2017 HOUSEHOLD ENERGY CONSUMPTION SURVEY REPORT

EUROPEAN UNION

Department of Energy

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Kingdom of Lesotho

2017 HOUSEHOLD ENERGY CONSUMPTION SURVEY

ANALYTICAL REPORT

MASERU, September 2019

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The 2017 Household Energy Consumption Survey report is divided into nine chapters which are meant to provide detailed analysis on the findings focusing on:

- Housing Characteristics
- Biomass
- Electricity
- Petroleum Products
- Cooking
- Space and Water Heating
- Lighting
- Solar Photovoltaic System
- Other Energy Sources and Preferences

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PREFACE

Sustainable development generally aims to establish long-term stability of the economy and environment and can only be attained through the integration and acknowledgement of economic, environmental, and social concerns throughout the decision-making process. Decision making can only be sound through the use of informed policies and up-to-date data (The Concept of Sustainable Development: Definition and Defining Principles Rachel Emas, Florida International University, 2015)

The Household Energy Consumption Survey (HECS) was conducted by the Bureau of Statistics under Ministry of Development Planning in partnership with the Department of Energy under the Ministry of Energy and Meteorology in 2017. The last (and the first) energy survey of this kind was undertaken by the Department of Energy in the late 1980's and the projections were made up to 2010. This implies that beyond 2010, there was lack of good data, particularly on the demand side; to advise energy policies and plans, thus calling for plans to collect new data hence the 2017 HECS. Moreover, there was an increasing demand from users of energy statistics.

The supply and use of energy in Lesotho continue to change. This includes changes in the type of energy used, how it is used and the intensity of use in different demand sectors. This is attributable to adoption of new technologies, economic growth and changes in the economic structure, as well as behavioral change and population growth. Keeping track of the energy flow/balance of a country is therefore vital and requires continued updating of energy data in order to make sound policy decisions and to develop informed and sustainable plans. Hence the need for timely, accurate, comprehensive and readily accessible energy statistics.

The 2017 HECS survey was undertaken in two phases; July and November representing winter and summer seasons respectively. The same questionnaire was used in both seasons with some few modifications in the summer season. HECS will serve as a tool for monitoring and evaluating government development programmes within the frameworks such as;

> National Strategic Development Plans (NSDP) 2012/13 – 2016/17: develop small-scale electricity generation models that are viable for communities, where connection to the national grid is not cost-effective
>
> Lesotho Energy Policy 2015-2025: integrating energy into national and sectoral planning as a catalyst for energy effective utilization to improve the livelihoods of the people of Lesotho as well as driving the economic growth
>
> Lesotho Vision 2020: development of the use of technology in all aspects of life. Ninety percent (90) of Basotho households will have access to electricity and thereby to communication and development technology

Information from Household Energy Consumption will also serve as a monitoring tool for **SDG 7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All**

The Ministry of Development Planning as well as Ministry of Energy and Meteorology wishes to extend its gratitude to all participants of Household Energy Consumption Survey from all angles. Special thanks are dedicated to IT specialist who developed the application as well as the analysis team. Finally, we are also thankful to UNDP which provided both technical and financial support towards this exercise.

M. Molato

Director, Bureau of Statistics

September, 2019

EXECUTIVE SUMMARY

The findings of 2017 Household Energy Consumption Survey indicate 36.9 percent access to electrification nation-wide, of which 71.3 percent is in urban, 11.4 percent Rural and 44.0 percent Peri-Urban. The study also revealed that 3.0 percent of households used the improved fuel wood stoves for cooking whereas Gas Heater, Paraffin Heater and Paola (31.4, 28.8 and 23.1 percent respectively) were the mostly used technologies by the households for space heating in the winter season. It was observed that most households had no access to car (91.0 percent). Of the 9.0 percent of households that had access to car, more were from the Lowlands (85.1 percent) and least from Senqu River Valley (3.3 percent).

Majority of the households used LPG (29.9 percent in winter and 31.2 percent in summer) and wood (31.2 percent in winter and 27.5 percent in summer) as the main sources of energy for cooking. It was also observed that households living in the rural areas had more functional solar photovoltaic systems and depended on solar energy for their day-to-day basic living.

Usable Area of Dwellings

The findings indicate that Polata (38.4 percent) occupied a larger usable area followed by Rontabole and Bungalow with 17.7 and 15.6 percent respectively. Predominantly, Rontabole had thatch as a type of insulation with 261,521 houses. Carpet was mostly found in Malaene with 3,487 houses. Generally, most houses had ceiling with Malaene constituting 23,246 houses.

Biomass

About 62.0 percent of the households used Biomass energy sources. Fuel wood was the most used type of Biomass with 96,539.6 tonnes in winter and 158,155.86 tonnes in summer. Greater share (45.0 percent) of households sourced their fuel wood from communal forests.

Biomass usage, time taken and smoke pollution had decreased when using improved fuel wood stove with 90.2, 89.0 and 92.7 percent of households respectively

Electrification Rate

Out of the 36.9 percent households with access to electricity, Botha Bothe and Thaba Tseka districts had 6.8 and 11.4 percent of households connected to electricity respectively. Most households used their individual expenditure to electrify their houses in all the districts of Lesotho. It was reported that for most households at least M500.00 was spent on electricity in both summer (78.9 percent) and winter (67.9 percent). A geyser consumed an average of 15.04 kWh of electricity per day. Most of the appliances consumed less than 3 KWh per day.

Petroleum Products

The results reveal that unleaded petrol (4,409,611.56 litres) was more consumed in Lowlands and least consumption was observed in Foothills (170,861.04 litres). It was observed that diesel 50ppm consumption (406,459.43 litres) was high in Lowlands, followed by Mountainous consumption with 196,358.47 litres.

Cooking

Majority of the households used LPG (29.9 percent in winter and 31.2 percent in summer) and wood (31.2 percent in winter and 27.5 percent in summer) as the main sources of energy used for cooking. About 29.6 percent of the households used paraffin as the alternative source of energy for cooking. About 42.4 per cent of households mainly used gas stove for cooking. Of all the energy sources used for cooking, more energy (197.97 TJ per month) was obtained from Animal dung.

Heating

Most households (44.7 percent) used Paraffin heater for space heating in winter while *Paola* ranked second by 35.9 percent. Electricity remained the largest energy source for space heating in Maseru for 53.8 percent of the households while Berea registered16.7 percent. Fuels such as Wood and Crop waste were predominantly used in Leribe and Maseru. About 4.5 percent of households from the Urban areas had heated the estimated area of 50m^2 and above.

Maseru (46.7 percent) followed by Leribe (15.3 percent) had the most percentage of households using electricity for water heating contrary to Botha Bothe with 0.8 percent. Animal dung was highly used by households residing in Mafeteng, Mokhotlong and Thaba-Tseka districts with 27.7, 18.6 and 16.4 percent respectively.

Lighting

The most commonly used energy sources for lighting in winter were Candles constituting 49.5 percent and Electricity (Grid) constituting 36.6 percent. In summer, the higher share of households (49.2 percent) used Paraffin as the main source of energy for lighting. Over 50 percent of households used Energy saver bulbs in both seasons.

About 45.2 percent of the households, who had plans to upgrade using CFL, stated not being connected to electricity as the main constraint while 17.3 percent of them sited not owning the house. A similar pattern is observed with LED. Households who wanted to upgrade with solar photovoltaic sited low income as the constraint towards the upgrade.

Solar

Twenty percent of the households in Leribe owned solar photovoltaic system while usage accounted for18.3 percent. Ownership and usage of PV System was least in Qacha's Nek with 2.5 and 1.9 percent respectively.

Energy Preferences

The highest proportion of households (59.2 percent) would appreciate to be availed with grid Electricity followed by LPG (15.0 percent) in winter. A similar pattern was observed in summer where 50.2 percent of households mentioned grid Electricity as the source of energy to be availed, followed by LPG with 13.1 percent of households

More than 40 .0 percent of the households could not install Solar PV due to low income.

CHAPTER 1: SURVEY DESIGN

1.0 Introduction

Lesotho Bureau of Statistics in partnership with the Department of Energy conducted the Household Energy Consumption Survey in 2017. The survey is important for obtaining the energy consumption patterns of the households. Information collected from the survey included usable area from the housing units, biomass and other energy sources, electricity, solar and petroleum products.

It was also important to gather information regarding energy sources used for cooking, lighting and heating. Moreover the study focused on the energy preferences indicated by households to be availed to them.

1.1 Sample Design

The 2016 census Enumeration Areas (EA) were used as Primary Sample Units (PSU) and all the private households in the selected EAs were included in the sample. The sample was designed such that all the ten districts, ecological zones as well as settlements were included.

The sample design of Household Energy Consumption Survey is a two-stage stratified sample design. The stratifying variables being the agro-ecological zones namely the lowlands, foothills, mountains and Senqu River Valley (SRV) and Settlements (urban, peri-urban and rural). The selection of sampling units followed the following stages: First stage referred to as the Primary Sampling Units (PSUs) was done to select Enumeration Areas (EAs). The number of households within the PSUs serves as the Measure of Size (MOS). The Second Stage Sampling Units (SSUs) are the households. They were selected systematically within the selected PSUs.

1.2 Sample Size

A sample size of 192 enumeration areas was selected countrywide. In each PSU, fifteen (15) households were selected. This resulted in a total of two thousand eight hundred and eighty (192*15) selected households. To compensate for non-response as well as non-coverage of the sampled units, sampling weights were employed to correct those imperfections.

1.3 Survey Instruments

The following instruments were used during data collection; Tablet installed CS Entry (questionnaire) and corresponding manual; 10-meter measuring tapes were used to measure usable area of housing units and aperture area of the solar water heater; Weighing scale used to weigh relevant energy source and a Shopping bag used to put energy source to be weighed. Stepladder was also used to climb up the roof in order to measure the aperture area

1.4 Trainings

Training of supervisors was conducted over a period of two weeks during May/June. Enumerators' training lasted three weeks whereby the first two weeks focused on questionnaire and one week on the application. The trainings also touched on Map reading as Enumeration maps were provided. Two days of the training were dedicated to mock interviews to give practice to the trainees.

1.5 Fieldwork

The survey was conducted over a period of two months; in July (winter) and November (summer) 2017 (for 30 days each month). Enumeration was done by engaging one hundred and ninety-two enumerators (both temporary & permanent BOS staff), thirty-eight supervisors, four regional Coordinators and six IT Coordinators. There were thirty-eight teams. Each team was allocated a hired vehicle. Government vehicles were used by regional coordinators.

Each supervisor was responsible for five to six enumerators in the lowlands and foothills while in the mountains the ratio of supervisor to enumerator was 1:3. The role of the supervisor was mainly to check data before synchronizing with both the enumerator and BOS headquarters on daily basis. Regional coordinators were responsible for overall logistics of their areas. IT coordinators were to take back-up of work done in their respective districts during data collection. They also helped with any Computer Assisted Personal Interview (CAPI) related problems.

An enumerator was to visit a household two times (successive days) in cases whereby physical measurements (weighing wood, coal etc) were to be done before cooking time.

The same households enumerated in July were also visited in November. This was done in order to check for any seasonal variation in the energy consumption patterns of the households.

1.6 Response Rate

Out of a total sample from 2,880 households, 2,715 responded giving a response rate of 94.3 percent. The 5.7 percent was made of “not found” households. The same households who were visited in winter were also enumerated in summer in order to check for seasonal variation in energy consumption.

CHAPTER 2: HOUSING CHARACTERISTICS

2.0 Introduction

Housing refers to the building or other shelter in which people live in. This can be a house, a block of flats, a shack (Mok'huk'hu), a tent or any improved shelter that people live in. People spend most of their lives in a physical dwelling that is normally referred to as home (LDS, 2011).

The housing unit as defined by US Census Bureau, 2001, is an apartment, a mobile home, a group of rooms, or a single room occupied, or intended for occupancy as separate quarters. However, the concepts used in this report are as defined in the enumerators' manual used during 2017 Household Energy Consumption Survey. The same definitions were adopted for both winter and summer seasons of the survey. Types of housing units commonly occupied in Lesotho are:

- Rontabole
- Heisi
- Polata
- Malaene
- Optaka
- Apartment/Town House
- Temporary Structure/Mok'huk'hu
- Bungalow/ Mansion

As part of the buildings envelope, walls account for a significant proportion of heat loss and gain. Almujahid, et al (2013) reported that about one third of heat loss occurs through walls in the case of un-insulated brick veneer dwellings. Selecting the proper wall components is of considerable importance in creating energy efficient buildings that consume less energy to maintain comfortable conditions in enclosed spaces. www.researchgate.net

2.1 Housing Usable Area

Usable Area: This area includes rooms for living – kitchen, living room, bathroom, hallway, bedroom etc. This does not include technical areas such as basement, attic (used for storage purposes), pantry, garage, boiler room, staircases, balcony, etc. and unfinished spaces.

The area was obtained by measuring the usable rooms within the housing units using a measuring tape. The readings were recorded taking into consideration the shape of the house to be measured. The differences in usable area for summer and winter seasons could be due to the following reasons: change of use of structures in the seasons, completion or built of new ones and disuse of others. The survey did not inquire as to whether any of the aforementioned reasons held or not within the household but were generally observed.

Figure 2.1 depicts the percentage usable area occupied by type of house for summer season. It is observed in the figure that Polata (38.4 percent) occupied a larger usable area followed by Rontabole and Bungalow with 17.7 and 15.6 percent respectively. The least usable area was observed in Apartment with 1.0 percent and Mok'huk'hu constituting 2.1 percent.

Figure 2.1: Percentage Distribution of Usable Area Occupied by Type of House, 2017 HECS

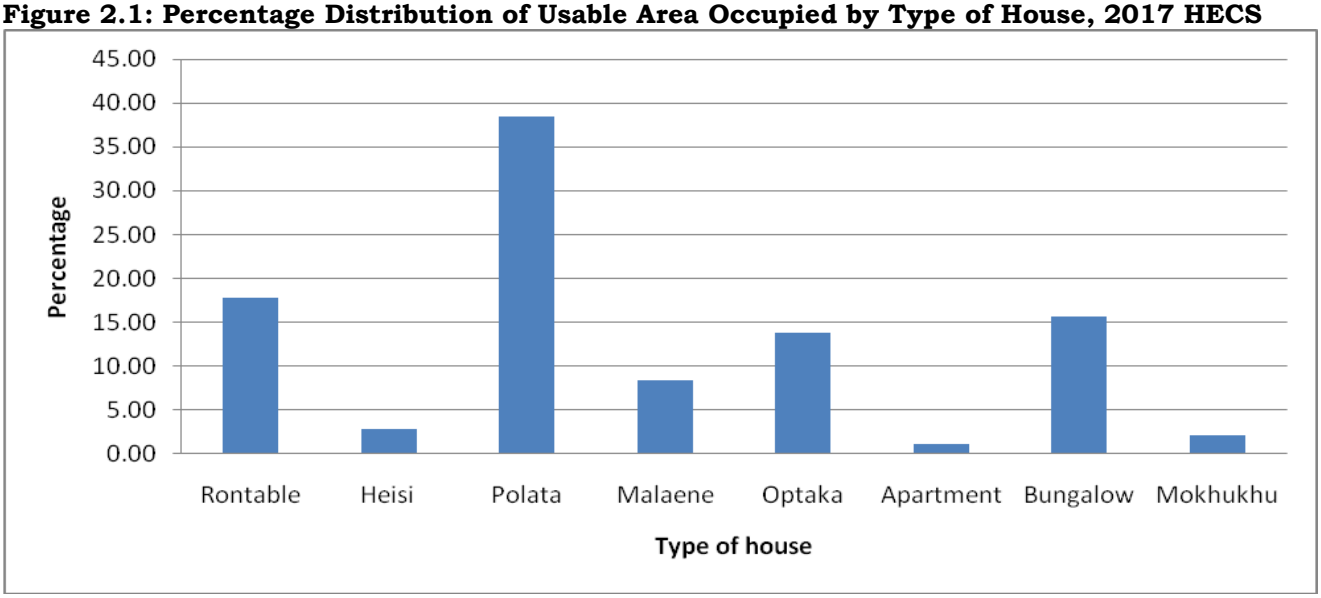


Table 2.1 shows usable area in square meters occupied by type of house in winter. For the winter season, Polata had the greatest usable area with 8,833,098 Square Meters. The least occupied types of houses were Mokh'ukh'u and Apartment with 476,329 and 269,621 square meters respectively.

Table 2.1 Usable Area in Square Meters Occupied by Type of House, 2017 HECS

Type of House	Usable Area (M²)
Rontabole	4,028,633
Heisi	679,113
Polata	8,833,098
Malaene	2,428,949
Optaka	3,423,813
Apartment/Town House	269,621
Bungalow/Mansion	3,304,387
Mokhukhu	476,329

2.2 Housing Electrification

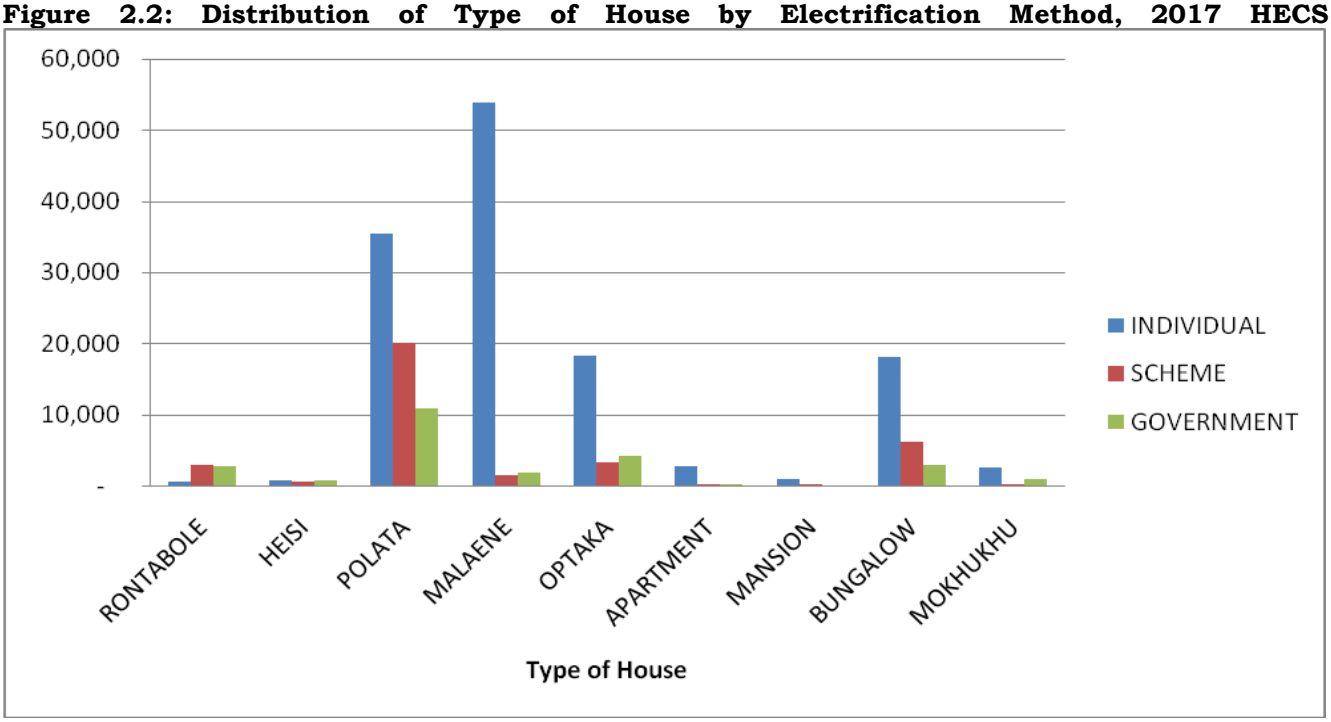
Lesotho has established rural electrification programmes that aim at bringing electrical power to rural and remote areas. Despite the serious efforts of the Government of Lesotho, Lesotho Electricity Company (LEC) and other stakeholders, the level of households connected to the grid is still low. In 2015, about 72% of the households in urban regions were connected to the grid while the share of households in the rural areas with access to electricity was just 5.5% according to Mpholo M., Steuerwald D., Kukeera T. (eds), Rural Electrification in Lesotho (2018).

The method by which an individual gets connected to grid, has a significant impact on the tariff payment per unit of electricity. When the government subsidizes a community during electrification, there is universal charge applied across the board on top of normal electricity unit cost.ie M0.15 could be applied. The charge is determined by policy. The Government expects to recover its capital cost within 7 years from the date of connection.

An individual can get connected on their own by getting electricity from the nearest grid. They would bear the whole cost of line extension. However, this method has proved to have a heavy up-front cost on individuals; hence scheme was proposed. Currently, Government policy is to subsidize a community.

Figure 2.2 illustrates distribution of houses by electrification method. It can be observed from the figure that Malaene (53,854) were commonly electrified by individuals followed by Polata and Optaka with 35,451 and 18,210 houses respectively. Incidentally, Mokhukhu dwelling not commonly found in Lesotho was also electrified with 2,518 houses.

Figure 2.2: Distribution of Type of House by Electrification Method, 2017 HECS



2.3 Housing Insulation

Insulation refers to an energy saving measure which provides resistance to heat flow. Naturally, heat flows from a warmer to a cooler space. By insulating a house, one can reduce the heat loss in buildings during the cold weather or climate and reduce the heat surplus in warmer weather or climate. Insulating a house has several benefits such as energy savings, cost savings and increased comfort.

Types of insulation that could be done in a house include installation of a ceiling, Wall cavity Inside/Outside wall, Roof, Floor, Window and Sealing cracks.

There are many materials that can be used for insulation in buildings. There are electrochromic windows, high performance windows, airtightness materials, cool roofing (Thatch), foams, to highlight a few. In 2017 HECS, the types of insulation materials considered were thatch, carpet, ceiling, foam and laminated board.

Table 2.2 indicates type of house and method of insulation in winter. Predominantly, Rontabole had thatch as a type of insulation with 261,521 houses. Carpet was mostly found in Malaene with 3,487 houses. Polata (775) and Optaka (775) had similar number of houses that had carpet. Generally, most houses had ceiling with Malaene constituting 23,246 houses.

Table 2.2: Type of House by Method of Insulation, 2017 HECS – Winter

Type of house	Method of Insulation					
	Thatch	Carpet	Ceiling	Carpet and Ceiling	Foam	Laminated Board
Rontabole	261,521		969			
Heisi	37,775					
Polata	194	775	1,937	194		
Malaene		3,487	23,246	2,906	194	
Optaka		775	13,754	3,103		969
Apartment/Town House			2,712	582		
Bungalow/ Mansion		194	16,079	4,263		
Mokh'ukh'u		581	194	194		
Total	**299,490**	**5,812**	**58,891**	**11,242**	**194**	**969**

Table 2.3 indicates type of house and method of insulation in summer. Likewise, as in winter season, predominantly Rontabole had thatch as a type of insulation with 249,511 houses. Carpet was mostly found in Polata followed by Optaka with 5,619 and 2,713 houses respectively. Generally, carpet as a method of insulation cut across most type of houses. However, the greatest number of houses (284,381) used Thatch as a method of insulation.

Table 2.3 Households Insulation Method by Type of House, 2017 HECS - Summer

Type of house	Method of Insulation			
	Thatch	Carpet	Ceiling	Laminated Board
Rontabole	249,511	194		
Heisi	34,482	387		
Polata	388	5,619	14,918	582
Malaene		2,712	24,796	194
Optaka		2,713	12,981	388
Apartment/Town House			3099	
Mansion/Bungalow		1163	17628	388
Mokh'ukh'u		387	388	194
Total	**284,381**	**13,175**	**73,810**	**1,746**

2.4 Summary

The findings indicate that Polata (38.4 percent) occupied a larger usable area followed by Rontabole and Bungalow with 17.7 and 15.6 percent respectively. Predominantly, Rontabole had thatch as a type of insulation with 261,521 houses. Carpet was mostly found in Malaene with 3,487 houses. Generally, most houses had ceiling with Malaene constituting 23,246 houses.

CHAPTER 3: BIOMASS

3.0 Introduction

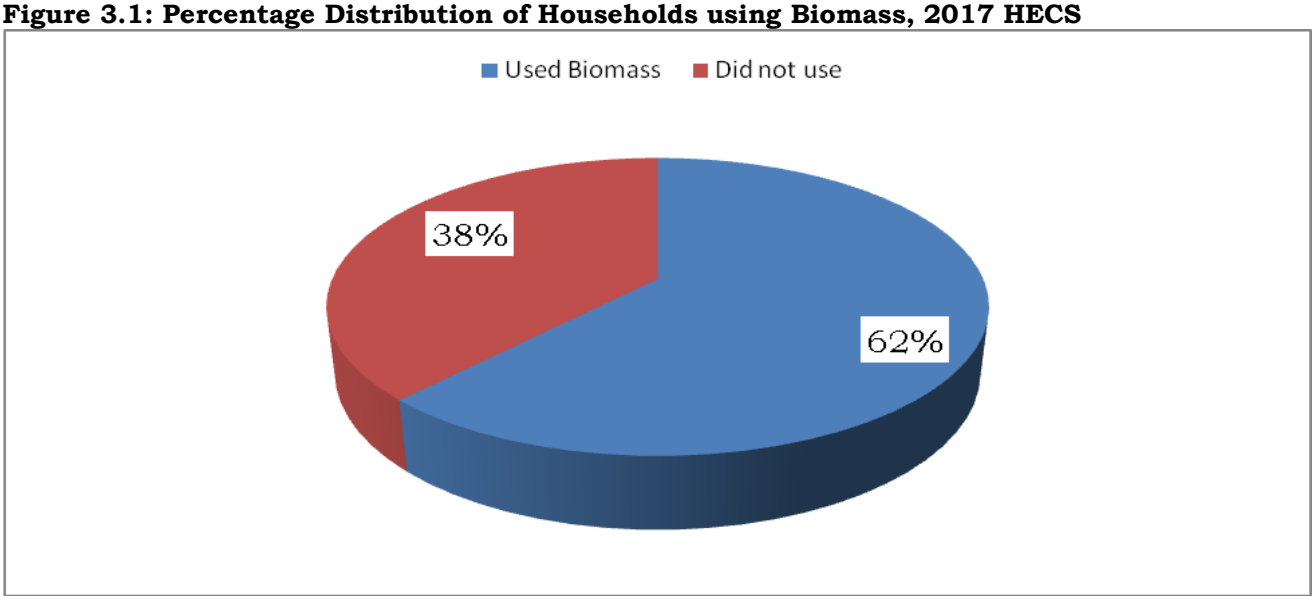
This chapter addresses ***SDG 7; indicator 7.2.1: Renewable energy share in the total final energy consumption.***

"Biomass is organic material that comes from plants and animals, and it is a renewable source of energy" (https://www.eia.gov/energyexplained/?page=biomass_home). In this report, biomass includes fuel wood, charcoal, wood waste, wood chips, wood pellets, crop waste, animal waste, aloe and shrubs.

The energy balance of Lesotho is characterized by a huge dependence on biomass in the rural areas, used mainly for cooking and space heating. Based on the 2017 Household Energy Consumption Survey, about 62.0 percent of the households used biomass in summer and 65.0 percent in winter. Fuel wood dominates the consumption patterns in all seasons preceded by animal dung and shrubs.

Figure 3.1 portrays percentage distribution of Households that used Biomass in summer 2017. The figure depicts that more than half (62.0 percent) of the households used at least one type of Biomass. It reveals that 38.0 percent of the households did not use any Biomass in summer 2017.

Figure 3.1: Percentage Distribution of Households using Biomass, 2017 HECS



Male-headed households in rural areas who had access to biomass accounted for 62.5 percent in rural areas as opposed to 37.5 of female-headed households. A similar pattern is observed in urban and peri-urban areas where proportions of male-headed households are higher than those of female-headed households.

Table 3.1: Percentage Distribution of Households Access to Biomass by Sex, 2017 HECS

Sex	Urban	Peri-Urban	Rural
Male Headed Households	60.5	58.4	62.5
Female Headed Households	39.5	41.6	37.5
Total	**100.0**	**100.0**	**100.0**

Figure 3.2 illustrates Quantity of Biomass by Type and Season. From the figure, it is observed that Fuel wood had the greatest quantity in both summer (96, 539.65 tonnes) and winter (158,155.86 tonnes) than any other type of Energy source. It is also shown that all winter quantities were higher than summer quantities in all energy sources except Aloe with 3,117.19 tonnes in summer and 2,691.37 tonnes in winter.

Figure 3.2: Quantity (tonnes) of Biomass by Type and Season, 2017 HECS

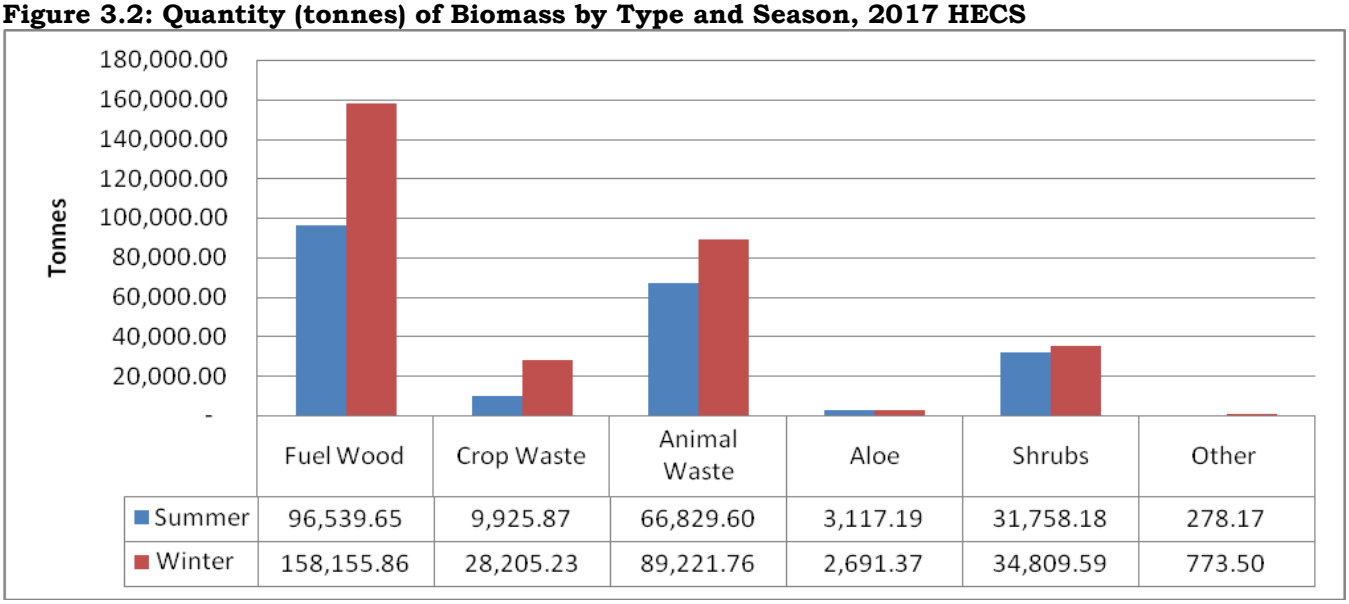


Table 3.2 presents quantity and energy of Biomass by settlement and season. The table reveals that Leribe had the highest (30,381,427.24kg) quantity of Biomass in summer with 506.18TJ. Maseru had the highest quantity in winter with 44,919,024.53kg resulting to 729.24TJ. The table further shows that winter (23,749,892kg) quantities of Biomass were much greater in urban settlement than that of summer (10,958,815.95kg) season. Most Biomass Energy was used in rural settlements with 2,843.20 TJ in summer and 5,254.77 TJ in winter.

Table 3.2: Quantity (kg) and Energy (TJ) of Biomass by Districts, Settlement and Season, 2017 HECS

	Summer		Winter	
District	**Quantity (kg)**	**Energy (TJ)**	**Quantity (kg)**	**Energy (TJ)**
Botha Bothe	12,123,276.56	195.17	31,773,257.01	512.02
Leribe	30,381,427.24	506.18	40,635,983.81	678.24
Berea	28,254,007.76	465	35,764,489.54	587.4
Maseru	30,023,461.74	481.15	44,919,024.53	729.24
Mafeteng	25,621,562.18	378.13	31,763,367.60	469.98
Mohale's Hoek	16,734,269.74	264.48	26,493,288.62	427.42
Quthing	11,426,922.90	179.17	20,653,471.36	328.29
Qacha's Nek	14,628,953.71	219.49	22,979,521.64	344.78
Mokhotlong	11,322,333.47	170.99	22,869,508.05	348.23
ThabaTseka	24,537,078.87	365.12	32,540,521.87	497.99
Settlement				
Urban	10,958,815.95	171.64	23,749,892	383.15
Peri-Urban	13,035,267.70	210.06	22,229,848	361.14
Rural	181,059,210.50	2,843.20	264,412,694	4,179.32

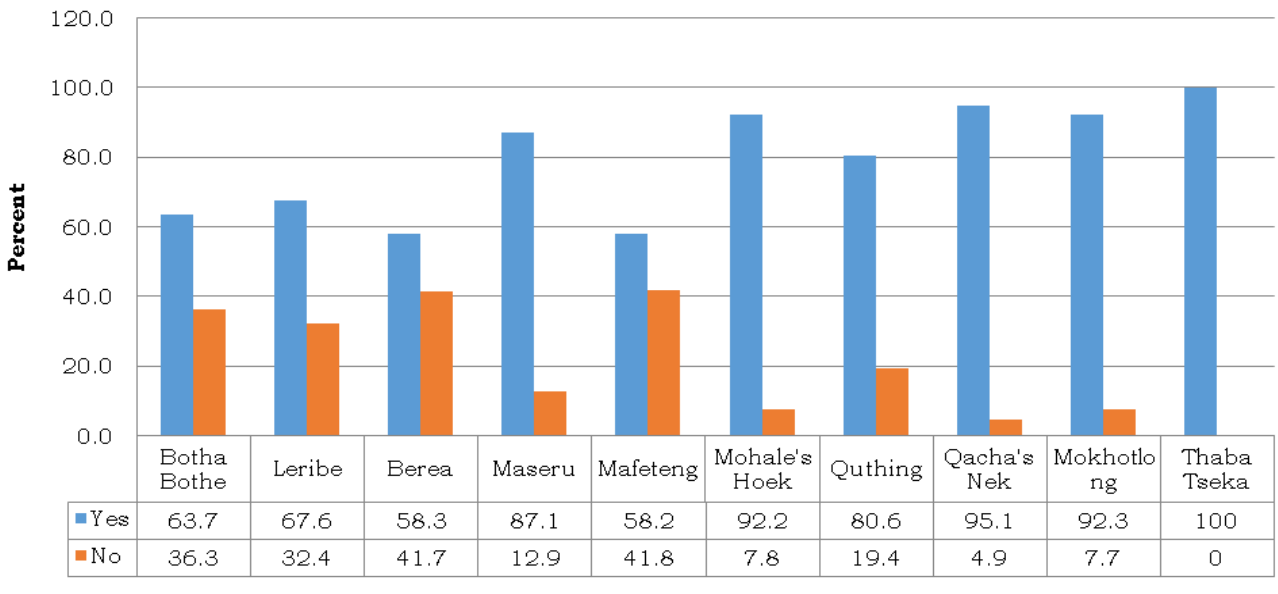
3.1 Fuel wood

Fuel wood is any wooden material that is gathered and used for fuel. Generally, Fuel wood is not highly processed and is in some sort of recognizable log or branch form, compared to other forms of wood fuel like pellets or chips. Fuel wood can be seasoned (dry) or unseasoned (wet) and further classified as hardwood or softwood (http://en.m.wikipedia.org/wiki/fuelwood).

Fuel wood is a renewable resource. However, demand for this fuel can outpace its ability to regenerate on a local or regional level. Good forestry practices and improvements in devices that use Fuel wood can improve local wood supplies.

Figure 3.3 displays percentage distribution of households using Fuel wood by districts. The figure illustrates that 95.1 percent of households in Qacha's Nek had a place where fuel wood can be collected, and 92.3 percent of households was true for Mokhotlong district. Mafeteng and Berea had 41.8 percent and 41.7 percent of households without a place where fuel wood can be collected respectively.

Figure 3.3: Percentage Distribution of Households with/without Area of Fuel wood Collection by Districts, 2017 HECS



	Botha Bothe	Leribe	Berea	Maseru	Mafeteng	Mohale's Hoek	Quthing	Qacha's Nek	Mokhotlong	Thaba Tseka
Yes	63.7	67.6	58.3	87.1	58.2	92.2	80.6	95.1	92.3	100
No	36.3	32.4	41.7	12.9	41.8	7.8	19.4	4.9	7.7	0

3.2 Harvesting and Collection of Fuel wood

Harvesting or collecting Fuel wood varies by the region and culture. Some places have specific areas for Fuel wood collection. Apart from commercial fuel wood obtained in market, the survey has discovered 3 (three) common places of fuel wood collection such communal forests which are normally under supervision of the village chief; private forests and household yards which are both privately owned. One important factor in fuel wood collection that echoes to energy access, economic as well as social development is the time taken, including travel time to collect fuel wood. The longer it takes to access fuel wood; the more productive time is deprived fuel wood collectors.

Figure 3.4 presents percentage distribution for Fuel wood source for 2017 HECS summer. Communal forest had the greatest share (45.0 percent) as the source for Fuel wood collection followed by Private forest with 24.0 percent. Other sources of Fuel wood collection had the lowest share of 3.0 percent.

Figure 3.4: Percentage Distribution for Fuel Wood Source, 2017 HECS

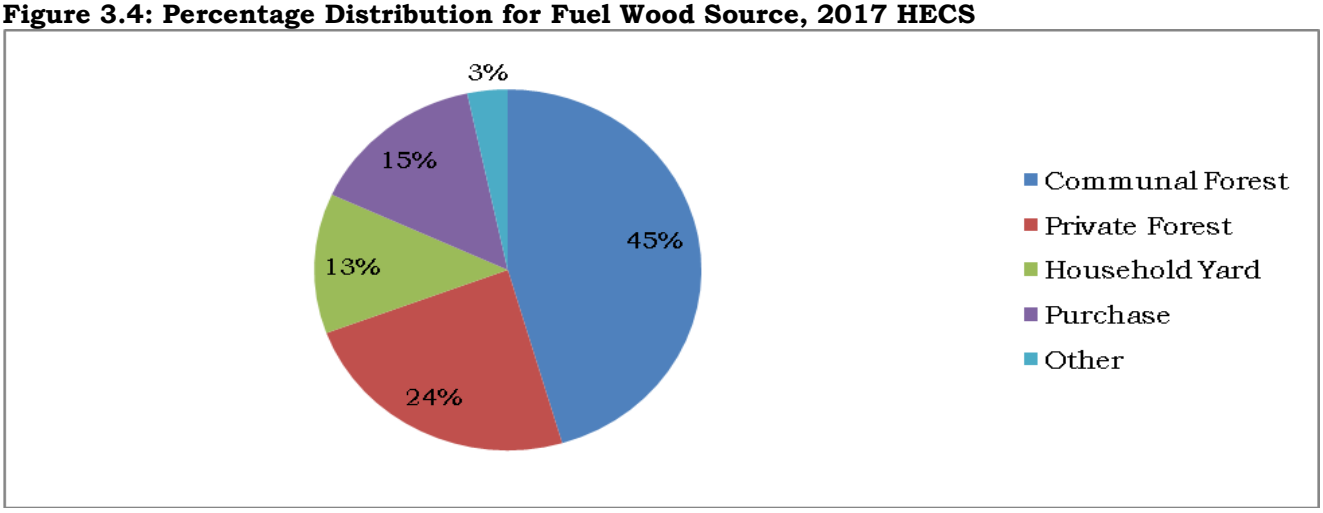
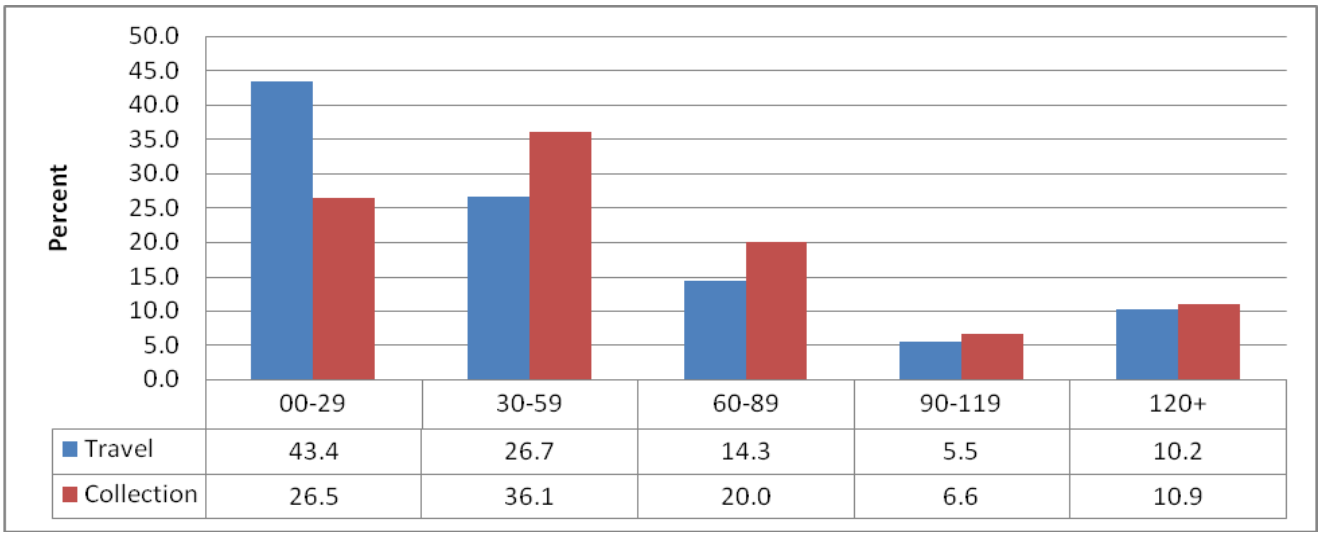


Figure 3.5 portrays percentage distribution for time taken to travel and collect Fuel wood. Majority of the households (43.4 percent) travel 00-29 minutes to reach their area of collection and only 5.5 percent travel 90-119 minutes. For fire wood collection, most households (36.1 percent) take 30-59 minutes. There were 10.9 percent of the households who take 120+ minutes to collect Fuel wood.

Figure 3.5: Percentage Distribution for Time (minutes) Taken to Travel and Collect Fuel wood, 2017 HECS



	00-29	30-59	60-89	90-119	120+
Travel	43.4	26.7	14.3	5.5	10.2
Collection	26.5	36.1	20.0	6.6	10.9

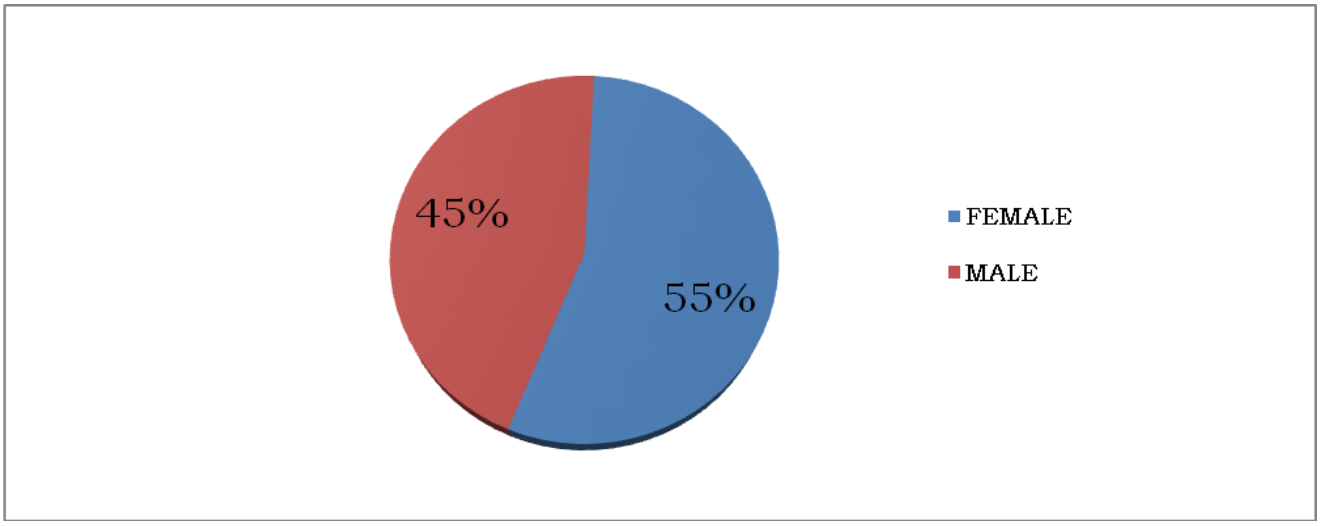
Table 3.3 shows percentage distribution of Fuel wood source by time. The table reveals that for Communal forests, most of the households (33.1 percent) travel 30-59 minutes to reach area for collection followed by those who take 00-29 minutes with 30.0 percent. For Household yard 95.5 percent take 00-29 minutes travelling to the area of Fuel wood collection and 4.5 percent take 30-59 minutes

Table 3.3: Percentage Distribution of Fire wood Source by Time (minutes), 2017 HECS-Summer

Source	Time					Total (%)	Total (N)
	00-29	30-59	60-89	90-119	120+		
Communal Forest	30	33.1	17.9	5.8	13.2	100	94,148
Private Forest	40.4	28.6	13.7	7.5	9.8	100	49,399
Household Yard	95.5	2.2	1.5	0	0.7	100	25,958
Other (specify)	50	16.7	16.7	8.3	8.3	100	6,974
Total	**43.4**	**26.7**	**14.3**	**5.5**	**10.2**	**100**	**176,479**

Figure 3.6 illustrates percentage share of household members involved in Fuel wood collection by sex. The results disclose that more females (55.4 percent) were involved in Fuel wood collection than males with 44.6 percent.

Figure 3.6: Percentage Share of Household Members Involved in Fuel wood Collection by Sex, 2017 HECS-Summer



3.3 Improved Fuel Stoves

A shortage of fuel for cooking is one of the many problems faced by people in the developing world. Gathering fuel is generally women's work but is fraught with dangers; they gamble with the risk of rape and life threatening attacks during their search for much needed fuel wood, in order to feed their families. In certain areas, local sources of fuel wood are completely depleted, leading to people to travel further and further afield or dig up tree roots, eliminating any chance of the trees growing again. Even if people survive this, they are still exposing themselves and their children to potentially deadly smoke fumes.

Practical actions are tackling this issue through the use of more fuel-efficient woodstoves, which are both affordable and easy to use. Improved fuel wood stoves use less fuel wood as opposed to open fire hence giving fuel wood collectors more time for productive work, cutting the number of risky trips for fuel wood collection and improvement on environmental degradation. Subsequently, burning smaller amounts of wood fuel means less smoke and thus less health risks. Only 3 percent of households are discovered to have used improved fuel wood stoves in Lesotho.

Figure 3.7 illustrates percentage distribution of households using improved fuel wood stoves. It is observed from the figure that 3.0 percent of the households used improved fuel

wood stoves. On contrary, 97 percent of the households did not use improved fuel wood stoves at all.

Figure 3.7: Percentage Distribution of Households using Improved Fuel wood Stoves, 2017 HECS-Summer

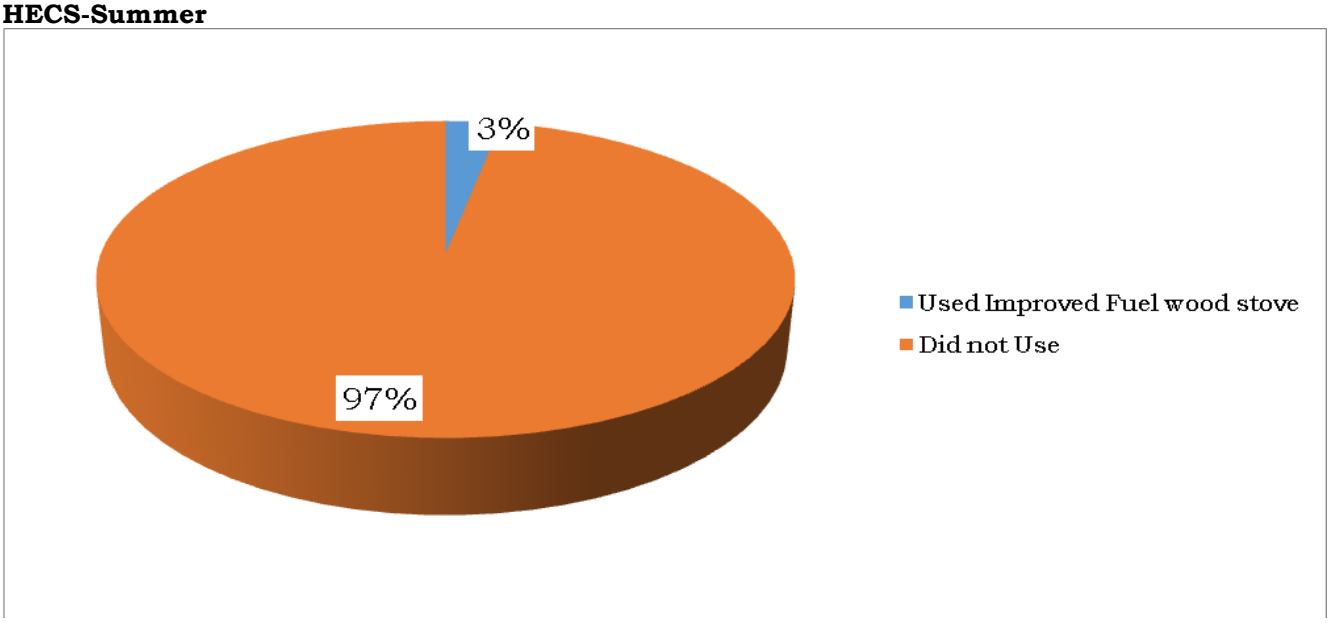


Figure 3.8 displays percentage share- of households that used improved fuel wood stoves by type. The results reveal that for the households that used improved fuel wood stoves 58.5 percent used Save 80 stoves more than any other type of improved fuel wood stoves. It is followed by Ace 1 smokeless cook stove with 39.0 percent and Rocket stove is the least used with 2.4 percent.

Figure 3.8: Percentage Share of Households that Used Improved Stove

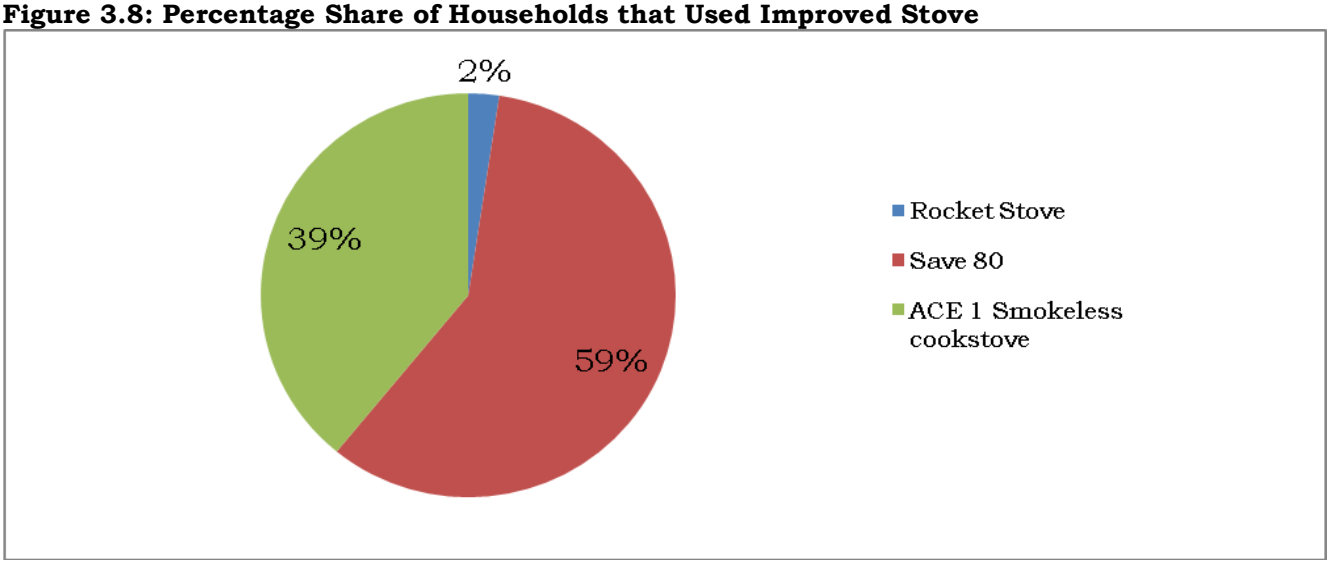


Table 3.4 shows percentage distribution of improved fuel wood stoves by type and settlement. From the table, it is observed that 83.3percent of the households that used Save 80 stoves were found in rural areas and 16.7 percent were in peri-urban areas.

Approximately 93.8 percent of households used Ace 1 stoves in rural settlement while 6.3 percent was used in urban.

Table 3.4: Percentage Distribution of Households that used Improved Fuel wood Stove by Type and Settlement, 2017 HECS – Summer

Settlement	Rocket Stove	Save 80	Ace 1
Urban	0	0	6.3
Peri-Urban	0	16.7	0
Rural	100	83.3	93.8
Total (%)	**100**	**100**	**100**
Total (N)	**387**	**9,299**	**6,199**

Table 3.5 reveals percentage distribution of improved fuel wood stoves by type and duration. The table shows that 50.0 percent of Save 80 stoves were used for 36+ months while 6.3 percent was used for 26-35 months. It further reveals that 41.5 percent of Ace 1 stoves were used for less than 5 months' period while 29.3 percent were used for 36+ months.

Table 3.5: Percentage Distribution of Improved Fuel wood Stoves by Duration and Type (months), 2017 HECS –Summer

Duration	Rocket Stove	Save 80	Ace 1
Less than 5	100	22.9	41.5
6-15	0	10.4	11
16-25	0	10.4	12.2
26-35	0	6.3	6.1
36+	0	50	29.3
Total (%)	**100**	**100**	**100**
Total (N)	**387**	**9,299**	**6,199**

Figure 3.9 presents percentage distribution of households by rating of improved fuel wood stoves. It is observed from the figure that Biomass usage, time taken and smoke pollution had decreased when using improved fuel wood stove with 90.2, 89 and 92.7 percent of households respectively. About 3.7 percent of households showed that there was an increase in biomass usage and time taken. There were households (6.1 percent) that did not notice any difference of smoke pollution and biomass usage.

Figure 3.9: Percentage Distribution of Households by Rating of Improved Fuel wood Stoves, 2017 HECS summer

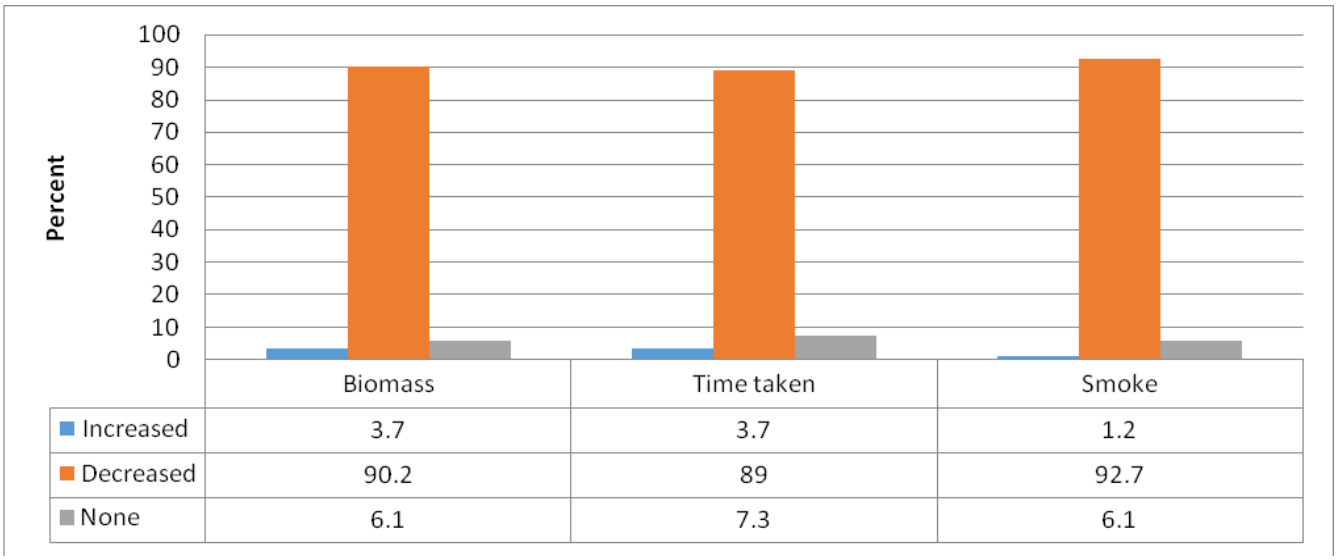
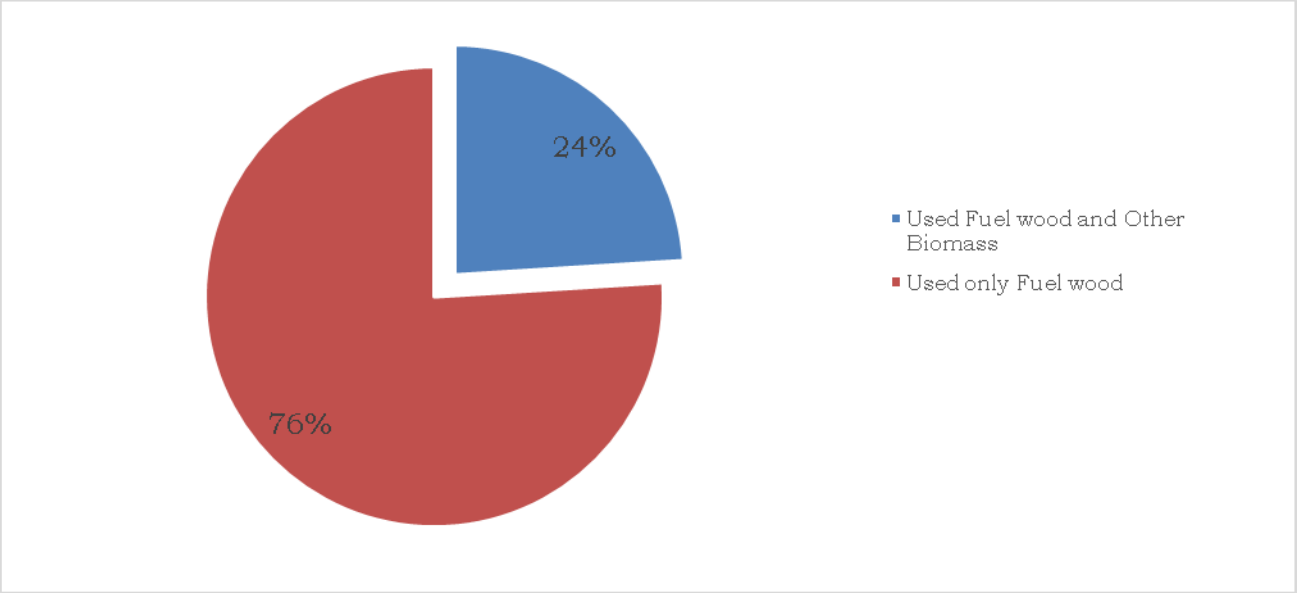


Figure 3.10 portrays percentage distribution of households using other biomass besides Fuel wood for improved fuel wood stoves. The results indicate that 75.6 percent of households used Fuel wood in the improved fuel wood stoves while 24.4 percent used fuel wood and other types of biomass such as animal dung.

Figure 3.10: Percentage Distribution of Households Using Other Biomass Besides Fuel wood for Improved Fuel wood Stoves, 2017 HECS



3.4 Summary

About 62.0 percent of the households used Biomass energy sources. Fuel wood was the most used type of Biomass with 96,539.6 tonnes in winter and 158,155.86 tonnes in winter. Greater share (45.0 percent) of households sources their fuel wood from communal forests. The study also revealed that 3.0 percent of households used the improved fuel wood stoves.

CHAPTER 4: ELECTRICITY

4.0 Introduction

"Electricity is an energy carrier with a very wide range of applications. It is used in almost all kinds of human activity ranging from industrial production, household use, agriculture, commerce for running machines, lighting and heating"(Energy Statistics Manual, IEA Publications, December 2010). It is a very convenient and most preferred form of energy. There are different sources of electricity which are wind, solar, hydro, biomass and coal.

The electricity supply industry in Lesotho is dominated by two state owned entities, namely the Lesotho Electricity Company (LEC), which is the monopoly transmitter, distributor and supplier of electricity, and the Lesotho Highlands Development Authority (LHDA), which is the main generator of electricity through its 'Muela Hydro Power Station. http://www.lewa.org.ls/sectors/default.php. Their mandate is to ensure that all Basotho have access to electricity.

The Lesotho Energy policy of 2015-2025 states that Government will increase access to electricity for all socio-economic sectors to meet electrification targets within the framework of reliability, affordability and efficiency.

4.1 Electricity Connection/access

This section addresses ***SDG 7; indicator 7.1.1: Proportion of households with access to electricity.***

Electricity access refers to the percentage of people in a given area that have relatively simple, stable access to electricity. It can also be referred to as the **electrification rate**. Not all countries and areas have equal access to electricity, and the level of access can be indicative of the development level of the country or area in question. This means that electricity access serves as a good proxy for other indicators of wealth and opportunity in a country. https://energyeducation.ca/encyclopedia/Access_to_electricity. From Lesotho Electricity and Water Authority (LEWA) report of 2015/2016, households' electrification rate was recorded as 42.0 percent.

Figure 4.1 illustrates the Percentage Distribution of households by Electricity Connection. It is noted that the electrification rate of Lesotho from 2017 HECS is 36.9 percent. This was the percentage of households which were electrified. The figure further shows that 63.1 percent of households did not have access to grid electricity.

Figure 4.1: Percentage Distribution of Households by Electricity Connection, 2017 HECS

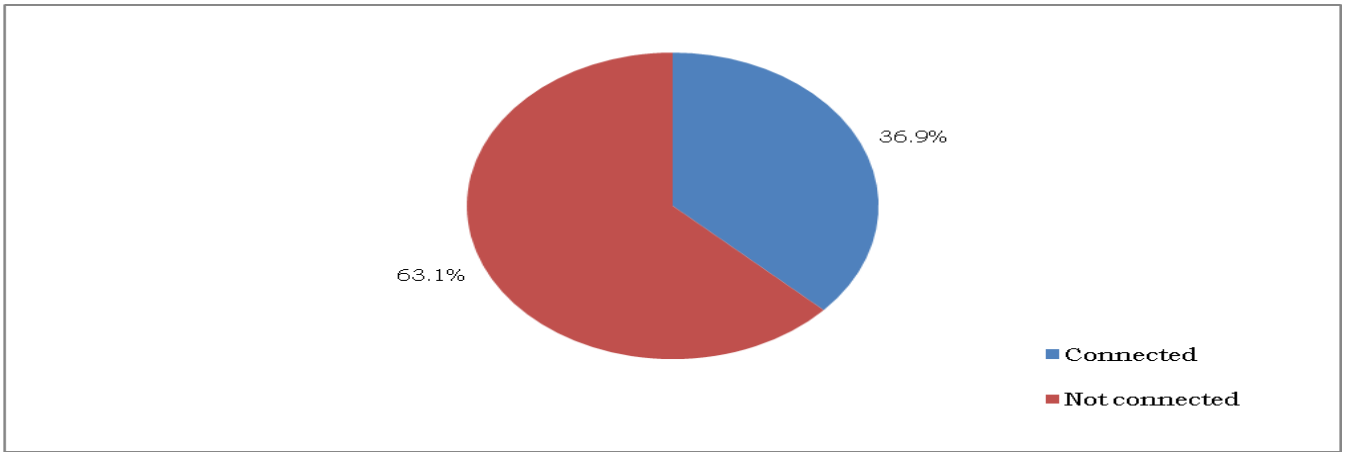


Figure 4.2 displays percentage distribution of households connected to grid electricity by district. It is observed that in Botha-Bothe, 6.8 percent of the households were connected to grid electricity and 11.4 percent in Thaba-Tseka. About 57.2 percent of households in Maseru and 44.5 percent in Berea reported to have access to grid electricity.

Figure 4.2: Percentage Distribution of Households Connected to Grid Electricity by District, 2017 HECS

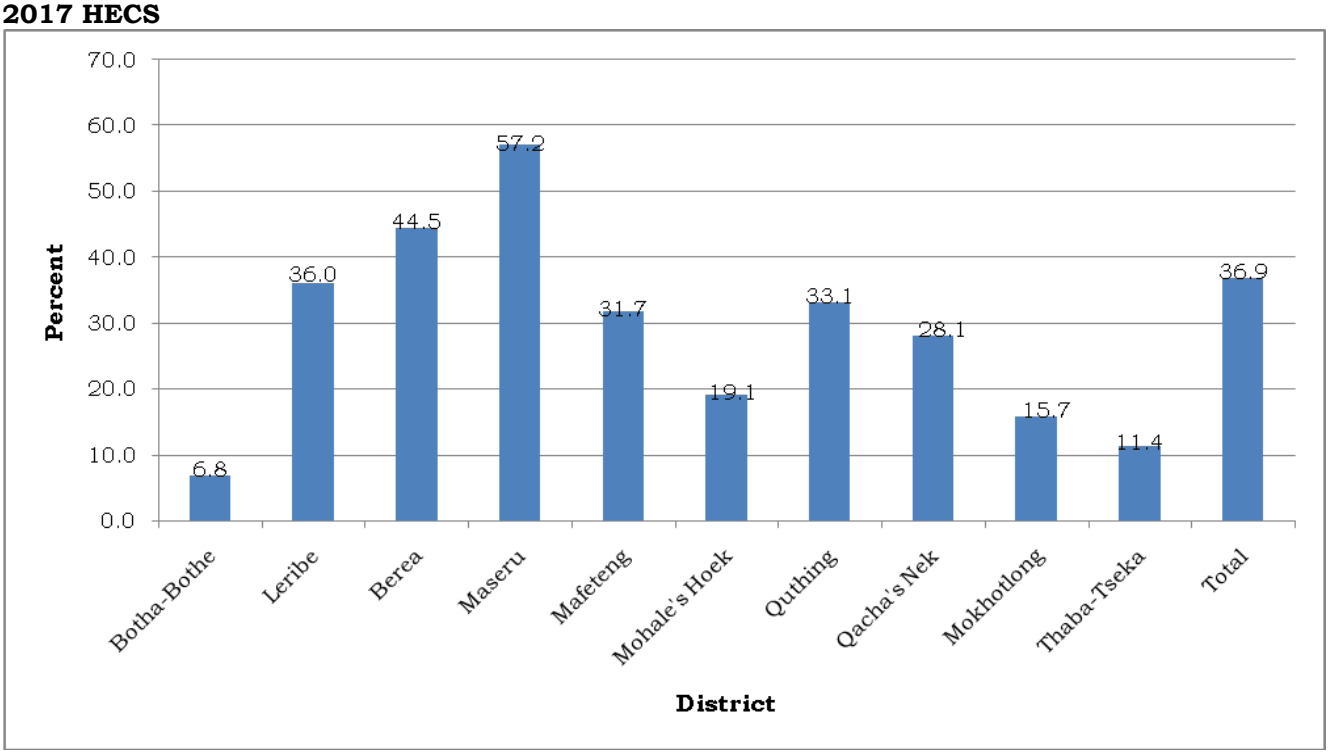


Table 4.1 shows percentage distribution of households connected to grid electricity by settlement. The table presents that 71.3 percent urban households reported to have been connected to grid electricity while 28.7 percent were not connected. About 44.0 percent of peri-urban households were connected to grid while 56.0 percent were not connected. Rural households (11.4 percent) indicated that they were electrified while 88.6 percent were not electrified.

Table 4.1: Percentage Share of Households Connected to Grid Electricity by Settlement, 2017 HECS

Settlement	Connected	Not Connected	Total (%)	Total (N)
Urban	71.3	28.7	100.0	**194,689**
Peri-Urban	44.0	56.0	100.0	**48,430**
Rural	11.4	88.6	100.0	**276,632**
Total	**36.9**	**63.1**	**100.0**	**519,751**

Figure 4.3 illustrates the percentage distribution of households with access to grid electricity by sex. The figure depicts that of all households connected to the grid, 64.9 percent were male headed as compared to 35.1 percent of female- headed households.

Figure 4.3: Percentage Distribution of Households with Access to Grid Electricity by Sex, 2017 HECS

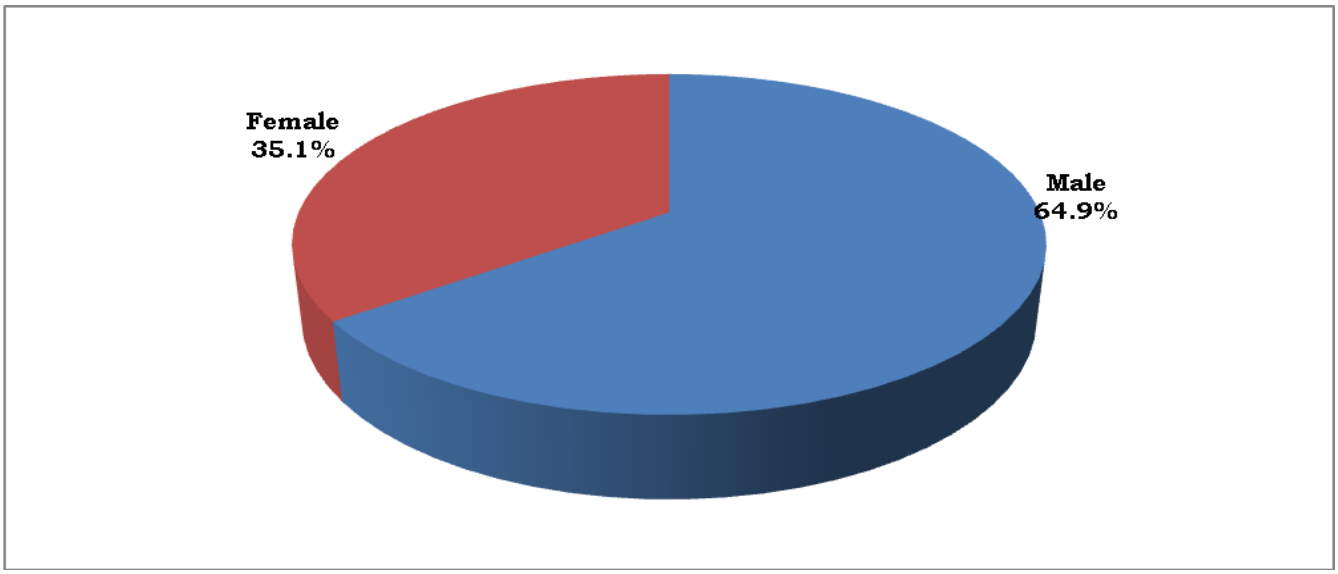


Table 4.2 shows percentage distribution of households' electricity connection and usage. The table presents that 99.6 percent of households was connected and used electricity. The table further explains that 0.4 percent of households was connected but did not use electricity, stating that it is expensive. Furthermore, 1.1 percent of households was not connected but used electricity while 98.9 percent was not connected and did not use electricity

Table 4.2: Percentage Distribution of Households by Electricity Connection and Usage, 2017 HECS-Summer

	Usage			
Connection	**Used**	**Did not use**	**Total (%)**	**Total (N)**
Connected	99.6	0.4	100.0	191,783
Not Connected	1.1	98.9	100.0	327,968
Total	**37.5**	**62.5**	**100.0**	**519,751**

Table 4.3 shows percentage distribution of households by main reason of not being connected to grid electricity and settlement. Most Rural households (85.9 percent) reported to have not been connected to grid electricity because there was "No electricity line" in their areas followed by 8.6 percent which reported lack of connection fee.

The least share of households (0.1 percent) reported to have used conventional off-grid (i.e. diesel generators). In Peri-urban areas, most households (41.4 percent) also reported that there is no electricity line hence not being connected to grid. Most households in urban areas (42.0 percent) reported to have not been connected to grid electricity because of "other" reasons. These "other" reasons include among others rented and disconnection by LEC.

Table 4.3: Percentage Distribution of Households by Main Reason for not being Connected to Grid Electricity by Settlement, 2017 HECS-Summer

	Settlement			
Reason	**Urban**	**Peri-Urban**	**Rural**	**Total (N)**
Lack of funds for wiring	23.6	28.6	3.9	30,414
Lack of funds for connecting	22.9	15.7	8.6	38,163
No electricity line	11.5	41.4	85.9	228,202
Renewable off-grid	0.0	0.0	0.8	1,937
Conventional off-grid	0.0	0.0	0.1	194
Other (Specify)	42.0	14.3	0.7	29,058
Total (%)	**100.0**	**100.0**	**100.0**	**327,968**

4.2 Electricity Usage

Table 4.4 represents percentage distribution of households using grid electricity by district and settlement. It is observed that in all districts the percentage of households not using electricity is greater than that of households using electricity except for Maseru. In Botha-Bothe, 6.8 percent of households use electricity while 93.2 percent do not use electricity. In Berea 44.8 percent used electricity while 55.2 percent did not use it. It is also observed that in Maseru, 58.1 percent of households use electricity and 41.9 percent do not use electricity.

It is further shown that in urban areas, 72.2 percent of households used electricity while 27.8 percent did not use. About 11.3 percent of rural households indicated that they used electricity and 88.7 percent did not use.

Table 4.4: Percentage Distribution of Households Using Grid Electricity by District and Settlement, 2017 HECS-Summer

	Usage					
District	**Using**		**Not using**		**Total (N)**	**Total (%)**
Botha Bothe	1,937	6.8	26,540	93.2	28,477	100.0
Leribe	29,445	36.0	52,304	64.0	81,750	100.0
Berea	31,576	44.8	38,938	55.2	70,514	100.0
Maseru	85,624	58.1	61,797	41.9	147,421	100.0
Mafeteng	16,466	33.7	32,351	66.3	48,817	100.0
Mohale's Hoek	8,136	19.5	33,514	80.5	41,650	100.0
Quthing	8,911	33.1	18,016	66.9	26,927	100.0
Qacha's Nek	4,843	28.1	12,398	71.9	17,241	100.0
Mokhotlong	3,874	15.7	20,728	84.3	24,602	100.0
Thaba Tseka	3,874	12.0	28,477	88.0	32,351	100.0
Total	**194,689**	**37.5**	**325,062**	**62.5**	**519,751**	**100.0**
Settlement						
Urban	140,641	72.2	54,048	27.8	194,689	100.0
Peri-Urban	22,859	47.2	25,571	52.8	48,430	100.0
Rural	31,189	11.3	245,443	88.7	276,632	100.0
Total	**194,689**	**37.5**	**325,062**	**62.5**	**519,751**	**100.0**

4.3 Electricity Acquisition

Table 4.5 depicts number and proportion of households by electricity acquisition. It is observed that 99.5 percent of households obtained the electricity consumed by purchasing it. It is further observed that 0.4 percent received it for free while 0.1 percent obtained it by "payment in-kind".

Table 4.5: Number and Proportion of Households by Electricity Acquisition, 2017 HECS, Summer

Method of Acquisition	Number	Percent
Received for free	775	0.4
Payment in-kind	194	0.1
Purchased	193,720	99.5
Total	**194,689**	**100.0**

Figure 4.4 depicts Percentage Distribution of Households' Electrification method by District in summer. It is observed that in Botha-Bothe all selected households (100 percent) reported to have electrified their houses with individual expenditure. Qacha's Nek had highest connections with Scheme (92.0 percent) and lowest connections (8.0 percent) with Individual Expenditure.

In Mokhotlong two methods of electrification were used which were: Individual expenditure which was the mostly used (95.0 percent) and other methods which were least used (5.0 percent). The other method used was LHDA. Thaba-Tseka used Individual Expenditure mostly (55.0 percent), followed by Government (35.0 percent), then scheme with 10.0 percent.

Figure 4.4: Percentage Distribution of Households by Electrification Method and District, 2017 HECS

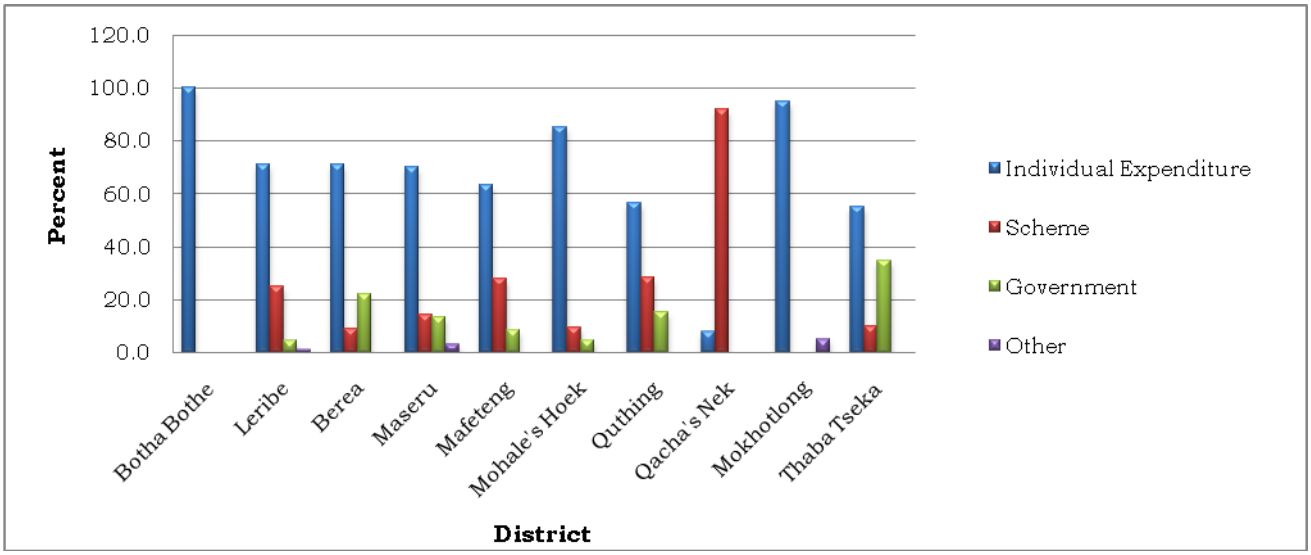


Table 4.6 demonstrates percentage distribution of households by amount spent (Maloti) on electricity in the warm months and settlement. It is detected that in all settlements, most households spent less than M500.00 on electricity. Majority of households (93.2 percent) in Rural areas spent less than M500.00 and the least (0.6 percent) of households spent M1,000.00 - M1,499.99. About 0.6 percent of Urban area households spent a large amount

on electricity which was "M2,500.00+". In Peri-urban areas maximum expenditure was M1,500.00 - M1,999.99 with a share of 1.7 percent.

Table 4.6: Number and Percentage Distribution of Households by Amount Spent (Maloti) on Electricity in the Warm Months and Settlement, 2017 HECS

	Settlement							
Amount Spent	**Urban (N)**	**%**	**Peri-Urban (N)**	**%**	**Rural (N)**	**%**	**Total (N)**	**Total (%)**
Less than M500.00	105,965	75.34	18,597	81.36	29,058	93.17	153,620	78.91
M500.00 - M999.99	20,922	14.88	3,874	16.95	1,937	6.21	26,733	13.73
M1,000.00 - M1,499.99	6,586	4.68	-	-	194	0.62	6,780	3.48
M1,500.00 - M1,999.99	4,456	3.17	387	1.69	-	-	4,843	2.49
M2,000.00 - M2,499.99	1,937	1.38	-	-	-	-	1,937	1.00
M2,500.00+	775	0.55	-	-	-	-	775	0.40
Total	**140,641**	**100.0**	**22,859**	**100.0**	**31,189**	**100.0**	**194,689**	**100.0**

Table 4.7 presents percentage distribution of households by amount spent on electricity and earnings in summer. Most of the households (27.1 percent) who spent "Less than M500.00" on electricity earn M1, 000-M1, 999. About 30.4 percent of households spending M500.00-M999.99 earn M2, 000-M4, 999. The table shows that 34.3 percent of households spending M1, 000.00-M1, 499.99 on electricity receive M5, 000-M9, 999 and M10, 000-M29, 999. Households spending M2, 500.00+ on electricity earn M10, 000-M29, 999.

Table 4.7: Percentage Distribution of Households by Amount Spent on Electricity and Earnings, 2017 HECS

	Amount Spent on Electricity						
Earnings	**Less than M500.00**	**M500.00 - M999.99**	**M1,000.00 - M1,499.99**	**M1,500.00 - M1,999.99**	**M2,000.00 - M2,499.99**	**M2,500.00+**	**Total**
None	10.0	2.9	2.9	0.0	0.0	0.0	**16,272**
Less than M300	2.9	0.0	0.0	0.0	0.0	0.0	**4,456**
M300-M499	5.4	2.9	0.0	0.0	0.0	0.0	**9,105**
M500-M999	17.2	5.8	2.9	4.0	0.0	0.0	**28,283**
M1000-M1999	27.1	10.9	2.9	0.0	0.0	0.0	**44,749**
M2000-M4999	25.7	30.4	20.0	12.0	10.0	25.0	**49,980**
M5000-M9999	9.8	29.0	34.3	20.0	10.0	25.0	**26,540**
M10000-M29999	1.6	15.2	34.3	60.0	80.0	50.0	**13,754**
M30000 and above	0.3	2.9	2.9	4.0	0.0	0.0	**1,550**
Total (%)	**100**	**100**	**100**	**100**	**100**	**100**	
Total (N)	**153,620**	**26,733**	**6,780**	**4,843**	**1,937**	**775**	**194,689**

Figure 4.5 depicts the percentage distribution of households by amount spent on electricity and season. It is observed that households spent more on electricity in winter than in Summer except for those who spent less than M500.00 in summer, most of the households

(78.9 percent) spent less than M500.00 on electricity. The lowest percentage share of households (0.4 percent) spent M2,500.00 and above. In winter majority of households spent less than M500.00 followed by those who spent M500.00 to M999.99 with 20.9 percent.

Figure 4.5: Percentage Distribution of Households by Amount Spent (Maloti) on Electricity and Season, 2017 HECS

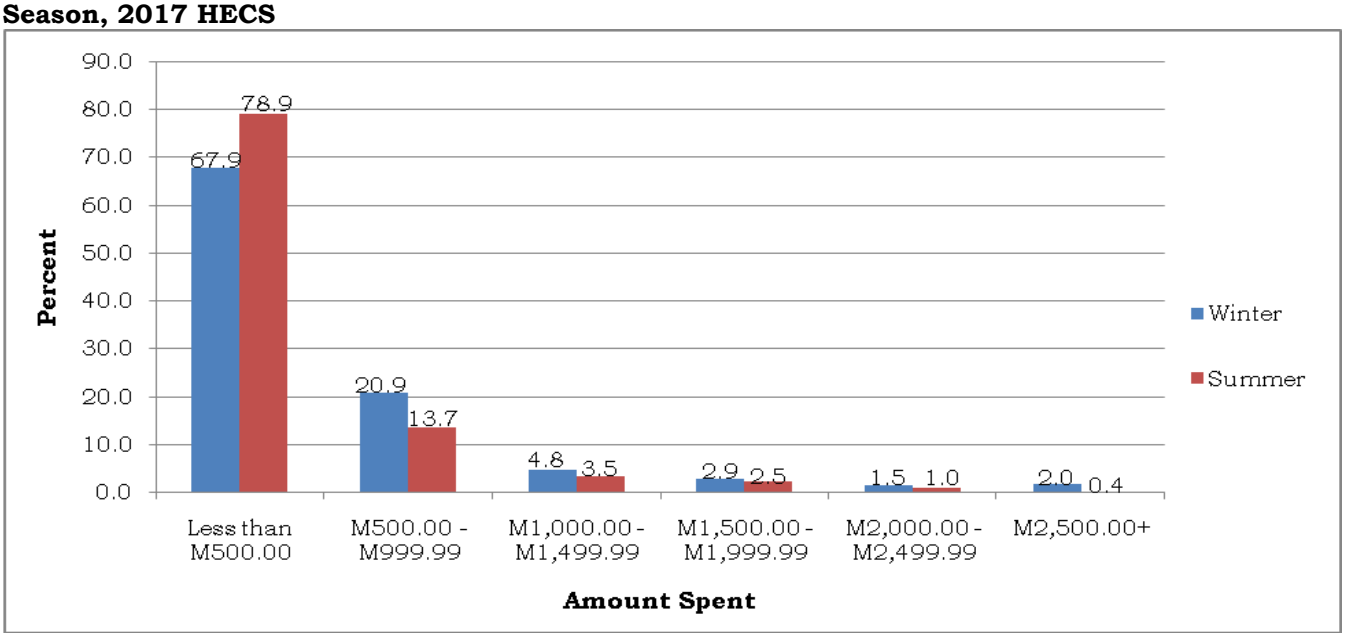


Table 4.8 explains the Percentage distribution of households by electricity usage. It is noted that majority of households used electricity for lighting with 99.5 percent, followed by charging then entertainment with 84.4 and 77.2 percent respectively. Few households used electricity for dishwashing (0.1 percent).

Table 4.8: Percentage Distribution of Households by Electricity usage, 2017 HECS- Summer

Uses	Percent
Cooking/Re-Heating	51.5
Entertainment (e.g. Radio, TV	77.2
Washing	1.9
Lighting	99.5
Ironing	62.2
Dishwashing	0.1
Sewing	1.0
Air-conditioning	0.9
Computer Powering	5.6
Water Pumping	0.3
Refrigeration	56.5
Charging	84.4
Space Heating	2.6
Water Heating	62.5
Workshop (welding, carpentry, etc)	0.3
Other	0.4

4.4 Improvements as a Result of Electrification

Table 4.9 shows the percentage distribution of households with improvements as a result of electrification for summer. Majority of households (82.0 percent) reported to have noticed an improvement in lighting followed by entertainment (61.4 percent). The lowest percentage share of households (1.1 percent) was able to do income generating activities due to electrification.

Table 4.9: Percentage Distribution of Households with Improvements as a Result of Electrification, 2017 HECS

Improvements	Percent	Total
Improved Lighting	82.0	160,013
Water Heating	48.5	94,535
Faster Cooking	35.1	68,383
Entertainment (TV, Radio)	61.4	119,719
Space heating/Air conditioning	1.9	3,681
Initiated income generating activities	1.1	2,131
None	16.8	32,739
Other	2.9	5,618
Total		**195,076**

Table 4.10 describes percentage distribution of households by ownership of appliances in the warm months. The mostly owned appliance was a television (70.8 percent) followed by iron then kettle with 61.7 and 59.7 percent respectively. Dishwasher was owned by 0.1 percent of households. 15.5 percent of households reported to have had other appliances which included among others, radio, DVD player and sewing machine. Some of the households (7.7 percent) reported to have had no appliances.

Table 4.10: Percentage Distribution of Households by Ownership of Appliances, 2017 HECS

Appliances	Percent	Total (N)
Refrigerator	56.2	109,646
Electrical Geyser	5.9	11,429
Chest/Deep Freezer	1.5	2,906
Electric stove	44.9	87,561
Electric Heater	3.4	6,586
Washing Machine	2.0	3,874
Dishwasher	0.1	194
Hoover	0.4	775
Hair Dryer	6.4	12,398
Television	70.8	138,122
Desktop Computer	2.1	4,068
Laptop	7.1	13,754
Air Conditioner	0.7	1,356
Iron	61.8	120,494
Electric kettle/element	59.7	116,426
Bread Maker	2.1	4,068
Toaster	7.0	13,560
Microwave	31.7	61,797
Electrical Pot	1.5	2,906
Electrical Hair Clipper	8.5	16,660
None	7.7	15,110
Other	15.5	30,220
Total (N)		**195,076**

4.5 Electricity Consumption

Table 4.11 represents total and average electricity consumption of appliances per day in kilowatt hours (kWh) in summer. It is observed that the largest total consumption was for refrigerators with 526,627.37 KWh per day, followed by stove and geyser with 281,519.55 and 171,928.44 KWh respectively. The lowest total consumption was for a hoover with 108.16 KWh. The largest average consumption was for geyser with 15.04 KWh and the lowest was for hair clipper with 0.01KWh per day.

Table 4.11: Total and Average Electricity Consumption of Appliances per day in KWh, 2017 HECS

Appliance	Total Consumption	Average Consumption
Refrigerator	526,627.37	4.69
Electrical Geyser	171,928.44	15.04
Chest/Deep Freezer	19,192.23	6.60
Electric stove	281,519.55	3.20
Electric Heater	25,521.96	3.56
Washing Machine	5,757.10	1.29
Dishwasher	1,782.22	9.20
Hoover	108.16	0.14
Hair Dryer	6,900.14	0.56
Television	94,029.83	0.66
Desktop Computer	2,362.32	0.61
Laptop	4,302.91	0.27
Air Conditioner	1,879.08	1.39
Iron	58,159.86	0.48
Electric kettle/element	97,280.05	0.84
Bread Maker	9,937.84	2.44
Toaster	3,325.37	0.24
Microwave	20,862.77	0.33
Electrical Pot	3,505.69	1.13
Electrical Hair Clipper	122.95	0.01
Other	12,594.61	0.39
Total	**1,347,700.45**	

4.6 Summary

The electrification rate of the country from the 2017 HECS was recorded as 36.9 percent. About 71.3 percent Urban, 11.4 percent Rural and 44.0 percent Peri-Urban households indicated that they were had access to electricity. Most households electrified their households through individual expenditure in all the districts of Lesotho. Most households spent less than M500.00 on electricity in both summer (78.9 percent) and winter (67.9 percent).

A geyser consumed an average of 15.04 kWh of electricity per day and hair clipper consumed 0.01 kWh on average per day. Most of the appliances consumed less than 3 kWh per day.

CHAPTER 5: PETROLEUM PRODUCTS

5.0 Introduction

This chapter reports on "access to automobiles" for the specified season of the year. Only light-duty passenger vehicles and reaction vehicles are included in this report. One could rent or have the permission of another party to use a vehicle or solar photovoltaic system during a specified season of the year. Besides "access" there are more words used in this part of the report like "fuel" and "lubricants".

Since the start of the twentieth century, the role of the car has become highly important through controversial, Erik Ackermann (2001). Ackermann argue that, car is used throughout the world and has become popular mode of transport in the more developed countries though its effects is not more visible but significant in the developing countries.

The development of the car built upon the transport sector first started by railways. The modern negative consequences of the heavy automotive use include the use of non-renewable fuels, a dramatic increase in the rate of accidental death. According to WHO data published in 2017, road traffic accidents in Lesotho reached 558 or 2.16 percent of the total deaths. The adjusted death rate is 26.76 per 100,000 of population, which ranks Lesotho number 49 in the world. Moreover, the modern negative consequences of the heavy automotive leads to the disconnection of the local community, the rise in obesity and cardiovascular diseases, the emission of the air and noise pollution and the emission of greenhouse gases. Other research argue that, the development of the car has contributed to changes in employment distribution, shopping patterns, social interactions, manufacturing priorities and city planning.

5.1 Access to Car

"Access to car" means opportunity to enter or have permission to use a vehicle regardless of ownership.

About 17.9 percent of households had access to car in summer within urban areas whereas 16.2 percent of such households were observed within the same settlement in winter. The table further shows that households who had access to car in peri-urban in summer accounted for 7.6 percent while in winter 5.6 percent was observed. Percentage of households who had access to car in winter and summer was 3.2 percent and 2.9 percent respectively in rural areas. Generally, a large percentage of households had no access (over 80%) to car.

Table 5.1: Percentage Distribution of Households with Access to Car by Settlement and Season, 2017 HECS

	Settlement					
	Summer			Winter		
Access	**Urban**	**Peri-Urban**	**Rural**	**Urban**	**Peri- Urban**	**Rural**
YES	17.9	7.6	2.9	16.2	5.6	3.2
NO	82.1	92.4	97.1	83.8	94.4	96.8
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**194,689**	**48,430**	**276,632**	**210,961**	**51,723**	**286,899**

5.1.1 Total Fuel used

Fuel is any material that can be made to react with other substances so that it releases energy as heat energy or to be used for work. Fuel is classified into categories such as Diesel 50ppm, Diesel 500ppm and Unleaded petrol.

Table 5.2 shows percentage distribution of households by income and expenditure on fuel per month. It is observed from the table that most households spend less than M1,000.00 on fuel per month. It is observed that 30.49 percent of the households that spend less than M1,000.00 per month earn between M2,000.00 and M4,999.00, followed by 20.73 percent of households that earn between M5,000.00 and M9,999.00. The table also shows that 59.96 percent of households that earn between M10,000.00 and M29,999.00 spend M4,000.00 and above on fuel per month.

Table 5.2: Percentage Distribution of Households by Income and Expenditure on Fuel per Month

	Money Used On Fuel				
Household Earnings	**Less than M1000**	**M1000 - M1999**	**M2000 - M2999**	**M3000 - M3999**	**M4000 and Above**
None	3.66	6.44	0.00	0.00	0.00
Less than M300	4.88	3.23	0.00	0.00	0.00
M300-M499	4.88	0.00	0.00	0.00	0.00
M500-M999	4.88	3.23	0.00	0.00	0.00
M1000-M1999	17.07	12.91	9.10	25.00	0.00
M2000-M4999	30.49	19.35	45.45	25.00	0.00
M5000-M9999	20.73	35.49	45.45	25.00	40.04
M10000-M29999	8.54	19.35	0.00	25.00	59.96
M30000 and above	4.88	0.00	0.00	0.00	0.00
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**15,885**	**6,005**	**2,132**	**1,548**	**969**

Table 5.3 presents total fuel used by cars for household mobility by districts, fuel type and season. The table shows that Unleaded (7,840,748.00 litres) and Diesel 500ppm (743,032.00 litres) were mostly consumed in winter seasons whereas Diesel 50ppm (602,817.90 litres) was mostly consumed in summer season. The table also shows that all these types of fuel were mostly consumed in Maseru districts in almost all the seasons except Diesel 500ppm (46,105.36 litres) in summer. The table shows that in Qacha's Nek, households that were selected did not use Diesel 50ppm in winter and in summer they did not use Diesel 500ppm and Unleaded petrol.

Table 5.3: Total Fuel Used by Cars for Household Mobility by Districts, Fuel Type and Season, 2017 HECS

	Total Fuel (Litres) Used					
	Diesel 50ppm		Diesel 500ppm		Unleaded Petrol	
Districts	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**
Botha Bothe	3,909.27	775.00	0.00	0.00	143,176.51	88,530.00
Leribe	39,131.44	13,948.00	0.00	29,058.00	731,420.86	1,273,205.00
Berea	78,456.60	118,556.00	219,484.76	210,185.00	745,608.91	1,603,052.00
Maseru	202,049.96	214,448.00	46,105.36	333,974.00	2,501,130.55	3,094,048.00
Mafeteng	5,811.60	33,320.00	0.00	0.00	320,606.60	470,643.00
Mohale's Hoek	84,074.48	58,116.00	3,448.22	156,913.00	195,870.29	524,594.00
Quthing	17,434.80	19,372.00	0.00	0.00	524,454.28	259,972.00
Qacha's Nek	58,116.00	0.00	0.00	8,059.00	0.00	4,029.00
Mokhotlong	96,398.95	112,358.00	0.00	4,843.00	178,997.28	80,995.00
Thaba Tseka	17,434.80	0.00	10,751.46	0.00	26,345.92	441,681.00
Total	**602,817.90**	**570,893.00**	**279,789.80**	**743,032.00**	**5,367,611.20**	**7,840,748.00**

Table 5.4 presents total fuel used by car for household mobility by type of fuel and ecological Zone in summer. The table shows that unleaded petrol was the most used fuel for household mobility with 5,367,611.20 litres, followed by Diesel 50ppm with 602,817.90 litres. The least is Diesel 500ppm with 279,789.80 litres. Evidently Unleaded petrol is the most used fuel in all ecological zones while Diesel 50ppm is only used in Lowlands (406,459.443 litres) and Mountains (196,358.47 litres).

Table 5.4: Total Fuel Used by Car for Household Mobility by Type of Fuel and Ecological Zone, 2017 HECS, Summer

	Total Fuel (Litres) Used				
Household Mobility	**Lowlands**	**Foothills**	**Mountains**	**S.R.V.**	**Total**
Diesel 50ppm	406,459.43	0.00	196,358.47	0.00	**602,817.90**
Diesel 500ppm	265,590.12	3,448.22	10,751.46	0.00	**279,789.80**
Unleaded Petrol	4,409,611.56	170,861.04	309,177.12	477,961.48	**5,367,611.20**

5.1.2 Amount of Lubricants

Lubricants are substances, usually organic, introduced to reduce friction between surfaces in mutual content, which ultimately reduces the heat generated when the surfaces move. They also have the function of transmitting forces, transporting foreign particles, or heating or cooling the surfaces (*https://en.wikipedia.org/wiki/lubricant*). Lubricants are classified into categories such as Motor oil, Brake fluid, Grease and other lubricants known by the household enumerated at the time of the survey.

Table 5.5 shows amount of lubricants (Litres/Kilogram) by ecological zone and type of lubricants used in summer. Lubricants used for household mobility were motor oil (93,204.50 litres), brake fluid (9,695.69 litres), other lubricants (3,002.66 litres) and least grease (1,356.04 kilo grams). A great amount of lubricants were used in the lowlands

followed by the mountains. Other lubricants (3,002.66 litres) include different types of transmission fluids not specified.

Table 5.5: Amount of Lubricants (Litres/Kilogram) by Ecological Zone and Type of Lubricants Used, 2017 HECS

	Type of Lubricants			
Ecological Zone	**Motor Oil(L)**	**Brake Fluid(L)**	**Grease(Kg)**	**Other Lubricant(L)**
Lowlands	78,505.03	7,671.31	387.44	2,808.94
Foothills	3,680.68	77.49	0.00	193.72
Mountains	6,466.37	687.71	968.60	0.00
S.R.V.	4,552.42	1,259.18	0.00	0.00
Total	**93,204.50**	**9,695.69**	**1,356.04**	**3,002.66**

5.2 Generators

Generator refers to a synchronous system generally powered by internal combustion engines which can establish an electricity grid and therefore operate as a voltage source. The typical nominal values are 230v at 50Hz for portable generators mostly used in households. The necessary configuration tools to regulate the idle speed of a generator are voltage and frequency. A well functional generator must be able to provide a stable grid; it must be capable of establishing electricity and supplying loads. However there may be some restrictions with regard to the power balance in the system. http://en.sma-jobblog.com/en/generator-settings-on-the-sunny-island-for-off-grid-system/

5.2.1 Generator Ownership

Households who own generators use it to power appliances which do not require a critical power domain.

Table 5.6 shows the percentage distribution of households owning a functional generator by districts, zones and settlement in summer. With reference to the table, the highest percentage of households who owned generators are mostly in rural areas (84.7) and, 66.7 are from the lowlands. Generators were mostly owned in the districts of Leribe (25.0), followed by Botha-Bothe (23.6) and Berea (15.3).

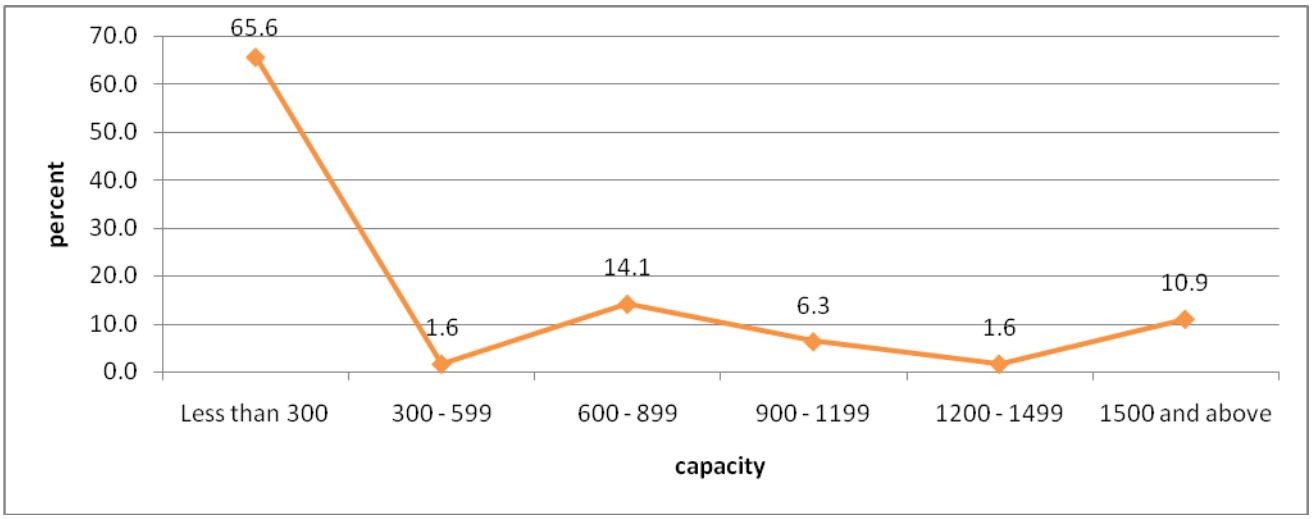
Table 5.6: Percentage Distribution of Households Owning a Functional Generator by Districts, Zones and Settlement, 2017 HECS

	Generator Ownership	
District	**Yes**	**No**
Botha Bothe	23.6	5
Leribe	25	15.4
Berea	15.3	13.5
Maseru	11.1	28.9
Mafeteng	9.7	9.4
Mohale's Hoek	2.8	8.1
Quthing	8.3	5.1
Qacha's Nek	1.4	3.4
Mokhotlong	1.4	4.8
Thaba Tseka	1.4	6.3
Total (%)	**100.0**	**100.0**
Total (N)	**13,948**	**506,578**
Zone		
Lowlands	66.7	65.7
Foothills	18.1	7
Mountains	9.7	17.7
Senqu River Valley	5.6	9.6
Total (%)	**100.0**	**100.0**
Total (N)	**13,948**	**506,578**
Settlement		
Urban	11.1	38.3
Peri-Urban	4.2	9.4
Rural	84.7	52.3
Total (%)	**100.0**	**100.0**
Total (N)	**13,948**	**506,578**

5.2.2 Generator Capacity

Figure 5.1 shows percentage distribution of households by a generator capacity. The results reveal that the highest percentage of households (65.6) own generators with power rating less than 300 Watts. About 10.9 percent of households own generators with power rating 1500 and above.

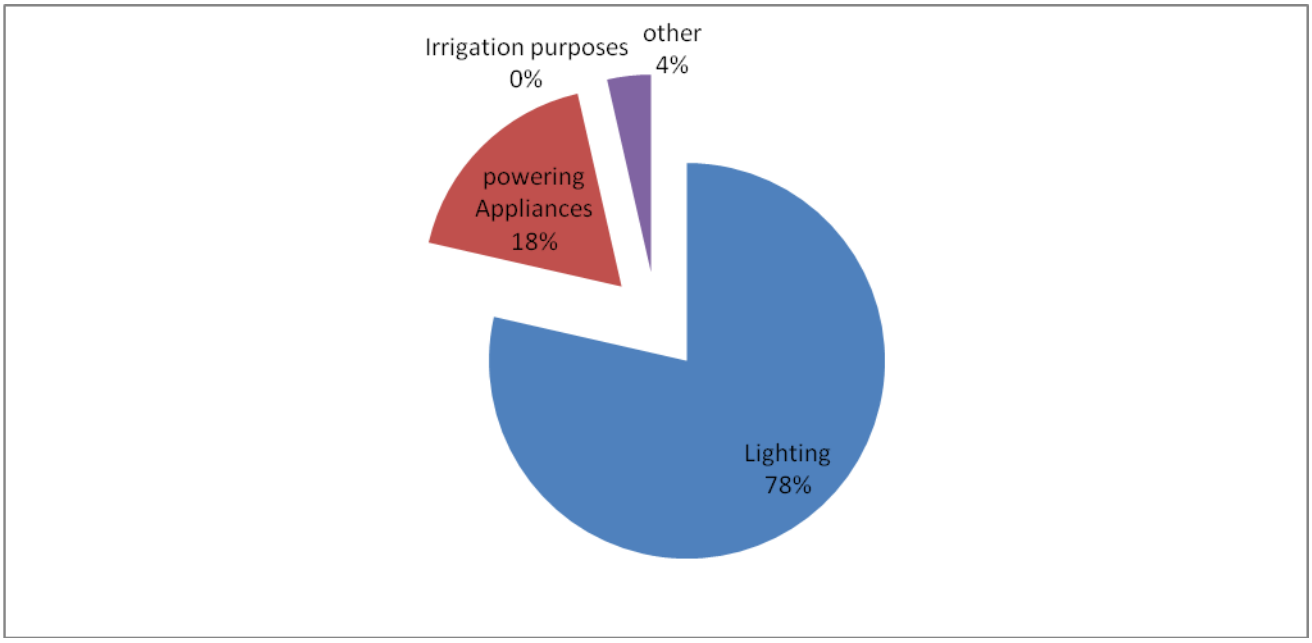
Figure 5.1: Percentage Distribution of Households by a Generator Capacity, 2017 HECS-Summer



5.2.3 Generator Purpose

Figure 5.2 depict percentage distribution of households by purpose of a generator. The figure reveal that the highest percent of households used generators for lighting (78.0) followed by those who used generators for powering appliances (18.0) and the least percent is of households who used generators for other purposes. None of the households indicated usage of generators for irrigation.

Figure 5.2: Percentage Distributions of Households by Purpose of a Generator, 2017 HECS-Summer

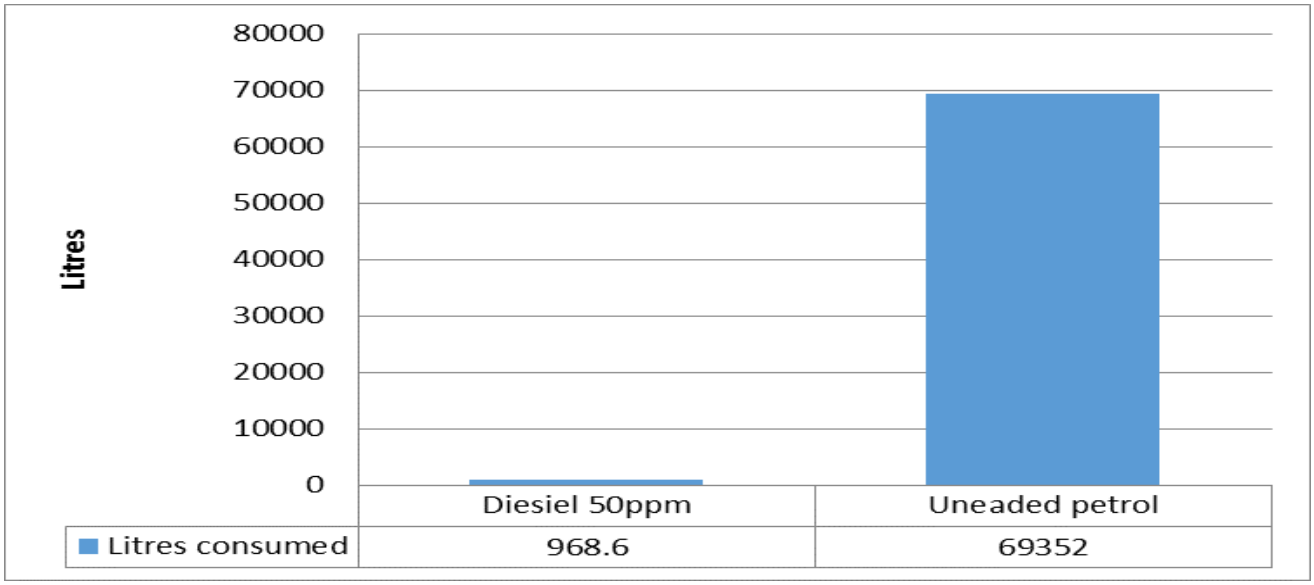


5.2.4 Type and Quantity of Fuel Used by Generator

Fuel used in generators differs according to generator specifications, some use petrol and some diesel.

Figure 5.3 depicts the type of fuel use by litres consumed. Most generators used unleaded petrol (69,352 litres), and the least type of fuel used was diesel 50 ppm with 968.6 litres.

Figure 5.3: Type of Fuel Use by Litres Consumed, 2017 HECS-Summer



5.3 Summary

It was observed that most households had no access to car (91.0 percent). Of the 9.0 percent of households that had access to car, more were from the Lowlands (85.1 percent) and least from Senqu River Valley (3.3 percent). It was observed that unleaded petrol (4,206,806.09 litres) was more consumed in Lowlands and least consumption was observed in Foothills (135,991.44 litres). It was observed that diesel 50ppm consumption (406,459.43 litres) was high in Lowlands and was followed by Mountainous consumption with 196,358.47 litres. It was also observed that more households living in the mountains use grease (968.60 grams) as their lubricant followed by those living in the Lowlands with 387.44 grams.

Generally, people who own generators are mostly in rural areas. Most generators used unleaded petrol (69,352 litres), and the least type of fuel used was diesel 50 ppm with 968.6 litres. Most households reported to have used generators for lighting.

CHAPTER 6: COOKING

6.0 Introduction

Cooking is one of the activities in a household that uses a lot of energy; therefore it is important and fitting to look into the cooking habits at the respective households. Equally important is the type of energy sources used, whether traditional or modern energy and methods of cooking. Traditional energy sources and cooking methods that include the traditional burning of fossil energy sources that have been heavily criticized on the adverse impacts they have to the environment and contribute significantly to the ongoing global warming.

Modern energy sources and methods of cooking are very important to the overall energy access. Moreover, modern energy sources and methods of cooking help reduce health implications to the users and they are more environmentally friendly and sustainable. The key and fundamental parameters of interest were; main and alternative sources of energy used, the time taken to cook food, and the kind of food usually cooked at the household for breakfast, lunch and dinner. Lastly the technique used to cook food at different times of the day (Swaziland report, 2014).

6.1 Sources of Energy for Cooking

This section will address ***SDG 7 indicator 7.1.2D: Proportion of households with reliance on clean fuels (LPG and Electricity) and technology by source.***

Figure 6.1 presents the percentage distribution of main sources of energy used for cooking by season. The figure reveals that more households used LPG (29.9 percent in winter and 31.2 percent in summer) and wood (31.2 percent in winter and 27.5 percent in summer) as the main sources of energy used for cooking. Animal dung follows with 10.8 and 13.1 percent of the households in winter and summer respectively.

Figure 6.1: Percentage Distribution of Households by Main Source of Energy used for Cooking and Season, 2017 HECS

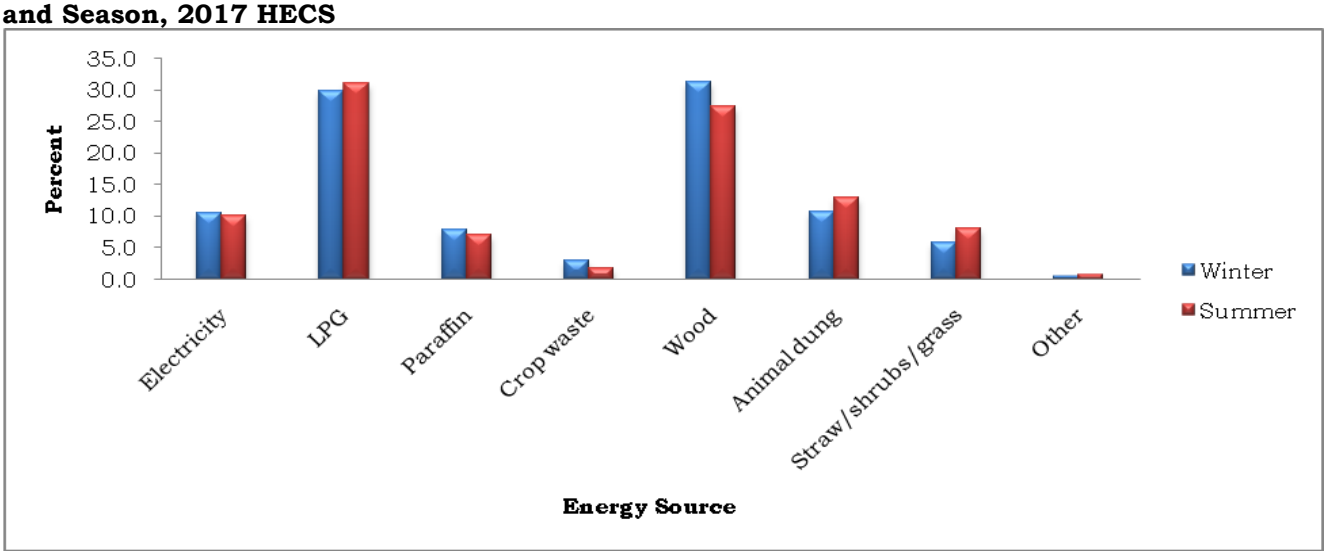


Table 6.1 presents the percentage distribution of households by main source of energy for cooking and settlement in summer. It is observed that Electricity, LPG and Paraffin were the main sources used for cooking at the Urban areas with 87.4, 67.5 and 63.2 percent respectively. It is also observed that Biomass was mainly used in the Rural areas than in

other settlements with 88.6 percent for both Animal dung and Straw/Shrubs/Grass, 84.5 percent for Wood and 80.0 percent for Crop Waste. Other energy sources (70.8 percent) were also used mostly in the urban areas.

Table 6.1: Percentage Distribution of Households by Main Source of Energy for Cooking and Settlement, 2017 HECS

Main Source of Energy	Urban	Peri-Urban	Rural	Total (N)
Electricity	87.4	5.9	6.7	**52,304**
LPG	67.5	11.4	21.1	**162,144**
Paraffin	63.2	13.0	23.8	**37,388**
Crop Waste	14.0	6.0	80.0	**9,686**
Wood	5.0	10.4	84.5	**142,772**
Animal dung	6.8	4.5	88.6	**68,189**
Straw/ shrubs/ grass	4.1	7.3	88.6	**42,618**
Other	26.3	10.5	70.8	**3,681**

Figure 6.2 portrays the percentage distribution of households by alternative sources of energy used for cooking. It is observed from this figure that a large percentage of households used Paraffin (29.6 percent) as an alternative source of energy for cooking. LPG and animal dung followed with 9.8 and 9.7 percent respectively. "Other" alternative source was the least used with 0.9 percent of households. 32.2 percent of the households reported they did not have an alternative source of cooking.

Figure 6.2: Percentage Distribution of Households by Alternative Sources of Energy used for Cooking, 2017 HECS- Summer

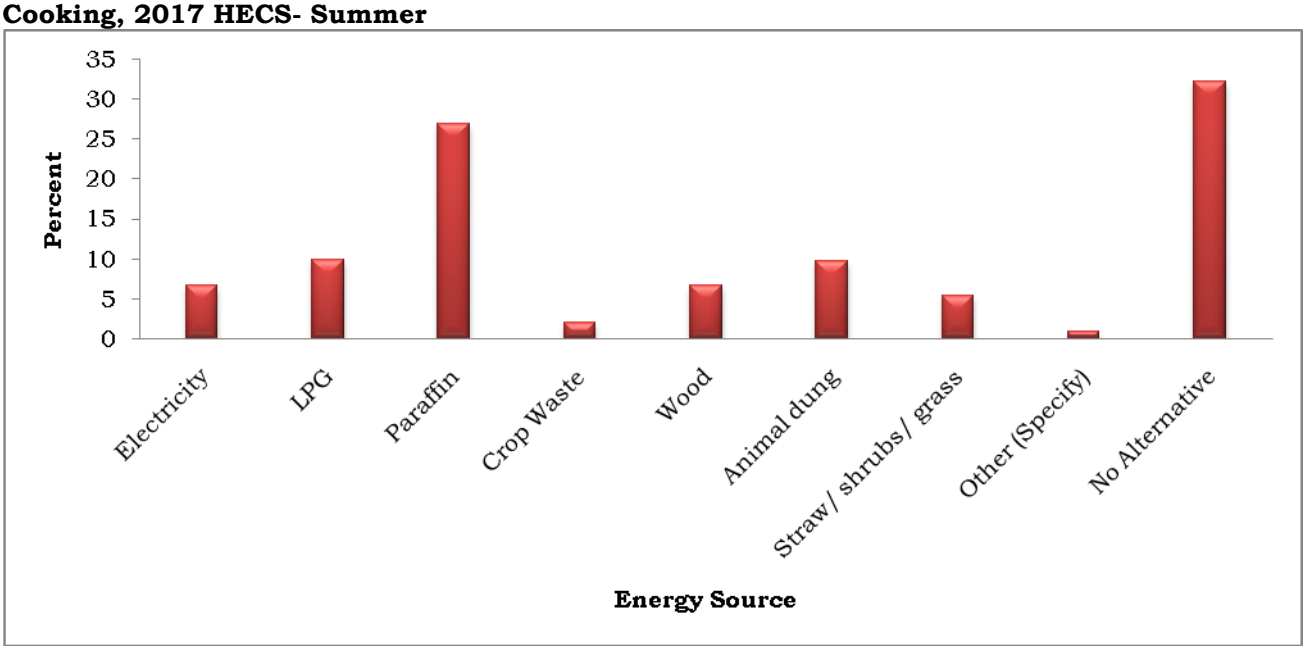


Table 6.2 shows the percentage distribution of households by main and alternative sources of energy for cooking and settlement type. The findings show that the main energy sources for cooking in urban areas were LPG (56.2 percent) and Electricity (23.5 percent) and the least energy sources used for cooking was "Other" sources of energy with 0.5 percent. It also

shows that more of the households in Peri-urban used LPG (38.0 percent) as the main source of energy for cooking.

The findings further show that contrary to the trend, observed in urban and peri-urban areas, the main energy source for cooking in rural areas was Wood (43.6 percent) and "Other" (1.2 percent) was the least used main energy source for cooking. Moreover, it shows that in all the settlements, the dominant alternative source of energy used for cooking was Paraffin with 32.8, 32.3, and 22.0 percent of the households in Peri-Urban, Urban and Rural settlement respectively.

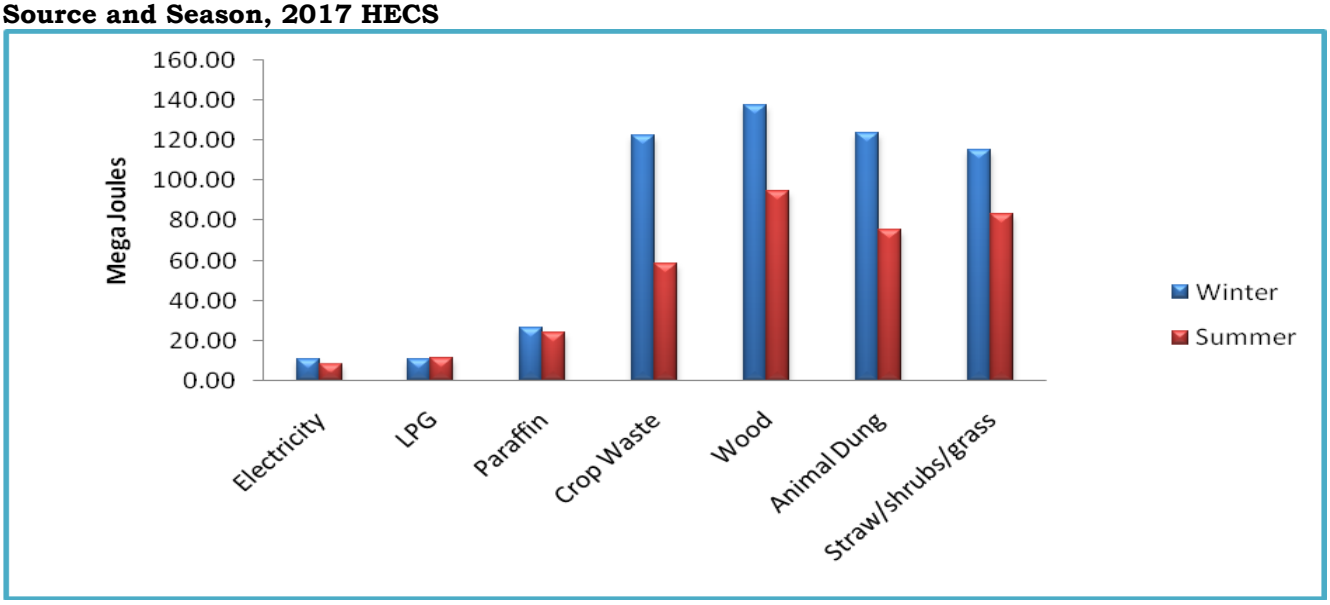
Table 6.2: Percentage Distribution of Households by Main and Alternative Sources of Energy for Cooking and Settlement Type, 2017 HECS- Summer

	Urban		Peri-Urban		Rural	
Source of Energy	**Main**	**Alternative**	**Main**	**Alternative**	**Main**	**Alternative**
Electricity	23.5	12.1	6.4	10.0	1.3	2.1
LPG	56.2	5.2	38.0	9.6	12.4	13.1
Paraffin	12.1	32.3	10.0	32.8	3.2	22.0
Crop Waste	0.7	0.5	1.2	3.2	2.8	2.8
Wood	3.7	2.8	30.8	9.2	43.6	9.0
Animal dung	2.4	2.0	6.4	5.2	21.8	15.8
Straw/ shrubs/ grass	0.9	0.8	6.4	2.8	13.7	8.8
Other (Specify)	0.5	0.0	0.8	0.0	1.2	1.6
Total (%)	**100.0**	**55.7**	**100.0**	**72.8**	**100.0**	**75.4**
Total (N)	**194,689**	**194,689**	**48,430**	**48,430**	**276,632**	**276,632**

6.2 Quantity (MJ) of Energy Used per Day

Figure 6.3 illustrates average amount of energy in Mega Joules (MJ) used for cooking per day by energy source and season. It is observed that more energy was used in winter than in summer for cooking per day. The figure also depicts on average more energy was produced from Wood (137.82MJ) in winter and 94.88MJ in summer, while less energy (13.91 and 8.33 MJ) produced from Electricity per day in both winter and summer respectively.

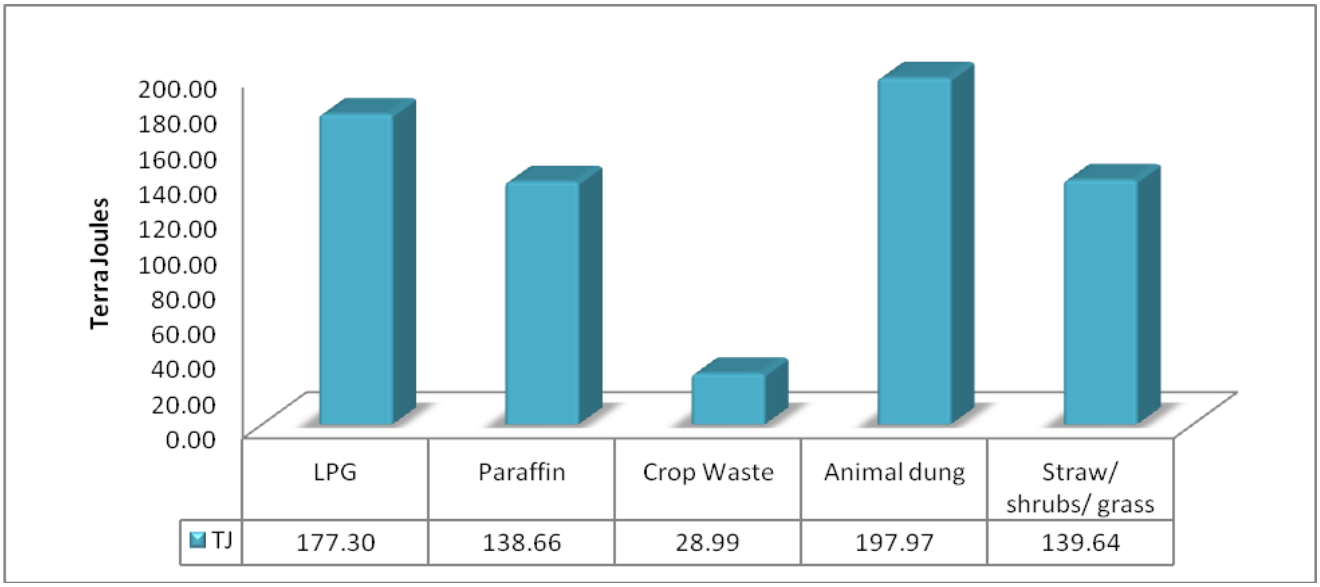
Figure 6.3: Average Amount of Energy in Mega Joules Used for Cooking per Day by Energy Source and Season, 2017 HECS



6.3 Quantity (TJ) of Energy Used per Month

Figure 6.4 shows the sources of energy for cooking per month by quantity in Tera Joules (TJ)in summer. The table shows that of all the energy sources used for cooking, more energy (197.97 TJ per month) was obtained from Animal dung, followed by energy from LPG with 177.30 TJ per month while the least energy (28.99 TJ per month) was obtained from Crop waste.

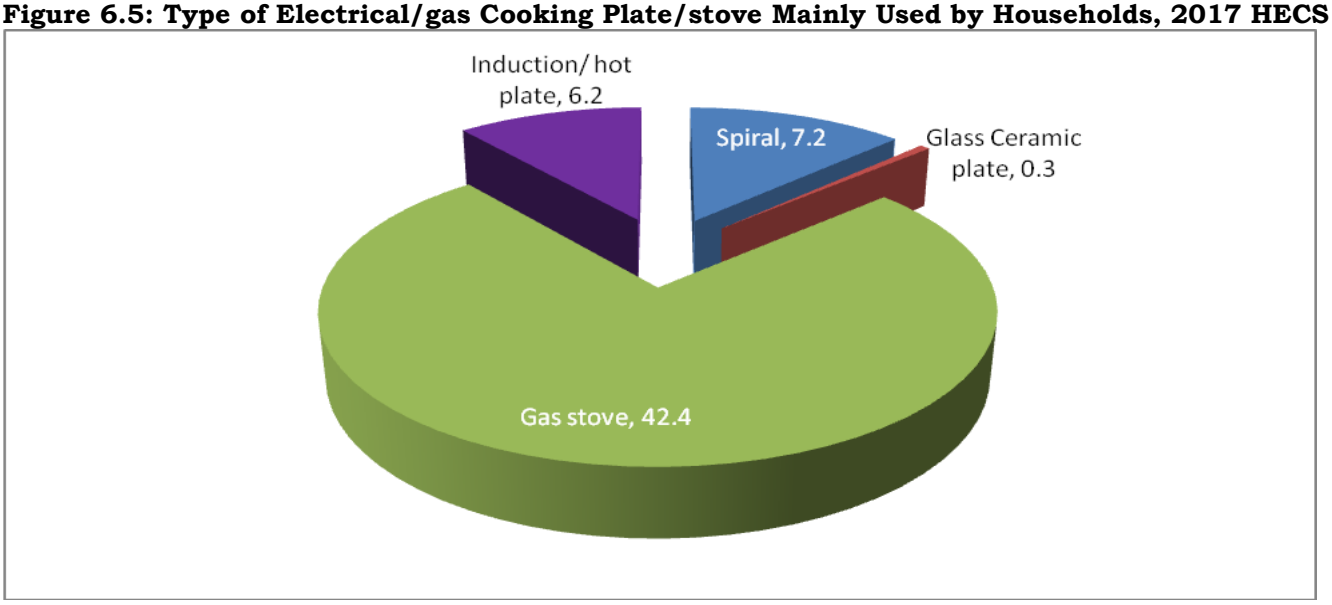
Figure 6.4: Sources of Energy for Cooking per Month by Quantity in Tera Joules (TJ), 2017 HECS



6.4 Electrical/gas Stove Used for Cooking

Figure 6.5 portrays the type of electrical/gas cooking plate/stove mainly used by the households in summer. It is observed that most of the households (42.4 percent) mainly used Gas stove for cooking, followed by spiral with 7.2 percent. Only 0.3 percent of the households used glass ceramic stove.

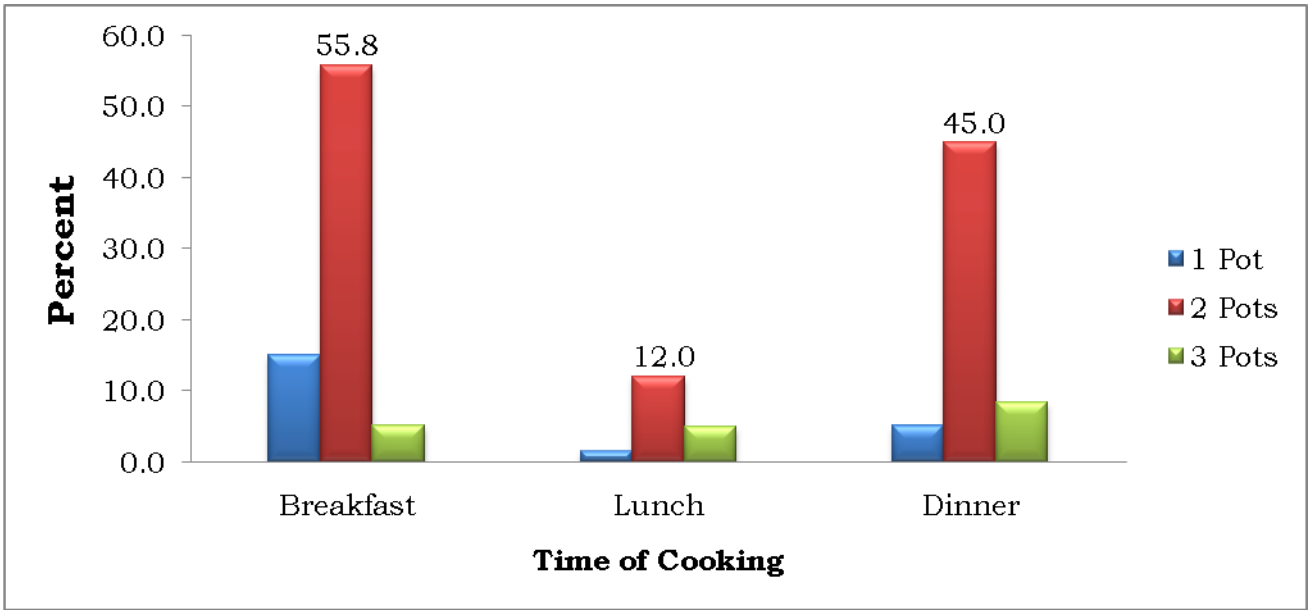
Figure 6.5: Type of Electrical/gas Cooking Plate/stove Mainly Used by Households, 2017 HECS



6.5 Cooking Pots Used

Figure 6.6 depicts the number of pots used at the time of cooking in summer. It is observed that a large proportion of households (55.8, 45.0 and 12.0 percent for breakfast, dinner and lunch respectively) used two pots at the time of cooking. The least proportion of households cooked lunch with 1.6, 12.0 and 5.1 percent using one, two and three pots respectively.

Figure 6.6: Number of Pots Used at the Time of Cooking, 2017 HECS



6.6 Daily Diets

Food commonly cooked for breakfast included; bread, eggs, porridge, papa, moroho, meat. Other types of food were also cooked though not often; russians, soup, vienna, and fish (tinned).

Food commonly cooked for lunch and dinner included; papa, moroho, beans, tomato/gravy, meat, eggs, rice. Other types of food were also cooked though not often; Russians, soup, fish (tinned), wors, milk, peas, and potatoes.

6.7 Cooking Techniques

Table 6.3 presents type of technique used for preparing food for breakfast/lunch/ dinner in summer. Majority of the households (66.7, 66.2 and 17.6 percent) simmered food for breakfast, dinner and lunch respectively. Other households boiled food for breakfast (42.8 percent) and dinner (36.3 percent) and fried food for lunch frying (11.4 percent).

Table 6.3: Percentage Distribution of Households by Type of Technique Used for Preparing Food for Breakfast/lunch/dinner, 2017 HECS

Technique	Breakfast	Lunch	Dinner
Boiling	42.8	8.7	36.3
Frying	23.4	11.4	32.6
Baking	2.2	0.3	0.6
Grilling/Roasting	0.1	0.3	0.7
Simmering	66.7	17.6	66.2
Other (Specified)	0.1	0.4	0.2
Total (N)	**519,751**	**519,751**	**519,751**

Figure 6.7 depicts the percentage share of the households that own a microwave in summer. It is observed that 12.2 percent of the households owned a microwave while 87.8 percent did not own.

Figure 6.7: Percentage Share of the Households Owning a Microwave, 2017 HECS

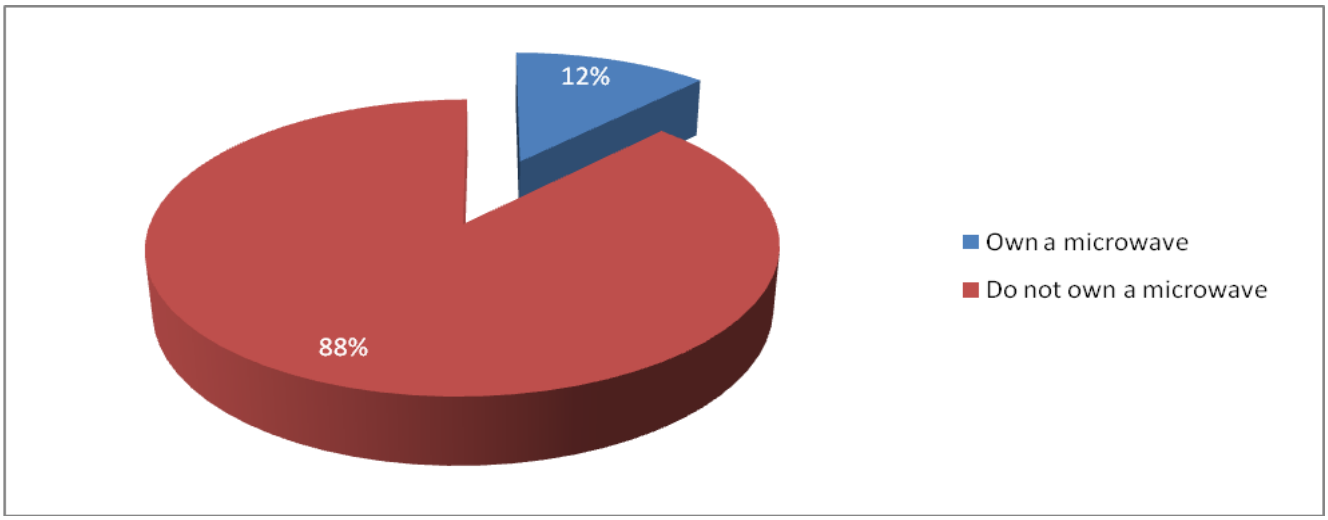
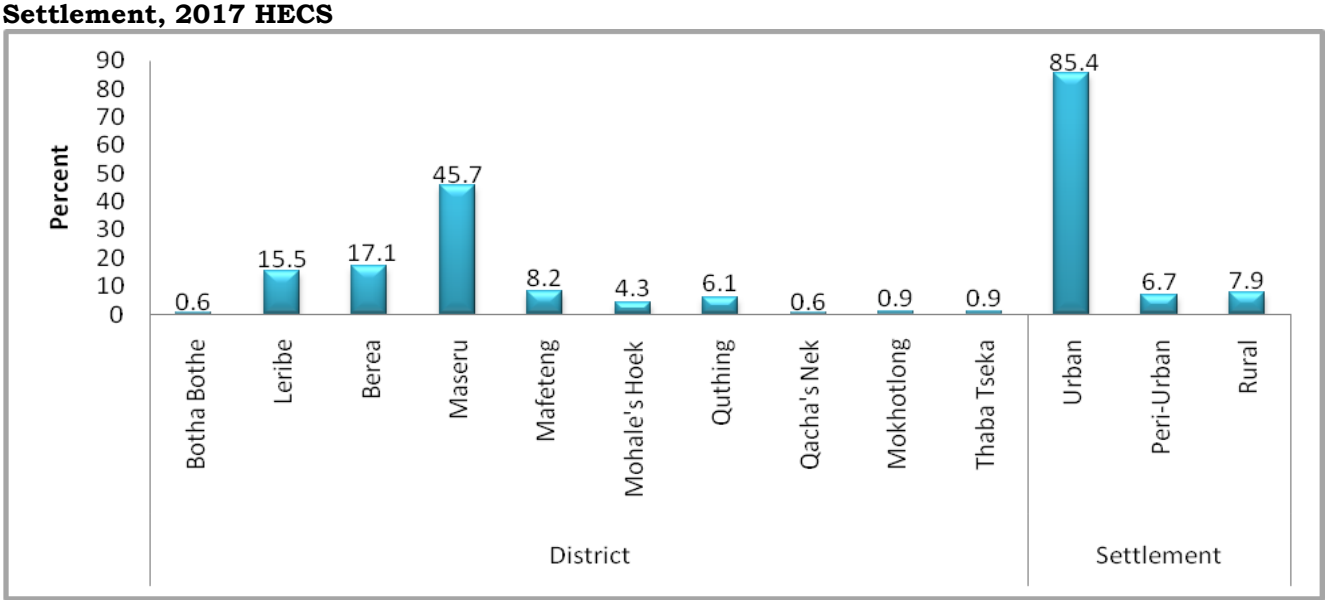


Figure 6.8 depicts percentage distribution of households owning a microwave oven by district and settlement in summer. The figure depicts that 45.7 percent of the households that owned a microwave were found in Maseru district, followed by 17.1 percent in Berea. The least proportions of households that owned a microwave were found in Botha Bothe and Qacha's Nek, both with 0.6 percent. It is also portrayed that 85.4 percent of the households that owned a microwave were found in the urban areas, 7.9 percent in the Rural and 6.7 percent in Peri-Urban areas.

Figure 6.8: Percentage Share of the Households Owning a Microwave by District and Settlement, 2017 HECS

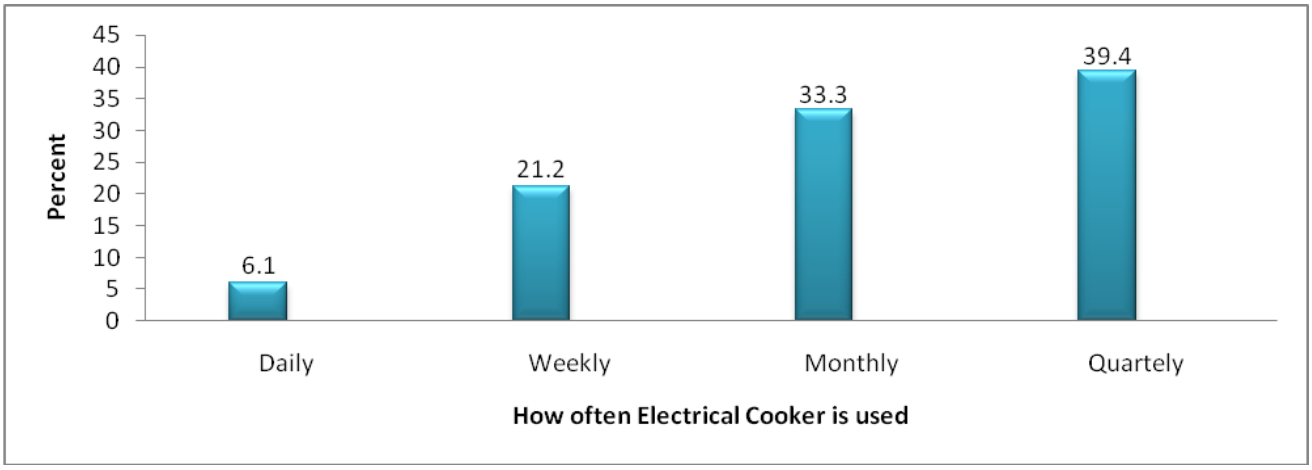


6.8 Electrical Cooker

Electrical cooker is an electrical pot that is plugged directly to electricity, it does not need to be put on the stove. Electrical cookers include; slow cooker, pressure cooker and many others.

Figure 6.9 portrays the percentage distribution of households by frequency of electrical cooker usage in summer. It is observed that most (39.4 percent) of the households that owned an electrical cooker used it quarterly, followed by 33.3 percent that used it monthly. The least percentage (6.1) used it daily.

Figure 6.9: Percentage distribution of Households by Frequency of Electrical Cooker Usage, 2017HECS



6.9 Summary

Majority of the households used LPG (29.9 percent in winter and 31.2 percent in summer) and wood (31.2 percent in winter and 27.5 percent in summer) as the main sources of energy for cooking. About 29.6 percent of the household used paraffin as the alternative source of energy for cooking while about 32.2 percent of the households reported not to have any alternative source of energy for cooking in summer.

Most households (42.2 percent) mainly used gas stove for cooking. A large number of the households eat/cook their meals in the morning (breakfast) with 76.0 percent and in the evening (dinner) with 59.3 percent of the households. Simmering (66.7 percent) and boiling (42.8 percent) are the most used cooking techniques. More energy is used for cooking per day in winter than in summer. Around 12.2 percent of the households reported they owned a microwave in summer and 85.4 percent of them were in urban areas.

Of all the energy sources used for cooking, more energy (197.97 TJ per month) was obtained from Animal dung.

CHAPTER 7: SPACE AND WATER HEATING

7.0 Introduction

Lesotho's climate usually has four distinct seasons of summer, autumn, winter and spring. Summer (November to January) is characterized by high temperatures and precipitation. Winter (May to July) is characterized by high-pressure dominance that results in clear skies, dry air and warm temperatures during the day and a sudden drop in temperature after sunset and low precipitation. Autumn (February to April) and spring (August to October) are transitional periods between summer and winter, respectively (LMS, undated).

Variations in weather from year to year, in particular temperature affects energy demand and can influence energy consumption particularly for space heating. The consumption for space heating is strongly seasonal. Nevertheless, due to these extreme fluctuations in climate change, cold weather season has prolonged from May to November thus leading people to resort to new ways of living. The seasonality effect was calculated using the 15 households that were monitored for one month in winter and one in summer season.

This section presents statistics on energy use in the residential sector, focusing on space heating appliances used in households, total fuel used, water heating, energy source used for lighting and quantity of electricity energy consumed.

7.1 Dwelling Heating

Space heating refers to heating of space of a limited area, a room, especially for human comfort. It is the major use of energy in buildings nationwide hence homeowners spend high on energy-related expenditures on space heating alone (Environment Protection Agency, 2017.

The number of households heating dwelling is displayed in figure 7.1. The figure depicts that there were 117,394 households that reported to have heated dwellings during the summer season as opposed to 402,163 that did no heat dwellings.

Figure 7.1: Number of Households Heating Dwelling, 2017 HECS

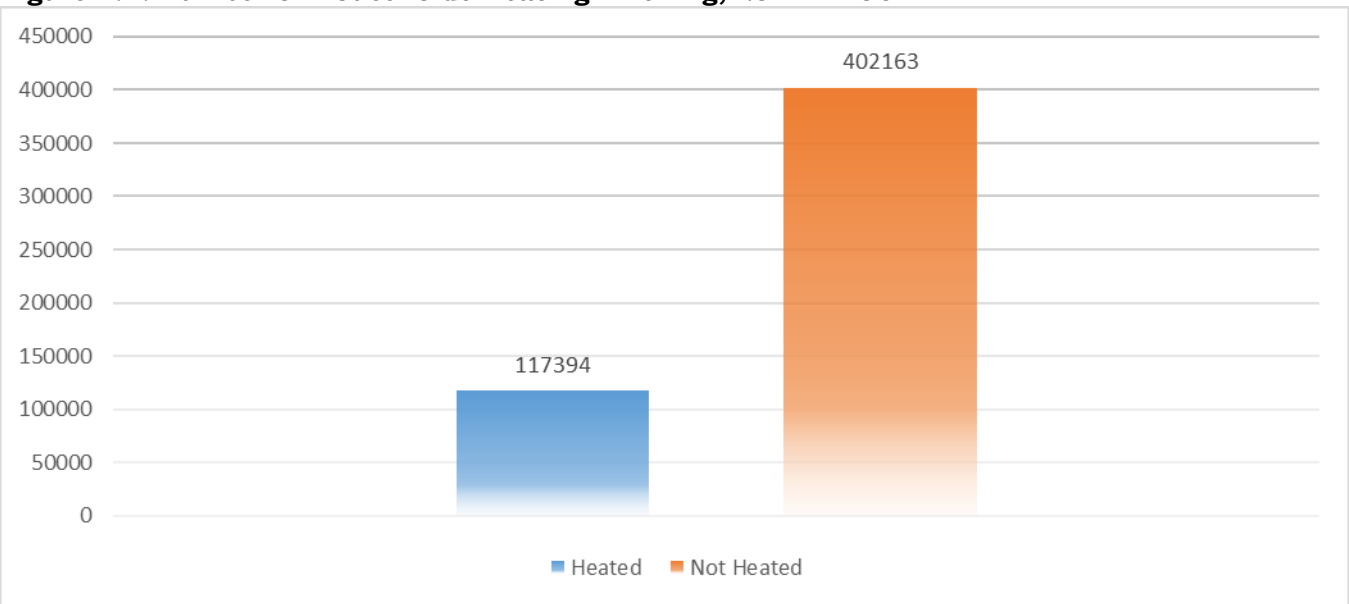
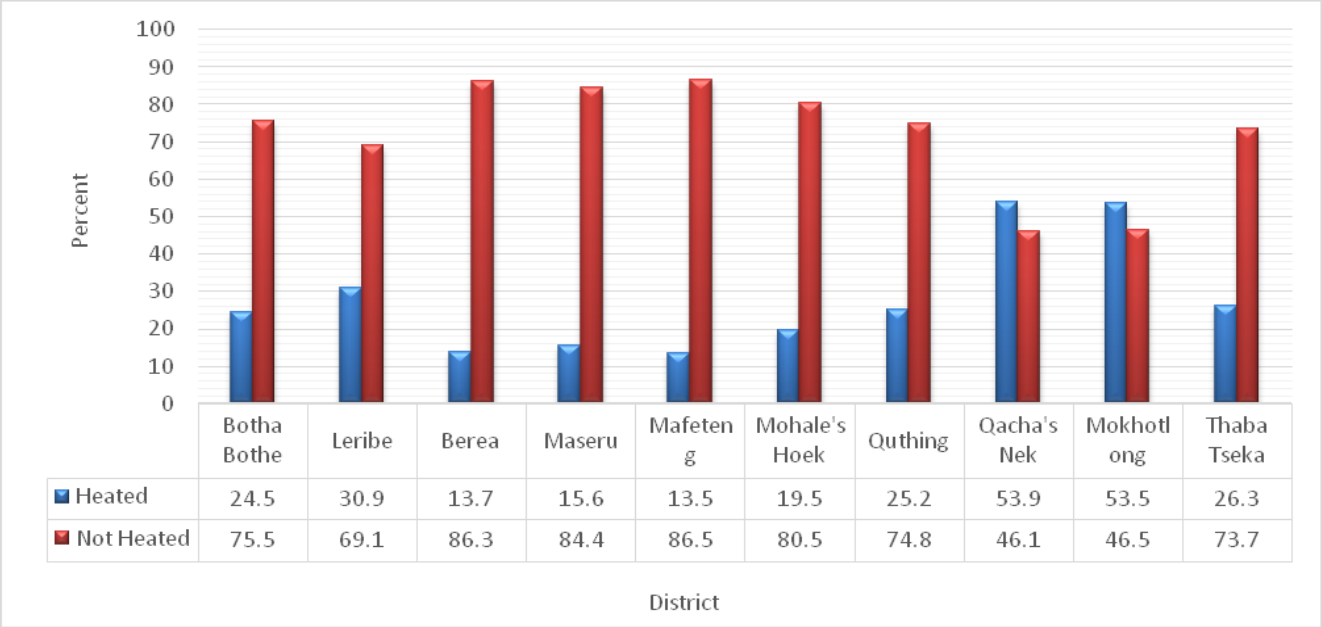


Figure 7.2 portrays percentage distribution of households heating dwelling by district. The figure demonstrates that out of 147,421households residing in Maseru district, 15.6 percent heated dwellings in the summer season. It further illustrates that, from 17,241 households living in Qacha's Nek district, 53.9 percent heated dwelling. The general observation is that a high percentage of households were less likely to heat dwellings in summer except Qacha's Nek and Mokhotlong districts.

Figure 7.2: Percentage Distribution of Households Heating Dwelling by District, 2017 HECS



	Botha Bothe	Leribe	Berea	Maseru	Mafeteng	Mohale's Hoek	Quthing	Qacha's Nek	Mokhotlong	Thaba Tseka
Heated	24.5	30.9	13.7	15.6	13.5	19.5	25.2	53.9	53.5	26.3
Not Heated	75.5	69.1	86.3	84.4	86.5	80.5	74.8	46.1	46.5	73.7

The percentage distribution of households that heated dwellings by settlement and season is shown in table 7.1. A high percentage across all the settlements had heated dwellings during the winter season (above 60.0 percent). However, the opposite was observed for the summer season where households were less likely to heat dwellings with 14.9, 14.0 and 29.6 percent in Urban, Peri-urban and Rural areas respectively.

Table 7.1: Percentage Distribution of Households Heating Dwellings by Settlement and Season, 2017 HECS

	Dwelling Heated			
Settlement Type	**Yes**	**No**	**Total (%)**	**Total (N)**
Winter				
Urban	68.4	31.6	**100.0**	**211,930**
Peri-urban	66.7	33.3	**100.0**	**51,723**
Rural	69.2	30.8	**100.0**	**287,287**
Summer				
Urban	14.8	85.2	**100.0**	**194,689**
Peri-urban	14.0	86.0	**100.0**	**48,430**
Rural	29.6	70.4	**100.0**	**276,438**

7.1.1 Space Heating Technologies

Space heating technologies in the context of this report refer to appliances and systems used to warm usable area in households.

Table 7.2 presents percentage share of households that used space heating technology by season. The table shows that Gas (31.4) and Paraffin Heater with 28.8 were the mostly used technologies by the households for space heating in the winter season. Sustainable Energy Africa (2015) indicated that the preference of paraffin heater is that many of these households are still in the process of acquiring electrical appliances; paraffin fuel is a suitable, cheap alternative to electric heaters. For the summer season, Paola and Paraffin Heater were the dominantly used appliances by the households with 42.5 and 30.4 percent respectively for heating the dwellings. Air conditioner space heating was not commonly found in the households in both seasons (0.1 and 1.6 percent respectively).

Table 7.2: Percentage Distribution of Households Used Space Heating Technology by Season, 2017 HECS

	Season	
Space Heating Technologies	**Winter**	**Summer**
Gas Heater	31.4	0.3
Coal/Wood stove	1.9	1.9
Air Conditioner	0.1	1.6
Paraffin Heater	28.8	30.4
Paola	23.1	42.5
Fireplace	0.6	2.9
Open Fire	7.8	15.7
Electric Heater	6.3	4.7
Total (%)	**100.0**	**100.0**
Total (N)	**586,197**	**121,656**

Studies further showed that households use multiple energy sources, because the different fuels that they use are not inter-substitutable. There were households in the survey, whether from detached or undetached dwellings that indicated to have used different space heating technologies, that is, one used paraffin heater in one room and electric heater in another room. Table 7.3 shows percentage distribution of households by main source of energy for space heating and season. The table reveals that the dominant main source of energy used for space heating by households was Paraffin for both seasons, 45.5 and 30.9 percent respectively. Wood and Animal Dung recorded the second and third mostly used sources of energy. The least source of energy used by the households was coal constituting 0.2 percent in winter and no recorded case in summer.

Table 7.3: Percentage Distribution of Households by Main Source of Energy for Space Heating and Season, 2017 HECS

	Season	
Main Source of Energy for Space Heating	**Winter**	**Summer**
Electricity	4.0	5.4
LPG	1.1	0.2
Paraffin	45.5	30.9
Coal	0.2	0.0
Wood	31.3	30.0
Animal Dung	10.9	20.1
Crop waste	1.6	1.7
Straw/Shrubs/Grass	5.4	11.7
Total (%)	**100.0**	**100.0**
Total (N)	**378,141**	**117,394**

Table 7.4 shows the percentage distribution of households by district and main source of energy for space heating in winter. The table indicates that Electricity remained the largest heating source used for space heating in Maseru (53.8 percent) and Berea (16.7 percent) districts. LPG was the second mostly used energy source in Maseru (45.5 percent) and Berea by 18.2 percent. Fuels such as Wood and Crop waste were predominantly used in Leribe and Maseru. Households in Thaba-Tseka (25.5 percent) and Mokhotlong (19.3 percent) relied highly on Animal dung. Straw/shrubs/grass were used by households from Mokhotlong and Leribe with 20.7 and 19.6 percent respectively. About 30.0 percent of the households used Coal as the main source of energy for space heating in Leribe, Maseru and Thaba-Tseka.

Table 7.4: Percentage Distribution of Households by District and Main Source of Energy for Space Heating, 2017 HECS

	Main Source of Energy for Space Heating								
District	**Electricity**	**LPG**	**Paraffin**	**Coal**	**Wood**	**Animal Dung**	**Crop waste**	**Straw/ Shrubs/ Grass**	**Total**
Botha Bothe	0.0	4.5	2.3	0.0	13.4	3.8	6.3	4.3	6.0
Leribe	11.5	4.5	19.9	33.3	18.5	6.6	28.1	19.6	17.7
Berea	16.7	18.2	14.3	0.0	14.6	1.4	12.5	1.1	12.4
Maseru	53.8	45.5	39.3	33.3	18.9	7.5	18.8	7.6	28.2
Mafeteng	5.1	4.5	8.3	0.0	3.8	15.6	3.1	1.1	7.1
Mohale's Hoek	6.4	4.5	5.3	0.0	10.0	4.7	0.0	13.0	7.0
Quthing	2.6	4.5	5.4	0.0	6.6	4.7	9.4	12.0	5.9
Qacha's nek	0.0	4.5	1.0	0.0	4.9	10.8	3.1	13.0	3.9
Mokhotlong	2.6	0.0	2.7	0.0	3.8	19.3	6.3	20.7	5.7
Thaba-Tseka	1.3	9.1	1.5	33.3	5.6	25.5	12.5	7.6	6.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**15,110**	**4,262**	**172,023**	**581**	**118,169**	**41,069**	**6,199**	**17,822**	**22,472**

LPG = Liquefied Petroleum Gas

The percentage distribution of households by main source of energy for space heating and settlement is presented in table 7.5 for winter. The observation from the table is that majority of households residing in urban and peri-urban areas (84.0 and 44.9 percent respectively) used Paraffin as the main source of energy for space heating during the winter season. Wood at 40.4 percent was the second mostly used source of energy in peri-urban areas. For the rural households, 50.1 percent used Wood followed by Animal Dung and Paraffin with 18.7 and 17.5 percent respectively.

Table 7.5: Percentage Distribution of Households by Main Source of Energy for Space Heating and Settlement, 2017 HECS

	Settlement Type		
Main Source of Energy	**Urban**	**Peri-Urban**	**Rural**
Electricity	7.8	3.9	1.3
LPG	1.9	1.1	0.6
Paraffin	84.0	44.9	17.5
Coal	0.3	0.0	0.1
Wood	3.2	40.4	50.1
Animal Dung	0.9	7.3	18.7
Crop waste	0.4	1.7	2.5
Straw/Shrubs/Grass	1.5	0.0	7.9
Other	0.1	0.6	1.3
Total (%)	**100.0**	**100.0**	**100.0**
Total (N)	**144,903**	**34,482**	**198,757**

Table 7.6 presents the percentage distribution of households by main source of energy for space heating and household earnings in winter. The table indicates that most households that reported to have no earnings "None" (45.9 percent) to those that earned "M500-M999", (47.1 percent) used Wood as the main source of energy for space heating followed by Animal Dung and Paraffin Household that earned "M1,000-M1,999" with 65.2 percent and 79.7 percent of those that earned "M2,000-M4,999" used Paraffin as the main source of energy for space heating then Wood as the second source. A higher percentage of households that earned "M5,000-M9,999", "M10,000-M29,999" and "M30,000 and above" (74.6, 63.8 and 534 percent respectively) used Paraffin followed by Electricity. Further observation is that households that earned "M30,000 and above" reported to have used three sources only, that is, Electricity, LPG and Paraffin as the main source of energy for space heating.

Table 7.6: Percentage Distribution of Households by Main Source of Energy for Space Heating and Household Earnings, 2017 HECS

	Household Earnings								
Main Source of Energy	**None**	**Less than M300**	**M300 - M499**	**M500 - M999**	**M1,000 - M1,999**	**M2,000 - M4,999**	**M5,000 - M9,999**	**M10,000 - M29,999**	**M30,000 and above**
Electricity	3.4	0.6	0.6	1.9	2.1	5.3	12.3	22.4	33.3
LPG	1.0	0.0	0.6	0.3	0.6	0.8	2.5	12.1	13.3
Paraffin	21.0	15.7	28.7	28.8	65.2	79.7	74.6	63.8	53.4
Coal	0.0	0.0	0.6	0.0	0.3	0.0	0.8	0.0	0.0
Wood	45.9	40.1	47.0	47.1	24.7	10.6	5.7	1.7	0.0
Animal Dung	17.1	27.9	16.5	11.1	3.7	1.6	2.5	0.0	0.0
Crop waste	2.0	5.8	0.0	3.6	0.6	0.8	0.0	0.0	0.0
Straw/Shrub/Grass	9.8	9.9	6.1	7.2	2.8	1.2	1.6	0.0	0.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**39,713**	**33,320**	**31,770**	**69,933**	**63,540**	**47,655**	**23,634**	**11,236**	**2,906**

7.1.2 Alternative Source of Energy for Space Heating

The percentage distribution of households by alternative source of energy for space heating and season is presented in table 7.7. The table explains that the vast majority (66.2 in winter and 71.5 in summer) of households reported to have "No Alternative" source of energy for space heating. Animal Dung (7.2 percent) and Paraffin with 6.1 percent were mostly used as alternative sources for space heating during winter season. In summer, Straw/Shrubs/Grass (7.9 percent) was highly used followed by Animal Dung with 7.1 percent of households. Coal was the least source used as an alternative in both seasons.

Table 7.7: Percentage Distribution of Households by Alternative Source of Energy for Space Heating and Season, 2017 HECS

	Season	
Alternative Source of Energy for Space Heating	**Winter**	**Summer**
Electricity	4.3	3.1
LPG	1.2	0.2
Paraffin	6.1	4.3
Coal	0.2	0.0
Wood	4.3	4.1
Animal Dung	7.2	7.1
Crop waste	6.0	1.8
Straw/Shrubs/Grass	4.7	7.9
No Alternative	66.0	71.5
Total (%)	**100.0**	**100.0**
Total (N)	**378,141**	**117,394**

The percentage distribution of households by district and alternative source of energy for space heating is shown in table 7.8 for winter. Electricity accounted for a larger share (44.6 percent of households) that used it as an alternative source of energy for space heating in Maseru, whereas Leribe was the second district with 22.9 percent. LPG was the dominant alternative heating energy source used for space heating in Berea (26.1 percent) and Maseru with 21.7 percent of the households. Paraffin, Wood and Crop waste were used by the majority of the households in the districts of Leribe, Berea and Maseru as an alternative source of energy for space heating. Coal was used by 66.7 percent and 33.3 percent of households in Maseru and Quthing respectively. There were also households that indicated not to have an alternative "No Alternative" source of energy for space heating.

Table 7.8: Percentage Distribution of Households by District and Alternative Source of Energy for Space Heating, 2017 HECS

	Alternative Source of Energy for Space Heating									
District	Electricity	LPG	Paraffin	Coal	Wood	Animal Dung	Crop waste	Straw/ Shrubs/ Grass	No Alternative	Total
Botha Bothe	0.0	0.0	11.8	0.0	8.3	17.1	12.0	3.3	4.3	6.0
Leribe	22.9	8.7	22.7	0.0	13.1	7.1	21.4	6.5	18.9	17.6
Berea	12.0	26.1	11.8	0.0	15.5	7.9	18.8	0.0	12.8	12.3
Maseru	44.6	21.7	21.8	66.7	20.2	14.3	16.2	9.8	32.0	28.1
Mafeteng	9.6	8.7	10.9	0.0	9.5	7.1	4.3	3.3	7.2	7.2
Mohale's Hoek	0.0	4.3	6.7	0.0	2.4	7.1	1.7	5.4	8.4	7.0
Quthing	6.0	8.7	3.4	33.3	4.8	5.7	6.0	19.6	5.1	5.9
Qacha's nek	2.4	0.0	2.5	0.0	3.6	8.6	5.1	2.2	3.7	3.9
Mokhotlong	1.2	17.4	3.4	0.0	10.7	15.7	4.3	30.4	3.3	6.0
Thaba-Tseka	1.2	4.3	5.0	0.0	11.9	9.3	10.3	19.6	4.3	6.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**16,079**	**4,456**	**23,053**	**581**	**16,272**	**27,121**	**22,665**	**17,822**	**249,124**	**377,173**

7.1.3 Total Fuel Used for Space Heating

Main source of energy for space heating by fuel used (kilograms/litres) and season is revealed in Table 7.9. The results indicated that fuel wood was chosen by households in both seasons as a considered energy source essential for space heating.

Animal dung recorded the second largest fuel used, thus 18,581,001kg in winter and 4,621,338kg in summer season. Paraffin ranked the third fuel used by the households with 8,859,124 liters in winter whereas in summer was Straw/Shrubs/Grass at 2,444,088kg. The table also shows that Coal was the least used fuel in winter (58,116kg) while in summer the least fuel used was LPG with 5,424kg.

Table 7.9: Main Source of Energy for Space Heating by Fuel used (kg/lt) by Season, 2017 HECS

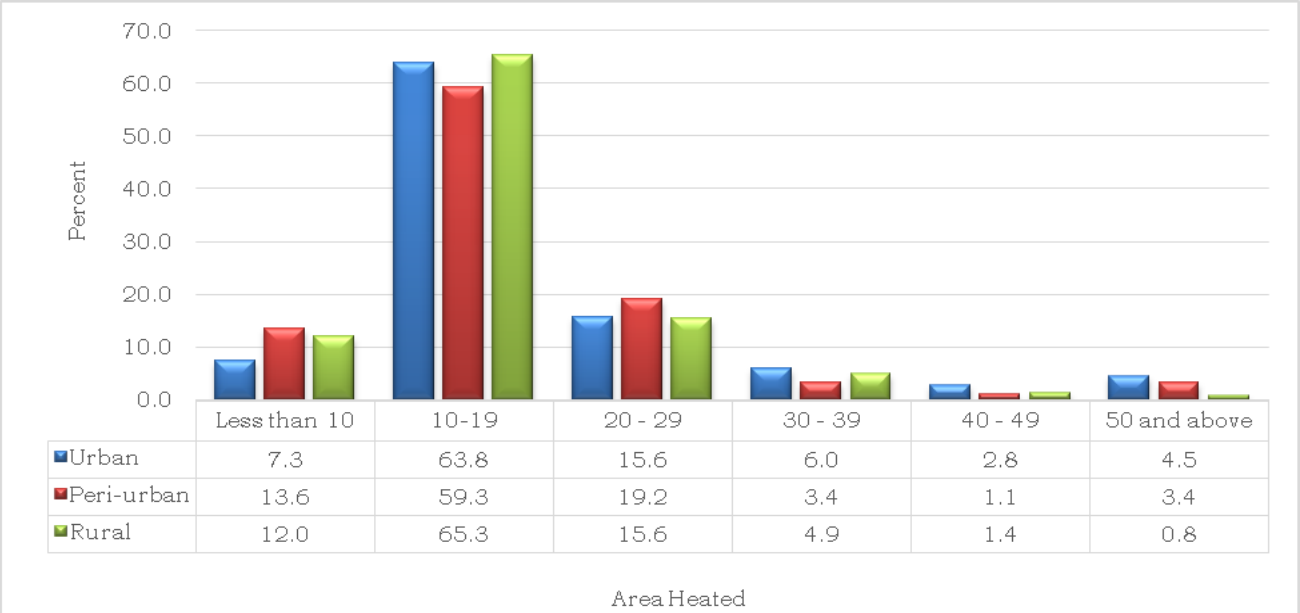
	Season	
Main Source of Energy for Space Heating	**Winter**	**Summer**
LPG	336,827	5,424
Paraffin	8,859,124	390,848
Coal	58,116	-
Wood	47,642,009	6,317,676
Animal Dung	18,581,001	4,621,338
Crop waste	2,106,337	36,148
Straw/Shrubs/Grass	5,440,376	2,444,088

7.1.4 Area Heated

Space heating consumes the largest portion of energy around the globe and can be correlated with cold winter season.

Figure 7.3 depicts the percent distribution of households by settlement and area heated in the winter season. It is observed that majority (63.8 percent) of 142,965 urban households reported to have heated area between 10-19m². It further demonstrates that, a high percentage of rural households (65.3 percent) from 197,788 heated area that is 10-19m².Generally, majority of the households in all the settlements heated an area of 10-19m² followed by area of 20-29m². The area of 40-49m² was the least area heated by household in all the settlements.

Figure 7.3: Percentage Distribution of Households by Settlement and area Heated in Winter, 2017 HECS.



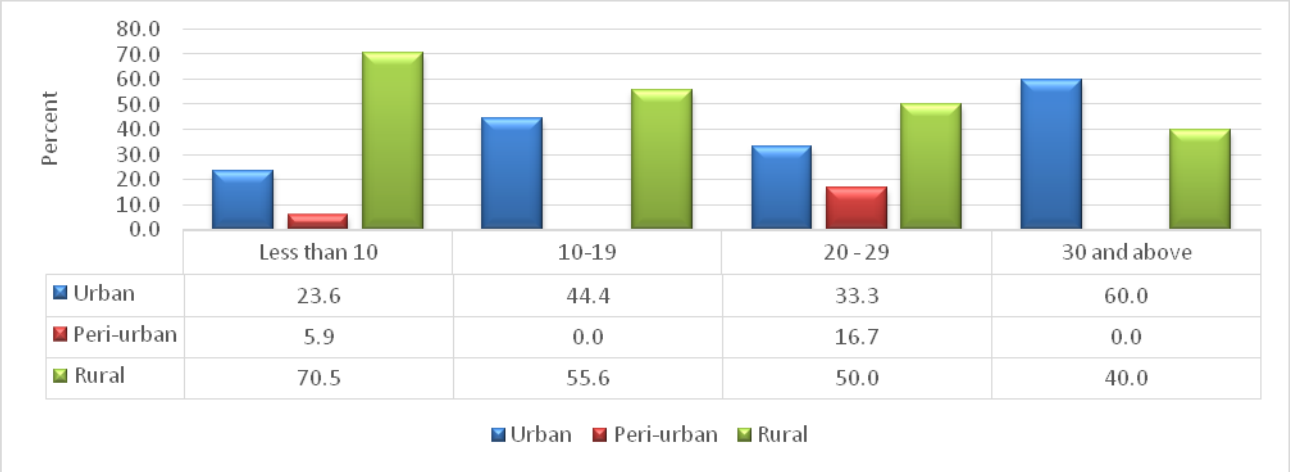
	Less than 10	10-19	20 - 29	30 - 39	40 - 49	50 and above
Urban	7.3	63.8	15.6	6.0	2.8	4.5
Peri-urban	13.6	59.3	19.2	3.4	1.1	3.4
Rural	12.0	65.3	15.6	4.9	1.4	0.8

7.1.5 Area Cooled

Space cooling represents a significant use of energy in buildings and important in warmer season. The dominant fuel used for space cooling tends to be electricity.

The percentage distribution of households by area cooled and settlement is portrayed in figure 7.4 for winter. The figure revealed that, most households (70.5 percent) from the rural areas have cooled an area that is less than 10m². Furthermore, it is noted that urban households (60.0 percent) reported to have cooled area that is more than 30m² compared to other settlement types. The results show that there were no reported cases of households that cooled area ranging between 10m² and 19m² as well as those occupying 30m² and more in Peri-urban.

Figure 7.4: Percentage Distribution of Households by Settlement type and Area heated, 2017 HECS



	Less than 10	10-19	20 - 29	30 and above
Urban	23.6	44.4	33.3	60.0
Peri-urban	5.9	0.0	16.7	0.0
Rural	70.5	55.6	50.0	40.0

7.2 Water Heating

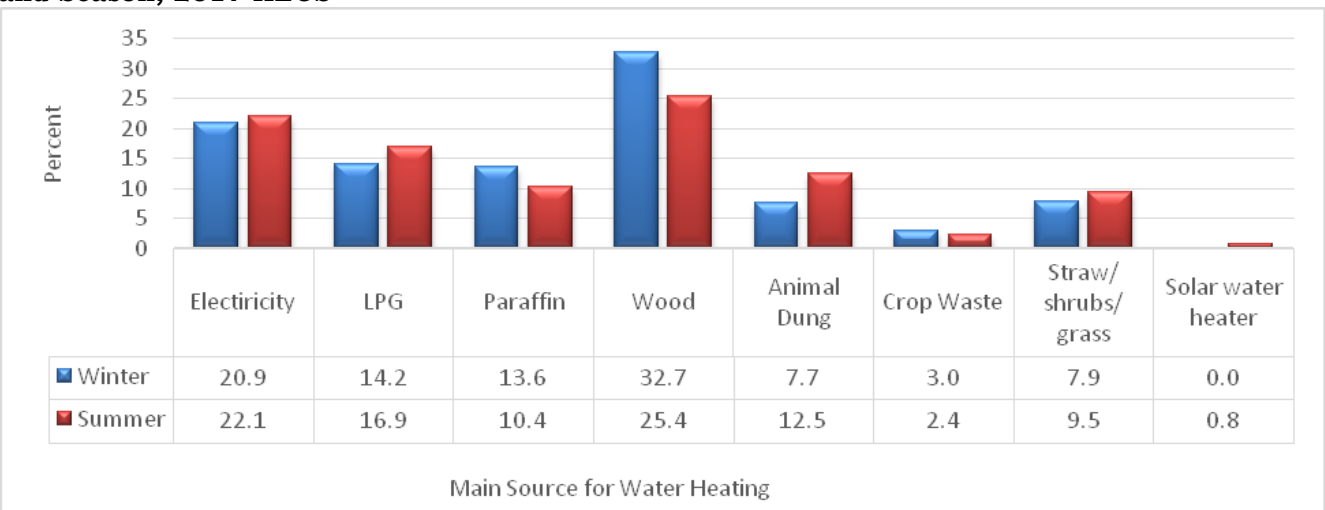
Water heating is a heat transfer process that uses an energy source to heat water above its initial temperature.

7.2.1 Main Source of Energy for Water heating

Li (2014) stated that efficiency of water heating could differ because of specific characteristics of each fuel source.

Figure 7.5 portrays the percentage distribution of households by main source of energy used for water heating and season. The figure describes that Wood, Electricity and LPG (32.7, 20.9 and 14.2 percent respectively) were the main sources of energy used for water heating by households in winter. A similar pattern was also observed for the summer season. There were no recorded cases for solar water heater during the winter season while a small proportion (0.8 percent) indicated to have used it in summer

Figure 7.5: Percentage Distribution of Households by Main Source of Energy for Water Heating and Season, 2017 HECS



	Electiricity	LPG	Paraffin	Wood	Animal Dung	Crop Waste	Straw/ shrubs/ grass	Solar water heater
Winter	20.9	14.2	13.6	32.7	7.7	3.0	7.9	0.0
Summer	22.1	16.9	10.4	25.4	12.5	2.4	9.5	0.8

Table 7.10 presents the percentage distribution of households by district and main source of energy for water heating in winter. The highest percentage of households (46.7 percent) reporting Electricity as the main source of energy used for water heating were living in Maseru followed by Leribe residents with 15.3 percent. Botha Bothe had the least number

of households with 0.8 percent. A similar trend was observed for other energy sources such as LPG, Paraffin, Wood and Crop waste in the same districts.

Animal dung was highly used by households residing in Mafeteng, Mokhotlong and Thaba-Tseka districts with 27.7 percent, 18.6 percent and 16.4 percent respectively. It further indicates that Straws/shrubs/grass were mostly used by households from Thaba-Tseka (22.6 percent) followed by Leribe (16.3 percent) and Mohale's Hoek (15.9 percent) districts for water heating.

Table 7.10: Percentage Distribution of Households by District and Main Source of Energy for Water Heating, 2017 HECS

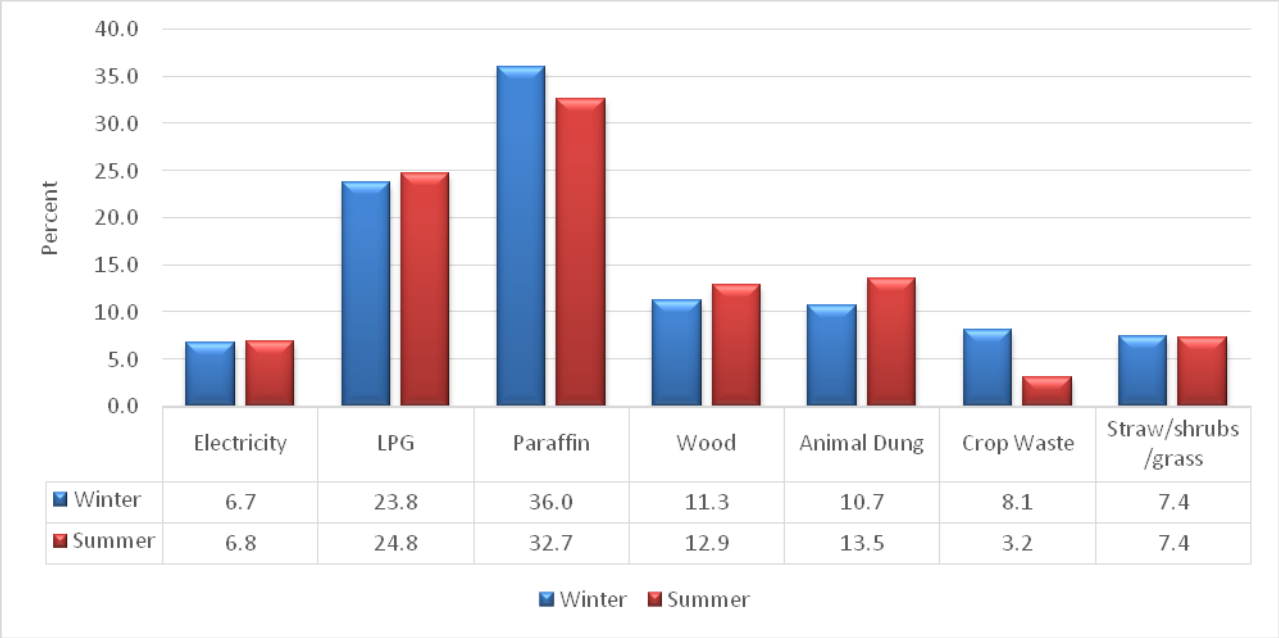
	Main Source of Energy for Water Heating							
District	**Electricity**	**LPG**	**Paraffin**	**Wood**	**Animal Dung**	**Crop waste**	**Straw/Shrubs/ Grass**	**Total**
Botha-Bothe	0.8	4.2	5.4	11.1	2.3	8.4	1.9	5.7
Leribe	15.3	15.3	18.9	18.2	5.5	25.3	16.3	16.3
Berea	14.2	13.9	15.8	15.4	1.8	16.9	1.0	12.9
Maseru	46.7	39.1	34.9	19.1	8.2	25.3	5.3	28.2
Mafeteng	9.4	10.1	7.8	6.5	27.7	7.2	4.3	9.3
Mohale's Hoek	4.0	7.2	5.9	10.8	6.8	1.2	15.9	8.0
Quthing	4.7	3.7	4.1	6.2	4.5	1.2	10.6	5.3
Qacha'sNek	1.2	0.7	1.0	3.8	8.2	2.4	9.6	3.1
Mokhotlong	2.4	3.2	2.8	2.7	18.6	4.8	12.5	4.7
Thaba-Tseka	1.2	2.5	3.4	6.3	16.4	7.2	22.6	6.3
Total (%)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Total (N)	**114,876**	**78,263**	**74,970**	**180,160**	**42,618**	**16,079**	**40,294**	**547,453**

7.2.2 Alternative Source of Energy for Water heating

Paraffin remained the predominant fuel used as an alternative source of energy for water heating

The percentage distribution of households by alternative source of energy for water heating is depicted by figure 7.6. The largest percentage of households reported Paraffin as an alternative source of energy for water heating in both seasons with 36.0 percent in winter and 32.7 percent in summer. The second largest percentage of households reported LPG as an alternative source of energy for water heating with23.8 percent of households in winter and 24.8 percent in summer season. Less prominent, was the use of Crop waste by households which accounted for 3.2 percent during the summer season. There was not much difference in both seasons for households that used Electricity and Straw/shrubs/grass as an alternative source for water heating.

Figure 7.6: Percentage Distribution of Households by Alternative Source of Energy for Water Heating,2017HECS



7.2.3 Solar Water heating

Solar water heating is the conversion of sunlight into heat for water heating using a solar thermal collector. SWHs are widely used for residential and some industrial applications, mostly in developed countries. Penetration of solar technologies, in particular solar water heating systems is increasing gradually in the residential sector. The results of the HECS show that only 581 households had installed Solar Water Heaters in 2017.

Figure 7.7 gives a picture of thermal capacity of a solar water heater by size (litres) owned by households in summer. The figure shows that the smaller the size of a SWH the smaller the capacity in kW(thermal). A solar water heater of 50 litres has capacity of 16,272.48 kW(thermal) whereas the SWH of 200 litres has capacity of 50,851.5 kW(thermal)

Figure 7.7: Thermal Capacity of SWH by Size (litres), 2017 HECS

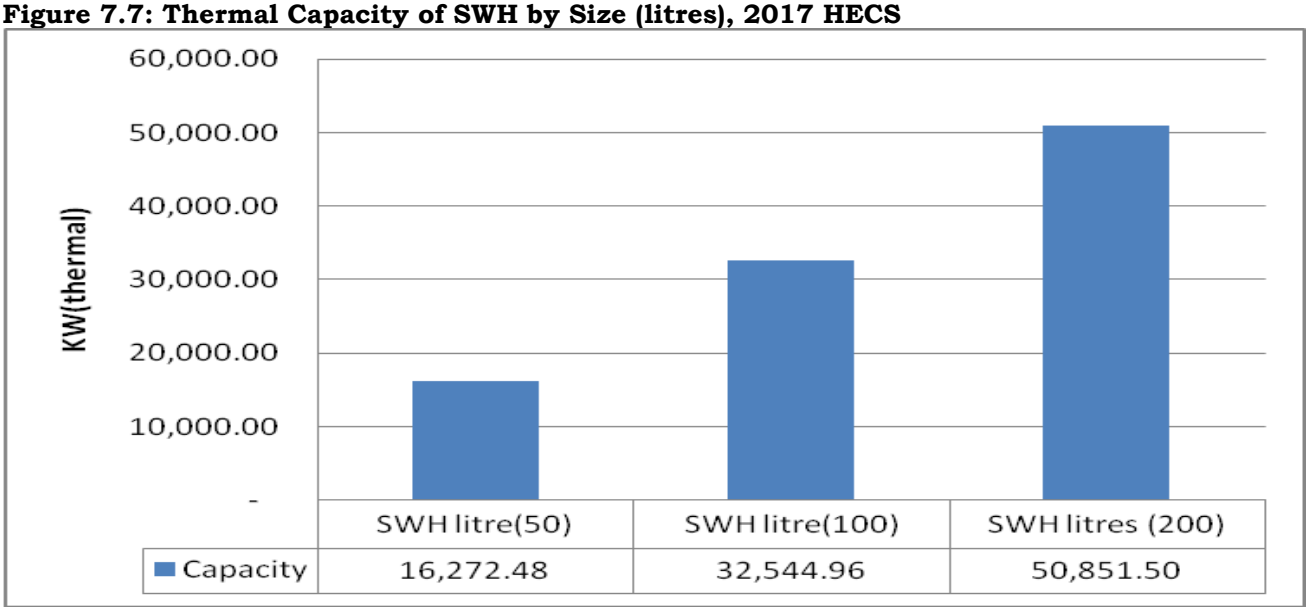
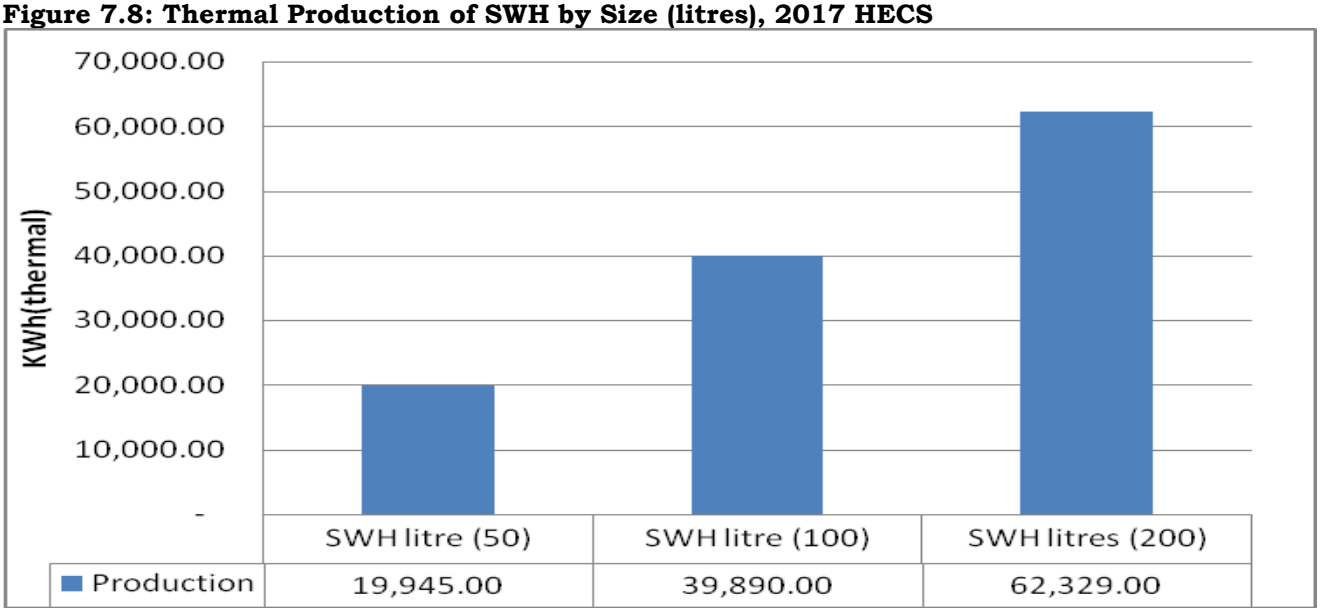


Figure 7.8 shows the production of a SWH by size in summer. The energy produced from heating water in a 50litre SWH heater accounted for 19,945kWh (thermal) per year whilst energy produced to heat water in a 200liter SWH was 62,329 kWh (thermal) per year.

Figure 7.8: Thermal Production of SWH by Size (litres), 2017 HECS



7.3 Summary

Gas Heater, Paraffin Heater and Paola (31.4, 28.8 and 23.1 percent respectively) were the mostly used technologies by the households for space heating in the winter season. For the summer season, Paola and Paraffin Heater were the dominantly used appliances by the households with 42.5 and 30.4 percent respectively for heating the dwellings. Majority of household (84.0 percent) residing in urban areas used Paraffin as the main source of energy for space heating during the winter season. Electricity remained the largest heating source used for space heating in Maseru (53.8 percent) and Berea (16.7 percent) districts

Most households that reported to have no earnings "None" (45.9 percent) to those that earned "M500-M999", (47.1 percent) used Wood as the main source of energy for space heating followed by Animal Dung and Paraffin. Wood, Electricity and LPG (32.7, 20.9 and 14.2 percent respectively) were the main sources of energy used for water heating by households in winter.

Animal dung was highly used by households residing in Mafeteng, Mokhotlong and Thaba-Tseka districts with 27.7 percent, 18.6 percent and 16.4 percent respectively. The largest percentage of households reported Paraffin as an alternative source of energy for water heating in both seasons with 36.0 percent in winter and 32.7 percent in summer.

CHAPTER 8: LIGHTING

8.0 Introduction

Reseach indicated that quality light is a critical tool in community development. Without light, rural development is inhibited as people spend their nights "in the dark" and are unable to engage in many types of evening activities.www.alternative.org/Glossary/light.html.

8.1 Lighting

Takei (2009) stated that lighting is a major source of power consumption, and when light is turned on, adequate power consumption always takes place, thus, it is imperative to employ efficient lighting. Further reseach also indicated that quality light is a critical tool in community development. Without light, rural development is inhibited as people spend their nights "in the dark" and are unable to engage in many types of evening activities. http://www.alternergy.org/Glossary/light.html.

8.1.1 Main Source of Energy for Lighting

The section focuses on several energy sources such as electricity (grid and solar), Rechargeable battery lamps, Solar lantern, LPG, Candles and Paraffin.

Table 8.1 presents the percentage distribution of households by the main energy source used for lighting and season. The obvious trend is with an increasing reliance on candles constituting 49.5 percent and Electricity (Grid) (36.6 percent). In summer, the higher share of households (49.2 percent) used Paraffin as the main source of energy for lighting followed by Electricity (Grid) accounting for 37.2 percent. LPG was classified as the third primary energy source used for lighting by the households (9.9 percent) for winter, likewise Candles in summer with 8.9 percent. Use of all other energy sources for lighting was very low for both seasons where a very small proportion (0.1 percent) of the households did not have energy source for lighting.

Table 8.1: Percentage Distribution of Households by Main Source of Energy for Lighting by Season

	Season	
Main Source of Energy for Lighting	**Winter**	**Summer**
Electricity (Grid)	36.6	37.2
Rechargeable Battery Lamps	0.7	0.8
Solar Lantern	1.6	2.2
Electricity (Solar)	1	1.6
LPG	9.9	0
Candle	49.5	8.9
Paraffin	0.6	49.2
None	0.1	0.1
Total (%)	**100.0**	**100.0**
Total (N)	**548,809**	**518,976**

8.1.2 Main Source of Energy for Lighting and Settlement Type

The percentage distribution of households by settlement type and main source of energy for lighting is presented in table 8.2. The table highlighted that 69.0 percent of the households

that resided in Urban areas used Electricity (Grid) as the major source of energy for lighting followed by those using Candles with 25.3 percent. The same scenario is observed for households living in Peri-Urban areas.

The highest percentage of the households (68.3 percent) from the rural areas used Candles as the main source of energy for lighting. LPG reported second with 14.4 percent. Rechargeable Battery Lamps, Solar Lantern, Electricity (Solar) and Paraffin were the least sources used for lighting by households in all the settlements.

Table 8.2: Percentage Distribution of Households by Main Source of Energy for Lighting and Settlement, 2017 HECS-Winter

	Settlement Type		
Main Source of energy for Lighting	**Urban**	**Peri-Urban**	**Rural**
Electricity (Grid)	69.0	45.7	10.9
Rechargeable Battery Lamps	0.2	1.5	1.0
Solar Lantern	0.4	1.5	2.6
Electricity (Solar)	0.2	0.0	1.7
LPG	4.5	7.1	14.4
Candle	25.3	44.2	68.3
Paraffin	0.3	0.0	0.9
None	0.1	0.0	0.2
Total (%)	**100.0**	**100.0**	**100.0**
Total (N)	**211,542**	**51,723**	**285,543**

8.1.3 Alternative Energy Source of Lighting

Table 8.3 represents the percentage distribution of households by alternative source of energy for lighting and settlement in winter. The table indicates a high percentage of households (34.5 percent) residing in urban areas used Candles as an alternative source of energy for lighting, then Paraffin with 23.6 percent. A similar pattern is also observed for Peri-Urban and Rural households dwellers. There were no reported cases of Electricity (Grid) and Rechargeable Battery Lamps in the Peri-urban settlement. There were also some households that indicated not have to alternative source of energy for lighting across all settlements.

Table 8.3: Percentage Distribution of Households by Settlement and Alternative Source of Energy for Lighting, 2017 HECS

	Settlement		
Main Source of Energy for Lighting	**Urban**	**Peri-Urban**	**Rural**
Electricity (Grid)	0.3	0.0	0.1
Rechargeable Battery Lamps	0.9	0.0	1.2
Solar Lantern	1.3	1.9	1.4
Electricity (Solar)	0.2	0.4	0.9
Candle	34.5	47.9	54.1
Paraffin	23.6	22.8	14.6
None	39.2	27.0	27.7
Total (%)	**100.0**	**100.0**	**100.0**
Total (N)	**211,930**	**51,723**	**287,093**

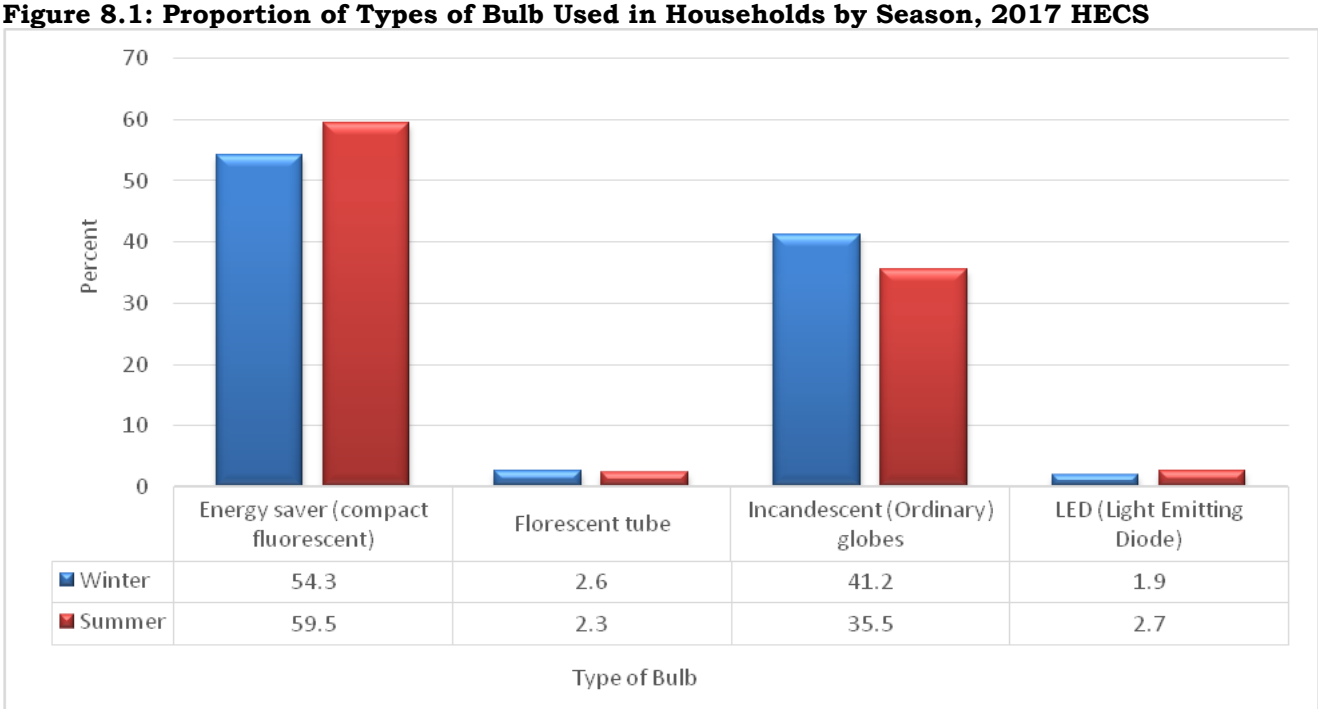
8.2 Light Bulbs

A light bulb (lamp) is a device that produces light from electricity essential to modern society. They provide interior and exterior lighting for buildings for evening and nighttime activities. They started from Incandescent in the 1900 century to florescent tubes, Energy savers then the Light-Emitting Diode (LEDs).

There have been policies banning the use of incandescent light bulbs which are less efficient than fluorescent lamps as a measure of reducing greenhouse gas emissions mainly in Europe and the United States of America. Then recently the manufacturing of Light Emitting Diodes (LED) which are more efficient with high quality lighting to the fluorescent lamps and energy savers. Data will present different energy sources used for lighting and which lighting sources were the households' primary and secondary lighting sources.

The proportion of types of bulbs used in households is displayed in figure 8.1. The results explain that most households (54.3 percent in winter and 59.5 percent in summer) used Energy saver bulbs. Incandescent recorded the second largest used bulbs in both seasons. Swaziland Energy Report (2014) showed that incandescent light bulbs (ordinary globes) are still being used by a fairly large proportion even though it is lower than the energy savers. A small fraction of households used Fluorescent tubes and LED as their source of energy for lighting in both seasons.

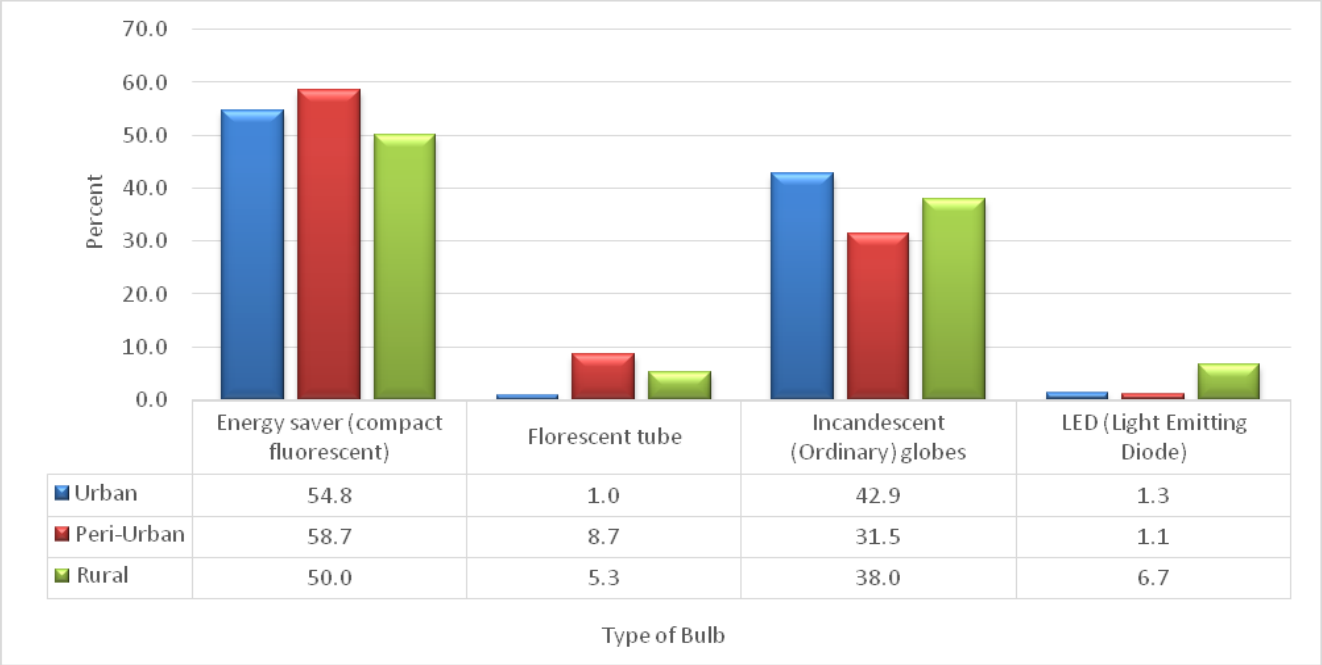
Figure 8.1: Proportion of Types of Bulb Used in Households by Season, 2017 HECS



	Energy saver (compact fluorescent)	Florescent tube	Incandescent (Ordinary) globes	LED (Light Emitting Diode)
Winter	54.3	2.6	41.2	1.9
Summer	59.5	2.3	35.5	2.7

Figure 8.2 portrays the proportions of types of bulbs used in households by settlement in winter. The figure ascertains that across all the settlements, a great proportion of the households (over 50.0 percent) used Energy saver bulbs for lighting. Incandescent globes were the second highly used bulbs by households (around 40.0 percent). Use of LED bulbs with high energy saving were used vastly by the Rural households (6.7 percent) compared to other settlements.

Figure 8.2: Proportions of Types of Bulbs used in Households by Settlement, 2017 HECS

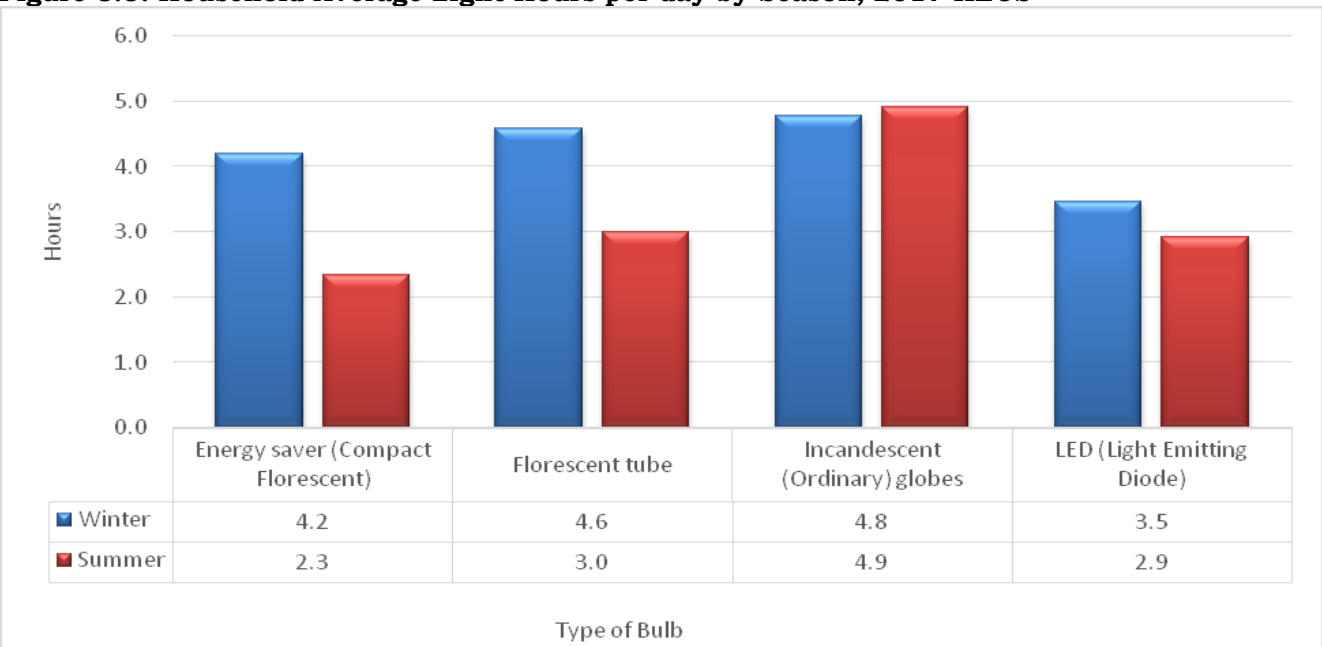


	Energy saver (compact fluorescent)	Florescent tube	Incandescent (Ordinary) globes	LED (Light Emitting Diode)
Urban	54.8	1.0	42.9	1.3
Peri-Urban	58.7	8.7	31.5	1.1
Rural	50.0	5.3	38.0	6.7

8.2.1 Average Hours for Lighting

Figure 8.3 depicts household average lighting hours per day by season. The noticeable trend is that all types of bulbs were lit on average, about 4 to 5 hours in winter. In summer they were lit for about three hours except for the Incandescent globes where there is not much difference.

Figure 8.3: Household Average Light Hours per day by Season, 2017 HECS



	Energy saver (Compact Florescent)	Florescent tube	Incandescent (Ordinary) globes	LED (Light Emitting Diode)
Winter	4.2	4.6	4.8	3.5
Summer	2.3	3.0	4.9	2.9

8.2.2 Total Electricity Consumption for Lighting

The total electricity consumption (kWh) per day by type of bulb and season is shown in table 8.4. Incandescent (ordinary) globes consumed a high amount of electricity per day in both seasons with 44,304.5kWh in winter and 42,138.15kWh in summer. The table further indicates that Energy savers were categorized second at 16,528.7kWh per day in winter and

16,874.56kWh in the summer season. Electricity consumption of LED was the lowest for both seasons, 91.8kWh in winter and 266.08kWh in summer, as compared to other bulbs. This is due to the fact that they offer better light quality and last longer

Table 8.4: Total Electricity (kWh) Used by Type of Bulb by Season

	Season	
Type of bulb	**Winter**	**Summer**
Energy Saver	16,528.7	16,874.56
Florescent Tube	1,758.6	1,623.939
Incandescent (ordinary) globes	44,304.5	42,138.15
LED	91.8	266.08
Total	**62,683.7**	**60,902.73**

8.3 Summary

The most commonly used energy sources for lighting in the winter were Candles constituting 49.5 percent and Electricity (Grid) (36.6 percent). In summer, the higher share of households (49.2 percent) used Paraffin as the main source of energy for lighting. The highest percentage of the households that used the rest of other forms of lighting were predominant in rural areas with Electricity (solar off grid) being the highly used source with 92.6 percent.

Most households (54.3 percent in winter and 59.5 percent in summer) used Energy saver bulbs. Electricity consumption of LED was the lowest for both seasons, 91.82kWh in winter and 266.08kWh in summer as compared to other bulbs. All types of bulbs were lit for longer hours in winter (about 4 to 5) than summer where they were lit for about three hours.

CHAPTER 9: SOLAR PHOTOVOLTAIC SYSTEM

9.0 Introduction

This chapter reports on "access to solar photovoltaic system" for the specified season of the year. Solar photovoltaic system comprised of a solar panel array, inverter and other electrical hardware. One could rent or have the permission of another party to use a solar photovoltaic system during a specified season of the year.

Researches show that despite the significant number of PV system installed in Lesotho, PV system is still a relatively young technology and is subject to frequent changes in product design and deployment. However there is no test data to prove which combinations of DC connectors are safe to use together as some may lead to fire sources.

9.1 Access to Solar Photovoltaic System

Access to Solar Photovoltaic System (Solar PV) means opportunity to use solar photovoltaic system regardless of ownership. A photovoltaic system also known as a solar PV system is an energy system that is designed to transform the energy from the Sun into electricity by means of photovoltaic (solar panels). This system is safe, reliable, low-maintenance and provides green energy without on-site pollution or emissions (*https/www.greenmatch.co.uk/solar-energy/photovoltaics/photovoltaic-system*).

Figure 9.1 depicts total percentage distribution of households by Solar PV system ownership. It is observed from the table that only 9.0 percent of the total households owned Solar PV while a maximum of 91.0 percent did not own Solar PV system.

Figure 9.1: Total Percentage Distribution of Households by Solar PV System Ownership, 2017 HECS

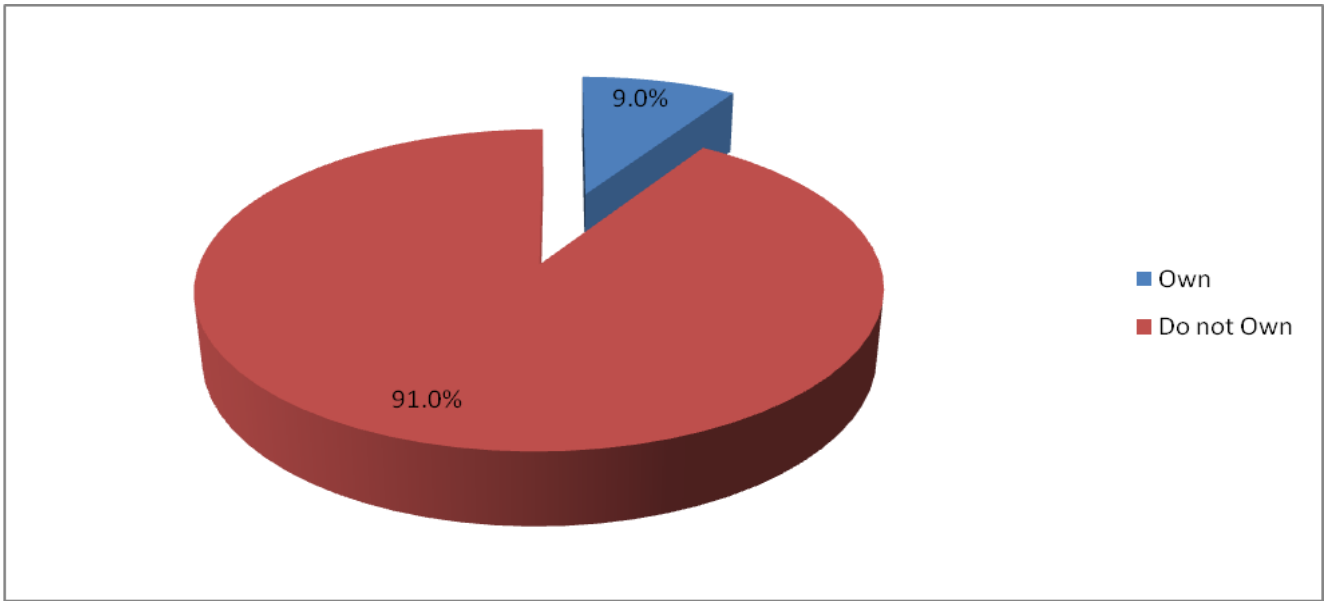


Table 9.1 presents percentage distribution of households by settlement and Solar PV systems ownership. The table shows that only 14.4 percent of rural households owned Solar PV systems and 85.6 percent did not own. It is also observed from the table that 98.2 percent of urban households did not own Solar PV and only 1.8 percent of urban households owned Solar PV.

Table 9.1: Percentage Distribution of Households by Settlement and Solar PV System Ownership, 2017 HECS

	Ownership			
Settlement	**Own Solar PV**	**Don't Own Solar PV**	**Total (%)**	**Total (N)**
Urban	1.8	98.2	**100.0**	**194,301**
Peri-Urban	7.2	92.8	**100.0**	**48,430**
Rural	14.4	85.6	**100.0**	**275,664**

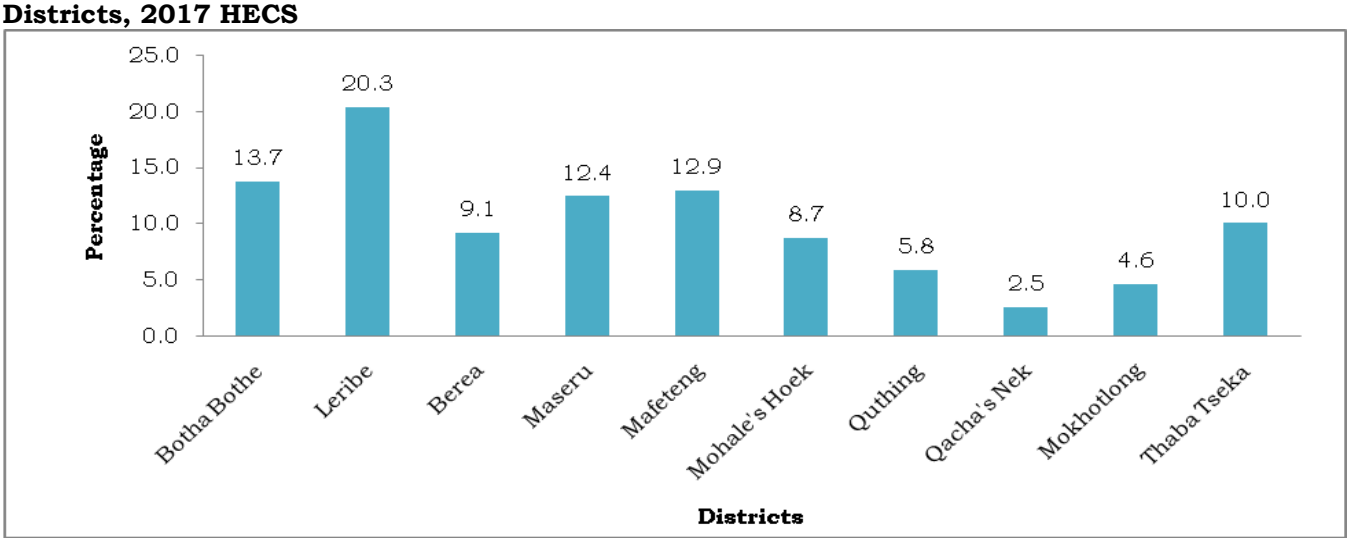
Table 9.2 shows percentage distribution of households with access to solar photovoltaic system by sex of household head and settlement type. The table shows that male headed households dominated female headed households with access to solar in all settlements.

Table 9.2: Percentage Distribution of Households with Access to solar photovoltaic system by Sex of Household Head and Settlement, 2017 HECS

Sex	**Urban**	**Peri-Urban**	**Rural**
Male Headed Households	72.2	66.7	71.2
Female Headed Households	27.8	33.3	28.8
Total (%)	**100.0**	**100.0**	**100.0**
Total (N)	**3,487**	**3,487**	**39,713**

Figure 9.2 depicts percentage distribution of households owning Solar Photovoltaic System by Districts. Ownership of solar photovoltaic system was high in Leribe (20.3 percent), followed by Botha-Bothe (13.7 percent). The least ownerhip was observed in Qacha's Nek with 2.5 percent.

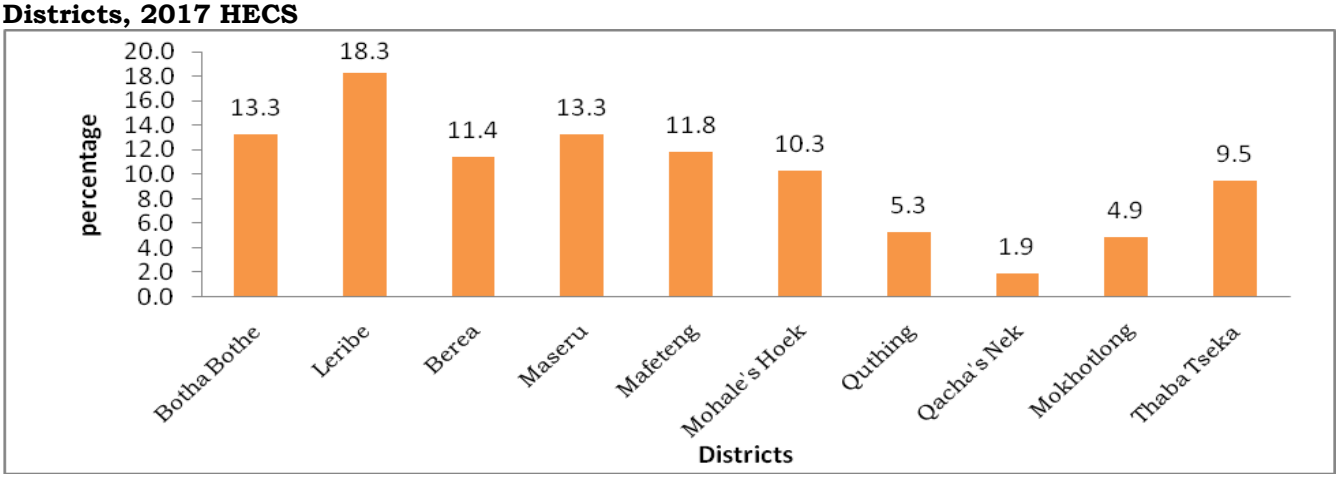
Figure 9.2: Percentage Distribution of Households Owning Solar Photovoltaic System by Districts, 2017 HECS



9.1.1 Solar PV Usage

Figure 9.3 depicts Percentage Distribution of Households using Solar Photovoltaic System by Districts in summer. Percentage of households that used solar photovoltaic system was more in Leribe with 18.3 percent. Botha Bothe and Maseru had 13.3 percent each of households that used Solar PV. Mafeteng and Berea accounted for 11.8 and 11.4 percent respectively while Qacha's Nek was the least with 1.9 percent.

Figure 9.3: Percentage Distribution of Households using Solar Photovoltaic System by Districts, 2017 HECS

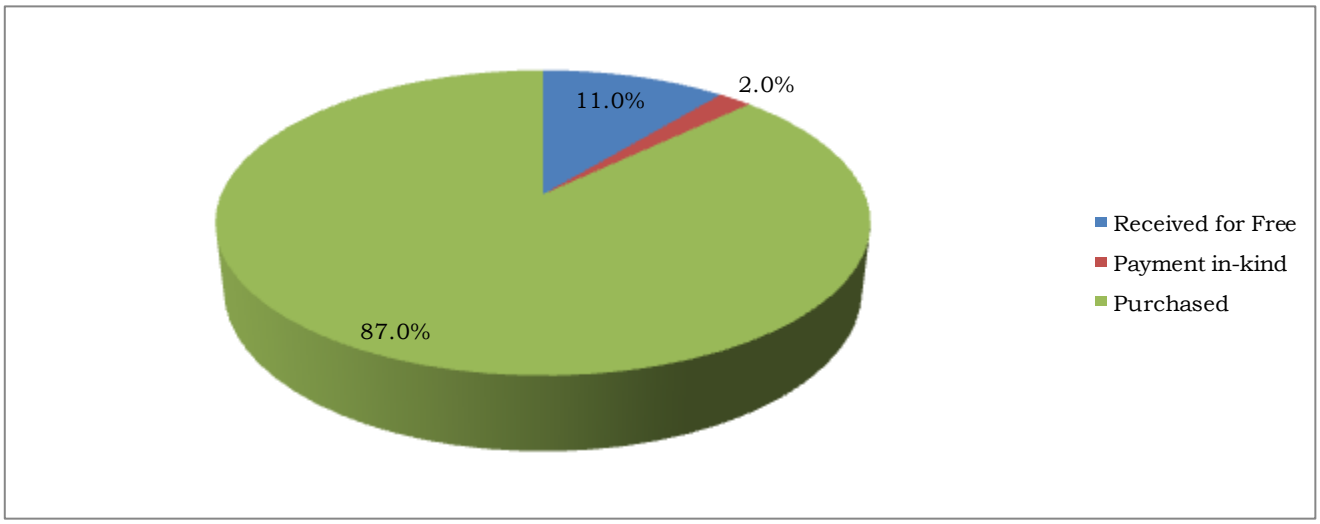


9.1.2 Methods of Obtaining Solar PV

In this part of the report there are three methods of obtaining PV. The methods are Received for free, Payment in-kind and Purchased. Received for free means did not pay anything to get solar PV. Payment in-kind means done something with the hope of getting solar PV in return while, Purchased means paying to get solar PV.

Figure 9.4 represents Percentage Distribution of Households by methods of Obtaining Solar PV System. It shows that more households purchased solar photovoltaic system with 87.0 percent, followed by those that received it for free (11.0 percent), while payment in-kind was only 2.0 percent of households.

Figure 9.4: Percentage Distribution of Households by methods of Obtaining Solar PV System, 2017 HECS



9.1.3 Information Acquisition

Information acquisition refers to the task of capturing all sorts of relevant information about how solar PV is used.

Figure 9.5 depicts percentage distribution of households that own solar PV system and received information on optimal use of the system. It is observed that of those households that owned solar PV system 58.0 percent received information on optimal use of the system while 42.0 percent did not.

Figure 9.5: Percentage Distribution of Households that Own Solar PV System and Received Information on Optimal Use of the System, 2017 HECS

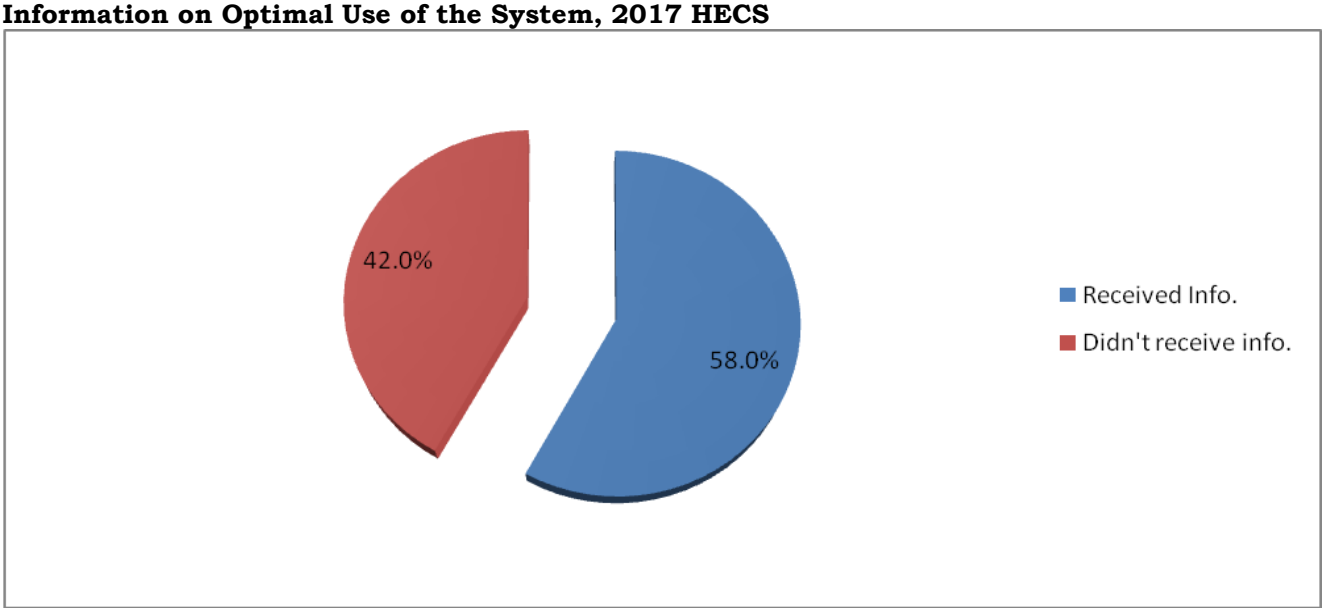
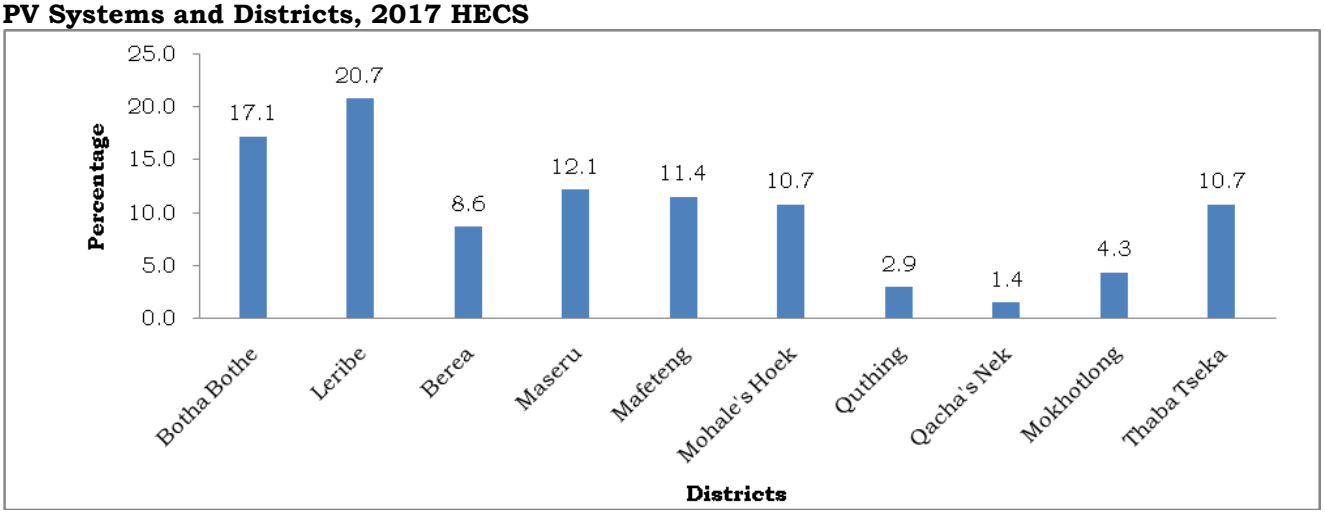


Figure 9.6 shows percentage distribution of households by information acquisition on using solar PV systems and districts. Leribe indicated 20.7 percent households that acquired information on how solar PV was used, followed by Botha Bothe with 17.1 percent. Mohale's Hoek and Thaba Tseka were 10.7 percent each while Qacha's Nek was least with 1.4 percent of households who received information on how solar PV is used.

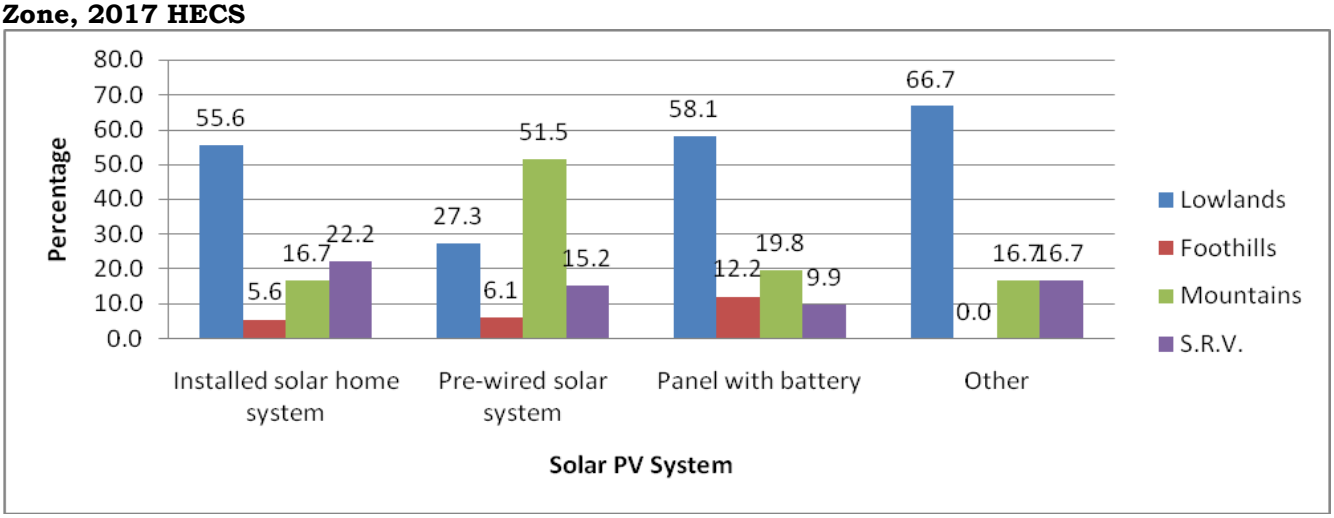
Figure 9.6: Percentage Distribution of Households by Information Acquisition on using Solar PV Systems and Districts, 2017 HECS



9.1.4 Types of Solar PV System

Figure 9.7 depicts percentage distribution of households by type of solar photovoltaic system and zone. All types of PV systems except Pre-wired, were mostly used by households residing in the lowlands. The figure shows that Pre-wired solar system is mostly used by households in the mountains (51.5 percent). The figure also shows that most households residing in foothills did not use solar PV.

Figure 9.7: Percentage Distribution of Households by Type of Solar Photovoltaic System and Zone, 2017 HECS



9.1.5 Number of Functional Solar Panels

Table 9.3 shows total percentage distribution of Solar panels by functionality and Settlement in summer. Percentage number of households who owned one functional solar panel was 85.3 percent in rural areas, 8.0 percent in peri-urban and 6.7 percent in urban areas. Percentage number of households who owned two functional solar panels was 88.5 percent in rural areas, 7.7 percent in urban areas. Those who owned three functional solar panels were 80.0 percent in rural areas and 20 percent in peri-urban areas.

Table 9.3: Total Percentage Distribution of Solar Panels by Functionality and Settlement Type, 2017 HECS

	One Solar Pane		Two Solar Panels		Three Solar Panels	
Settlement	**Functional**	**Not Functional**	**Functional**	**Not Functional**	**Functional**	**Not Functional**
Urban	6.7	20.0	7.7	0.0	0.0	100.0
Peri-Urban	8.0	0.0	3.8	0.0	20.0	0.0
Rural	85.3	80.0	88.5	100.0	80.0	0.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**43,587**	**2,906**	**5,037**	**775**	**969**	**194**

9.1.6 Cost of PV System

Table 9.4 shows percentage distribution of Households by Cost in Maloti (M) of solar photovoltaic system and settlement type. Percentage of households that reported cost of solar photovoltaic system to be less than M3,000 constituted 86.6 percent in rural areas. The least was observed in urban areas with 6.4 percent. The households with solar photovoltaic system ranging between M3,000 and M5,999 were highest (90.9 percent) in rural areas and followed by 9.1 percent in peri-urban. Households in both rural and peri-

urban areas with solar photovoltaic system that cost between M6,000 and M8,999 constituted 50.0 percent each.

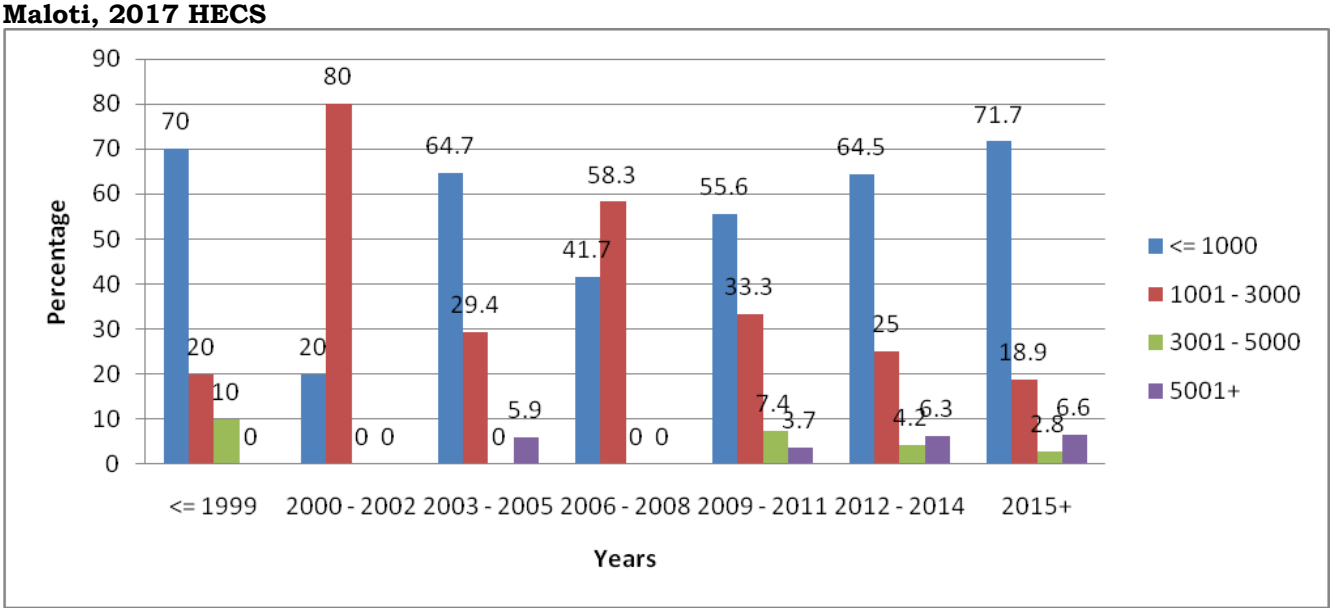
Table 9.4: Percentage Distribution of Households by Cost in Maloti (M) of Solar Photovoltaic System and Settlement, 2017 HECS

	Cost				
Settlement	**Less than 3000**	**3000 - 5999**	**6000 - 8999**	**9000 and above**	**Total**
Urban	6.4	0	0	0	5.8
Peri-Urban	7	9.1	50	0	7.9
Rural	86.6	90.9	50	100	86.4
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**33,320**	**2,131**	**775**	**775**	**37,001**

9.1.7 Year the Solar PV is Obtained

Figure 9.8 depicts percentage distribution of solar PV system by year obtained and cost (range) in Maloti (M). The figure shows that in almost all the years solar PV systems that were mostly bought cost less or equal to M1000 except between the years 2000 and 2002 and the years 2006 and 2008 where 80 percent and 58.3 percent of solar PV system that cost between M1001 and M3000 were bought.

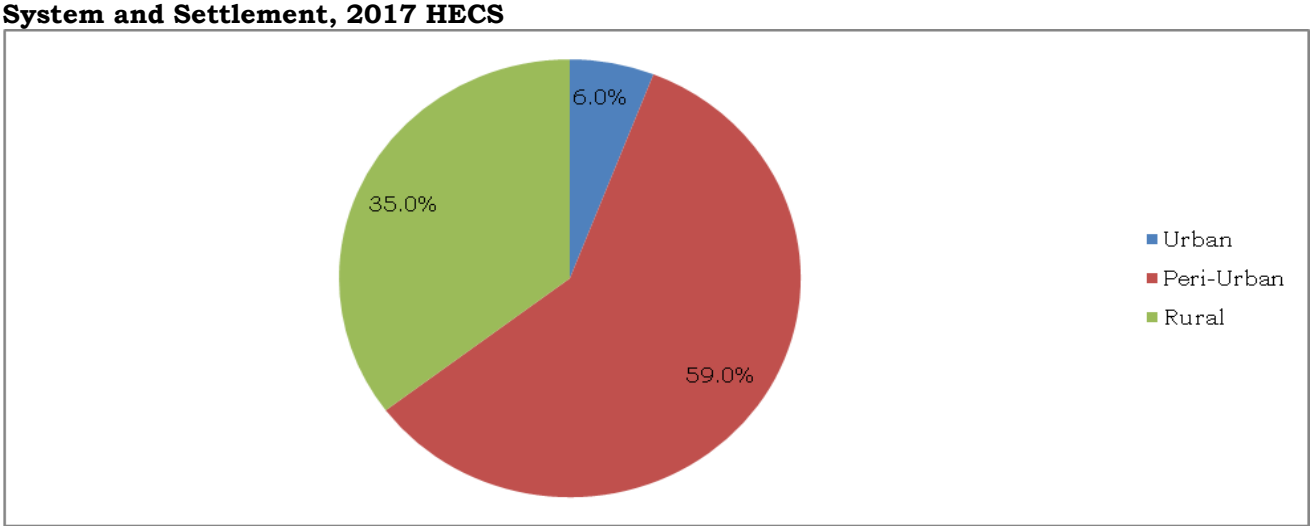
Figure 9.8: Percentage Distribution of Solar PV System by Year Obtained and Cost (Range) in Maloti, 2017 HECS



9.1.8 Subsidized Main Solar PV System

Figure 9.9 depicts percentage distribution of households with subsidized main solar photovoltaic system and settlement type. Percentage number of households with subsidized main solar panel system was 59.0 percent in peri-urban, followed by rural with 35.0 percent and least urban with 6.0 percent of households.

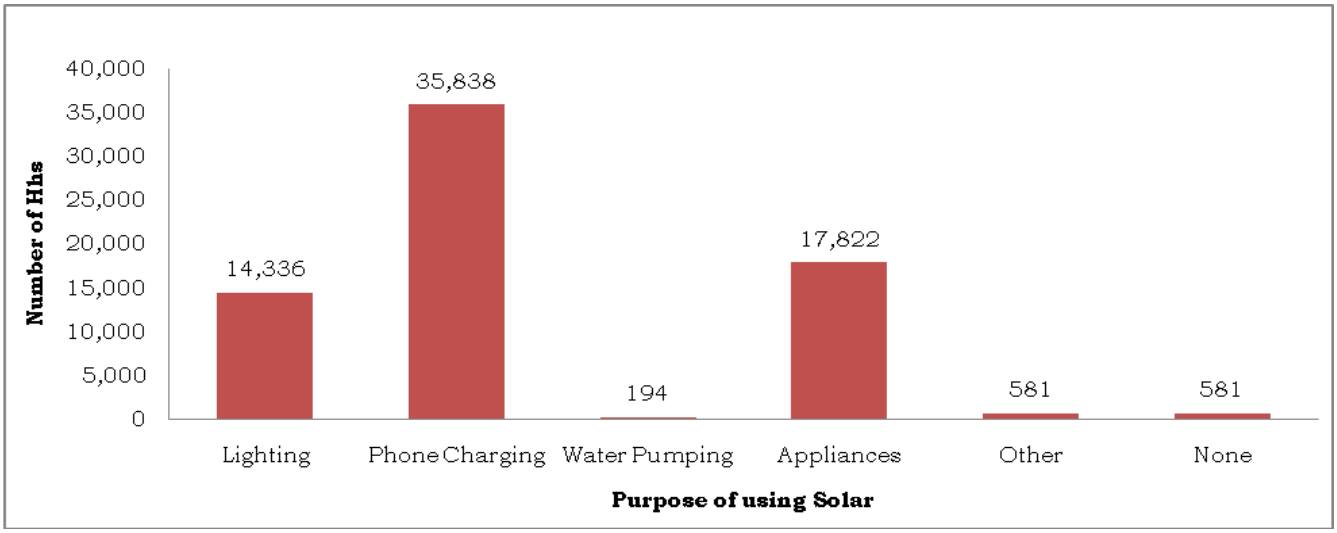
Figure 9.9: Percentage Distribution of Households with Subsidized Main Solar Photovoltaic System and Settlement, 2017 HECS



9.1.9 Purpose of Using Main Solar PV

Figure 9.10 depicts households distribution by main solar photovoltaic system and purpose for summer. There were 35,838 households that indicated to use solar photovoltaic system for phone charging, and 17,822 households used it for appliances. Households that used it for other purpose and those that did not use it were 581 respectively. About 194 households used solar PV for water pumping.

Figure 9.10: Households Distribution by Main Solar Photovoltaic System and Purpose, 2017 HECS



9.1.10 Amount of Solar Energy used

Table 9.5 shows total amount of solar energy (kilowatt hour) used by bulb type and settlement in summer. The table indicates that Incandescent globes used at most 616.23 kWh whereas Florescent tubes consumed only 20.34 kWh of solar energy. The table also shows that when using solar energy, Incandescent globes and LED were mostly used in summer in all settlements while energy savers and florescent tubes were not used in urban areas.

Table 9.5: Total Amount of Solar Energy (kilowatt hour) used by Bulb Type and Settlement, HECS 2017

	Types of Bulbs				
Settlement	**Energy saver (compact florescent)**	**Incandescent (Ordinary) globes**	**LED (Light Emitting Diode)**	**Florescent tube**	**Total**
Urban	0.00	174.35	17.73	0.00	**192.08**
Peri-Urban	12.52	15.69	18.60	8.72	**55.53**
Rural	359.74	426.19	205.70	11.62	**1,003.25**
Total	**372.26**	**616.23**	**242.03**	**20.34**	**1,250.86**

9.2 Summary

It was observed that households living in Leribe recorded a high percent in solar photovoltaic system ownership (20.3 percent) as well as its usage (18.3 percent). Qacha's Nek was least in solar photovoltaic ownership (2.5 percent) as well as its usage (1.9 percent). It was also observed that households living in the rural areas had more functional solar photovoltaic systems and depended on solar energy for their day-to-day basic living.

CHAPTER 10: OTHER ENERGY SOURCES AND PREFERENCES

10.0 Introduction

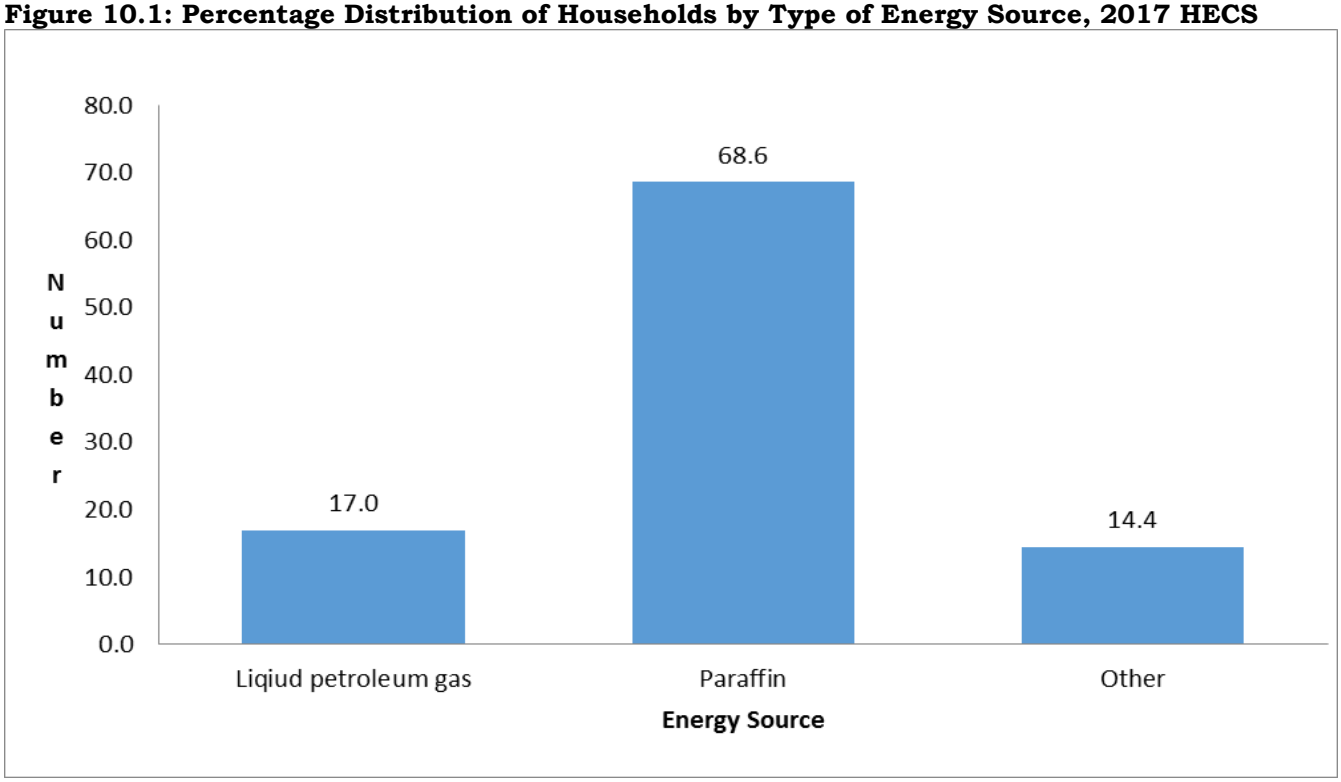
Energy is the ability to do work. It comes in different form such as heat or thermal, light, motion, electrical etc. Form of energy can fall into two basic categories such as potential energy and kinetic energy. Potential energy is stored energy while kinetic energy is the motion energy. https://www.eia.gov

10.1 Other Energy Sources

Other energy sources were classified as Liquefied Petroleum Gas (LPG), coal, paraffin, biogas and other.

Figure 10.1 indicates percentage distribution of households by type of energy source, 2017 HECS in summer. Paraffin was the most used energy source constituting 68.6 percent followed by LPG with 17.0 percent. The least was other energy source with 14.4 percent.

Figure 10.1: Percentage Distribution of Households by Type of Energy Source, 2017 HECS



10.1.1Method of Acquisition

The acquisition of other energy sources was categorized as Self-Production, Received for free, Payment in-kind, Purchased and collected.

Table 10.1 presents percentage distribution of households by methods of acquisition in summer. The table reveals that almost all households purchased coal while Biogas was self-produced. About 99.6 and 99.7 percent of the households reported to have purchased Paraffin and LPG respectively.

Table 10.1: Percentage Distribution of Households by Method of Acquisition and Type of Energy Source, 2017 HECS

	Energy sources			
Acquisition	**LPG**	**Coal**	**Paraffin**	**Biogas**
Self-Production	0	0	0	100.0
Received for Free	0.3	0	0.2	0
Payment in-kind	0	**0**	0.2	0
Purchased	99.7	100.0	99.6	0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**216,385**	**194**	**401,969**	**194**

10.1.2 Amount Spent on Liquefied Petroleum Gas

This section focuses on the amount (in Maloti) spent by households on Liquefied Petroleum Gas (LPG).

Table 10.2 shows percentage distribution of households by districts and amount spent on LPG in summer. The results reveal that households that spent more on LPG were from Maseru district constituting 33.4 percent. Qacha's Nek recorded the lowest percentage of households (1.6 percent) that reported to have spent on LPG.

Generally, most households (89,305) spent between M101 and M200 on LPG. The second category was that of households that spent between M301 and M400. Fewer households (1,743) also reported to have spent money ranging from M601 to M700 on LPG.

Table 10.2: Percentage Distribution of Households in Districts by Amount (Maloti) Spent on LPG, 2017 HECS

	Maloti (M)								
District	**<= 100**	**101 - 200**	**201 - 300**	**301 - 400**	**401 - 500**	**501 - 600**	**601 - 700**	**701+**	**Total**
Botha Bothe	0.0	6.7	0.8	4.4	1.5	2.3	11.1	0.0	4.3
Leribe	14.3	16.3	12.3	20.8	8.1	10.2	22.2	8.7	15.2
Berea	9.5	19.1	10.0	11.2	9.6	12.5	0.0	21.7	14.3
Maseru	19.0	29.7	33.8	24.4	53.3	47.7	44.4	39.1	33.4
Mafeteng	19.0	9.3	15.4	13.6	12.6	9.1	11.1	4.3	11.5
Mohale'sHoek	14.3	6.3	11.5	8.8	5.9	4.5	0.0	4.3	7.3
Quthing	4.8	4.1	6.9	8.0	5.2	6.8	0.0	4.3	5.6
Qacha's Nek	14.3	1.5	0.0	0.4	0.7	5.7	0.0	4.3	1.6
Mokhotlong	0.0	2.0	3.1	6.4	0.7	0.0	11.1	4.3	2.9
ThabaTseka	4.8	5.0	6.2	2.0	2.2	1.1	0.0	8.7	3.8
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**4,068**	**89,305**	**25,184**	**48,430**	**26,152**	**17,047**	**1,743**	**4,456**	**216,385**

10.1.3 Amount Spent on Paraffin

This section is mainly on the amount (in Maloti) spent by households on paraffin.

Table 10.3 shows percentage distribution of households by amount spent on paraffin and zone. The table indicates that most households (77.5 percent) residing in the Mountain zone

spent an amount in the range (<=100) Maloti on paraffin. A similar pattern was observed for households residing in other zones. Generally, majority of households that spent on paraffin were mainly from the lowlands (239,632).

Table 10.3: Percentage Distribution of Households by Amount (Maloti) Spent on Paraffin by Zone, 2017 HECS

	Zone				
Maloti (M)	**Lowlands**	**Foothills**	**Mountains**	**Senqu River Valley**	**Total**
<= 100	60.8	75.6	77.5	72.7	66.8
101 - 200	23.3	16.9	15.2	16.4	20.3
201 - 300	7.2	2.3	2.6	5.9	5.7
301 - 400	4.1	2.3	0.9	2.1	3.1
401 - 500	2.0	1.2	0.9	1.3	1.6
501 - 600	1.1	0.6	1.6	1.7	1.2
601 - 700	0.3	0.6	0.2	0.0	0.3
701+	1.2	0.6	0.9	0.0	1.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**239,632**	**33,320**	**82,718**	**46,105**	**401,775**

10.1.4 Seasonal Spending on Liquefied Petroleum Gas and Paraffin

This segment of the chapter concentrates on the amount spent on both Liquefied Petroleum Gas and Paraffin in winter and summer.

Table 10.4 reflects percentage distribution of households by amount spent on paraffin and LPG in both seasons. The table reveals that in winter more households (482,750) purchased paraffin than in summer (401,775). A similar trend was observed for LPG.

Table 10.4: Percentage distribution of households by Amount spent on paraffin and LPG and Season, 2017 HECS

	Paraffin		LPG	
Maloti (M)	**Summer**	**Winter**	**Summer**	**Winter**
<= 100	66,8	39,6	1,9	1,3
101 - 200	20,3	20,7	41,3	30,9
201 - 300	5,7	11,5	11,6	9,8
301 - 400	3,1	6,9	22,4	17,3
401 - 500	1,6	6,2	12,1	8,5
501 - 600	1,2	4,9	7,9	22,2
601 - 700	0,3	2,2	0,8	4,9
701+	1,0	8,1	2,1	5,2
Total (%)	**100,0**	**100,0**	**100,0**	**100,0**
Total (N)	**401,775**	**482,750**	**216,385**	**221,228**

10.1.5 Quantity of Source of Energy

The quantity of sources of energy used in Households is reported in this section including on quantity of Liquefied Petroleum Gas used and Paraffin.

Table 10.5 shows percentage distribution of households by district and LPG quantities (kg) used in summer. Majority of households (82,331) consumed Liquid Petroleum Gas (LPG) in the range 6-10kg followed by 49,399 households (16-20kg). A greater share of households in Maseru (33.4 percent) and Leribe (15.2 percent) consumed LPG. Qacha's Nek was the least with1.6 percent of households consuming LPG.

Table 10.5: Percentage Distribution of Households by District and LPG Quantities (kg) Used, 2017 HECS

District	Quantity (Kg)							
	<= 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	31+	Total
Botha Bothe	1.9	6.6	1.8	4.3	3.9	1.3	2.8	4.3
Leribe	11.5	14.8	15.0	20.4	14.5	10.0	13.9	15.2
Berea	17.3	20.0	9.7	11.0	5.3	10.6	16.7	14.3
Maseru	26.9	28.7	31.0	30.6	13.2	62.5	38.9	33.4
Mafeteng	9.6	8.9	17.7	12.2	25.0	8.1	5.6	11.5
Mohale'sHoek	11.5	6.4	13.3	6.3	18.4	1.9	2.8	7.3
Quthing	5.8	4.7	7.1	5.9	17.1	1.3	5.6	5.6
Qacha's Nek	11.5	0.9	0.9	0.8	2.6	0.6	5.6	1.6
Mokhotlong	0.0	2.8	0.0	6.3	0.0	1.9	2.8	2.9
ThabaTseka	3.8	6.1	3.5	2.4	0.0	1.9	5.6	3.8
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**10,073**	**82,331**	**21,890**	**49,399**	**14,723**	**30,995**	**6,974**	**216,385**

Table 10.6 indicates percentage distribution of households by district and paraffin quantities used for summer. In the first range (<=5) litres, the greatest percentage of households (23.2 percent) that used paraffin was in Maseru followed by Leribe (14.9 percent) and Berea (11.4 percent).

Table 10.6: Percentage Distribution of Households by district and Paraffin Quantities (Litres) used, 2017 HECS

District	Quantity (L)							
	<= 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	31+	Total
Botha Bothe	4.9	8.0	5.8	8.1	5.2	7.4	5.2	6.0
Leribe	14.9	14.1	19.2	20.7	15.5	5.6	21.4	15.9
Berea	11.4	13.3	11.7	11.9	6.9	13.0	7.8	11.5
Maseru	23.2	22.2	30.8	23.7	13.8	33.3	33.1	24.6
Mafeteng	10.0	9.3	7.9	11.9	10.3	20.4	11.7	10.1
Mohale's Hoek	10.6	5.1	8.3	10.4	25.9	9.3	3.2	8.9
Quthing	6.0	6.8	5.4	3.7	8.6	5.6	7.8	6.2
Qacha's Nek	4.5	3.6	2.1	3.0	5.2	3.7	5.2	4.0
Mokhotlong	6.5	5.5	2.5	5.2	3.4	1.9	3.2	5.3
Thaba Tseka	8.0	12.2	6.2	1.5	5.2	0.0	1.3	7.6
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**185,971**	**91,823**	**46,493**	**26,152**	**11,236**	**10,461**	**29,833**	**401,969**

10.2 Preferences

Energy sources preferences refer to certain characteristics any consumer wants to have in a good or service to make it preferable. The preferences are the main factors that influence consumer demand. https://economictimes.indiatimes.com/definition.com>preferences

Table 10.7 presents percentage of distribution of form of energy by district, 2017 HECS-summer. Households were asked which form of energy they would appreciate to be availed. About 28.5 percent of the households in Maseru district appreciate to be availed with at least one form of energy. Leribe district followed with 15.8 percent and Qacha's Nek was the least with 3.3 percent. In Maseru district, it was observed that LPG among other forms of energy was used more than the other forms of energy with 45.1 percent in Maseru.

Table 10.7: Percentage Distribution of Form of Energy by District, 2017 HECS

	Form of Energy								
District	**Electricity (grid)**	**LPG**	**Wood**	**Paraffin**	**Solar PV**	**Bio-gas**	**None**	**Other**	**Total**
Botha Bothe	9.0	1.7	8.8	3.1	1.0	0.0	0.5	0.0	5.5
Leribe	17.9	14.9	16.8	18.8	13.0	13.5	11.6	0.0	15.8
Berea	13.0	8.9	11.7	6.3	13.6	17.6	17.6	0.0	13.1
Maseru	17.5	45.1	23.4	32.8	35.5	39.2	44.8	40.0	28.5
Mafeteng	9.0	7.4	13.1	14.1	14.0	10.8	7.1	0.0	9.5
Mohale's Hoek	10.6	3.1	0.7	6.3	9.6	4.1	6.3	0.0	8.1
Quthing	5.5	4.3	5.8	1.6	2.7	0.0	8.1	20.0	5.2
Qacha's Nek	4.6	2.9	5.1	3.1	1.7	2.7	0.3	0.0	3.3
Mokhotlong	5.5	2.0	8.8	3.1	6.3	1.4	2.8	20.0	4.8
Thaba Tseka	7.2	9.7	5.8	10.9	2.7	10.8	1.0	20.0	6.3
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**259,197**	**67,802**	**26,,540**	**12,398**	**58,310**	**14,335**	**76,907**	**969**	**516,458**

Households also mentioned the energy sources they would like to be availed to them other than what they already have. The category of 'None' represent households who are satisfied with the energy sources at hand and would not want to be availed with any other energy source.

Table 10.8 displays form of energy source households would appreciate to be availed by season. The highest proportion of households (59.2 percent) would appreciate to be availed with Electricity (grid) followed by LPG (15.0) in winter. A similar pattern was observed in summer where 50.2 percent of households mentioned Electricity (grid) as the source of energy to be availed to them followed by LPG with 13.1 percent of households. The category of None denotes households who were comfortable with current energy sources and did not wish to be availed any other energy source.

Table 10.8: Form of Energy Source Households Would Appreciate to be Availed by Season, 2017 HECS

	Season	
Form of Energy	**Winter**	**Summer**
Electricity (grid)	59.2	50.2
LPG	15.0	13.1
Wood	4.8	5.1
Paraffin	4.2	2.4
Solar PV	12.8	11.3
Bio-gas	3	2.8
None	0.3	14.9
Other (specify)	0.5	0.2
Total (%)	**100**	**100**
Total (N)	**467,446**	**516,458**

10.3 Plans to Upgrade

Upgrading is the process of replacing an old product with a newer version of the same product https://en.wikipedia.org>wiki>upgrade

Table 10.9 portrays the households asked about plans to upgrade the houses in the next 2-3 years to reduce energy use. Most of the households (24.9 percent) reported fitting a ceiling as a major plan. About 17.9 percent of households reported that they plan to replace the light bulbs with CFL therefore only 5.1 percent of the households reported they plan to replace the light bulbs with LED.

Table 10.9: Percentage Distribution of Households by Plans to Upgrade the House

Plans	**Percent**
Replace the light bulbs with CFL	17.9
Replace the light bulbs with LED	5.1
Install a solar water heater	17.2
Install a PV system	12.3
Insulate the walls	6.4
Replace the windows	16.2
Fit a ceiling	24.9
Total (%)	**100.0**
Total (N)	**186,359**

10.4 Constraints

Constraint means limitation or impossible to do something. This part points out the type of constraints that households were faced with in order to access some forms energy.

Table 10.10 shows the households' constraints to upgrade houses. About 45.2 percent of the households sited 'not connected to electricity' as the main reason for not fitting CFL bulbs. Another constraint mentioned by about 17.3 percent of households for not fitting CFL bulbs was that they did not own a house. Households accounting for 40.1 percent could not install Solar PV due to low income.

Table 10.10: Percentage Distribution of Households by Constraints and Upgrades

	Upgrades						
Constraints	**CFL**	**LED**	**Solar Water Heater**	**Photovoltaic**	**Insulate**	**Window**	**Ceiling**
I do not own the house	17.3	17.7	26.0	25.7	26.1	28.3	26.1
Low income	13.8	13.6	37.3	40.1	35.5	40.0	35.7
Low quality of products	0.5	0.5	0.2	0.7	0.2	0.3	0.2
High purchasing costs	3.8	4.1	11.6	13.1	9.2	13.7	7.8
High installation/ labour costs	0.2	0.2	2.6	2.3	1.1	0.5	0.2
Lack of device on local market	0.1	0.2	0.3	0.3	0.3	0.2	0.0
Don't know which is best choice	2.9	2.8	0.5	1.1	0.7	1.1	0.5
I do not know about these technologies	9.8	12.5	16.9	10.5	24.9	10.6	6.1
Not connected to electricity	45.2	44.4	4.1	1.6	1.0	0.7	0.7
Already have	6.5	4.0	0.4	4.2	1.0	4.4	22.6
Other	0.0	0.1	0.2	0.4	0.0	0.2	0.0
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Total (N)	**463,572**	**463,572**	**432,383**	**437,032**	**444,394**	**410,299**	**396,351**

10.5 Summary

Majority of the households would appreciate to be availed with at least one form of energy. The highest proportion of households (59.2 percent) would appreciate to be availed with Electricity (grid) followed by LPG (15.0) in winter. A similar pattern was observed in summer where 50.2 percent of households mentioned Electricity (grid) as the source of energy to be availed to them followed by LPG with 13.1 percent of households

About 45.2 percent of the households sited 'not connected to electricity' as the main reason for not fitting CFL bulbs. Another constraint mentioned by about 17.3 percent of households for not fitting CFL bulbs was that they did not own a house. Households accounting for 40.1 percent could not install Solar PV due to low income.

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ANNEX A

2017 HOUSEHOLD ENERGY CONSUMPTION SURVEY

PHASE 2 (NOVEMBER)

SECTION A

Identification information **Codes**											
District											
Constituency											
Community council											
Zone											
Settlement type											
Enumeration Area (EA) Code											
Ward											
Village											
Household Head and Number											
Name of Respondent											
Staff details											
Name of Enumerator											
Date of interview											
Name of Supervisor											
Response Details											
1 Completed											
2 Not Completed											

SECTION B

B	DEMOGRAPHICS PARTICULARS OF ALL PERSONS										
B1. PERSON NUMBER		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
B2.List the members of the household who usually live and eat in this household. Please start with the head of the household. ***For babies with no names, write BABY.***											
B3. What is (name's) relationship to the head of the household?	1 Household Head 2 Spouse/Partner 3 Son/Daughter 4 Son/daughter in-law 5 Step child 6 Sibling 7 Own Parent 8 Parent in-law 9 Grandmother/father 10 Grandchild/Great Grandchild 11 Other relative 12 Not related										
B4. Is (name) a male or a female?	1 Male 2 Female										
B5. How old is (name) in completed years?	*Enter age in completed years ("000" for children less than one year old)*										
B6.What is (name's) date of birth?	**MONTH**										
	YEAR										
B7. Has (name) ever attended school? ***For persons aged 3 years and above***	1 Never Attended 2 Still Attending 3 Left school 9 Don't know										
B8. What is the highest level of education that (name) has completed? *e.g. 01 Standard 1* *02 Standard 2 etc.*	00 Pre – schools 01- 07 (Std1-7) 11-15 (Form 1-5) 18 None 19 Non-Formal Education 20 Diploma/certificate after primary 21 Vocational training after										

	primary 22 Diploma /certificate after secondary 23 Vocational training after secondary 24 Diploma /certificate after high school 25 Vocational after high school 26 Graduate 27 Post graduate Diploma/Honors 28 Masters 29 PHD 30 Other (Specify)_ _ _ _ _ _ _ _ _ 88 Not Applicable 99 Don't know										

SECTION C

Housing and Household Characteristics

C1. How many housing units does this household have? .....

C2. Which of the following houses does this household have?

Type of House 1 Rontabole 2 Heisi 3 Polata 4 Malaene 5 Optaka 6 Apartment/town house 7 Mansion 8 Bungalow 9 Mok'huk'hu/ temporary structure 10 Other (Specify) ..... (a)	**No of Rooms** (b)	**Usable area size** (sqM) (c)	**Year house occupied** 1 Before 1966 2 1966- 1975 3 1976- 1985 4 1986- 1995 5 1996-2005 6 2006- 2015 7 After 2015 8 Don't Know (d)	**Main Wall Material** 1 Cane/Tree trunk 2 Stick and Mud 3 Masonite 4 Stone with mud 5 Burnt mud bricks 6 Mud bricks/ Makoete 7 Stone with cement 8 Advanced stone 9 Sand/concrete blocks 10 Advanced burnt brick 11 Corrugated iron/metal sheet 12 Other (Specify)..... (e)	**Main Roofing Material** 1 Thatch/grass/straw 2 Corrugated iron/metal sheets 3 Corrugated roof tiles 4 Ceramic/clay tiles 5 Slab 6 Other (Specify)..... (f)	**Main Floor Material** 1 Mud/dung 2 Laminated board 3 Brick tiles 4 Tiles (ceramic) 5 Cement 6 Vinyl/linoleum 7 Carpet 8 Wood 9 Other (Specify).... (g)	In order to maintain efficiency, is your house(s) insulated in any way? *If coded 2, skip to C3* 1. Yes 2. No (h)	If 'Yes' how? (Multiple response) 1. Thatch 2. Carpet 3. Ceiling 4. Foam 5. Laminated Board 6. Other (Specify...) (i)

C3. What is the ownership status of the house(s) used by the household? 1 Owned by household 2 Free government housing 3 Free Private housing 4 Subsidized government housing 5 Subsidized private housing 6 Rented by government 7 Rented private housing 8 Other (Specify)_ _ _ _ _ _ _ _ _ _ _ _ _ _	

SECTION D
Economic Characteristics

D1. How much does the household earn per month? *Give total amount of the household earnings* 1. None 2. Less than M300 3. M300 - M499 4. M500 - M999 5. M1, 000 - M1, 999 6. M2,000 - M4,999 7. M5, 000 – M9, 999 8. M10, 000 – M29, 999 9. M 30,000 and above	
D2. Did the household receive any remittances/transfers during the warm months (Sept-November)? *If no remittances received code 2, and skip to* ***Section E.*** **1 Yes** **2 No**	
D3. What is the value of the remittances (in Maloti) received during the warm months (Sept-November)? 1. Less than M300 2. M300 - M499 3. M500 - M999 4. M1, 000 - M1, 999 5. M2, 000 - M4, 999 6. M5, 000 - M9, 999 7. M10, 000 - M29, 999 8. M 30,000 & above	

SECTION E

BIOMASS

E1. Which of the following Biomass did you use?

Energy sources	Did you use the following energies for housing purposes in the warm months (Sept-November) of the year? **1 Yes** **2 No** *If coded 2, skip to next energy source* (a)	How did you mainly obtain the Energy sources you consumed in the warm months (Sept-November) of the year? Self-Production=1 Received for Free=2 Payment in-kind=3 Purchased=4 Collected=5 (b)	The amount spent on energy source in the warm months (Sept-November) year? (c)	What are total quantities of energy product used in the warm months (Sept-November) of the year? (d)	Units (e)
1. Charcoal					kg
2. Fuel wood					kg
3. Wood waste					kg
4. Wood chips					kg
5. Wood pellets, briquettes, others					kg
6. Crop waste					kg
7. Animal waste/dung					kg
8. Aloe					kg
9. Shrubs (Sehalahala)					kg
10. Other (Specify).....					

E2. Is there an area where you can collect fuel wood in your community? *If coded 1 in E1a and 1, 3 to 10 in energy sources skip to E8* **1. Yes** **2. No**	☐
E3. Where do you normally source your fuel wood? *If coded 4, skip to E6* 1. Communal forest 2. Private Forest 3. Household yard 4. Purchase 5. Other (Specify).....	☐
E4. How long does it take to go from your house to the edge of the main collecting area and back and collect fuel wood? ***Time in minutes*** 1. 00 - 29 2. 30 - 59 3. 60 - 89 4. 90 - 119 5. 120+	Travel Time ☐ Collecting Time ☐

E5.Which household member(s) was usually involved in fuel wood collection? (Use the codes in the household roster)	**1.....** **2.....** **3.....** **4.....**
E6. How much fuel wood do you use per day (kg)? **Wet** **Dry** 1 Day 1 2 Day 2	

E7. What type of fuel wood (litompo, metso/methapo etc) is being collected/purchased in warm months (Sept-November) and how often?

Type of fuelwood	How often do you collect/purchase fuel wood? 0- None 1- One to five times 2- Six to ten times 3- More than ten times
Logs (Litompo)	
Twigs (thupa tse sesanyane)	
Roots (Metso/kutu)	
Bark of trees (Makhekhebu)	
Trees (e.g Poplar, blue wattle)	
Other (Specify)	

E8. What type of improved fuel wood stove do you use? *If coded 6 skip to Section F* 1 Rocket Stove 2 Eco-Zoom 3 EnviroTech 4 Save 80 5 ACE 1 Smokeless cook stove 6 None 7 Other (Specify)	
E9.For how long have you been using the improved fuel wood stove? *Code "00" for less than a month and skip to E11*	.....Months

E10. Did you notice any of the following difference since using improved fuel wood stove? *(give response to each of the options)*

Rating

1 Increased **2 Decreased** **3 None**

Fuel Wood Time taken to cook/heat Smoke

E11. Do you sometimes use other types of biomass as fuel in the stove e.g. cow dung, etc? **1 Yes** **2 No**	

SECTION F

Electricity

F1. Is your household connected to grid electricity?, Include Meter Nunber of the household **1 Yes** **2 No**	☐ **Meter Number ……**
F2. Did you use electricity for housing purposes in the warm months (Sept-November) of the year? *If coded 2 in F1 and F2, skip to F11.* **1 Yes** **2 No**	☐
F3. How did you mainly obtain the Electricity you consumed in the warm months (Sept-November) of the year? 1. Received for Free 2. Payment in-kind 3. Purchased 4 None	☐
F4. How much did you spent on electricity in the warm months (Sept-November) of the year?	M…… ….
F5. What is the main reason for not using grid electricity? *For those coded 1 in F1 and 2 in F2.* 1. Expensive 2. Lack of knowledge 3. Fear 4. Disconnected 5. Other (Specify)……	☐
F6. How long have you been using/connected to grid electricity? *(Code 00 for less than 1 year)*	..Year(s)

F7. What do you use electricity for? (*multiple responses*) *Please tick appropriate answers.*
For those coded 1 in F2

1. Cooking/Re-Heating ☐ 2. Entertainment (e.g. Radio, TV) ☐ 3. Washing ☐
4. Lighting ☐ 5. Ironing ☐ 6. Dishwashing ☐
7. Sewing ☐ 8. Air-conditioning ☐ 9. Computer Powering ☐
10. Water Pumping ☐ 11. Refrigeration ☐ 12. Charging ☐
13. Space Heating ☐ 14. Water Heating ☐ 15. Workshop (welding, carpentry, etc) ☐
16. Other (Specify)…… ☐

F8. How did you electrify this house? *If coded 10, skip to F10*

Type of House 1Rontabole 2 Heisi 3 Polata 4 Malaene 5 Optaka 6 Apartment/town house 7 Mansion 8 Bungalow 9 Mok'huk'hu/ temporary structure 10. Other (Specify).....	**Electrification Method** 1 Individual Expenditure 2 Scheme 3 Government 4 Other (Specify)..... 5 Non 6 Not Applicable
(a)	(b)

F9. What are the major improvements (household-based) as a result of electrification (grid)? (*multiple responses*)

1. Improved Lighting		2. Water Heating	
3. Faster Cooking		4. Entertainment (TV, Radio)	
5. Space heating/Air conditioning		6. Initiated income generating activities	
7. None			
8. Other (Specify).....			

F10. Which electrical appliances did you use in your household in the warm months (Sept-November)?

Ownership	How many do you have? (a)	How long have you been using the appliance? 1 0-5 Years 2 6- 10 Years 3 11- 15 Years 4 16- 20 Years 5 21+ Years (b)	How much did it cost? (c)	What is the power rating of the appliance (Watts) (d)	How many minutes per day is it used? (e)
Refrigerator					
Electrical geyser					
Chest /Deep freezer					

Electric stove					
Electric heater					
Washing machine					
Dishwasher					
Tumble dryer					
Hoover					
Hair Dryer					
Television – Plasma					
Television – LED					
Television – LCD					
Television – CRT					
Desktop computer					
Laptop					
Air conditioner					
Iron					
Electric Kettle/element					
Bread Maker					
Toaster					
Microwave					
Electrical pot					
Electrical hair clipper					
Other Specify……					
None					

F11. What are the reasons for not being connected to grid electricity? ***For only those coded 2 in F1***

1. Lack of funds for wiring
2. Lack of funds for connecting
3. No electricity line
4. Renewable off-grid
5. Conventional off-grid
6. Other (Specify)……

SECTION G

Cooking and Kitchen utensils

G1. What is the source of energy for cooking for the household specifying both main and alternative? *If coded 10 for Alternative skip G2 for Alternative.* 1. Electricity 2. LPG 3. Biogas 4. Paraffin 5. Crop waste 6. Coal 7. Wood 8. Animal dung 9. Straw/shrubs/grass 10. No alternative 11. Other (Specify).....	**Main** ☐ **Alternative** ☐
G2. How much fuel on average do you use for cooking per month? *Please use appropriate units eg. Litres, kg etc* ***exclude fuelwood and electricity by coding "00"***	**Main** ☐ **Alternative** ☐
G3. What kind of electrical/gas cooking plate/stove do you mainly use? *If coded 5 skip to G6.* 1. Spiral 2. Induction/hot plate 3. Gas stove 4. Glass Ceramic plate 5. None 6. Other (Specify).....	☐
G4. How long has the type of stove been in use? *Code "00" for less than a year*	..... Years
G5. Does the stove have a Chimney, Hood or Window?	1.Yes ☐ 2.No ☐

G6. State what usually happens in the household by filling in appropriately	**Period**		
	Breakfast (a)	Lunch (b)	Dinner (c)
G6i. What type of pots are usually used at the time of cooking? (*multiple response)* *If coded 10 for G6a skip to G6b* *If coded 10 for G6b skip to G6c* *If coded 10 for G6c skip to G8* 1. Stainless steel pot 2. Alminium pot 3. Nonstick pot 4. Copper pot 5. Enameled Cast Iron 6. Uncoated Cast Iron 7. Carbon-Steel & Blue Steel 8. Safe 80 pots 9. Electrical pot 10. None			
G6ii. How many pots are used at time of cooking?			
G6iii. What kind of cooking technology/method do you usually use for preparing food? (*multiple response)* 1. Stove 2. Open fire 3. Prima stove/Paraffin heater 4. Paola 5. None			
G6iv. Type of food usually cooked			

G6v. Type of energy source usually used? (*multiple response)* 1. Electricity 2. LPG 3. Biogas 4. Paraffin 5. Crop waste 6. Coal 7. Wood 8. Animal dung 9. Straw/shrubs/grass 10. Other (Specify).....			
G6vi. What technique is used for preparing food? *(multiple response)* 1.Boiling 2.Frying 3.Baking 4.Grilling/Roasting 5.Simmering 6.Other Specify).....			
G6vii. Time taken to cook a meal (minutes)			

G7. Which energy sources and their quantities did you use for cooking per day?

Energy Sources	**DAY 1**		**DAY 2**	
	Energy source used *(Tick answer)*	**Quantity used**	**Energy source used** *(Tick answer)*	**Quantity used**
1. Electricity				
2. LPG				
3. Biogas				
4. Paraffin				
5. Crop waste				
6. Coal				
7. Wood				
8. Animal dung				
9. Straw/shrubs/grass				
10. None				
11. Other *Specify)*.....				

G8. Do you have a microwave oven? *If coded 2, skip to G12* **1 Yes 2 No**	
G9. How much time (in minutes) in a week do you use the microwave instead of the electric oven for cooking? *Write "00" for Reheating and defrosting food.,and skip to G11*	..... Minutes
G10. Which answer best describes how frequently your household uses microwave to prepare hot meals and snacks in a typical week? 1. Used to cook most meals and snacks 2. Used to cook about half of meals and snacks 3. To cook a few meals and snacks	
G11. Does your household use the microwave for defrosting? **1 Yes 2 No**	

G12. Do you have an Electric Cooker (slow cooker or pressure cooker)? *If coded 2, skip to section H* **1 Yes 2 No**	☐
G13. How often do you use Electric Cooker (slow cooker or pressure cooker)? 1. Daily 2.Weekly 3. Monthly 4. Quartely	☐

SECTION H

Heating/Cooling

H1. Did you heat your house(s) in the warm months (Sept-November) of the year? *If coded 2, skip to **H7*** **1 Yes 2 No**	☐
H2. Which of the following did your household use for space heating in the warm months (Sept-November) of the year? (*multiple response*) 1. Gas heater ☐ 2. Coal/Wood stove ☐ 3. Air Conditioner ☐ 4. Paraffin heater ☐ 5. Paola ☐ 6. Fireplace ☐ 7. Open Fire ☐ 8. Electric Heater ☐ 9. Other (Specify)..... ☐	
H3. What is the main and alternative source of energy for space heating for the household? *If coded 1or 3 as main and 10 as alternative, skip to H6* *If coded 1 or 3 as Main skip H5 for Main,* *If coded 1 or 3 as Alterative skip H5 for Alternative.* 1. Electricity 2. LPG 3. Biogas 4. Paraffin 5. Coal 6. Wood 7. Animal dung 8. Crop waste 9. Straw/shrubs/grass 10. No Alternative 11. Other (Specify).....	**Main** ☐ **Alternative** ☐
H4. How much fuel did you use for space heating in the warm months (Sept-November) of the year and how much did it cost? *Please use appropriate units.*	**Main** ☐ **Cost** ☐ **Alternative** ☐ **Cost** ☐
Note: H5 and H6 measurements have to be taken only for rooms that were heated or cooled	
H5. How many square metres (m^2) of household area did you heat in the warm months (Sept-November) of the year?	
H6. How many square metres (m^2) of household area did you cool in the warm months (Sept-November) of the year?	.....

H7. What is the main source of energy for water heating for the household? 1. Electricity 2. LPG 3. Biogas 4. Paraffin 5. Coal 6. Wood 7. Animal dung 8. Crop waste 9. Straw/shrubs/grass 10. Solar water heater 11. Other *(*Specify*)*.....	☐
H8. Which of the following alternative sources do you use for water heating? *(multiple response)* 1. Electricity ☐ 2. LPG ☐ 3. Biogas ☐ 4. Paraffin ☐ 5. Coal ☐ 6. Wood ☐ 7. Animal dung ☐ 8. Crop Waste ☐ 9. Straw/shrubs/grass ☐ 10. Solar water heater ☐ 11. Other *(*Specify*)*..... ☐	

SECTION I

Lighting

I1.What is the main and alternative source of energy for lighting for the household? *For those coded 1 to 4 as main and 10 as alternative skip to I3* *For those coded 1 to 6 as main skip I2 for main* *For those coded 1 to 6 as alternative, skip I2 for alternative* *For those coded 5 or 6 as main and 10 as alternative skip to Section J* 1. Electricity (Grid) 2. Electricity (Generator) 3. Electricity (Battery) 4. Rechargeable Battery Lamps 5. Solar Lantern 6. Electricity (Solar) 7. LPG 8. Candle 9. Paraffin 10. None 11. Other (Specify).....	**Main** ☐ **Alternative** ☐
I2. How much energy source did you use for lighting in the warm months (Sept-November)? *Please use appropriate units.*	**Main** ☐ **Alternative** ☐

I3. What type of light bulb do you use? (*multiple responses*) ***For those coded 1to 4 in I1***

Type of Bulb	How many do you have? (a)	What is the capacity of the bulb? (b)	How many minutes are they switched on per day? (c)

Energy saver (compact florescent)			
Florescent tube			
Incandescent (Ordinary) globes			
LED (Light Emitting Diode)			
Other (Specify).....			

SECTION J

Access to Automobiles

NB: Only light-duty passenger vehicles and recreation vehicles are included in this survey **(exclude large trucks, motor cycles, buses, tractors)**

J1. Did this household have access to a car (family owned, hired or borrowed) in the warm months (Sept-November) of the year ? *If coded 2 skip to* ***Section K*** **1 Yes** **2 No**	

J2. What make of a car(s) did the household have access to in the warm months (Sept-November) of the year? Fill in accordingly information pertaining to cars that were used.

Make of Car (a)	**Type of Fuel used by the car** 1.Diesel 50ppm 2.Diesel 500ppm 3.Lead replacement petrol 4.Unleaded petrol (b)	**Amount of Money used on Fuel** (Maloti) (c)	**Amount of Fuel used** (Litres) (d)

J3. Which of the following lubricants did the household use in the warm months (Sept-November) of the year? *Fill in appropriately.* ***Include only lubricants used in the car***		
Type of lubricant	**Quantity** (a)	**Amount of Money** (Maloti) (b)
Motor oil (litres)		
Brake fluid (litres)		
Grease (kilograms)		
Other (Specify).....		

SECTION K

Solar Energy Usage

K1. Do you own a Solar Photovoltaic (PV) system(s)? **1 Yes 2 No**	☐
K2. Did you use Solar PV for housing purposes in the warm months (Sept-November) of the year? *If coded 2 in K1 and coded 1 or 2 in K2, skip to K12* **1 Yes 2 No**	☐
K3. How did you obtain the Solar PV? 1. Received for Free 2. Payment in-kind 3. Purchased	☐
K4. Did you ever receive information on how the Solar PV works or can be used? **1 Yes 2 No**	☐

K5. What kind of solar PV system(s) do you have? *Multiple response*

1. Installed solar home system	☐	2. Pre-wired solar system	☐
3. Panel with a battery	☐	4. Mini grid	☐
5. Solar for water pumping	☐	6. Other (specify).....	☐

K6**.** Give the number of solar panels owned by the household and their capacities. *If coded 2 for all in column c, skip to K12.*

Note: *For panels with the* ***same*** *wattage, write the number of such panels and capacity of* ***ONLY*** *one solar panel. Panels should be functional in the* warm months (Sept-November)

Number of panels (a)	Capacity of panel (watts) (b)	Functionality **1 Yes 2 No** (c)

K7. What was the cost of the whole system(s)? *Including cost of installation if applicable* M……	
K8. Which year was the main system obtained? ……	
K9. Was the main system subsidised? **1 Yes 2 No**	☐

K10. What do you use solar PV for? Tick appropriately (*multiple response) if not coded 1, skip to K12*

1. Lighting ☐ 2. Phone charging ☐ 3. Water Pumping ☐
4. Appliance: radio, TV, etc. ☐ 5. Other (Specify) …… 6. None ☐

K11. What types of bulbs are connected to the PV System? **Note:** *Aggregate bulbs of similar capacity. for example, in a household where there are 2 bulbs of 11 watts, then under number, record 2 and under capacity record 11.*

Type of Bulb	How many do you have? (a)	What is the Capacity (watts)? (b)	How many minutes are they turned on per day? (c)
Energy saver (compact florescent)			
Florescent tube			
Incandescent (Ordinary) globes			
LED (Light Emitting Diode)			
Other (Specify) ……			

Solar Water Heating

K12. Do you have a solar water heater (geyser)? *If coded 2 skip to* ***Section L*** **1 Yes 2 No**	☐

K13. Give the number of solar water heating systems owned by the household and their capacities.

Note: *For solar water heating systems bearing the* ***same*** *characteristics write the number of such and fill in characteristics of* ***ONLY*** *one solar water heating system.*

Number of solar water heating systems (a)	What is the capacity of a solar water heater? Volume (in Litres) (b)	What is the collector area (Aperture area) of the solar water heater? Give area in cm^2 (c)	What was the cost of the whole system (including cost of installation)? (d)	Which year was the system installed? (e)	Is the solar water heating system functional? **1 Yes 2 No** If coded 2, skip to section L (f)	Do you have electrical backup for the solar water heating system? **1 Yes 2 No** (g)

SECTION L

Generators

L1. Did the household own a functional generator in the warm months (Sept-November)? **1 Yes** **2 No**	☐
L2. Did the household use a generator in the warm months (Sept-November)? *If coded 1 in L1 and 2 in L2, skip to L4* *If coded 2 in L1 and 2 in L2 skip to* ***Section M*** **1 Yes** **2 No**	☐

L3. What did you use the generator for? *(Multiple response)*

1. Lighting ☐
2. Powering electrical appliances (radio, TV etc.) ☐
3. Irrigation purposes ☐
4. Other (Specify)..... ☐

L4. What is the brand of the generator? Fill appropriately.

Note: *For generators bearing the* ***same*** *characteristics write the number of such and fill in characteristics of* ***ONLY*** *one generator.*

Brand (a)	Number of generators (b)	Capacity (kVA) of each generator (c)	Type of Fuel used 1.Diesel 50ppm 2.Diesel 500ppm 3.Leadreplacement petrol 4.Unleaded petrol (d)	Litres consumed in the warm months (Sept-November) (e)	How much did it cost? (Maloti) (f)

SECTION M

General Energy Use

M1. What form of energy would you appreciate to be availed to you? 1. Electricity (grid) 2. LPG 3. Wood 4. Paraffin 5. Solar PV 6. Bio-gas 7. None 8. Other (Specify).....	
M2. Did the household use any garden appliances in the warm months (Sept-November)? *If coded 2 skip to Section N.* **1 Yes 2 No**	

M3. What energy source and quantity did the household use in any of the following garden appliances in the warm months (Sept-November)?

Garden Appliances	**Type of energy source** 1.Diesel 50ppm 2.Diesel 500ppm 3.Lead replacement petrol 4.Unleaded petrol (a)	**Quantity** (litres) (b)
1 Chain saw		
2 Lawn mower		
3 Garden blower		
4 Other (Specify).....		

SECTION N: Other Energy Sources

N1. Which of the following energy sources did you use?

Energy sources	Did you use the following energies for housing purposes in the warm months of the year? **1 Yes** **2 No** (a)	How did you mainly obtain the Energy sources you consumed in the warm months of the year? Self-Production=1 Received for Free=2 Payment in-kind=3 Purchased=4 Collected=5 (b)	The amount (Maloti) spent on energy source in the warm months of the year? (c)	What are total quantities of energy product used in the warm months of the year? (d)	Units (e)
Liquid petroleum gas					kg
Coal					kg
Kerosene/ paraffin					Lit
Biogas					
Other (Specify).....					

N2. Are there any plans to upgrade the house in the next 2-3 years to reduce energy use by doing the following: (*multiple response*)

If coded 2 in all go to N3

If coded 1 in any of the responses, don't answer N3 **1 Yes** **2 No**

1. Replace the light bulbs: 1(a) with CFL ☐ 1(b). with LED ☐ 2. Install a Solar Water Heater ☐

3. Install a PV system ☐ 4. Insulate the walls ☐ 5 Replace the windows ☐

6. Fit a ceiling ☐

N3. What are the constraints against making any of the above investments? **(*multiple response*)**

For ONLY those coded 2 in N2

1. I do not own the house ☐ 2. Low income ☐ 3. Low quality of products ☐

4. High purchasing costs ☐ 5. High interest rates on commercial loans ☐

6. High installation / labour costs ☐ 7.Lack of device on local market ☐

8. Don't know which is best choice ☐ 9. I do not know about these technologies ☐

10. Not connected to electricity ☐ 11. Other (specify): _____