda interviewed in districts of Wakiso indicated that matooke is best prepared using firewood on the three stones. This view however was more prevalent among the older adults and it was not generally shared among all respondents. In a focus group discussion for stance, the following voices were seemingly contradicting each other:

"For you to prepare matooke very well and keep its original taste, it needs to be cooked on firewood and kept on the fire on stones for the whole day. Imagine if you are using gas how can you keep it on the entire day? On the other hand, if you cook matooke in a rush, it will not bring out its original scent and taste. You will lose the original taste"

Immediately, another respondent had this to say:

"No! you can prepare matooke even on a charcoal stove. You just leave little fire there and cover it with ash. The food will be there the whole day and it will be as soft and tasty as the one prepared on firewood".

While another one noted that;

"I have my traditional cooking stones where I put my matooke, but I have a stove also which I use for simpler foods like rice or sauce and vegetables".

This implies that some households could not rely on one type of fuel or technology, because of what they perceived could be cooked or not by the different technologies. In the northern part of the country however, respondents noted that they could prepare *kalo* (millet paste) on any cooking technology, including LPG and improved charcoal stoves as well as they did on firewood and cooking stones.

3.3.2 Cooking stones complement other activities

Respondents especially mothers noted that when they cook using firewood, they either have to kneel down or sit down in the kitchen. Many of them noted that when they do this, they are also able to conduct other activities at the same time, such as breast feeding, peeling food or washing dishes. Other technologies such as LPG or electricity does not seem to favour that. "*When I am in the kitchen, I am not only cooking but doing many other things; I can breastfeed in the kitchen because I am sitting down, I can peel food and I can wash dishes down there when I am kneeling* *or sitting. But now cooking from electricity will mean that I have to keep getting up to check on the food and then go back to do my other activities. I also don't like cooking when I am standing"*. This might have two implications; one, that cooking stones and kitchens are not only used for cooking but many other complementary activities as well. The second implication here might be that, if we wish to change and transform the cooking atmosphere in homes, this does not move alone but other infrastructural issues within the homes should be considered, such as drying racks that can enable one to wash dishes without having to sit down.

3.3.3 Other uses of fire

Respondents also often noted that one of the barriers for the adoption of modern fuels and improved cooking technologies, are the "other" benefits of fire that can seemingly only be enjoyed with the traditional technologies especially the cooking stones. Many argued that many families gather in the kitchen, especially children in the evening and there is a lot of socialising that takes place around these fires regardless of what is being cooked. Parents also noted that this is the time they get to speak to their children about issues like behaviour, culture, providing guidance and many other things. Doing away with such technologies might seemingly be threatening to some of the families for its potential to erode social cohesion. Two participants during an FGD in Jinja pointed out that their family stays in the kitchen all the day and only go to the main house for sleeping unless guests or strangers were around

Other uses of fire mentioned also included preparing certain snacks such as roasted maize which they said you could not do on certain technologies such as LPG. Other studies also found that in rural areas, people argued that they prefer to use firewood, as the smoke from the firewood helped to reduce the smell from the animals especially in communities where humans shared shelter with the animals.

3.3.4 Importance of smoke

The community perceived wood smoke as beneficial though they knew it has negative effects on their eyes and respiratory health. Although they noted that did not enjoy the smoke while cooking, smoke was perceived to have some benefits such as keeping the cooking saucepans strong. One respondent noted that; *"a saucepan that you use on firewood is much stronger than other saucepans that you use on other technologies. The firewood saucepans hardly break or become perforated"*.

"We like smoke because if someone's kitchen does not bring out any smoke, the neighbours might think that you are poor or that your wife is not a good cook".

The above findings might not be very surprising as earlier studies in other African countries and in rural areas revealed that there are various perceptions towards the importance of smoke in the houses: a study in rural areas of Ethiopia revealed that smoke was important as it shows a better status of the household and cooking skill of the wife. In this culture, smoke was perceived as good for a mother newly giving birth and her baby especially in the first months.

3.3.5 General Positive Attitude

Overall, the study found the communities had a positive attitude towards using improved technologies and modern fuels in spite the barriers that they experienced in accessing them as well as the perceptions that they had towards the benefits of the traditional cooking technologies and fuels.

It is argued that technological absorption cannot occur without the proper social, cultural, considerations as these influence the adoption. When not considering socio-cultural aspect, it may inevitably lead to project failure in the long run. There are various examples of stove programmes that have been unsustainable due to failure to consider the local social and cultural setting of intended beneficiary communities. One such example comes from rural Mexico where LPG stoves were introduced so as to reduce people's over reliance on firewood for cooking. It was soon noticed that communities did not abandon the use of fire wood, as a result of a cultural incompatibility of the new stoves. It was discerned that the new stoves were not adequate for the cooking of the popular tortilla. Since tortillas are customarily prepared over open wood fire, it was reported that the tortillas prepared over a gas flame were distasteful. Furthermore it was also noticed that the design of the LPG stove did not allow for the large enough surface, necessary for efficiently cooking tortillas (Masera et al. 2000).

There are also cases where a stove developed and designed for use in one developing country, is unsuitable for another. The jiko stove of Kenya is a ceramic stove suitable for more efficient burning of charcoal. The design of the stove was largely a bottom up initiative and production was carried out by local artisans, enabling for its wide spread acceptance and popularity in Kenya (Budds et al. 2001:30). When the same jiko stove was introduced in neighbouring Tanzania, it proved to be unpopular amongst households as it failed to meet consumer preferences. This demonstrates the culture specific context in which stoves should be designed. Only after design modifications to suit the Tanzanian local needs, was the stove later adopted (Barnes et al. 1993). Unfortunately, the authors do not elaborate why the jiko stove did not work well in Tanzania. Such cases however call for more attention to socio-cultural dynamics within household energy choice. Household cooking interventions may also be in the form of household modification and awareness raising campaigns.

It is also important to recognise that technologies should be appropriate to people's needs, rather than trying to change people's behaviour to suit the technological option" (Bates, 2001). Budds et al. (2001) asserts that "Many initiatives have been designed according to the priorities of the implementers, or assumed priorities of the intended beneficiaries, with little perception from users. As with other development projects, many initiatives have failed to meet user's needs, which include both practical and socio-cultural factors." It is therefore important to consider and assess consumer needs and preferences, both towards the current energy sources used, as well as to the new technologies introduced. Understanding the reasons why households choose certain fuels will ultimately provide a framework for assessing whether newly developed technologies correspond to the selection criteria of fuel choice by consumers in target regions of the country.

4.0 Cost Benefit Analysis of Improved Technologies/Clean Fuels

4.1 The Controlled Cooking Tests

The study performed Controlled Cooking Tests (CCTs) in order to compare costs and benefits of the traditional and the improved cook stoves found in the markets and widely used by households and institutions. The tests were carried out in conformity with the Controlled Cooking Test Protocol version 2.0 of August 2004 by Rob Bailis and ISO 17025: 2017. Each of the stove samples was tested three times by the same cook to ensure uniformity in application of the protocols. A commonly prepared dish of beans was cooked on each of the stove samples. For each meal, 500g of beans was prepared with ingredients such as tomatoes, green paper, onions, salt, Ryco and water to make a replica of a typical meal.

Considering that different fuels were used for different stoves, a metric of MJ of energy/kg of food was adopted for specific fuel consumption.

For charcoal, firewood and LPG fuel, the energy consumed per kilogram of food cooked was derived by multiplying the fuel heating value (MJ/kg) with the quantity of fuel consumed per kilogram of food cooked. The Lower heating values (LHVs) used are 29.5MJ/kg for charcoal, 17.3MJ/kg for wood, 21.0MJ/kg for (briquettes and 46.1MJ/kg for LPG.

For electricity, the energy consumed per kilogram of food was derived by multiplying the stove power rating (1000J/s) with the cooking time (in second).

4.1.1 A description of the Samples that were tested in the CCTs

Name of stoves	Traditional three-stone	Traditional Ceramic	Improved Installed Household Stove (Commonly known as Rolena)	Mobile improved Stove (size 2) /Charcoal & Briquettes	Home Gas Stove	Electric Hot Plate
Quantity	1	3	1	3	1	1
Manufacturer	Unknown	Unknown	Unknown	Ugastove	Iman	Saachi
Fuel Type	Wood	Charcoal & briquettes	Wood	Charcoal & briquettes	LPG Gas	Electricity
Condition of sample	Good	Good	Used	Good	Good	Good
Fuel characteristics	Water content: 7.1% (charcoal), 11.5% (wood), 7.2% (briquettes)					
	Low heating value (LHV): 29.5MJ/kg (charcoal), 17.3MJ/kg (wood), 21.0MJ/kg (briquettes), 46.1MJ/kg (LPG)					

Test environment conditions:	**Ambient temperature**: 29ºC - 32ºC **Wind speed:** controlled wind environment

Stove description and physical characteristics	
	Three Stone Stove. Uses Firewood as fuel: Found in Kinoni, Makerere a Kampala Suburb. Its is exactly a replica of stone stoves predominantly found in Rural areas in Uganda as per the study findings
	Improved Installed household Stove. It uses firewood as fuel: Found in Nansana Town Nansana Municipality in Wakiso District. This stove is commonly reffered as Rolena across the country. It varies in size and specifications and this too comes with varied perfomance. There is no clear standardisation of this stove.

	Traditional Ceramic mobile stove. It uses both charcoal and briquettes. Found in Gulu central market in Nothern Uganda. This is a replica of traditional stoves predominant in urban households across the country
	An improved mobile charcoal/briquettes stove. This was purchased in Soweto market in Masaka town masaka municipality.
	An LPG stove with two cooking points. This kind of stove was largely used by urban households who used LPG as fuel for cooking. It was purchased in Wandegeya Market in Kampala Capital City

				An electric stove with two cooking points. This was largely utilised in urban households that used electricity for cooking. It was purchased in Soroti Town Soroti District in Eastern Uganda.
Identification of test method				
Test equipment:	Weighing scale	Barometer	Moisture meter	Weighing Scale
Serial no/asset no.	CIR/WBT/03	BRM001	CIR/MST/04	CIR/PBS/41

The results from CCTs formed the basis for performing the cost benefit analysis based on the comparisons of the performance of the different stoves and fuels.

4.2 Comparison of stoves using wood as the Fuel

Parameter	Type of stove			
	Traditional 3-stone fire	Improved installed wood stove	Home Gas stove	Electric Hot Plate
Food cooked (kg)	0.5	0.5	0.5	0.5
Cooking time (min)	153	129	151	174
Specific fuel consumption (MJ/kg)	102.438	38.811	13.281	10.420
Percentage difference (%)	-	62.1%	65.8%	73.2%

4.2.1 Comparison of Time period to Cook using the Wood as Baseline Fuel

Wood performance was conducted in two types of stoves (traditional 3 stone and the improved installed wood stove) in comparison with LPG and electricity. An electric hot plate of power rating (1000W) cooked 0.5Kgs of beans using the same cook took 174m minutes which was longer than the Home gas stove (151m), the improved installed wood stove (129m) and even the traditional stone cook stove (153). The cooking tests were done on a cold start implying the extended duration for the hot plate could be attributed to the transfer of electric energy to heat the plates. The improved installed wood stove cooked fastest because it losses less energy during cooking and it maximizes the use of every energy produced by the fuel.

4.2.2 Comparison of Fuel consumption using Wood as baseline Fuel

In comparing the fuel consumed by wood stoves to cook the same 500gm meal of beans with LPG and electric stoves, the traditional 3 stove consumed the highest amount of fuel 102.44MJ/28.46KWh; the improved installed wood stove

38.81MJ/10.78KWh; home gas stove 13.28MJ/3.69KWh; and electric hot plate 10.42MJ 2.89KWh

In comparison for wood as a stove in the three stone cook stove with other improved stove, the electric hot plate is 73.2% more efficient in term of cooking duration and fuel consumed. The LPG and the home gas performed equally better than the three stone stove with a percentage difference of 65.8% and 62.1 % respectively.

4.3 Comparison of Stoves using charcoal as the Fuel

Parameter	Type of stove			
	Traditional ceramic stove	Ugast ove	Home Gas stove	Electric Hot plate
Food cooked (kg)	0.5	0.5	0.5	0.5
Cooking time (min)	166	164	151	174
Specific fuel consumption (MJ/kg)	9.183	6.717	13.281	10.420
Percentage difference (%)		26.9%	-97.7%	-55.1%

4.3.1 Comparison of Time period to Cook using Charcoal as Baseline Fuel

Charcoal performance was conducted in two types of stoves; traditional ceramic stove in comparison with the Uga-stove, LPG and electricity stoves; an electric hot plate of power rating (1000W) cooked 0.5Kgs of beans using the same cook took 174m minutes which was longer than the Home gas stove (151m), the Uga-Stove (164m) and even the traditional ceramic stove (166m).

Generally, it was observed that charcoal stoves (163.75m) cooked the same meals longer than wood stoves (151.75m) which could be because it is easy to ignite and combust dry wood as compared to charcoal.

4.3.2 Comparison of Fuel consumption using Charcoal as baseline Fuel

In comparing the fuel consumed by charcoal stoves to cook the same 500gm meal of beans with LPG and electric stoves, the UgaStove improved stove consumed the least amount of fuel 6.717MJ/1.87KWh; traditional ceramic stove 9.183MJ/2.55KWh; electric hot plate 10.42MJ 2.89KWh and the home gas stove consumed the most at 13.28MJ/3.69KWh.

In comparison for charcoal as a stove in the traditional ceramic stove with other improved stove, the UgaStove brand showed a 26.9% percentage difference whereas the electric hot plate is (-55.1)% and the home gas stove using LPG at (-97.7%) in term of cooking duration and fuel consumed.

4.4 Comparison of stoves using briquettes as the fuel

Parameter	Type of stove			
	Traditional ceramic stove	Ugast ove	Home Gas stove	Electric Hot plate
Food cooked (kg)	0.5	0.5	0.5	0.5
Cooking time (min)	156	170	151	174

Specific fuel consumption (MJ/kg)	5.182	3.751	13.281	10.420
Percentage difference (%)		27.6%	-254.0%	-177.8%

4.4.1 Comparison of Time Period to Cook using Briquettes as Baseline Fuel

Briquettes performance was conducted in two types of stoves traditional ceramic stove in comparison with the Uga-stove, LPG and electricity stoves; an electric hot plate of power rating (1000W) cooked 0.5Kgs of beans using the same cook took 174m minutes which was longer than the Home gas stove (151m), the Uga-Stove (170m) and even the traditional ceramic stove (156m).

Generally, it was observed that briquettes stoves (162.75m) cooked the same meals longer than charcoal (163.75m) and wood stoves (151.75m) which could be because it is easy to ignite and combust dry wood as compared to charcoal.

4.4.2 Comparison of Fuel consumption using Briquettes as baseline Fuel

In comparing the fuel consumed by briquette stoves to cook the same 500gm meal of beans with LPG and electric stoves, the UgaStove improved stove consumed the least amount of fuel 3.751 MJ/1.04KWh; traditional ceramic stove 5.182 MJ/1.44KWh; electric hot plate 10.42MJ 2.89KWh and the home gas stove consumed the most at 13.28MJ/3.69KWh.

In comparison for charcoal as a stove in the traditional ceramic stove with other improved stove, the UgaStove brand showed a 27.6% percentage difference whereas the electric hot plate is (-177.8)% and the home gas stove using LPG at (-254%) in term of cooking duration and fuel consumed.

4.5 Cost Comparisons for Fuels using Different Stoves

4.5.1 Comparison of Costs using Wood as a Baseline Fuel

Stove type	**Quantity of fuel used for the meal (Kg) /(KWh)**	**Cost of fuel per unit (Ugx)**	**Cost per meal**
Traditional 3-stone fire	12.804	400	5,121.6
Installed mud stove	4.852	400	1,940.8
Home Gas stove	0.56	9833 (12Kg cylinder upper limit for most HH)	5,506.5
Electric Hot Plate	5.788 KWh	759	4,393.1

Key to the question of adoption is the cost of the fuel which greatly influences the choice of any improved and traditional devices to be adopted by a household. The amount of energy required to prepare 1Kg of the NABE 1 variety locally known as "masavu" was on average 12.8Kg when using the traditional 3-stone fire, 4.9Kg for the Installed mud stove, 0.56Kg for the

Home Gas stove (LPG), and 5.8units when using an electric hot plate. The cost of boiling and frying a Kg of beans while using electricity was Ugx 4,393.1/= cooked on an electric hot plate of 1000W power rating; which remains high for most rural and urban households in comparison to the available options. Wood fuel combusted in the Installed mud stove ranked was the cheapest at Ugx 1,940.8/=; in comparison to the LPG at Ugx5, 506.5/=. It can generally be concluded that cooking with wood fuel an improved installed wood stove like a Installed mud stove is cheaper than cooking with a traditional 3 stone stoves (Ugx 5,121.6/=), LPG (Ugx 5,506/=) and an electric hot plate (Ugx4,393.1/=).

4.5.2 Comparison of Costs using Charcoal as a Baseline Fuel

Stove type	**Quantity of fuel used for the meal (Kg) /(KWh)**	**Cost of fuel per unit (Ugx)**	**Cost of fuel per unit**
Traditional ceramic Stove	0.634	1000	634.0
UgaStove	0.464	1000	464.0
Home Gas stove	0.56	9833 (12Kg cylinder upper limit for most HH)	5,506.5
Electric Hot Plate	5.788 KWh	759	4,393.1

The results were different when using charcoal in the traditional ceramic stove in comparison to the improved charcoal stove (UgaStove); LPG and electric hot plate**.** The amount of charcoal required to prepare 1Kg of Beans was on average 0.634 Kg when using the traditional ceramic stove, 0.464Kg for the improved charcoal stove (UgaStove), 0.56Kg for the Home Gas stove (LPG), and 5.8units when using an electric hot plate which remains high for most rural and urban households in comparison to the available options. The cost of boiling and frying a Kg of masavu beans while using electricity was Ugx 4,393.1/=, cooked on an electric hot plate of 1000W power rating. Charcoal combusted in the Improved mobile charcoal stove ranked was the cheapest at Ugx 464/=; in comparison to the LPG at Ugx5, 506.5/=. It can generally be concluded that cooking with charcoal a fuel in an improved mobile charcoal stove (Uga-Stove) in cheaper than cooking with a traditional ceramic one stove (Ugx 635/=), LPG (Ugx 5,506/=) and an electric hot plate (Ugx4,393.1/=).

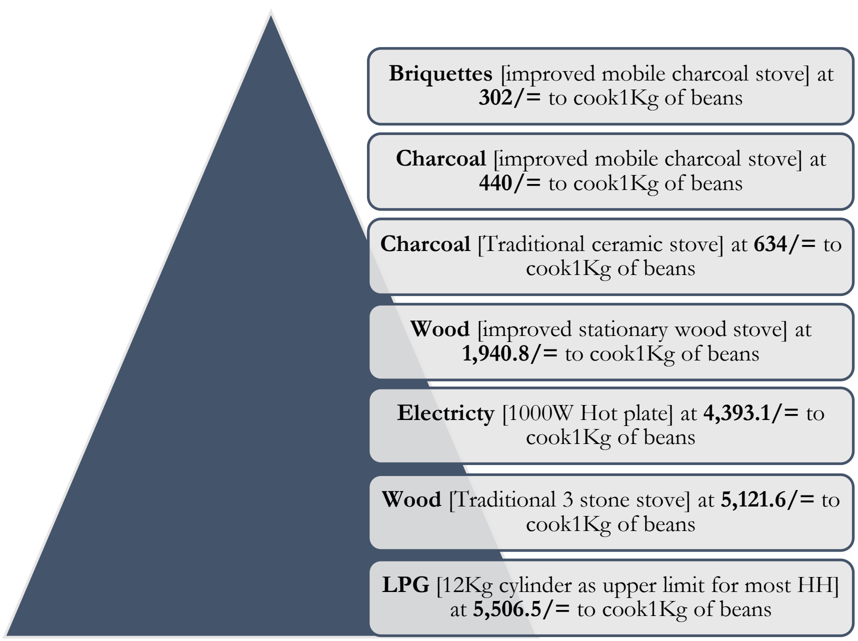
4.5.3 Comparison of Costs using Briquettes as a Baseline Fuel

Stove type	**Quantity of fuel used for the meal (Kg) /(KWh)**	**Cost of fuel per unit (Ugx)**	**Cost of fuel per unit**
Traditional ceramic Stove	0.416	1000	416.0

UgaStove	0.302	1000	302.0
Home Gas stove	0.56	9833 (12Kg cylinder upper limit for most HH)	5,506.5
Electric Hot Plate	5.788 KWh	759	4,393.1

The results were different when using briquettes in the traditional ceramic stove in comparison to the improved charcoal stove like (UgaStove); LPG and electric hot plate**.** The amount of **briquettes** required to prepare 1Kg of beans was on average 0.416 Kg when using the traditional ceramic stove, 0.302 Kg for the improved charcoal stove (UgaStove), 0.56Kg for the Home Gas stove (LPG), and 5.8units when using an electric hot plate. The cost of boiling and frying a Kg of beans while using electricity was Ugx 4,393.1/= cooked on an electric hot plate of 1000W power rating which remains high for most rural and urban households in comparison to the available options. Briquettes combusted in the Improved mobile charcoal stove ranked was the cheapest at Ugx 302/= for 1Kg of beans; in comparison to the LPG at Ugx5, 506.5/=. It can generally be concluded that cooking with briquettes as a fuel in an improved mobile charcoal stove like a Uga-Stove is cheaper than cooking with a traditional ceramic one stove (Ugx 416/=), LPG (Ugx 5,506/=) and an electric hot plate (Ugx4,393.1/=).

Ranking from top- bottom is cheapest to most expensive fuel in a specific device



From this analysis, Briquettes is the cheapest option followed by Charcoal. It is important to note that briquettes did not pass the test for availability and accessibility and thus did not find its way into our recommendations. Though efforts to make it available are commendable, the survey of the briquettes suppliers revealed a low capacity and number to avail the briquettes in all the fuel outlets in the country. However supporting the suppliers to build this capacity would be a good move towards availing this cleaner energy to the households and institutions.

4.6 Other Benefits Associated with Clean Fuels and Improved Technologies

4.6.1 Reduced Carbon Emissions and Associated Health Benefits

According to Climate and Clean Air Coalition 2020, in 2016 2.6 million people in the developing world died prematurely from exposure to kitchen air pollution. Additionally, each year tens of millions are sickened, injured or burned as a result of using biomass as fuel with traditional devices. This study discovered that households and large institutions are aware of this danger but continue to use the same due to social, economic and technical factors. Already there is positive shift towards a better direction as adoption starts with awareness. Supporting players in the sector to avail clean fuels conveniently will increase the chances of many institutions and households escaping the dangers of using traditional stoves and biomass fuels.

4.6.2 Improved Forest Cover and associated Climate Benefits

Forests are central to SDG 15 and contributes to achievement of SDG 7 targets. The adoption of clean fuels and improved efficient stoves will greatly contribute to the improved forest cover and the associated ecosystem benefits.

To conclude this chapter, the adoption of clean fuels and technologies has both economic and social benefits. The economic benefits are two; 1) fuel saving and time saving. The social benefits are also broadly grouped into two 1) improved forest ecosystems and reduced carbon emissions. Marketing and communication messages that promote adoption of clean fuels and improved technologies should focus on marketing these benefits.

5.0 Recommendations and Conclusions

5.1 Recommendation of the Appropriate Technologies for Institutions and Households

5.1.1 Recommended Cooking Technologies/fuels for Households

Based on a 4 criteria (accessibility, availability, affordability and performance) that formed the foundation of this study, the study recommends 4 household stoves that have the potential to significantly reduce deforestation in Uganda. This is due to their efficiency in maximising power but at the same time have higher chances of being adopted. The recommendation is based on analysis based on accept/reject or pass & fail basis. The results are presented as follows;

Improved Technology	**Decision Criteria**						
	Accessibility		**Availability of fuels**		**Affordability**		**Performance**
	Rural	Urban	Rural	Urban	Rural	Urban	
Improved Installed Household Wood Stove (IHWS) /Wood Fuel	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Mobile improved Stove (size 1,2 &3) /Charcoal & Briquettes	Pass	Pass	Pass	Pass	Pass	Pass	Pass
LPG Stove /LPG Fuel	**Fail**	Pass	**Fail**	Pass	**Fail**	Pass	Pass
Electric Stove /Electricity as Fuel	**Fail**	Pass	**Fail**	Pass	**Fail**	Pass	Pass[1]

Based on this analysis, the study recommends mass promotion of biomass stoves for rural households (improved installed household wood stove & mobile improved charcoal stove) that are highly efficient in maximizing use of fuel and ultimately reduce on deforestation. The study recommends all the 4 technologies i.e. improved installed household wood stove, mobile improved charcoal stove, LPG Stove /LPG Fuel, Electric Stove /Electricity as Fuel since they all pass the 5 criteria. The protocols for manufacturing these stoves are attached as annex A.

5.1.2 Recommended Cooking Technologies for Institutions

The same criteria (accessibility, availability, affordability and performance) was used to make a recommendation for institutional stoves that have the potential to significantly reduce deforestation in Uganda due to their efficiency in maximising power but at the same time have higher chances of being adopted. The recommendation too is based on accept/reject or pass & fail basis. The results are presented as follows;

[1] Passes just because it is a clean fuel. However its performance is lower compared to biomass stoves and LPG

Improved Technology	**Decision Criteria**			
	Accessibility	**Availability of fuels**	**Affordability**	**Performance**
Improved Installed institutional wood stove	Pass	Pass	Pass	Pass
Mobile Improved Charcoal stoves (size 4 to 8)	Pass	Pass	Pass	Pass
Institutional LPG Stove	Pass	Pass	Pass	Pass
Institutional Electric Stove	Pass	Pass	Pass	Pass [2]

Based on this analysis, the study recommends mass promotion of biomass stoves for institutions (improved installed institutional wood stove & mobile improved charcoal stove size 4 to 8) and clean fuel stoves i.e. LPG stove electric stove. These recommended stoves have high efficiency in maximizing use of fuel and ultimately reduce on deforestation. The protocols for manufacturing these stoves are attached as annex B.

5.2 An Analysis of Switching Costs to Cleaner Fuels and Improved Technologies

In order to analyse the likely hood of institutions and households switching from traditional to improved cooking technologies, the study conducted an analysis based on the identified switching costs. The switching costs identified include; Capital investment to acquire a new device or ventilation system, maintenance and operational costs, money costs of acquiring the fuel, learning costs of using the new technology, and time costs incurred while preparing and acquiring the new device. This is against the benefits of 1) Time saving 2) Health benefits 3) Fuel Saving 4) improved forest ecosystems and 5) Reduced carbon emissions. Based on a scale of very low, low, moderate, high and very high the results are presented in the table as follows;

[2] Passes just because it is a clean fuel. However its performance is lower compared to biomass stoves and LPG

Improved Technology	Capital Investment	Maintenance/Operational Costs	Money Costs of acquiring Fuel	Time and Learning Costs
		Household		
Improved Installed Household Wood Stove (IHWS)	High: Costs on average 200,000 to install the (IHWS) [3]	Moderate: Requires regular maintenance bi-annually or annually depending on the user	Low: Cost of acquiring wood is low can be purchased in small quantities and is available	Very Low: Functionality is as simple as traditional stoves already known
Mobile improved charcoal Stove (size 1,2 &3)	Moderate cost: Size 2 which is most common ranges between 20,00 to 50,000 depending on the market[4]	Have no maintenance costs	Low: Cost of acquiring charcoal is low can be purchased in small quantities and is available	Very Low: Functionality is as simple as traditional stoves already known
LPG Stove	High: The cost of LPG Cylinder and Stove is high ranges between 200,000 to 500,000 Uganda shillings[5]	Has no maintenance costs	High: The cost of refilling a gas cylinder is high. Ranges between 50 to 200,000[6]	High: Especially given the fact that the public perceive it to have a danger of burning the house
Electric Stove	Moderate: the cost of purchasing an electric stove/hot plate is moderate. Depends on size and functionality. Can get as low as	Moderate: To repair the switches, fuses, plugs, thermostat etc.	Very High: The cost of installing electricity is very high for new users switching to it. However, those	High: Especially given the fact that the public perceive it be dangerous

[3] Costs between 50,00 to 100,000 for labor and expertise and average of 50,000 to 100,000 for materials i.e. mud, bricks, stones and cement

[4] For instance smart home costs 30,000 and Ugastove costs 25,000 in Major outlet towns in Uganda. However in Wandegeya and Nakasero Markets the same stoves cost 45,000 Uganda shillings.

[5] A 13 kg cylinder (Oryx) with LPG costs 300,000 Uganda shillings at retail price. The stove costs with two cooking points (muni brand) costs 150,000 Uganda shillings

[6] The cost of refilling a 13 kg cylinder for total is 118000 at retail outlets

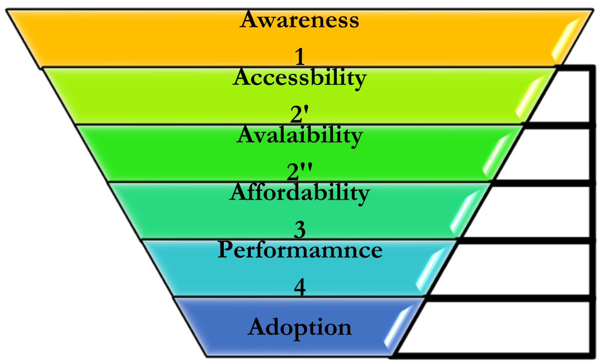
Improved Technology	Capital Investment	Maintenance/Operational Costs	Money Costs of acquiring Fuel	Time and Learning Costs
	30,000 and can get as high as 2,000,000.[7]		already installed the cost of purchasing power units is very low since any money can purchase units	
Institutions				
Improved Installed institutional wood stove	Moderate: Institutions that have their business depend on cooking (hotels, schools and bakeries) consider the cost as moderate. It costs between 500,000 to 5,000,000 depending on size and materials used[8]	Moderate: Requires regular maintenance bi-annually or annually depending on the user	Low: Cost of acquiring wood is low can be purchased in small quantities and is available	Very Low: Functionality is as simple as traditional stoves already known
Mobile Improved Charcoal stoves (size 4 to 8)	Low: Size 5 which is most common (in hotels & schools) costs between 200,000 to 500,000 depending on the market	Have no maintenance costs	Low: Cost of acquiring charcoal is low can be purchased in small quantities and is available	Very Low: Functionality is as simple as traditional stoves already known
Institutional LPG Stove	High: The cost of LPG Cylinder and Stove is high ranges between 500,000 to	Have no maintenance costs	The cost of refilling a gas cylinder is high.	High: Especially given the fact that the public perceive it to have a danger of

[7] A two cooking pot electric stove of a Philips brand costs 160,000 Uganda shillings in an electric appliances shop in Mbarara town
[8] It costs 1000,000 in labour and expertise and approximately 1,500,000 in materials to build a medium 4 cook pots in a school

Improved Technology	**Capital Investment**	**Maintenance/Operational Costs**	**Money Costs of acquiring Fuel**	**Time and Learning Costs**
	10,000,000 Uganda shillings			burning the house
Institutional Electric Stove	High: Moderate: the cost of purchasing an institutional electric stove is high.	Moderate: To repair the switches, fuses, plugs, thermostat etc.	High: The cost of installing electricity is very high for new users switching to it. However, those already installed the cost of purchasing power units is very low since any money can purchase units	High: Requires training to use the stove.

5.3 Decision Ladder for Uptake of Renewable Energy Fuels and Technologies

Based on the findings of the study, we unleash a decision criteria based on the 5 parameters of awareness, accessibility, availability, affordability, and performance. The figure below demonstrates the hierarchy of decision steps that households and institutions follow in making a decision to adopt a clean fuel and or an improved technology. The figure also demonstrates the rate at which households and institutions drop off as the go higher of the decision ladder. The shape of the figure shows that many households and institutions can get messages about clean fuels and technologies but drop off as they go higher the ladder and a few adopt.



The decision points considered at each stage of the decision ladder include the following;

Awareness: What is considered at this level is 1) Awareness of the advantages and disadvantages of the available fuels and technologies. 2) Awareness of the health benefits and dangers of available fuels and technologies. This determines whether an institution or household will move to the next level on the decision ladder

Accessibility: What is considered at this level is 1) Source of the fuel or device (market, nearby shop, private/public, main grid etc.) 2) distance from the supplier/shop or device outlet. The institution or household is concerned with the ease/flexibility with which it can get a refill of the fuel or can get a replacement or repair of the device without incurring additional costs from the cost of refill or purchase.

Availability: What is key at this level is 1) consistency of the supply of the fuel or the device/technology and 2) the reliability of the supplier or the fuel or device in terms of quality, uniformity and meeting physical characteristic requirements.

Affordability: What is key at this level is the 1) prices of fuel/devices 2) operation and maintenance costs of the devices and fuels, 3) distance and associated costs and 4) cost drivers of fuel and devices e.g. policy, inflation etc. The household/institution is concerned with installation costs/initial purchase costs as well as regular costs of refilling the fuel. The decision whether the switching costs are within the acceptable range according to the decision maker.

Performance: What is key at this level is 1) the anticipated fuel saving for the improved stove 2) the anticipated time saving while cooking the food at home and at the institution 3) the ease to ignite the fuel and the stove 4) other attributes such as cleanliness of the fuel/device, emissions and additional benefits of using the stove or fuel. It is at this level that the household will decide to adopt the fuel/device or reject it.

Adoption: the household/institution will adopt the technology based on the available information concerning availability, accessibility, affordability and performance of the device as explained above. It is therefore important that any promotion of clean fuels or improved technologies should focus first on making the fuels and devices accessible, available whenever needed, are priced well and perform better than the existing fuels and technologies if the objective is to achieve sustainable use.

NB: The decision criteria is based on findings from this study and therefore the use of the same should put in consideration the context of the study.

5.3 Conclusions

Though the criteria of awareness, accessibility, availability, affordability and performance are key points to consider for any intervention that promotes improved and clean cooking technologies and fuels, it is important to take note of the social economic and cultural factors that actually shape people's attitudes towards the fuels and technologies.

Given the fact that the average percentage difference in fuel efficiency/saving between using traditional stoves vis-à-vis the improved stoves is 51.12, it is key to note that the adoption of the improved stoves and clean fuels have a potential to reduce the rate of deforestation that is caused by a search for firewood by 51.12 percent. This is a significant reduction and thus any interventions to channel fuel consumption for cooking towards this direction would be a great asset to the country.

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C. List of Tables Showing Data Disaggregated by Rural/Urban,

Table 1: Awareness of Fuels

		Institutions	Households*		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
Awareness of renewable energy/ fuels					
Fuel types aware of	Briquettes	50.0	18.9	25.8	33.3
	Charcoal	97.8	95.1	97.2	96.2
	Firewood	84.8	86.9	91.6	89.4
	Biogas	75.0	47.5	71.1	60.2
	Biodiesel	5.5	0.8	4.2	2.7
	Bioethanol	4.4	1.6	4.2	3.0
	Hydropower Electricity	72.8	41.8	64.8	54.2
	Solar power	64.1	30.3	47.2	39.4
	Wind energy	10.9	2.5	5.6	4.2
	Geothermal	8.7	1.6	2.8	2.3
	Oil& its Products	17.4	2.5	18.3	11.0
	Wood	16.3	5.7	16.2	11.4
	Other	6.5	1.6	1.4	1.5
Awareness of health hazards*	Clean air	73.3	50.6	54.8	52.0
	Reduced deforestation	57.1	53.0	54.8	53.6
	Modifications in the microclimate	25.7	9.6	4.8	8.0
	Clean water	38.1	3.6	38.1	15.2
	Improved soil fertility	22.9	7.2	21.4	12.0
	Improved ecosystem health	36.2	2.4	16.7	7.2
	Reduced kitchen smokiness	67.6	32.5	59.5	41.6
	Other	9.5	22.9	7.1	17.6
Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households					

Table 2: Awareness of technologies

		Institutions	Households*		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
Aware					
Awareness of technologies	Installed Improved cooking stoves	91.7	91.2	95.4	93.4
h*	Installed bio-digesters	34.5	23.0	42.6	33.5
	Installed Modern baking ovens	70.2	14.2	37.2	26.5

	Installed Insulations that minimize loss	10.7	0.9	3.9	2.5
	Other	1.2	4.4	1.6	2.9
Awareness of benefits of improved technologies	Improved kitchen ventilation	66.7	32.6	57.8	44.9
i* h*	Improved air quality	65.7	38.3	57.0	47.5
	Reduced wood consumption	50.5	41.1	61.5	51.1
	Reduced charcoal consumption	61.9	25.5	63.0	43.8
	Reduced cooking time	64.8	36.9	63.0	49.6
	Other	8.6	16.3	6.7	11.6
Awareness of dangers of traditional stoves	It is dangerous to my health	80.0	59.6	68.9	64.1
	Causes environmental risks	59.1	38.3	57.8	47.8
h*	Increases air pollution	64.8	38.3	52.6	45.3
	Time consuming	64.8	24.8	60.7	42.4
	Use a lot of fuel	47.6	18.4	48.2	33.0
	Other	6.7	16.3	6.7	11.6
Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households					

ACCESSIBILITY					
		Institutions	**Households**		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
Access to electricity					
Type of Electricity	Solar	14.5	0.0	18.3	18.1
	Hydro power electricity	87.7	100.0	99.0	99.1
i*	Biogas powered lights	0.4	0.0	1.0	1.0
	Other	0.9	0.0	5.8	5.7
Uses hydro power for Cooking					
Average distance to nearest source of fuel					
Briquettes	**Fuels**				
	Nearest Trading Centre (with in 5 km ra)	1.0	3.7	7.8	5.6
	Big Town/District town (between 5 to 10 Km)	1.0	0.5	0.0	0.2
	City/Regional Town (Outside the district)	0.0	0.0	1.6	0.7
	Weekly Markets	1.9	1.4	0.5	1.0
	NA/ don't know	96.2	93.5	88.1	91.0
	Other		0.9	2.1	1.5

Charcoal					
h*	Nearest Trading Centre (with in 5 km ra)	47.6	24.1	63.7	42.8
	Big Town/District town (between 5 to 10 Km)	3.8	1.9	1.6	1.7
	City/Regional Town (Outside the district)	0.0	0.0	2.1	1.0
	Weekly Markets	6.7	37.5	15.5	27.1
	NA/ don't know	41.0	27.3	11.4	19.8
	Other	1.0	9.3	5.7	7.6
Firewood					
	Nearest Trading Centre (with in 5 km ra)	17.1	18.5	15.5	17.1
h*	Big Town/District town (between 5 to 10 Km)	5.7	2.8	2.1	2.4
	City/Regional Town (Outside the district)	1.0	0.5	1.0	0.7
	Weekly Markets	2.9	33.3	6.7	20.8
	NA/ don't know	72.4	19.9	63.2	40.3
	Other	1.0	25.0	11.4	18.6
Biodiesel					
	Nearest Trading Centre (with in 5 km ra)	0.0	0.9	1.6	1.2
	Big Town/District town (between 5 to 10 Km)	0.0	2.8	1.6	2.2
	City/Regional Town (Outside the district)	0.0	0.5	1.0	0.7
	Weekly Markets	0.0	2.3	1.0	1.7
	NA/ don't know	100.0	93.1	94.3	93.6
	Other	0.0	0.5	0.5	0.5
Bioethanol					
	Nearest Trading Centre (with in 5 km ra)	1.0	2.8	2.1	2.4
	Big Town/District town (between 5 to 10 Km)	0.0	2.3	2.1	2.2
	City/Regional Town (Outside the district)	0.0	0.5	1.0	0.7
	Weekly Markets	0.0	1.4	1.0	1.2
	NA/ don't know	99.0	93.1	93.8	93.4
	Other	0.0	0.0	0.0	0.0
Biogas					
	Nearest Trading Centre (with in 5 km ra)	1.9	6.5	4.2	5.4
	Big Town/District town (between 5 to 10 Km)	0.0	3.7	2.6	3.2

	City/Regional Town (Outside the district)	0.0	0.0	1.0	0.5
	Weekly Markets	1.0	1.4	0.0	0.7
	NA/ don't know	97.1	87.5	90.2	88.8
	Other	0.0	0.9	2.1	1.5
Electricity					
	Nearest Trading Centre (with in 5 km ra)	49.5	18.5	24.9	21.5
h*	Big Town/District town (between 5 to 10 Km)	0.0	4.6	1.6	3.2
	City/Regional Town (Outside the district)	0.0	2.3	2.1	2.2
	Weekly Markets	0.0	1.9	0.5	1.2
	NA/ don't know	33.3	67.1	57.5	62.6
	Other	17.1	5.6	13.5	9.3
Solar power					
	Nearest Trading Centre (with in 5 km ra)	5.7	17.1	4.7	11.3
h*	Big Town/District town (between 5 to 10 Km)	0.0	1.4	1.6	1.5
	City/Regional Town (Outside the district)	1.0	0.5	0.5	0.5
	Weekly Markets	1.0	2.8	1.6	2.2
	NA/ don't know	88.6	70.8	86.0	78.0
	Other	3.8	7.4	5.7	6.6
Wind energy					
	Nearest Trading Centre (with in 5 km ra)	0.0	1.4	1.0	1.2
	Big Town/District town (between 5 to 10 Km)	0.0	1.4	1.0	1.2
	City/Regional Town (Outside the district)	0.0	0.5	1.6	1.0
	Weekly Markets	1.0	1.9	1.6	1.7
	NA/ don't know	98.1	94.4	94.3	94.4
	Other	1.0	0.5	0.5	0.5
Geothermal					
	Nearest Trading Centre (with in 5 km ra)	0.0	0.5	0.5	0.5
l	Big Town/District town (between 5 to 10 Km)	0.0	0.5	0.5	0.5
	City/Regional Town (Outside the district)	1.9	0.0	1.6	0.7
	Weekly Markets	1.0	1.4	2.1	1.8
	NA/ don't know	97.1	97.7	95.3	96.6

	Other	0.0	0.0	0.0	0.0
LPG					
	Nearest Trading Centre (with in 5 km ra)	45.7	3.2	7.8	5.4
	Big Town/District town (between 5 to 10 Km)	1.9	0.9	4.2	2.4
	City/Regional Town (Outside the district)	0.0	0.9	1.0	1.0
	Weekly Markets	1.9	0.5	0.0	0.2
	NA/ don't know	44.8	90.7	85.0	88.0
	Other	5.7	3.7	2.1	2.9
Kerosene (Liters)					
	Nearest Trading Centre (with in 5 km ra)	3.8	8.3	4.7	6.6
h*	Big Town/District town (between 5 to 10 Km)	0.0	1.4	1.0	1.2
	City/Regional Town (Outside the district)	0.0	0.5	1.6	1.0
	Weekly Markets	1.0	13.0	4.7	9.1
	NA/ don't know	94.3	74.1	87.6	80.4
	Other	1.0	2.8	0.5	1.7
Oil & its Products					
	Nearest Trading Centre (with in 5 km ra)	1.0	2.8	1.6	2.2
	Big Town/District town (between 5 to 10 Km)	0.0	0.0	1.6	0.7
	City/Regional Town (Outside the district)	0.0	0.5	0.5	0.5
	Weekly Markets	1.9	1.9	2.1	2.0
	NA/ don't know	97.1	94.0	92.8	93.4
	Other Technologies	0.0	0.9	1.6	1.2
Kerosene stove					
	Nearest Trading Centre (with in 5 km ra)	0.0	10.2	5.2	7.8
h*	Big Town/District town (between 5 to 10 Km)	0.0	3.2	1.6	2.4
	City/Regional Town (Outside the district)	0.0	0.5	1.6	1.0
	Weekly Markets	1.0	11.6	4.7	8.3
	NA/ don't know	99.0	70.4	85.0	77.3
	Other	0.0	4.2	2.1	3.2
Charcoal stove					

h*	Nearest Trading Centre (with in 5 km ra)	25.7	10.2	40.4	24.5
	Big Town/District town (between 5 to 10 Km)	1.0	0.5	1.6	1.0
	City/Regional Town (Outside the district)	0.0	0.0	1.6	0.7
	Weekly Markets	4.8	25.0	5.2	15.7
	NA/ don't know	66.7	63.4	48.7	56.5
	Other	1.9	0.9	2.6	1.7
Installed Improved cooking stoves					
	Nearest Trading Centre (with in 5 km ra)	10.5	10.2	3.1	6.9
h*	Big Town/District town (between 5 to 10 Km)	6.7	1.9	2.6	2.2
	City/Regional Town (Outside the district)	4.8	1.4	1.0	1.2
	Weekly Markets	1.9	3.7	3.6	3.7
	NA/ don't know	69.5	81.0	84.5	82.6
	Other	6.7	1.9	5.2	3.4
Installed Institutional bio-digesters					
	Nearest Trading Centre (with in 5 km ra)	1.0	3.2	0.5	2.0
h*	Big Town/District town (between 5 to 10 Km)	0.0	1.4	3.1	2.2
	City/Regional Town (Outside the district)	0.0	0.0	1.6	0.7
	Weekly Markets	1.0	0.5	2.1	1.2
	NA/ don't know	97.1	93.1	92.8	92.9
	Other	1.0	1.9	0.0	1.0
Installed Modern baking ovens					
	Nearest Trading Centre (with in 5 km ra)	7.6	1.4	1.6	1.5
	Big Town/District town (between 5 to 10 Km)	3.8	2.3	0.0	1.2
	City/Regional Town (Outside the district)	3.8	1.4	1.6	1.5
	Weekly Markets	2.9	0.9	1.0	1.0
	NA/ don't know	72.4	92.6	95.3	93.9
	Other	9.5	1.4	0.5	1.0
Installed Insulations that minimize loss					
	Nearest Trading Centre (with in 5 km ra)	0.0	2.3	1.0	1.7
	Big Town/District town (between 5 to 10 Km)	0.0	0.0	0.5	0.2

	City/Regional Town (Outside the district)	0.0	0.0	1.0	0.5
	Weekly Markets	1.0	0.5	2.6	1.5
	NA/ don't know	99.0	96.8	94.8	95.8
	Other	0.0	0.5	0.0	0.2
Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households					

ADOPTION OF FUELS					
		Institution	**Households**		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
Fuels	Briquettes	3.8	0.5	4.7	2.4
	Charcoal	61.0	58.3	89.6	73.1
	Firewood	25.7	74.5	26.4	51.8
	Biogas	1.9	1.9	0.0	1.0
	Electricity	68.6	0.5	16.6	8.1
	Solar power	3.8	0.5	0.5	0.5
	LPG	61.9	0.9	13.5	6.9
	Kerosene	1.9	0.0	6.7	3.2
	Other	1.9	0.0	0.5	0.2
Source of fuels	Private wood lot	2.9	14.4	4.7	9.8
	Charcoal/Firewood bought from market	77.1	77.8	92.2	84.6
	Main grid	40.0	1.9	11.4	6.4
	Micro grid	12.4	0.0	1.6	0.7
	Solar roof harvest	1.9	0.0	0.5	0.2
	Other	29.5	20.4	9.8	15.4

ADOPTION OF TECHNOLOGIES					
		Institutions	**Households**		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
Stoves used	Improved Charcoal stove	6.7	3.2	11.9	7.3
	Traditional mud/clay charcoal stove	39.1	0.0	5.2	2.4
	Electric Stove	41.9	45.4	85.0	64.1
	Installed Improved cooking stoves	33.3	0.5	8.8	4.4
	Improved cook stove with chimney	15.2	4.2	7.3	5.6
	Installed bio-digesters	1.0	0.0	1.6	0.7
	Installed Modern baking ovens	23.1	0.9	0.0	0.5
	Traditional three-stone stove	7.7	68.5	10.4	41.1

AVAILABILITY					
		Institutions	Households		
Aspect	Category	Overall	Rural	Urban	Overall
Has access to all fuels needed					
Distance to the market					
Briquettes					
	Nearest Trading Centre	1.0	3.7	7.8	5.6
	Big Town/District tow	1.0	0.5	0.0	0.2
	City/Regional Town (O	0.0	0.0	1.6	0.7
	Weekly Markets	1.9	1.4	0.5	1.0
	NA/ don't know	96.2	93.4	88.1	91.0
	Other	0.0	0.9	2.1	1.5
Charcoal					
	Nearest Trading Centre	47.6	24.1	63.7	42.8
h*	Big Town/District tow	3.8	1.9	1.6	1.7
	City/Regional Town (O	0.0	0.0	2.1	1.0
	Weekly Markets	6.7	37.5	15.5	27.1
	NA/ don't know	41.0	27.3	11.4	19.8
	Other	1.0	9.3	5.7	7.6
Firewood					
h*	Nearest Trading Centre	17.1	18.5	15.5	17.1
	Big Town/District tow	5.7	2.8	2.1	2.4
	City/Regional Town (O	1.0	0.5	1.0	0.7
	Weekly Markets	2.9	33.3	6.7	20.8
	NA/ don't know	72.4	19.9	63.2	40.3
	Other	1.0	25.0	11.4	18.6
Biodiesel					
	Nearest Trading Centre	0.0	0.9	1.6	1.2
	Big Town/District tow	0.0	2.8	1.6	2.2
	City/Regional Town (O	0.0	0.5	1.0	0.7
	Weekly Markets	0.0	2.3	1.0	1.7
	NA/ don't know	100.0	93.1	94.3	93.6
	Other	0.0	0.5	0.5	0.5
Bioethanol					
	Nearest Trading Centre	1.0	2.8	2.1	2.4
	Big Town/District tow	0.0	2.3	2.1	2.2
	City/Regional Town (O	0.0	0.5	1.0	0.7
	Weekly Markets	0.0	1.4	1.0	1.2
	NA/ don't know	99.0	93.1	93.8	93.4
	Other	0.0	0.0	0.0	0.0

Biogas					
	Nearest Trading Centre	1.9	6.5	4.2	5.4
	Big Town/District tow	0.0	3.7	2.6	3.2
	City/Regional Town (O	0.0	0.0	1.0	0.5
	Weekly Markets	1.0	1.4	0.0	0.7
	NA/ don't know	97.1	87.5	90.2	88.8
	Other	0.0	0.9	2.1	1.5
Electricity					
	Nearest Trading Centre	49.5	18.5	24.9	21.5
h*	Big Town/District tow	0.0	4.6	1.6	3.2
	City/Regional Town (O	0.0	2.3	2.1	2.2
	Weekly Markets	0.0	1.9	0.5	1.2
	NA/ don't know	33.3	67.1	57.5	62.6
	Other	17.1	5.6	13.5	9.3
Solar power					
	Nearest Trading Centre	5.7	17.1	4.7	11.3
	Big Town/District tow	0.0	1.4	1.6	1.5
	City/Regional Town (O	1.0	0.5	0.5	0.5
	Weekly Markets	1.0	2.8	1.6	2.2
	NA/ don't know	88.6	70.8	86.0	78.0
	Other	3.8	7.4	5.7	6.6
Wind energy					
	Nearest Trading Centre	0.0	1.4	1.0	1.2
	Big Town/District tow	0.0	1.4	1.0	1.2
	City/Regional Town (O	0.0	0.5	1.6	1.0
	Weekly Markets	1.0	1.9	1.6	1.7
	NA/ don't know	98.1	94.4	94.3	94.4
	Other	1.0	0.5	0.5	0.5
Geothermal					
	Nearest Trading Centre	0.0	0.5	0.5	0.5
	Big Town/District tow	0.0	0.5	0.5	0.5
	City/Regional Town (O	1.9	0.0	1.6	0.7
	Weekly Markets	1.0	1.4	2.1	1.7
	NA/ don't know	97.1	97.7	95.3	96.6
	Other	0.0	0.0	0.0	0.0
LPG					
	Nearest Trading Centre	45.7	3.2	7.8	5.4
	Big Town/District tow	1.9	0.9	4.2	2.4
	City/Regional Town (O	0.0	0.9	1.0	1.0
	Weekly Markets	1.9	0.5	0.0	0.2
	NA/ don't know	44.8	90.7	85.0	88.0

	Other	5.7	3.7	2.1	2.9
Kerosene (Liters)					
	Nearest Trading Centre	3.8	8.3	4.7	6.6
h*	Big Town/District tow	0.0	1.4	1.0	1.2
	City/Regional Town (O	0.0	0.5	1.6	1.0
	Weekly Markets	1.0	13.0	4.7	9.1
	NA/ don't know	94.3	74.1	87.6	80.4
	Other	1.0	2.8	0.5	1.7
Oil & its Products					
	Nearest Trading Centre	1.0	2.8	1.6	2.2
	Big Town/District tow	0.0	0.0	1.6	0.7
	City/Regional Town (O	0.0	0.5	0.5	0.5
	Weekly Markets	1.9	1.9	2.1	2.0
	NA/ don't know	97.1	94.0	92.8	93.4
	Other	0.0	0.9	1.6	1.2
Kerosene stove					
	Nearest Trading Centre	0.0	10.2	5.2	7.8
h*	Big Town/District tow	0.0	3.2	1.6	2.4
	City/Regional Town (O	0.0	0.5	1.6	1.0
	Weekly Markets	1.0	11.6	4.7	8.3
	NA/ don't know	99.0	70.4	85.0	77.3
	Other	0.0	4.2	2.1	3.2
Charcoal stove					
	Nearest Trading Centre	25.7	10.2	40.4	24.5
h*	Big Town/District tow	1.0	0.5	1.6	1.0
	City/Regional Town (O	0.0	0.0	1.6	0.7
	Weekly Markets	4.8	25.0	5.2	15.7
	NA/ don't know	66.7	63.4	48.7	56.5
	Other	1.9	0.9	2.6	1.7
Installed Improved					
cooking stoves	Nearest Trading Centre	10.5	10.2	3.1	6.9
h*	Big Town/District tow	6.7	1.9	2.6	2.2
	City/Regional Town (O	4.8	1.4	1.0	1.2
	Weekly Markets	1.9	3.7	3.6	3.7
	NA/ don't know	69.5	81.0	84.5	82.6
	Other	6.7	1.9	5.2	3.4
Installed Institutional bio-					
digesters	Nearest Trading Centre	1.0	3.2	0.5	2.0
h*	Big Town/District tow	0.0	1.4	3.1	2.2
	City/Regional Town (O	0.0	0.0	1.6	0.7
	Weekly Markets	1.0	0.5	2.1	1.2

	NA/ don't know	97.1	93.1	92.8	92.9
	Other	1.0	1.9	0.0	1.0
Installed Modern baking ovens					
	Nearest Trading Centre	7.6	1.4	1.6	1.5
	Big Town/District tow	3.8	2.3	0.0	1.2
	City/Regional Town (O	3.8	1.4	1.6	1.5
	Weekly Markets	2.9	0.9	1.0	1.0
	NA/ don't know	72.4	92.6	95.3	93.9
	Other	9.5	1.4	0.5	1.0
Installed Insulations that minimize loss					
	Nearest Trading Centre	0.0	2.3	1.0	1.7
	Big Town/District tow	0.0	0.0	0.5	0.2
	City/Regional Town (O	0.0	0.0	1.0	0.5
	Weekly Markets	1.0	0.5	2.6	1.5
	NA/ don't know	99.0	96.8	94.8	95.8
	Other	0.0	0.5	0.0	0.2
feeling about the unit prices	Prices are ok	27.6	41.2	36.3	38.9
h*	Prices are slightly expensive	21.9	25.9	29.5	27.6
	They are expensive	25.7	17.1	22.3	19.6
	They are very expensive	18.1	4.6	10.4	7.3
	Other	6.7	11.1	1.6	6.6
How often they refill					
Firewood	Once a Months	16.2	41.2	28.0	35.0
	Bi-Monthly	4.8	6.5	5.2	5.9
h*	Weekly	1.9	29.6	10.4	20.5
	Everyday	28.6	22.7	56.5	38.6
	Not applicable	48.6	0.0	0.0	0.0
Charcoal	Once a Months	36.2	53.2	62.7	57.7
	Bi-Monthly	9.5	5.6	9.8	7.6
	Weekly	7.6	14.4	10.9	12.7
	Everyday	18.1	26.9	16.6	22.0
	Not applicable	28.6	0.0	0.0	0.0
Hydropower Electricity	Once a Months	59.1	51.9	55.4	53.6
	Bi-Monthly	6.7	18.1	2.1	10.5
h*	Weekly	2.9	6.0	8.8	7.3
	Everyday	11.4	24.1	33.7	28.6
	Not applicable	20.0	0.0	0.0	0.0
Solar power	Once a Months	5.7	44.9	16.6	31.5
	Bi-Monthly	1.0	22.7	4.7	14.2

h*	Weekly	31.4	6.0	5.7	5.9
i*	Everyday	61.9	26.4	73.1	48.4
	Not applicable	0.0	0.0	0.0	0.0
Wind energy	Once a Months	6.7	43.1	15.5	30.1
	Bi-Monthly	1.0	25.0	5.2	15.7
h*	Weekly	28.6	5.1	4.7	4.9
i*	Everyday	63.8	26.9	74.6	49.4
	Not applicable	0.0	0.0	0.0	0.0
Geothermal	Once a Months	5.7	44.4	15.5	30.8
	Bi-Monthly	1.0	22.2	4.7	13.9
	Weekly	28.6	5.6	5.7	5.6
	Everyday	64.8	27.8	74.1	49.6
	Not applicable	0.0	0.0	0.0	0.0
LPG	Once a Months	45.7	44.0	24.9	35.0
	Bi-Monthly	6.7	24.1	5.2	15.2
h*	Weekly	4.8	5.1	4.2	4.7
	Everyday	14.3	26.9	65.8	45.2
	Not applicable	28.6	0.0	0.0	0.0
Kerosene	Once a Months	6.7	48.2	20.7	35.2
i*	Bi-Monthly	1.9	20.4	4.2	12.7
h*	Weekly	28.6	6.5	5.7	6.1
	Everyday	62.9	25.0	69.4	46.0
	Not applicable	0.0	0.0	0.0	0.0
How easy it is to get a refill	Once a Months	21.0	44.9	30.1	37.9
h*	Bi-Monthly	0.0	22.2	5.2	14.2
	Weekly	2.9	6.5	6.7	6.6
	Everyday	32.4	26.4	58.0	41.3
	Not applicable	43.8	0.0	0.0	0.0
Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households					

AFFORDABILITY					
		Institutions	**Households**		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
Costs of installation					
Perceptions about cost of maintenance	It is very costly to maintain	19.1	11.1	19.2	14.9
i*	It is costly to maintain	36.2	13.9	21.8	17.6
h*	It is not costly to maintain	29.5	22.2	25.4	23.7

	It is somewhat costly to maintain	13.3	3.7	17.1	10.0
	NA	8.6	0.0	0.0	0.0
	Other	13.3	50.9	29.0	40.6
Maintenance cost items	Insulation	14.3	13.9	7.8	11.0
h*	Sealing cracks	23.8	27.3	16.6	22.3
	Replacing metallic rods	23.8	1.4	8.3	4.7
	Labor costs for regular maintenance	31.8	4.2	24.9	13.9
	Other	27.6	61.1	52.3	57.0
Challenges faced in utilization	They take long to heat up	8.6	8.3	20.7	14.2
h*	Make half cooked food	3.8	0.5	1.0	0.7
	Highly smoky	20.0	11.1	10.4	10.8
	Costly to purchase	51.4	23.2	47.2	34.5
	Costly to maintain	58.1	13.4	43.0	27.4
	Unreliable supply	19.1	2.8	11.4	6.9
	Changing market prices of the stoves	13.3	1.9	21.8	11.3
	Other	15.2	53.7	26.9	41.1
Perceptions about cost of maintenance	It is very costly to maintain	19.1	11.1	19.2	14.9
	It is costly to maintain	36.2	13.9	21.8	17.6
	It is not costly to maintain	29.5	22.2	25.4	23.7
	It is somewhat costly to maintain	13.3	3.7	17.1	10.0
	Other	13.3	50.9	29.0	40.6

PERFORMANCE					
Motivations for using device/fuel					
		Institutions	**Households**		
Aspect	**Category**	**Overall**	**Rural**	**Urban**	**Overall**
aware about some of the health and environmental benefits of improved cooking technologies (**i*h*)**	Improved kitchen ventilation	66.7	32.6	57.8	44.9
	Improved air quality	65.7	38.3	57.0	47.5
	Reduced wood consumption	50.5	41.1	61.5	51.1
	Reduced charcoal consumption	61.9	25.5	63.0	43.8
	Reduced cooking time	64.8	36.9	63.0	49.6
	Other	8.6	16.3	6.7	11.6
	It is dangerous to my health	80.0	59.6	68.9	64.1

aware about the dangers/risks of using traditional cooking technologies (**h*)**	Causes environmental risks	59.1	38.3	57.8	47.8
	Increases air pollution	64.8	38.3	52.6	45.3
	Time consuming	64.8	24.8	60.7	42.4
	Use a lot of fuel	47.6	18.4	48.2	33.0
	Other	6.7	16.3	6.7	11.6
Level of satisfaction derived from the fuel/devices in use		95.2	84.3	88.1	86.1
Level of satisfaction with devices used					
Briquettes	Somewhat satisfied	25.0	100.0	0.0	10.0
	Satisfied	25.0	0.0	55.6	50.0
	Very satisfied	25.0	0.0	44.4	40.0
	Don't want to answer	25.0	0.0	0.0	0.0
Charcoal h*	Somewhat satisfied	7.8	2.4	5.2	4.0
	Satisfied	26.6	11.9	19.1	16.1
	Very satisfied	34.4	54.8	38.2	45.2
	Don't want to answer	31.3	31.0	37.6	34.8
Firewood	Somewhat satisfied	11.1	5.6	13.7	7.6
	Satisfied	22.2	37.3	23.5	34.0
	Very satisfied	33.3	22.4	27.5	23.6
	Don't want to answer	29.6	34.8	35.3	34.9
Biodiesel	Somewhat satisfied				
	Satisfied				
	Very satisfied				
	Don't want to answer				
Bioethanol	Somewhat satisfied				
	Satisfied				
	Very satisfied				
	Don't want to answer				
Biogas	Somewhat satisfied	0.0	25.0	0.0	25.0
	Satisfied	0.0	25.0	0.0	25.0
	Very satisfied	100.0	50.0	0.0	50.0
	Don't want to answer	0.0	0.0	0.0	0.0
Electricity	Somewhat satisfied	8.3	0.0	31.3	30.3
	Satisfied	22.2	100.0	18.8	21.2
	Very satisfied	47.2	0.0	21.9	21.2
	Don't want to answer	22.2	0.0	28.1	27.3
Solar power	Somewhat satisfied	50.0	100.0	0.0	50.0
	Satisfied	50.0	0.0	100.0	50.0
	Very satisfied	0.0	0.0	0.0	0.0
	Don't want to answer	0.0	0.0	0.0	0.0

Wind energy	Somewhat satisfied				
	Satisfied				
	Very satisfied				
	Don't want to answer				
Geothermal	Somewhat satisfied				
	Satisfied				
	Very satisfied				
	Don't want to answer				
LPG	Somewhat satisfied	12.3	0.0	3.9	3.6
	Satisfied	29.2	50.0	3.9	7.1
	Very satisfied	58.5	50.0	42.3	42.9
	Don't want to answer	0.0	0.0	50.0	46.4
Kerosene	Somewhat satisfied	0.0	0.0	7.7	7.7
	Satisfied	0.0	0.0	30.8	30.8
	Very satisfied	50.0	0.0	46.2	46.2
	Don't want to answer	50.0	0.0	15.4	15.4
Oil & its Products	Somewhat satisfied				
	Satisfied				
	Very satisfied				
	Don't want to answer				
Other	Somewhat satisfied	50	0.0	100.0	100.0
	Satisfied	0.0	0.0	0.0	0.0
	Very satisfied	0.0	0.0	0.0	0.0
	Don't want to answer	50.0	0.0	0.0	0.0

Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households

		Institutions				Households			
statement on attitudes	**Fuel**	**Agree**	**Neutral**	**Disagree**	**Overall**	**Agree**	**Neutral**	**Disagree**	**Over all**
Household's need to adopt energy efficiency fuels and technologies is urgent	Briquettes	3.2	11.1	0.0	3.8	2.8	1.5	0.0	2.4
	Charcoal	62.1	44.4	100.0	61.0	74.5	69.7	61.1	73.1
	Firewood	26.3	22.2	0.0	25.7	48.9	65.2	55.6	51.8
	Biogas	2.1	0.0	0.0	1.9	1.2	0.0	0.0	1.0
	Electricity	67.4	77.8	100.0	68.6	9.9	1.5	0.0	8.1
	Solar power	4.2	0.0	0.0	3.8	0.6	0.0	0.0	0.5
	LPG	63.2	44.4	100.0	61.9	8.3	1.5	0.0	6.9
	Kerosene	1.1	11.1	0.0	1.9	3.7	1.5	0.0	3.2
	Other	2.1	0.0	0.0	1.9	0.3	0.0	0.0	0.2
Improved cooking	Briquettes	4.0	0.0	0.0	3.8	3.0	0.0	0.0	2.4
	Charcoal	60.4	50.0	100.0	61.0	73.4	70.2	78.6	73.1

technologies are better than traditional cooking stoves	Firewood	24.8	100.0	0.0	25.7	51.8	54.4	42.9	51.8
	Biogas	2.0	0.0	0.0	1.9	1.2	0.0	0.0	1.0
	Electricity	70.3	0.0	50.0	68.6	9.2	3.5	0.0	8.1
	Solar power	4.0	0.0	0.0	3.8	0.6	0.0	0.0	0.5
	LPG	64.4	0.0	0.0	61.9	7.7	1.8	7.1	6.9
	Kerosene	2.0	0.0	0.0	1.9	3.3	1.8	7.1	3.2
	Other	2.0	0.0	0.0	1.9	0.3	0.0	0.0	0.2
Food prepared on improved cooking technologies is as good as food prepared using traditional cooking technologies	Briquettes	2.9	8.7	0.0	3.8	2.2	2.4	3.3	2.4
	Charcoal	55.7	65.2	83.3	61.0	73.8	69.1	78.7	73.1
	Firewood	21.4	43.5	16.7	25.7	49.3	57.7	49.2	51.8
	Biogas	1.4	4.4	0.0	1.9	1.3	0.8	0.0	1.0
	Electricity	72.9	47.8	83.3	68.6	6.2	10.6	9.8	8.1
	Solar power	4.3	0.0	8.3	3.8	0.4	0.0	1.6	0.5
	LPG	68.6	39.1	66.7	61.9	6.2	4.9	13.1	6.9
	Kerosene	2.9	0.0	0.0	1.9	1.8	5.7	3.3	3.2
	Other	2.9	0.0	0.0	1.9	0.4	0.0	0.0	0.2
It is dangerous to my health and the environment to use traditional cooking technologies for a very long time	Briquettes	4.4	0.0	0.0	3.8	3.0	1.1	0.0	2.4
	Charcoal	62.0	45.5	100.0	61.0	74.0	68.1	83.3	73.1
	Firewood	26.1	27.3	0.0	25.7	50.7	58.2	38.9	51.8
	Biogas	2.2	0.0	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	68.5	63.6	100.0	68.6	7.7	5.5	27.8	8.1
	Solar power	3.3	0.0	50.0	3.8	0.7	0.0	0.0	0.5
	LPG	64.1	36.4	100.0	61.9	7.3	4.4	11.1	6.9
	Kerosene	2.2	0.0	0.0	1.9	2.7	4.4	5.6	3.2
	Other	2.2	0.0	0.0	1.9	0.3	0.0	0.0	0.2
I will adopt clean cooking technologies even when no one in my circles/peers use the improved cooking stove	Briquettes	4.8	0.0	0.0	3.8	2.5	2.5	0.0	2.4
	Charcoal	57.1	80.0	66.7	61.0	72.7	72.8	84.6	73.1
	Firewood	28.6	13.3	16.7	25.7	53.0	49.4	38.5	51.8
	Biogas	2.4	0.0	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	66.7	73.3	83.3	68.6	9.2	4.9	0.0	8.1
	Solar power	4.8	0.0	0.0	3.8	0.6	0.0	0.0	0.5
	LPG	64.3	46.7	66.7	61.9	7.0	3.7	23.1	6.9
	Kerosene	2.4	0.0	0.0	1.9	3.2	2.5	7.7	3.2
	Other	2.4	0.0	0.0	1.9	0.3	0.0	0.0	0.2
Renewable fuels are readily available in my community	Briquettes	6.2	0.0	0.0	3.8	2.8	3.5	0.0	2.4
	Charcoal	61.5	58.1	66.7	61.0	72.3	81.4	63.9	73.1
	Firewood	24.6	29.0	22.2	25.7	52.1	40.7	66.3	51.8
	Biogas	3.1	0.0	0.0	1.9	0.5	1.8	1.2	1.0
	Electricity	75.4	58.1	55.6	68.6	8.5	8.0	7.2	8.1

	Solar power	6.2	0.0	0.0	3.8	0.9	0.0	0.0	0.5
	LPG	63.1	61.3	55.6	61.9	9.9	4.4	2.4	6.9
	Kerosene	3.1	0.0	0.0	1.9	3.8	4.4	0.0	3.2
	Other	1.5	3.2	0.0	1.9	0.5	0.0	0.0	0.2
Our community has the necessary expertize to construct, operate and maintain renewable energy fuels and technologies	Briquettes	7.3	0.0	0.0	3.8	3.6	2.5	0.0	2.4
	Charcoal	58.2	59.0	81.8	61.0	75.0	77.9	59.0	73.1
	Firewood	30.9	20.5	18.2	25.7	49.4	48.5	64.1	51.8
	Biogas	3.6	0.0	0.0	1.9	1.8	0.0	1.3	1.0
	Electricity	72.7	64.1	63.6	68.6	6.6	9.2	9.0	8.1
	Solar power	5.5	2.6	0.0	3.8	0.0	1.2	0.0	0.5
	LPG	58.2	66.7	63.6	61.9	6.0	7.4	7.7	6.9
	Kerosene	3.6	0.0	0.0	1.9	4.2	3.1	1.3	3.2
	Other	1.8	2.6	0.0	1.9	0.6	0.0	0.0	0.2
Existing political, institutional, cultural and policy factors affecting the renewable energy technology products are favorable.	Briquettes	2.0	5.4	5.3	3.8	3.1	2.0	0.0	2.4
	Charcoal	55.1	54.1	89.5	61.0	74.6	72.1	67.7	73.1
	Firewood	30.6	27.0	10.5	25.7	48.3	55.8	58.8	51.8
	Biogas	2.0	2.7	0.0	1.9	1.3	0.7	0.0	1.0
	Electricity	65.3	73.0	68.4	68.6	9.2	4.1	17.7	8.1
	Solar power	6.1	2.7	0.0	3.8	0.0	0.7	2.9	0.5
	LPG	57.1	62.2	73.7	61.9	5.7	6.8	14.7	6.9
	Kerosene	2.0	0.0	5.3	1.9	3.1	3.4	2.9	3.2
	Other	0.0	5.4	0.0	1.9	0.4	0.0	0.0	0.2
We have access to improved energy efficient cook stoves at our household	Briquettes	1.5	11.1	5.3	3.8	2.4	2.8	2.3	2.4
	Charcoal	57.4	61.1	73.7	61.0	73.4	80.4	66.9	73.1
	Firewood	26.5	11.1	36.8	25.7	46.8	49.5	60.2	51.8
	Biogas	1.5	5.6	0.0	1.9	2.4	0.0	0.0	1.0
	Electricity	72.1	72.2	52.6	68.6	12.4	5.6	4.5	8.1
	Solar power	2.9	0.0	10.5	3.8	0.6	0.0	0.8	0.5
	LPG	61.8	72.2	52.6	61.9	10.7	2.8	5.3	6.9
	Kerosene	1.5	0.0	5.3	1.9	4.7	1.9	2.3	3.2
	Other	1.5	5.6	0.0	1.9	0.6	0.0	0.0	0.2
Renewable energy fuels and technology solutions present economic savings to our household	Briquettes	3.5	5.6	0.0	3.8	3.1	1.5	0.0	2.4
	Charcoal	62.4	55.6	50.0	61.0	74.0	75.7	33.3	73.1
	Firewood	25.9	27.8	0.0	25.7	48.8	54.4	80.0	51.8
	Biogas	1.2	5.6	0.0	1.9	1.2	0.7	0.0	1.0
	Electricity	69.4	66.7	50.0	68.6	9.3	5.2	13.3	8.1
	Solar power	3.5	5.6	0.0	3.8	0.4	0.7	0.0	0.5
	LPG	61.2	61.1	100.0	61.9	8.9	2.9	6.7	6.9

	Kerosene	2.4	0.0	0.0	1.9	3.5	2.9	0.0	3.2
	Other	1.2	5.6	0.0	1.9	0.4	0.0	0.0	0.2
Initial investment cost of most renewable energy fuels and technologies is a huge constrain	Briquettes	3.8	4.8	0.0	3.8	3.0	1.0	0.0	2.4
	Charcoal	57.5	71.4	75.0	61.0	72.6	72.5	100.0	73.1
	Firewood	28.8	14.3	25.0	25.7	51.8	55.1	12.5	51.8
	Biogas	1.3	4.8	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	65.0	76.2	100.0	68.6	9.2	3.1	25.0	8.1
	Solar power	2.5	9.5	0.0	3.8	0.7	0.0	0.0	0.5
	LPG	57.5	71.4	100.0	61.9	7.6	4.1	12.5	6.9
	Kerosene	2.5	0.0	0.0	1.9	3.6	2.0	0.0	3.2
	Other	0.0	9.5	0.0	1.9	0.3	0.0	0.0	0.2
It is advantageous for me in terms of health and my environment to adopt clean cooking technologies	Briquettes	3.3	8.3	0.0	3.8	2.6	2.1	0.0	2.4
	Charcoal	58.9	66.7	100.0	61.0	73.4	72.9	62.5	73.1
	Firewood	27.8	16.7	0.0	25.7	50.5	56.3	50.0	51.8
	Biogas	1.1	8.3	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	66.7	83.3	66.7	68.6	10.2	1.0	12.5	8.1
	Solar power	3.3	8.3	0.0	3.8	0.7	0.0	0.0	0.5
	LPG	62.2	50.0	100.0	61.9	7.9	3.1	12.5	6.9
	Kerosene	2.2	0.0	0.0	1.9	3.3	3.1	0.0	3.2
	Other	1.1	8.3	0.0	1.9	0.3	0.0	0.0	0.2
Renewable energy require high net energy yield compared to other sources of energy.	Briquettes	4.8	0.0	20.0	3.8	2.9	2.1	0.0	2.4
	Charcoal	59.7	57.9	100.0	61.0	73.2	72.5	80.0	73.1
	Firewood	27.4	23.7	20.0	25.7	50.7	55.0	26.7	51.8
	Biogas	3.2	0.0	0.0	1.9	1.5	0.5	0.0	1.0
	Electricity	69.4	63.2	100.0	68.6	9.8	5.3	20.0	8.1
	Solar power	3.2	2.6	20.0	3.8	1.0	0.0	0.0	0.5
	LPG	62.9	60.5	60.0	61.9	9.8	4.2	0.0	6.9
	Kerosene	1.6	0.0	20.0	1.9	2.0	4.2	6.7	3.2
	Other	1.6	2.6	0.0	1.9	0.5	0.0	0.0	0.2
It is less time consuming using renewable energy technologies i*	Briquettes	2.3	12.5	0.0	3.8	3.3	0.0	0.0	2.4
	Charcoal	57.0	75.0	100.0	61.0	73.6	70.2	87.5	73.1
	Firewood	24.4	37.5	0.0	25.7	50.2	59.6	25.0	51.8
	Biogas	1.2	6.3	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	70.9	50.0	100.0	68.6	9.5	3.2	12.5	8.1
	Solar power	2.3	6.3	33.3	3.8	0.7	0.0	0.0	0.5
	LPG	69.8	12.5	100.0	61.9	8.1	2.1	12.5	6.9
	Kerosene	2.3	0.0	0.0	1.9	3.3	1.1	25.0	3.2
	Other	1.2	6.3	0.0	1.9	0.3	0.0	0.0	0.2
	Briquettes	3.1	6.3	0.0	3.8	3.1	2.4	0.0	2.4

Improved cook stoves are available in my community	Charcoal	54.7	68.8	77.8	61.0	75.9	77.0	54.2	73.1
i*	Firewood	29.7	18.8	22.2	25.7	50.0	46.8	69.5	51.8
	Biogas	1.6	3.1	0.0	1.9	1.3	0.0	1.7	1.0
	Electricity	71.9	68.8	44.4	68.6	9.8	6.4	5.1	8.1
	Solar power	4.7	3.1	0.0	3.8	0.5	0.0	1.7	0.5
	LPG	67.2	50.0	66.7	61.9	8.9	3.2	6.8	6.9
	Kerosene	3.1	0.0	0.0	1.9	4.0	3.2	0.0	3.2
	Other	1.6	3.1	0.0	1.9	0.5	0.0	0.0	0.2
Improved cook stoves require a lot of technical knowledge to operate and local people cannot handle	Briquettes	4.1	4.2	3.1	3.8	1.3	3.8	4.2	2.4
	Charcoal	59.2	75.0	53.1	61.0	70.4	77.9	72.9	73.1
h*	Firewood	36.7	12.5	18.8	25.7	53.5	51.9	43.8	51.8
	Biogas	4.1	0.0	0.0	1.9	1.7	0.0	0.0	1.0
	Electricity	57.1	70.8	84.4	68.6	7.4	4.6	20.8	8.1
	Solar power	2.0	4.2	6.3	3.8	0.9	0.0	0.0	0.5
	LPG	51.0	66.7	75.0	61.9	7.4	2.3	16.7	6.9
	Kerosene	2.0	0.0	3.1	1.9	2.2	1.5	12.5	3.2
	Other	0.0	8.3	0.0	1.9	0.4	0.0	0.0	0.2
I save time and money when I use improved cook stoves	Briquettes	1.1	17.7	0.0	3.8	2.5	2.6	0.0	2.4
	Charcoal	58.0	76.5	0.0	61.0	73.7	72.8	60.0	73.1
h*	Firewood	27.3	17.7	0.0	25.7	51.9	50.9	60.0	51.8
	Biogas	1.1	5.9	0.0	1.9	1.4	0.0	0.0	1.0
	Electricity	67.1	76.5	0.0	68.6	8.8	7.0	0.0	8.1
	Solar power	2.3	11.8	0.0	3.8	0.4	0.0	10.0	0.5
	LPG	63.6	52.9	0.0	61.9	8.4	2.6	10.0	6.9
	Kerosene	1.1	5.9	0.0	1.9	3.9	0.9	10.0	3.2
	Other	1.1	5.9	0.0	1.9	0.4	0.0	0.0	0.2
Improved cook stoves require regular	Briquettes	4.7	3.2	0.0	3.8	2.7	2.4	0.0	2.4
	Charcoal	54.7	74.2	60.0	61.0	70.7	76.2	83.3	73.1

maintenance and therefore additional maintenance costs									
h*	Firewood	31.3	12.9	30.0	25.7	54.4	47.6	45.8	51.8
	Biogas	1.6	3.2	0.0	1.9	1.5	0.0	0.0	1.0
	Electricity	62.5	80.7	70.0	68.6	7.3	5.6	29.2	8.1
	Solar power	3.1	3.2	10.0	3.8	0.4	0.0	4.2	0.5
	LPG	57.8	64.5	80.0	61.9	7.0	4.0	20.8	6.9
	Kerosene	3.1	0.0	0.0	1.9	2.3	2.4	16.7	3.2
	Other	0.0	6.5	0.0	1.9	0.4	0.0	0.0	0.2
Market prices for these renewable energy technologies remain high and unaffordable to many potential customers,	Briquettes	2.4	11.8	0.0	3.8	2.9	1.1	0.0	2.4
	Charcoal	60.0	64.7	66.7	61.0	72.8	71.4	100.0	73.1
i*	Firewood	27.1	11.8	66.7	25.7	52.8	50.6	33.3	51.8
	Biogas	1.2	5.9	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	65.9	76.5	100.0	68.6	8.7	4.4	22.2	8.1
	Solar power	2.4	5.9	33.3	3.8	0.7	0.0	0.0	0.5
	LPG	62.4	64.7	33.3	61.9	7.8	3.3	11.1	6.9
	Kerosene	2.4	0.0	0.0	1.9	2.9	2.2	22.2	3.2
	Other	0.0	11.8	0.0	1.9	0.3	0.0	0.0	0.2
The market prices for these renewable energy fuels & technologies remain high and unaffordable to many potential customers, especially in Uganda.	Briquettes	4.5	0.0	0.0	3.8	3.2	0.0	0.0	2.4
	Charcoal	59.6	71.4	50.0	61.0	73.1	71.6	88.9	73.1
	Firewood	28.1	7.1	50.0	25.7	50.6	56.8	44.4	51.8
	Biogas	2.3	0.0	0.0	1.9	1.3	0.0	0.0	1.0
	Electricity	66.3	78.6	100.0	68.6	8.3	4.6	33.3	8.1
	Solar power	3.4	7.1	0.0	3.8	0.6	0.0	0.0	0.5
	LPG	60.7	71.4	50.0	61.9	7.7	3.4	11.1	6.9
	Kerosene	2.3	0.0	0.0	1.9	3.2	2.3	11.1	3.2
	Other	0.0	14.3	0.0	1.9	0.3	0.0	0.0	0.2

Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households

		Institutions				Households			
statement on attitudes	**Technology**	**Agree**	**Neutral**	**Disagree**	**Overall**	**Agree**	**Neutral**	**Disagree**	**Overall**
Household's need to adopt energy efficiency fuels and technologies is urgent	Improved Charcoal stove	7.4	0.0	0.0	6.7	9.2	0.0	0.0	7.3
	Kerosene stove	0.0	0.0	0.0	39.1	2.8	1.5	0.0	2.4
	Traditional mud/clay charcoal stove	41.1	22.2	0.0	41.9	65.5	62.1	44.4	64.1
	Electric Stove	41.1	55.6	0.0	33.3	5.5	0.0	0.0	4.4
	Installed Improved cooking stoves	33.7	22.2	100.0	15.2	5.5	6.1	5.1	5.6
	Improved cook stove with chimney	16.8	0.0	0.0	1.0	0.9	0.0	0.0	0.7
	Installed bio-digesters	1.1	0.0	0.0	22.9	0.6	0.0	0.0	0.5
	Traditional three-stone stove	7.4	11.1	0.0	7.6	37.5	53.0	61.1	41.1
Improved cooking technologies are better than traditional cooking stoves	Improved Charcoal stove	5.9	0.0	50.0	6.7	7.4	5.3	14.3	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.4	1.8	7.1	2.4
	Traditional mud/clay charcoal stove	37.6	50.0	100.0	39.1	63.6	68.4	57.1	64.1
	Electric Stove	43.6	0.0	0.0	41.9	5.0	1.8	0.0	4.4
	Installed Improved cooking stoves	32.7	100.0	0.0	33.3	5.9	1.8	14.3	5.6
	Improved cook stove with chimney	15.8	0.0	0.0	15.2	0.9	0.0	0.0	0.7
	Installed bio-digesters	1.0	0.0	0.0	1.0	0.6	0.0	0.0	0.5
	Traditional three-stone stove	7.9	0.0	0.0	7.6	40.2	47.4	35.7	41.1
Food prepared on improved cooking technologies is as good as food prepared using traditional cooking technologies	Improved Charcoal stove	8.6	0.0	8.3	6.7	5.3	6.5	16.4	7.3
i*	Kerosene stove	0.0	0.0	0.0	0.0	1.3	4.1	3.3	2.4
	Traditional mud/clay charcoal stove	34.3	34.8	75.0	39.1	64.9	59.4	70.5	64.1
	Electric Stove	47.1	30.4	33.3	41.9	5.3	4.1	1.6	4.4
	Installed Improved cooking stoves	31.4	43.5	25.0	33.3	5.8	5.7	4.9	5.6
	Improved cook stove with chimney	17.1	13.0	8.3	15.2	0.9	0.8	0.0	0.7

	Installed bio-digesters	0.0	0.0	8.3	1.0	0.9	0.0	0.0	0.5
	Traditional three-stone stove	4.3	17.4	8.3	7.6	41.8	45.5	29.5	41.1
	Other	27.1	13.0	16.7	22.9				
It is dangerous to my health and the environment to use traditional cooking technologies for a very long time	Improved Charcoal stove	7.6	0.0	0.0	6.7	5.7	11.0	16.7	7.3
i*	Kerosene stove	0.0	0.0	0.0	0.0	2.0	3.3	5.6	2.4
	Traditional mud/clay charcoal stove	40.2	27.3	50.0	39.1	64.0	65.9	55.6	64.1
	Electric Stove	44.6	27.3	0.0	41.9	5.0	1.1	11.1	4.4
	Installed Improved cooking stoves	33.7	27.3	50.0	33.3	7.0	2.2	0.0	5.6
	Improved cook stove with chimney	15.2	9.1	50.0	15.2	1.0	0.0	0.0	0.7
	Installed bio-digesters	0.0	9.1	0.0	1.0	0.7	0.0	0.0	0.5
	Traditional three-stone stove	7.6	9.1	0.0	7.6	40.7	44.0	33.3	41.1
I will adopt clean cooking technologies even when no one in my circles/peers use the improved cooking stove	Improved Charcoal stove	7.1	6.7	0.0	6.7	6.7	6.2	30.8	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.2	3.7	0.0	2.4
	Traditional mud/clay charcoal stove	35.7	46.7	66.7	39.1	61.9	72.8	61.5	64.1
	Electric Stove	41.7	40.0	50.0	41.9	5.4	0.0	7.7	4.4
	Installed Improved cooking stoves	33.3	46.7	0.0	33.3	6.7	1.2	7.7	5.6
	Improved cook stove with chimney	16.7	6.7	16.7	15.2	1.0	0.0	0.0	0.7
	Installed bio-digesters	1.2	0.0	0.0	1.0	0.6	0.0	0.0	0.5
	Traditional three-stone stove	9.5	0.0	0.0	7.6	42.5	38.3	23.1	41.1
Renewable fuels are readily available in my community	Improved Charcoal stove	6.2	9.7	0.0	6.7	8.5	4.4	8.4	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.8	3.5	0.0	2.4
	Traditional mud/clay charcoal stove	41.5	32.3	44.4	39.1	64.3	78.8	43.4	64.1
	Electric Stove	46.2	35.5	33.3	41.9	4.7	3.5	4.8	4.4
	Installed Improved cooking stoves	29.2	48.4	11.1	33.3	7.5	1.8	6.0	5.6
	Improved cook stove with chimney	16.9	12.9	11.1	15.2	0.9	0.0	1.2	0.7
	Installed bio-digesters	0.0	3.2	0.0	1.0	0.0	0.9	1.2	0.5

	Traditional three-stone stove	7.7	6.5	11.1	7.6	40.4	31.9	55.4	41.1
	Other	27.7	19.4	0.0	22.9	0.0	0.0	0.0	0.0
Our community has the necessary expertize to construct, operate and maintain renewable energy fuels and technologies	Improved Charcoal stove	3.6	10.3	9.1	6.7	6.6	4.9	14.1	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	3.6	2.5	0.0	2.4
	Traditional mud/clay charcoal stove	40.0	30.8	63.6	39.1	67.9	69.9	43.6	64.1
	Electric Stove	43.6	43.6	27.3	41.9	3.6	4.9	5.1	4.4
	Installed Improved cooking stoves	32.7	41.0	9.1	33.3	5.4	3.7	10.3	5.6
	Improved cook stove with chimney	18.2	12.8	9.1	15.2	1.2	0.0	1.3	0.7
	Installed bio-digesters	0.0	2.6	0.0	1.0	1.2	0.0	0.0	0.5
	Traditional three-stone stove	9.1	5.1	9.1	7.6	38.1	39.3	51.3	41.1
Existing political, institutional, cultural and policy factors affecting the renewable energy technology products are favorable.	Improved Charcoal stove	12.2	2.7	0.0	6.7	5.7	7.5	17.7	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.6	2.7	0.0	2.4
	Traditional mud/clay charcoal stove	32.7	32.4	68.4	39.1	63.2	68.0	52.9	64.1
	Electric Stove	38.8	48.7	36.8	41.9	5.7	2.0	5.9	4.4
	Installed Improved cooking stoves	38.8	32.4	21.1	33.3	5.3	6.8	2.9	5.6
	Improved cook stove with chimney	22.5	8.1	10.5	15.2	1.3	0.0	0.0	0.7
	Installed bio-digesters	2.0	0.0	0.0	1.0	0.9	0.0	0.0	0.5
	Traditional three-stone stove	10.2	5.4	5.3	7.6	39.9	42.2	44.1	41.1
	Other	24.5	21.6	21.1	22.9	0.0	0.0	0.0	0.0
We have access to improved energy efficient cook stoves at our household	Improved Charcoal stove	4.4	16.7	5.3	6.7	7.7	4.7	9.0	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	4.1	1.0	1.5	2.4
	Traditional mud/clay charcoal stove	35.3	33.3	57.9	39.1	65.7	72.0	55.6	64.1
	Electric Stove	44.1	50.0	26.3	41.9	7.1	2.8	2.3	4.4
	Installed Improved cooking stoves	35.3	33.3	26.3	33.3	9.5	3.7	2.3	5.6

	Improved cook stove with chimney	17.7	5.6	15.8	15.2	1.8	0.0	0.0	0.7
	Installed bio-digesters	1.5	0.0	0.0	1.0	1.2	0.0	0.0	0.5
	Traditional three-stone stove	5.9	5.6	15.8	7.6	32.5	36.5	55.6	41.1
	Other	30.9	5.6	10.5	22.9	0.0	0.0	0.0	0.0
Renewable energy fuels and technology solutions present economic savings to our household	Improved Charcoal stove	4.7	16.7	0.0	6.7	7.0	7.4	13.3	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.3	2.9	0.0	2.4
	Traditional mud/clay charcoal stove	40.0	38.9	0.0	39.1	65.5	64.7	33.3	64.1
	Electric Stove	41.2	44.4	50.0	41.9	5.0	2.9	6.7	4.4
	Installed Improved cooking stoves	34.1	27.8	50.0	33.3	6.6	4.4	0.0	5.6
	Improved cook stove with chimney	17.7	5.6	0.0	15.2	0.8	0.7	0.0	0.7
	Installed bio-digesters	1.2	0.0	0.0	1.0	0.8	0.0	0.0	0.5
	Traditional three-stone stove	5.9	16.7	0.0	7.6	37.6	44.1	73.3	41.1
Initial investment cost of most renewable energy fuels and technologies is a huge constrain	Improved Charcoal stove	3.8	19.1	0.0	6.7	6.9	7.1	25.0	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	2.6	2.0	0.0	2.4
	Traditional mud/clay charcoal stove	35.0	47.6	75.0	39.1	64.0	64.3	62.5	64.1
	Electric Stove	42.5	38.1	50.0	41.9	5.3	0.0	25.0	4.4
	Installed Improved cooking stoves	35.0	28.6	25.0	33.3	5.6	4.1	25.0	5.6
	Improved cook stove with chimney	17.5	4.8	25.0	15.2	1.0	0.0	0.0	0.7
	Installed bio-digesters	1.3	0.0	0.0	1.0	0.7	0.0	0.0	0.5
	Traditional three-stone stove	8.8	4.8	0.0	7.6	40.3	46.9	0.0	41.1
	Other	23.8	14.3	50.0	22.9	0.0	0.0	0.0	0.0
It is advantageous for me in terms of health and my environment to adopt clean cooking technologies	Improved Charcoal stove	4.4	16.7	33.3	6.7	7.5	6.3	12.5	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.6	2.1	0.0	2.4
	Traditional mud/clay charcoal stove	38.9	33.3	66.7	39.1	62.6	68.8	62.5	64.1
	Electric Stove	42.2	41.7	33.3	41.9	5.9	0.0	0.0	4.4
	Installed Improved cooking stoves	33.3	33.3	33.3	33.3	6.6	3.1	0.0	5.6
	Improved cook stove with chimney	16.7	8.3	0.0	15.2	0.7	0.0	12.5	0.7

	Installed bio-digesters	1.1	0.0	0.0	1.0	0.7	0.0	0.0	0.5
	Traditional three-stone stove	7.8	8.3	0.0	7.6	39.3	46.9	37.5	41.1
Renewable energy require high net energy yield compared to other sources of energy.	Improved Charcoal stove	3.2	13.2	0.0	6.7	9.8	4.8	6.7	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	1.5	3.7	0.0	2.4
	Traditional mud/clay charcoal stove	41.9	29.0	80.0	39.1	67.8	59.8	66.7	64.1
	Electric Stove	38.7	42.1	80.0	41.9	4.9	3.2	13.3	4.4
	Installed Improved cooking stoves	30.7	36.8	40.0	33.3	6.3	5.3	0.0	5.6
	Improved cook stove with chimney	19.4	10.5	0.0	15.2	1.0	0.5	0.0	0.7
	Installed bio-digesters	1.6	0.0	0.0	1.0	0.5	0.5	0.0	0.5
	Traditional three-stone stove	4.8	13.2	0.0	7.6	37.6	46.6	20.0	41.1
	Other	25.8	18.4	20.0	22.9	0.0	0.0	0.0	0.0
It is less time consuming using renewable energy technologies	Improved Charcoal stove	5.8	12.5	0.0	6.7	7.8	5.3	12.5	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.6	1.1	12.5	2.4
	Traditional mud/clay charcoal stove	33.7	62.5	66.7	39.1	65.2	59.6	75.0	64.1
	Electric Stove	46.5	18.8	33.3	41.9	5.5	0.0	12.5	4.4
	Installed Improved cooking stoves	32.6	43.8	0.0	33.3	5.2	6.4	12.5	5.6
	Improved cook stove with chimney	16.3	6.3	33.3	15.2	1.0	0.0	0.0	0.7
	Installed bio-digesters	1.2	0.0	0.0	1.0	0.7	0.0	0.0	0.5
	Traditional three-stone stove	7.0	12.5	0.0	7.6	39.4	48.9	12.5	41.1
Improved cook stoves are available in my community	Improved Charcoal stove	3.1	12.5	11.1	6.7	6.7	4.8	15.3	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	2.7	3.2	0.0	2.4
	Traditional mud/clay charcoal stove	34.4	43.8	55.6	39.1	69.2	70.6	30.5	64.1
	Electric Stove	45.3	40.6	22.2	41.9	6.3	3.2	0.0	4.4
	Installed Improved cooking stoves	29.7	43.8	22.2	33.3	5.8	1.6	13.6	5.6
	Improved cook stove with chimney	20.3	6.3	11.1	15.2	1.3	0.0	0.0	0.7
	Installed bio-digesters	1.6	0.0	0.0	1.0	0.9	0.0	0.0	0.5
	Traditional three-stone stove	7.8	6.3	11.1	7.6	36.2	41.3	59.3	41.1
	Other	25.0	25.0	0.0	22.9	0.0	0.0	0.0	0.0

Improved cook stoves require a lot of technical knowledge to operate and local people cannot handle	Improved Charcoal stove	4.1	12.5	6.3	6.7	8.3	3.1	14.6	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	2.2	1.5	6.3	2.4
	Traditional mud/clay charcoal stove	38.8	37.5	40.6	39.1	60.0	72.5	60.4	64.1
	Electric Stove	28.6	45.8	59.4	41.9	3.5	2.3	14.6	4.4
	Installed Improved cooking stoves	36.7	37.5	25.0	33.3	5.2	2.3	16.7	5.6
	Improved cook stove with chimney	22.5	8.3	9.4	15.2	0.4	0.0	4.2	0.7
	Installed bio-digesters	2.0	0.0	0.0	1.0	0.9	0.0	0.0	0.5
	Traditional three-stone stove	12.2	4.2	3.1	7.6	43.5	42.8	25.0	41.1
I save time and money when I use improved cook stoves	Improved Charcoal stove	5.7	11.8	0.0	6.7	7.0	6.1	30.0	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	2.8	1.8	0.0	2.4
	Traditional mud/clay charcoal stove	38.6	41.2	0.0	39.1	64.6	64.0	50.0	64.1
	Electric Stove	43.2	35.3	0.0	41.9	4.9	3.5	0.0	4.4
	Installed Improved cooking stoves	30.7	47.1	0.0	33.3	6.7	3.5	0.0	5.6
	Improved cook stove with chimney	17.1	5.9	0.0	15.2	1.1	0.0	0.0	0.7
	Installed bio-digesters	1.1	0.0	0.0	1.0	0.7	0.0	0.0	0.5
	Traditional three-stone stove	9.1	0.0	0.0	7.6	40.4	42.1	50.0	41.1
Improved cook stoves require regular maintenance and therefore additional maintenance costs	Improved Charcoal stove	4.7	9.7	10.0	6.7	8.9	1.6	20.8	7.3
	Kerosene stove	0.0	0.0	0.0	0.0	2.3	2.4	4.2	2.4
	Traditional mud/clay charcoal stove	35.9	41.9	50.0	39.1	59.9	71.4	70.8	64.1
	Electric Stove	34.4	58.1	40.0	41.9	3.9	4.8	8.3	4.4
	Installed Improved cooking stoves	28.1	41.9	40.0	33.3	5.8	4.0	12.5	5.6
	Improved cook stove with chimney	21.9	6.5	0.0	15.2	0.8	0.8	0.0	0.7
	Installed bio-digesters	1.6	0.0	0.0	1.0	0.8	0.0	0.0	0.5
	Traditional three-stone stove	10.9	0.0	10.0	7.6	43.2	38.9	29.2	41.1
Market prices for these renewable	Improved Charcoal stove	3.5	17.7	33.3	6.7	7.8	3.3	33.3	7.3

energy technologies remain high and unaffordable to many potential customers,	Kerosene stove	0.0	0.0	0.0	0.0	2.3	2.2	11.1	2.4
	Traditional mud/clay charcoal stove	36.5	47.1	66.7	39.1	63.1	68.1	55.6	64.1
	Electric Stove	42.4	41.2	33.3	41.9	5.5	1.1	0.0	4.4
	Installed Improved cooking stoves	34.1	29.4	33.3	33.3	5.5	4.4	22.2	5.6
	Improved cook stove with chimney	17.7	0.0	33.3	15.2	1.0	0.0	0.0	0.7
	Installed bio-digesters	1.2	0.0	0.0	1.0	0.7	0.0	0.0	0.5
	Traditional three-stone stove	8.2	5.9	0.0	7.6	42.4	38.5	22.2	41.1
The market prices for these renewable energy fuels & technologies remain high and unaffordable to many potential customers, especially in Uganda.	Improved Charcoal stove	3.4	21.4	50.0	6.7	7.1	5.7	33.3	7.3
h*	Kerosene stove	0.0	0.0	0.0	0.0	2.2	2.3	11.1	2.4
	Traditional mud/clay charcoal stove	37.1	50.0	50.0	39.1	63.5	69.3	33.3	64.1
	Electric Stove	41.6	42.9	50.0	41.9	5.5	0.0	11.1	4.4
	Installed Improved cooking stoves	36.0	21.4	0.0	33.3	5.5	3.4	33.3	5.6
	Improved cook stove with chimney	18.0	0.0	0.0	15.2	1.0	0.0	0.0	0.7
	Installed bio-digesters	1.1	0.0	0.0	1.0	0.6	0.0	0.0	0.5
	Traditional three-stone stove	7.9	7.1	0.0	7.6	42.0	39.8	22.2	41.1

Note: i* denotes significant variation among rural/urban institutions; h* denotes significant variation among rural/urban households

UPTAKE OF CLEAN FUELS				
***Institutions**				
aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Aware about clean fuels/ energy	No	reference		
	Yes	0.4	0.4	0.375
Has access to all clean fuels/ energy*	No	reference		
	Yes	7.6	5.0	0.002
Indicates that clean fuels are affordable	Prices are okay	reference		
	Prices are slightly expensive	2.3	2.3	0.406
	They are expensive	1.1	0.9	0.867

	They are very expensive	1.2	1.1	0.867
	Other	0.6	0.8	0.692
Availability	Bi-Monthly	reference		
	Weekly	0.04	0.1	0.025
	Everyday	0.5	0.5	0.518
Performance: clean fuel currently meets/satisfies cooking needs	No	reference		
	Yes	5.5	6.6	0.160
***Households**				
aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Access to electricity*		reference		
	No			
	Yes	5.1	2.6	0.002
Aware about clean fuels/ energy	No	reference		
	Yes	1.7	0.7	0.254
Has access to all clean fuels/ energy*	No	reference		
	Yes	6.2	2.9	0.000
Indicates that clean fuels are affordable	Prices are okay	reference		
	Prices are slightly expensive	1.2	0.5	0.674
	They are expensive	1.4	0.6	0.449
	They are very expensive	0.8	0.5	0.781
	Other	0.3	0.4	0.300
Availability	Bi-Monthly	reference		
	Weekly	0.1	0.1	0.040
	Everyday	0.3	0.1	0.005
Performance: clean fuel currently meets/satisfies cooking needs	No	reference		
	Yes	1.2	0.7	0.714

UPTAKE OF IMPROVED TECHNOLOGIES				
*Institutions				
aspect	**categories**	**OR**	**Std. Err.**	**p-value**
Aware about Improved cooking technologies	No	reference		
	Yes	0.7	0.5	0.671
Has access to all Improved cooking technologies	No	reference		
	Yes	2.3	1.6	0.244
Indicates that Improved cooking technologies are affordable	Prices are okay	reference		
	Prices are slightly expensive	0.8	0.5	0.723
	They are expensive	11.1	12.5	0.034
	They are very expensive	3.5	3.2	0.173

	Other			
Availability	Bi-Monthly	reference		
	Weekly	0.3	0.4	0.362
	Everyday	0.5	0.4	0.365
Performance: Improved cooking technology currently meets/satisfies cooking needs	No	reference		
	Yes			
*Households				
aspect	categories	OR	Std. Err.	p-value
Access to electricity*				
	No	reference		
	Yes	2.1	0.8	0.037
Aware about Improved cooking technologies	No	reference		
	Yes	1.0	0.4	0.914
Has access to all Improved cooking technologies*	No	reference		
	Yes	4.0	1.5	0.000
Indicates that Improved cooking technologies are affordable	Prices are okay	reference		
	Prices are slightly expensive	0.8	0.3	0.613
	They are expensive	0.9	0.3	0.752
	They are very expensive*	0.1	0.1	0.021
	Other	0.6	0.4	0.516
Availability	Bi-Monthly	reference		
	Weekly	1.0	0.6	0.979
	Everyday	1.0	0.3	0.885
Performance: Improved cooking technology currently meets/satisfies cooking needs	No	reference		
	Yes			