Field Report: Market Attractiveness Analysis and Demand Assessment for M-Kopa Solar Systems in Mozambique

Report prepared for M-Kopa Kenya Limited – October 2016

GreenLight Consult
Rua da Argélia no 159
Maputo – Mozambique
www.greenlight-africa.com

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

DFID	Department for International Development
EDM	Electricidade de Mocambique
FGD	Focus Group Discussion
MWTP	Market Willingness to Pay
MZN	Mozambique Metical
PAYG	Pay As You Go
USD	United Stated Dollar

1. INTRODUCTION

M-KOPA Solar is the global leader of "pay-as-you-go" solar energy, serving over 330,000 customers in Kenya, Uganda and Tanzania. M-KOPA has a proven, scalable approach to this sector and brings this experience to bear in assessing the attractiveness of new markets. The Department for International Development (DFID) is supporting M-KOPA in undertaking an assessment of the Mozambican market in March 2016, through the review of the existing literature as well as stakeholder interviews.

As part of its assessment of the Mozambican market, M-KOPA wishes to further evaluate the potential demand for its solar products, assuming that the main drivers of demand are willingness to pay and ability to pay.

Greenlight Consult, Lda, a mozambican based-company, has carried out a qualitative and quantitative field study looking at the following aspects in detail:

a) Household energy habits and expenditure;
b) Awareness and understanding of solar products;
c) Awareness and usability of mobile payment systems;
d) Market willingness to pay for m-kopa services; and
e) Other energy related behavioral aspects.

This report is divided in 4 sections:

1) Methodology
2) Field survey results
3) Focus group results
4) Discussion
5) Conclusion and recommendations

2. METHODOLOGY

The methodology for the proposed project encompasses both qualitative and quantitative research methodology as to gain a deeper understanding of household energy practices and willingness to adopt the M-KOPA solar system solution. A combination of household questionnaires and focus group discussions (FGD) were chosen as research techniques. The household questionnaires allowed the survey team to capture measurable data on the several aspects being studied. The FGD allowed the survey team to understand better the qualitative aspects behind the household energy decisions making. Critical aspects such as Market Willingness to Pay and awareness level have been focused on in both the questionnaire and FGD. It should be noted that at the time of the survey, the Mozambican currency (Metical) had been experiencing a strong devaluation against the USD. The exchange rate used in this report

is that of June 2016 market at 60 Meticais per one USD. This currency fluctuation may affect the perception of households with regards to price comparisons of different goods and services as compared to the M-KOPA suggested price intervals.

2.1. SEMI-STRUCTURED QUESTIONNAIRE

The semi structured questionnaires was developed according to the specific needs of M-KOPA. They were administered either in Portuguese or Shangana (depending on the preference of household). The survey was administered using electronic tablets with Do It Forms software. The following questions have been included in the questionnaire:

1) Socio-economic profile of respondent and household
- Gender, education level, household size, house type, number of rooms in the house, expenditure on different goods and services

2) Energy use and expenditure
- Main energy sources used for lighting, daily/weekly/monthly costs for energy source, place of purchase, satisfaction level with source of energy
- Phone ownership and charging behaviour, MWTP for charging phone at home
- Radio ownership, usage behaviour, cost and running cost

3) Awareness level
- Household awareness level and understanding of solar home system features and benefits;
- Perception about solar energy and value for money;
- Respondent awareness about mobile money and usage level
- Awareness and expectation for when the electric grid is to arrive in the neighbourhood/community

4) Market willingness and ability to pay
- Willingness to switch to solar energy
- Willingness to pay for solar energy
- Willingness and ability to pay US$ 30 (1700 MZN) deposit on solar home system;
- Willingness and ability to pay US$ 0.50 (25 MZN) daily fee
- If respondents not willing to pay suggested price – inquiry about the maximum price which respondents are able to pay (both start-up and daily fee);
- Willingness to pay M-KOPA via mobile money platform and willingness to open account to acquire M-KOPA

5) Radio
- Radio ownership and frequency of listening;
- Type of radio programs and channels listened to;

Figure 2.1- Image of batteries used to facilitate respondent answer about battery type used

2.2. Focus Group Discussion

The objective of the FGD is to "fill in the gaps" and "understand better what's behind the quantitative answers". The following questions have be focused upon:

1) Different sources of energy for lighting and reason for preference
2) Purchase cost of energy source and running costs;
3) Awareness and understanding of solar home system features and benefits;
4) Perception about solar energy and products currently in the market;
5) Perception of the M-KOPA system and feedback on functionality and design (demo product to be requested form M-KOPA)
6) Market Willingness to Pay for the M-KOPA system (both focus group participants as well as their perception for others in the community).
7) Ability to pay start-up cost of US$ 30 as well as daily fee of US$ 0.50. – If not, what price are participants willing to pay;
8) Awareness level and understanding about mobile payment platforms and willingness to adopt;
9) Radio usage and preferences;
10) Additional comments and feedback about the technology and service offering of M-KOPA

2.3. SITE SELECTION

The site selected for carrying out the research is the district of Moamba, in Maputo province. The reason for selecting this site was primarily due to four reasons:

1. Several communities in Moamba district still do not have access to the electric grid and it is uncertain if they will have in the near future;
2. Moamba district has typical rural communities which can be found across southern Mozambique. Households engage in agriculture, cattle herding and some engage in paid labour activities. Households generally have sufficient income to be viable clients for solar systems;
3. The Vodacom network is well spread across the district – enabling the use of M-Pesa. An M-Pesa agent is also present in the main district centre.
4. The proximity to Maputo (80 km) and well connected roads make it possible to carry out a pilot project in the same communities if M-Kopa wished to do so in the future.

The survey was carried out in the communities of Lizuveve, Muchia and Nhoqueiro during the 15th and 16th of June 2016.

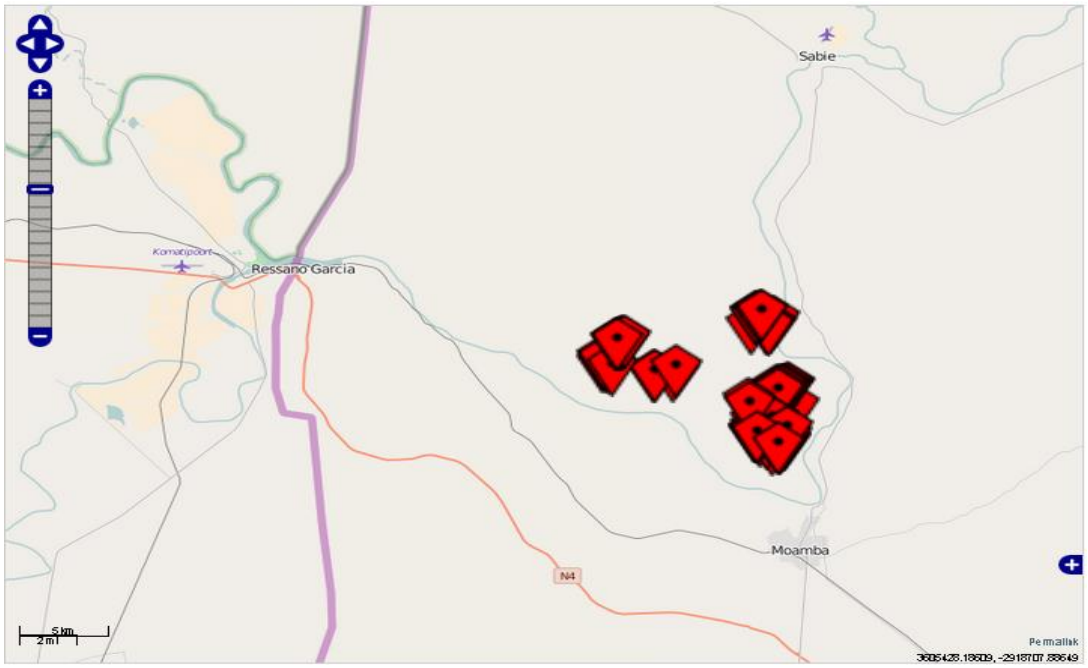


Figure 2.2- GIS pinpoints of surveyed households

2.4. Sample Size And Sample Selection

2.4.1. Questionnaire

The questionnaire was administered to 80 households. These households were selected using a stratified random sampling technique. Local leaders were approached to assist with the division on the neighbourhoods into quarters.

From a total estimated of 200 households in the selected communities, 66 households were selected as a sample. This selected sample is representative with a confidence index of 95% and sample error of 10%. The sample selection had in account statistical factors (permissible error, and desired frequency) as well as non-statistical factors (financial and logistical resources available).

It should also be noted that an additional 14 households were surveyed, as to safeguard against possible quality issues with the selected sample. As such, 40 households were surveyed in the Lizuveve community, 20 surveys in Muchia community and 20 surveys in the Nhoquene community.

The selection of households was carried out using the excel function – Random Between(1.200) whereby the 80 households were selected amongst the 200 identified households. The list of households is available in ANNEX 3: LIST OF SELECTED SAMPLE HOUSEHOLDS (AS PER ID)

2.4.2. Focus Groups

In the focus groups undertaken in the community, nine people participated in the discussions. This size is ideal for a well managed and interactive discussion. The participants were selected to be representative of the community members. The village leader and some traditional leaders were also present.

In terms of gender division, 5 participants were male while 4 were female. **Table 2-1** presents the focus group participants involved in the study.

Table 2-1: Focus group participants

Name	Occupation	Years living in the community
Ulisse Seussone	Village leader	N.A.
Armindo Manhiça	Guard	34
Armando Tembe	Traditional leader	24
Samussone Mulemba	Public administration	N.A.
Amusse Xavier	Farmer	N.A.
Amélia Chiúre	Farmer	24
Mércia António	House-wife	2
Ana Paulla	Chief of 10 houses	54
Maria	Farmer	N.A.

3. RESULTS

This section is a compilation of the results from the survey as well as the focus group discussion. The sections are divided according to the following themes:

- Socio-economic characteristics of households;
- Energy use patterns, expenditures and purchase behaviour;
- Mobile phone usage and mobile services;
- Awareness level about solar energy and solar home systems;
- Market willingness to pay for the M-Kopa system.

3.1. SOCIOECONOMIC RESULTS

3.1.1. BASIC HOUSEHOLD DATA

The household survey was administered to both male and female household representatives. Enumerators were asked to interview the persons responsible for energy related decisions. 56% of the respondents were male and 44% were female. The average age of respondents was 42 years and the highest education level achieved by household members was the completion of primary school (78% of respondents).

The average household size is 5 members. Most of the respondents (52%) live in a reed/thatch house (considered traditional building material in the region) while 45% live in cement brick houses (considered modern building material). The average amount of room (or divisions) in the house was reported to be 5. **Table 3-1** presents the basic household data.

Table 3-1: Basic household data

Gender	
Male	56%
Female	44%
Average age of respondents	42
Percentage between 19 and 30 years	29%
Percentage between 31 and 50 years	34%
Percentage above 50 years	31%
Highest education level attained in household	
Percentage with no schooling	6%
Percentage which have completed primary school	78%
Percentage which have completed high school	15%
No responses	1%
Average household size (members)	5
Construction material of house	
Stick and mud	1%
Cement block	45%
Reeds / thatch or bamboo	52%
Other	1%
Average number of division (rooms) in house	5
Percentage with 1 room	6%
Percentage with 2 rooms	12.5%
Percentage with 3 rooms	20%

Percentage with 4 rooms	21%
Percentage with 5 rooms	10%
Percentage with more than 5 rooms	30%

3.1.2. Income And Expenditure

An average of 2 people in each household performs an economic activity. 4 % of household do not engage in any economic activity. The most common primary economic activity performed in this region in formal employment (29%), followed by livestock sale (21%) and agriculture (20%). Common secondary income generating activities include agriculture (21%) and formal employment (18%). 34% of households do not engage in a secondary economic activity.

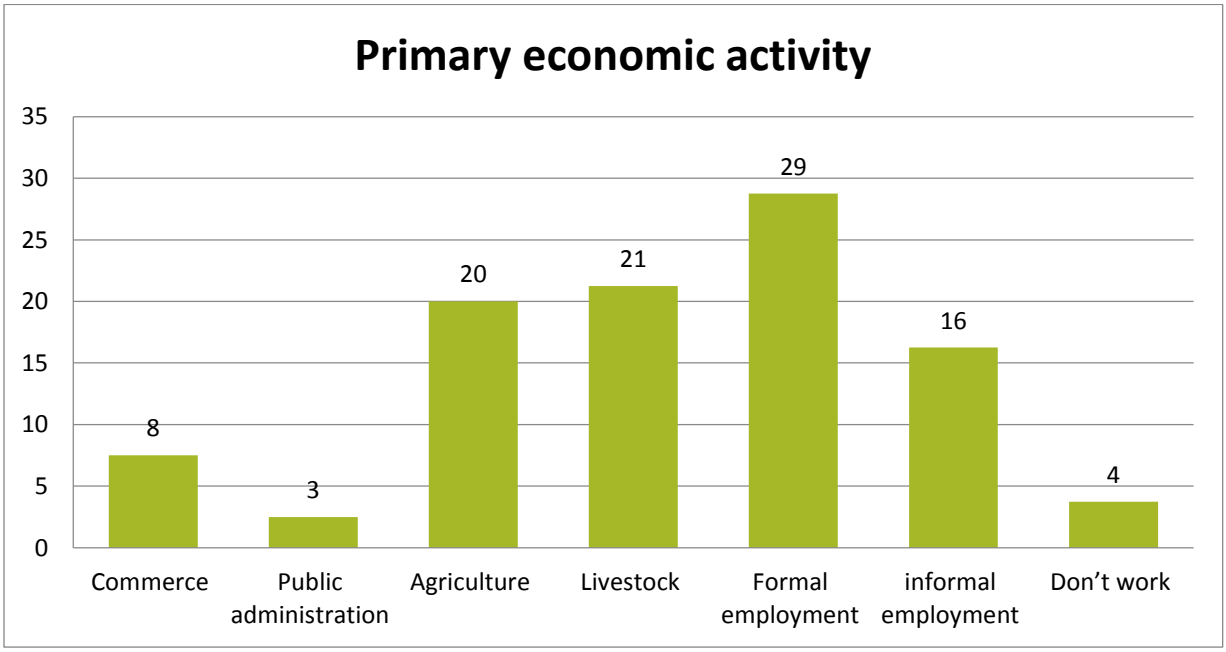
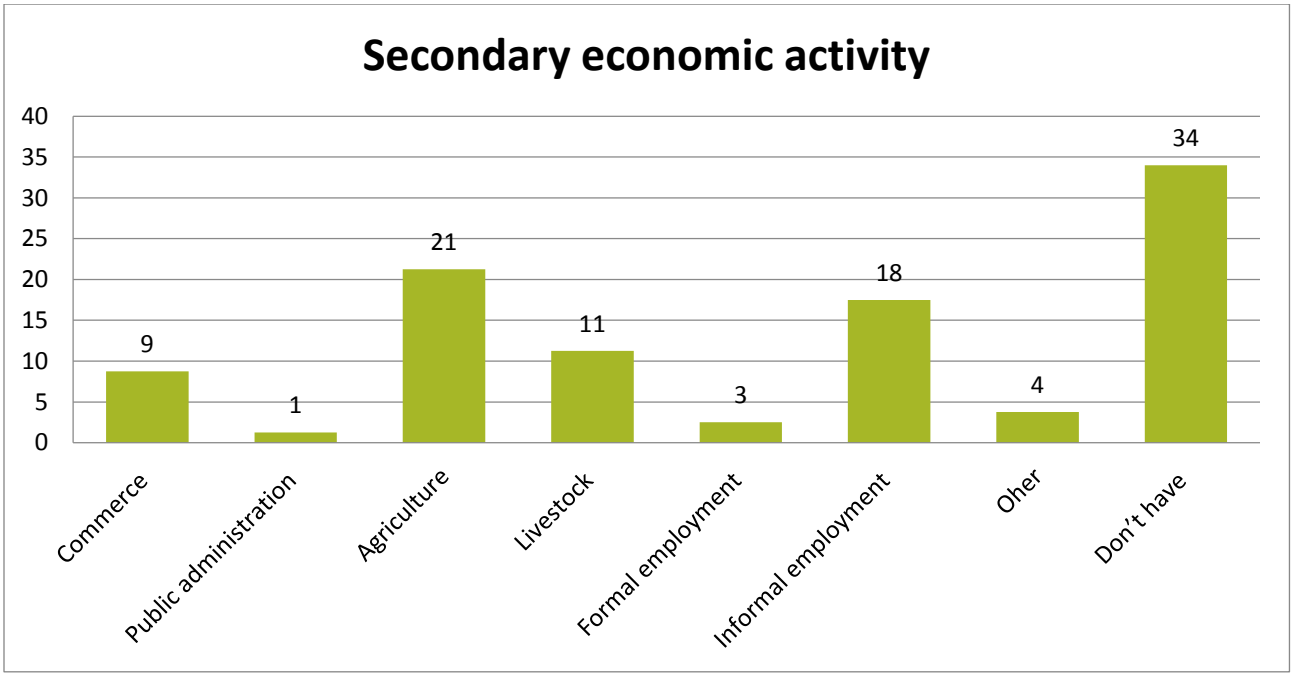


Figure 3.1- Primary Economic Activity of Households



F**igure 3.2-** Secondary Economic Activity Performed by Households

Box 1: Focus group results corresponding to economic activity

FGD Results
"People in this community depend on cattle and agriculture for income. This year however it has been very dry and much of the cattle has died. Many people have gone to work in Maputo and South Africa".

On average household spend 4.520 Meticais (75 USD) per month on common good and services such as food (3.112 MZN), transport (418 MZN) and mobile phone credit (416 MZN). Other goods and services can be seen in table 3 bellow. Surprisingly, the second highest expenditure for 59% of households is on drinking alcohol (520 MZN).

Table 3-2: Household Monthly Expenditure on Different Goods and Services

Percentage of households buying cooking fuel	8%
Average monthly expenditure on cooking fuel	350 MZN
Percentage of households purchasing food	100%
Average monthly expenditure on food	3.112 MZN
Percentage of households spending money on healthcare	65%
Average monthly expenditure on healthcare	158 MZN
Percentage of households spending money on transport	90%
Average monthly expenditure related to transport	418 MZN
Percentage of households spending money on mobile phone credit	95%
Average monthly expenditure on mobile phone credit	416 MZN
Percentage of households spending money on charging phone battery	35%
Average monthly expenditure on charging phone battery	155 MZN
Percentage of households spending money on schooling	24%
Average monthly expenditure on schooling	127 MZN
Percentage of households spending money on alcoholic beverages	59%
Average monthly expenditure on alcohol	520 MZN
Estimated average monthly expenditure per household	4520 MZN

89% of the households fall under the first two income quintiles. 43% of households earn bellow 5.000 MZN (83 USD) per month. 46% earn between 5.001 and 10.000 MZN per month (83-167 USD).

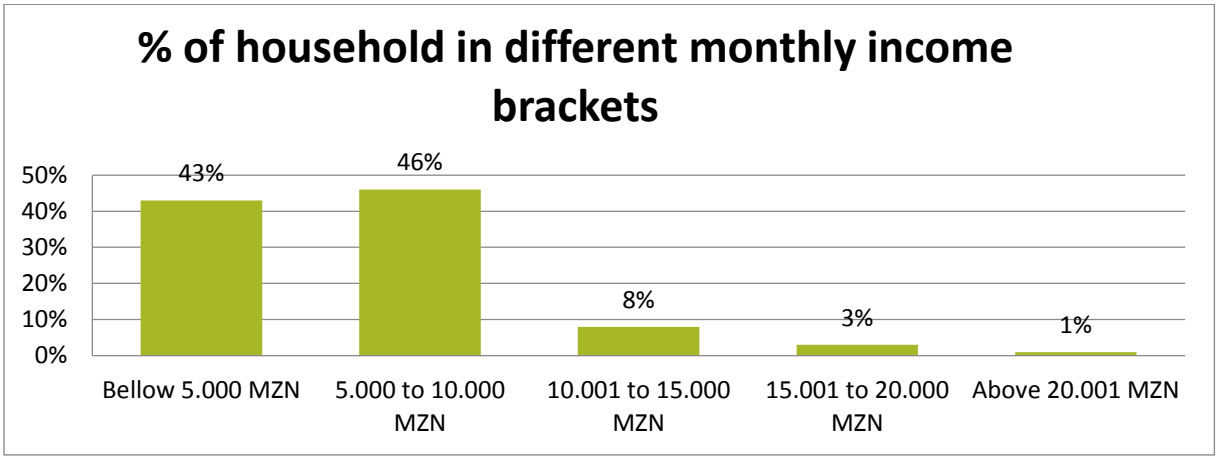


Figure 3.3- Income brackets among sample households

3.2. ENERGY DATA

3.2.1. SOURCE OF ENERGY AND LIGHT

None of the households surveyed have access to the national electrical grid supplied by Electricidade de Mocambique (EDM). 32% of households have access to a source of electrical energy. The large majority of households do not know when the grid will arrive to their community (66%); while 30% believe that the national grid will never arrive.

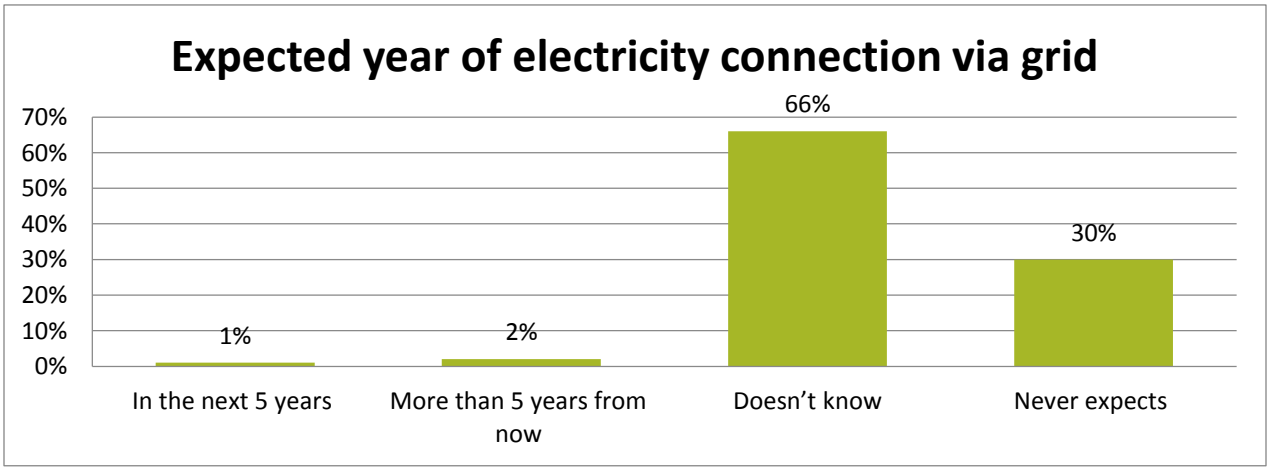
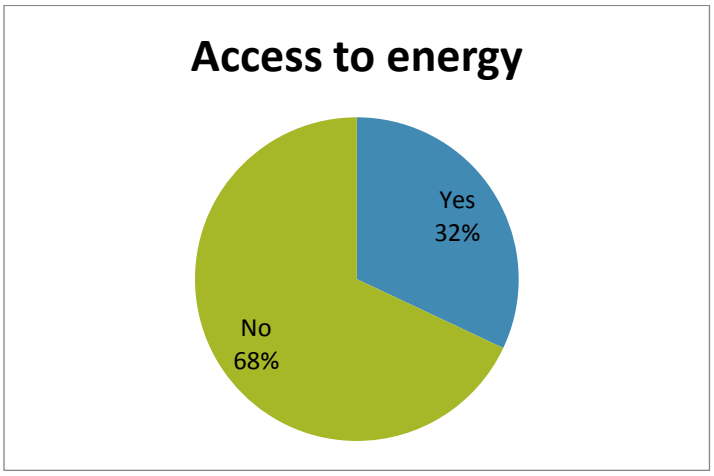


Figure 3.4- Expected year of electricity connection as perceived by households

Box 2: Focus group results corresponding to the access to energy

FGD Results
"The community leaders have requested several times that the government extends the EDM line to the village. This request has been ignored for many years now. We are not sure why they don't extend the line".

Despite not being connected to the national electrical grid, 32% of households have access to energy. Sources include generators, car batteries and solar energy. It is not certain however if all households use such sources continuously as only few reported the use of electrical energy for lighting purposes.



F**igure 3.5-** Households with access to energy source

Box 3: Focus group results corresponding to source of energy

FGD Results
"Some of us have solar energy kits from South Africa and Maputo. They are good and help us"…"People use the batteries from their cars to watch television sometimes or charge the mobile phones".

With regards to the main source of energy for illumination (lighting): 65% of households make use of battery operated torches. The second most common source of light is kerosene (15%) followed by solar energy (9%).

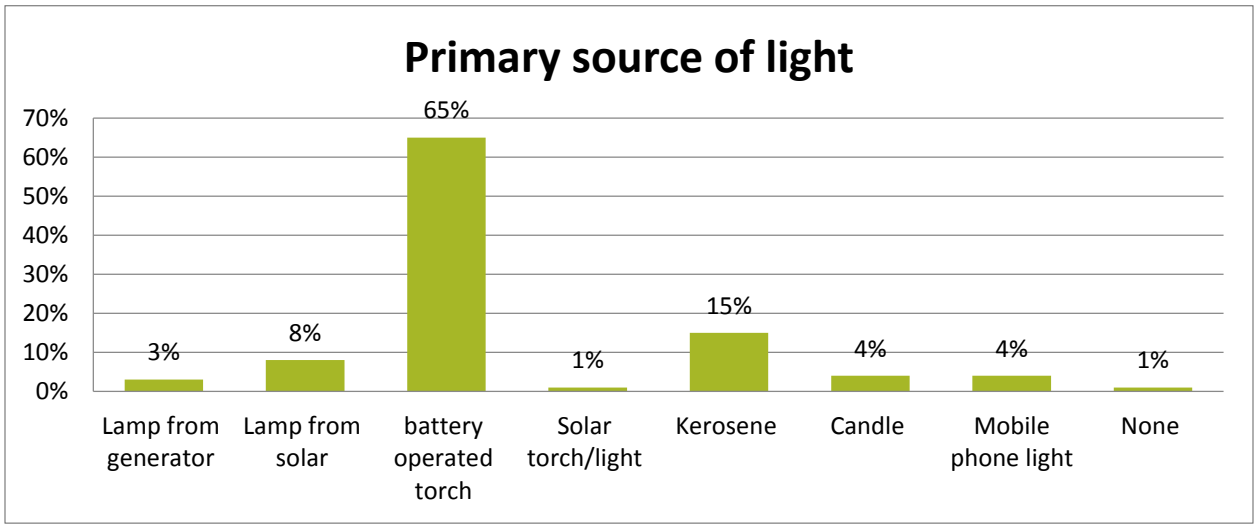


Figure 3.6- Primary Source of light used by households

48% of households have no secondary source of energy for lighting. The most common secondary source of light is however the light from the mobile phone (used by 16%) of households. 15% of households rely on candles as secondary sources.

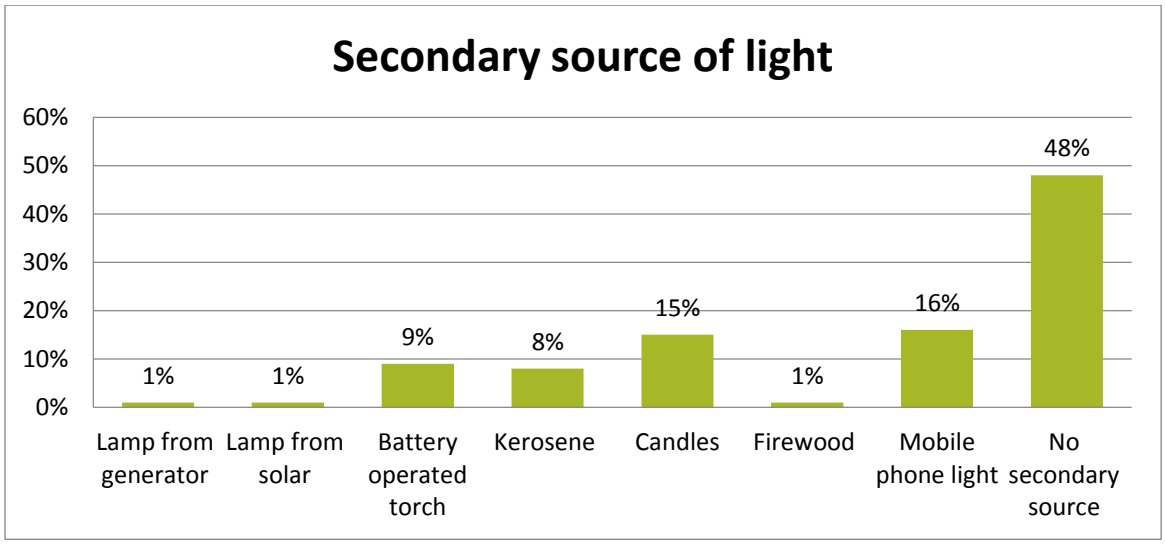


Figure 3.7- Secondary source of light used by households

Box 4: Focus group results corresponding to energy source used for light

FGD Results

- 2/8 participants in the focus group use kerosene for lighting
- 6/9 participants in the focus group use battery operated torches for lighting

"People prefer to use battery torches because it is cheaper compared to kerosene. The light from the torch is also stronger compared to kerosene"

"Some people have solar energy systems. These work well and some can also charge the mobile phones. My system is from South Africa and it was a gift from my son working there".

3.2.2. Purchase Behaviour And Expenditure

Households which make use of petrol generators for energy purposes spend on average 1.125 MZN (19 USD) per month on fuel. This is the most expensive energy source recorded in the survey. Households which rely on kerosene for lighting spend on average 388 MZN (6.5 USD) per month. Those households reliant on torches for light, spend on average 221 MZN (4 USD) per month on batteries. Those reliant on candles spend 152 MZN (2.5 USD) per month.

Table 3-3: Average monthly expenditure per energy source used for lighting purposes

Energy source for Light	Average monthly expenditure
Petrol generator	1.125 MZN
Batteries	221 MZN
Kerosene	388 MZN
Candles	152 MZN

Solar systems owned by households vary in price. The solar kits were purchased at an average price of 1000 MZN (17 USD), while solar operated torches were purchased for 700 MZN (12 USD). The exchange rate however may have skewed the price as the systems may have been bought before the Metical had devaluated since mid 2015. (from 32 MZN to 60 MZN for 1 USD).

Table 3-4: Average price of solar systems owned by households

Type of solar system	Purchase price
Solar light	1000 MZN
Solar torch	700 MZN

Box 5: Focus group results corresponding to expenditure on energy sources

FGD Results

"We spend between 150 MZN and 250 MZN on batteries for torches each month"

"I spend around 300 MZN for kerosene each month. Our family uses up to 5 litres for the lanterns"

"The solar system has two lights and can charge the phone. The battery however is not so good anymore"

The table below summarises the key data from households using petrol generators. Petrol is bought once or twice a month for an average price of 1.125 MZN. It is usually purchased from private sellers reported to charging 50 MZN per litre. Households spend on average 30 minutes of time to purchase the petrol. Generators usually power several electrical appliances including an average of 5 light bulbs.

Table 3-5: Data on petrol generator usage

Indicator	Value
Monthly expenditure	1.125 MZN
Purchase frequency	Once or twice a month
Purchase location	Private sellers in village
Time required for purchase	30 minutes
Price per litre	50 MZN
Average number of light fittings	5
Usage with other electrical appliances	Yes

Those households reliant on battery operated torches for lighting purchase their batteries from the local market. Those which purchase batteries several times per week (11%) can purchase on average 4 batteries and spend 73 MZN (1.2 USD). Others purchase batteries once a week and can spend 67 MZN (1.1 USD) per purchase of an average of 3.6 batteries. Most households however (44%) tend to purchase batteries once a month and can spend on average 105 MZN (1.75 USD) for 5.4 batteries. Based on the different purchase habits it can be estimated that households spend on average 221 MZN (4 USD) per month for batteries. While this wasn't discussed in the surveys or focus groups, previous surveys suggest that torches are on average used for 3.5 hours per night.

Table 3-6: Data on battery use for lighting

Purchase frequency	Percentage of households	Number of batteries purchased	Expenditure
Several times a week	11%	4	73 MZN
Once a week	23%	3.6	67 MZN
Twice a month	19%	5.5	109 MZN
Once a month	44%	5.4	105 MZN

Most households (67%) purchase D size batteries, while 23% purchase C size and 6% purchase AA sized batteries. Only 4% purchase the AAA batteries.

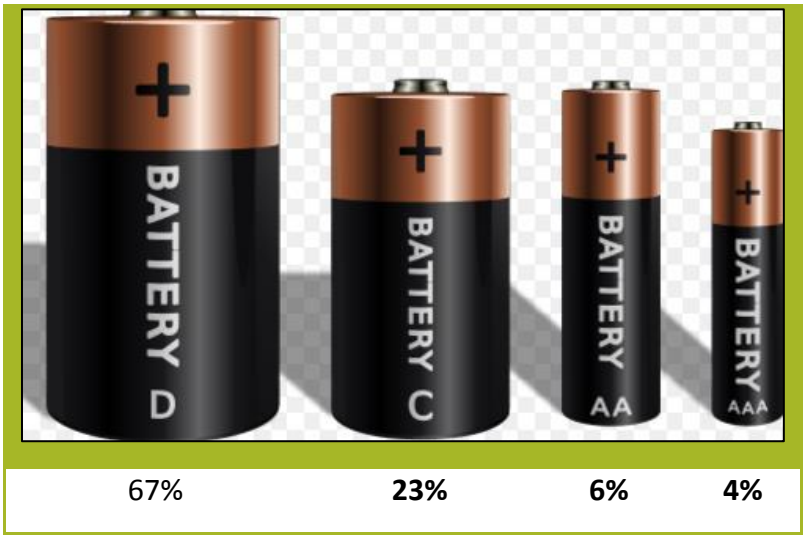


Figure 3.8- Type of batteries purchased by households for torches

Households reliant on kerosene for lighting purposes have different purchase strategies. Those which purchase kerosene once a week (25%) spend on average 160 MZN (2.7 USD) for 2 litres of fuel. Those purchasing twice a month (8%) can spend 120 MZN on an average of 2 litres of kerosene. The majority of household (67%) purchase kerosene once a month and spend 312 MZN (5.2 USD) on an estimated 4 litres of fuel. Based on the different expenditure patterns an average monthly expenditure calculated for kerosene users is 388 MZN (6.5 USD). The average price for 1 litre of kerosene was reported to be 77 MZN (1.3 USD) by respondents.

Table 3-7: Data on kerosene use for light

Frequency of purchase	Percentage of households	Quantity bought	Expenditure
Once a week	25%	2 Litres	160 MZN
Twice a month	8%	2 litres	120 MZN
Once a month	67%	4 litres	312 MZN

Most households (75%) purchase their kerosene from the main village market, while 17% purchase from the petrol station (+/- 10 KM away), while 8% purchase from a vendor in another community. Purchase time is on average 4 hours; however, this may include the time spent on other purchase in the markets.

Table 3-8: Purchase location for kerosene

Purchase location	Percentage of households	Time spent on purchase
Market in main village	75%	4 hours
Private vendor in another community	8%	4 hours
Petrol station	17%	3.5 hours

As mentioned before, household have spent on average 1000 MZN (17 USD) for their solar systems. 86% own a small solar system with two lights and capability to charge a mobile phone, while 14% own a solar system with one light and no phone charging capacity. Furthermore, 43% of those who own a solar stem have received it as a gift.

Table 3-9: Solar system ownership data

Average price for system paid	1000 MZN
Type of system	
Small solar system with two lights and phone charging	86%
Solar light with no phone charging	14%
Those which purchased their own system	57%
Those which received the system as gift	43%

3.2.3. Purchase Behaviour And Expenditure – Batteries for Radio

35% of households use battery operated radios. Batteries for radios are bought at different intervals depending on usage. 25% buy batteries either once a week or several times a week. Average expenditure is 65 MZN and 86 MZN (1.1 USD and 1.4 USD) respectively. 29% of households chose to purchase batteries twice a month and spend on average 66 MZN (1.1 USD). Those purchasing once a month (46%) spend on average 75 MZN (1.13 USD). Based on different purchase preferences – an average monthly expenditure for radio users is estimated at 268 MZN (4.5 USD).

Table 3-10: Purchase frequency and cost for batteries used in radios

Purchase frequency	Percentage of households	Number of batteries bought	Expenditure
Several times per week	14%	4	65 MZN
Once a week	11%	4.3	86 MZN
Twice a month	29%	3.4	66 MZN
Once a month	46%	3.8	75 MZN

Box 6: Focus group results corresponding to Radio usage

FGD Results
"I use the radio for music and the news. I usually listen to radio for about 4 hours every day."
"Some people prefer to listen to bigger speakers. For that we use car batteries or generators"

3.2.4. EXPENDITURE ON CHARGING MOBILE PHONES

95% of households own mobile phones. The average number of phones owned is 2 per household. 37% of respondents pay for their phones to be charged. Households spend an average of 40 minutes just to travel back and forth to the phone charging location if it is away from home.

With regards to phone charging location – 45% of households charge at home; 38% of households charge at the home of another person; 13% charge their phones at the local market; while 4% charge their phones through a private vendor.

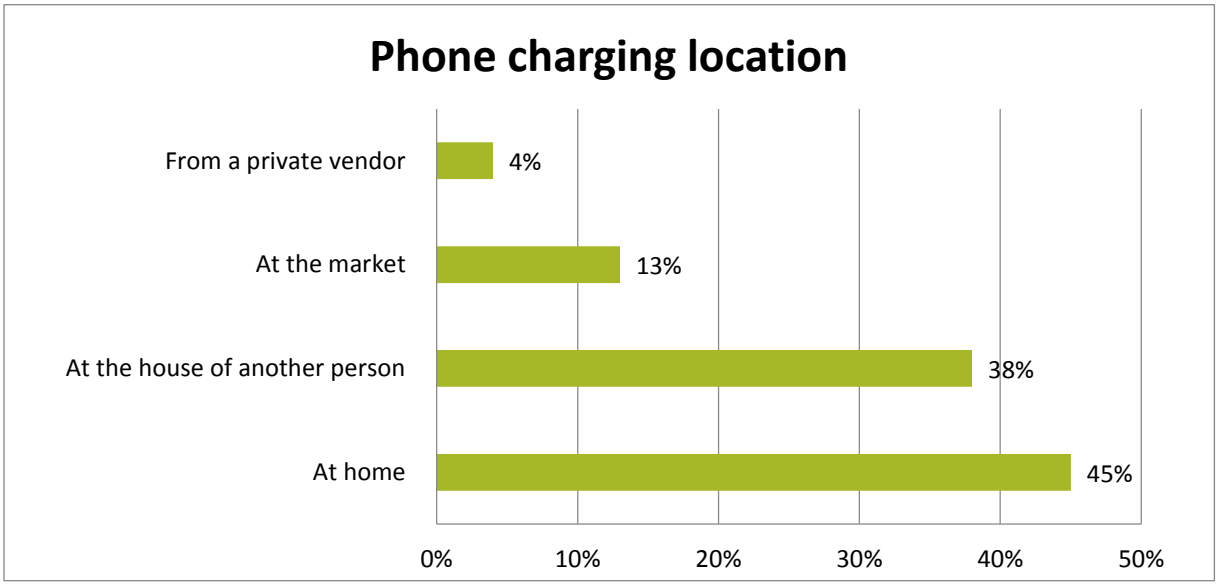


Figure 3.9- Location of charging stations for mobile phones

Mobile phone charging frequency is relative to each household and dependent on factors such as usage hours and battery capacity. The table below shows the percentage of households charging their phones at different intervals. It is most common for households to charge their phones every 3 days.

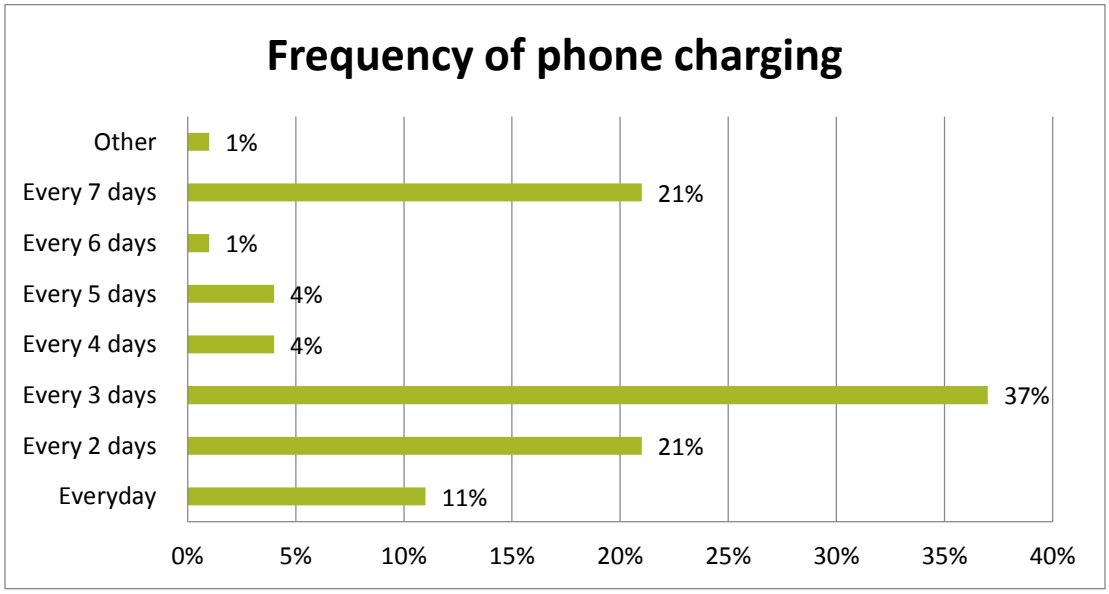
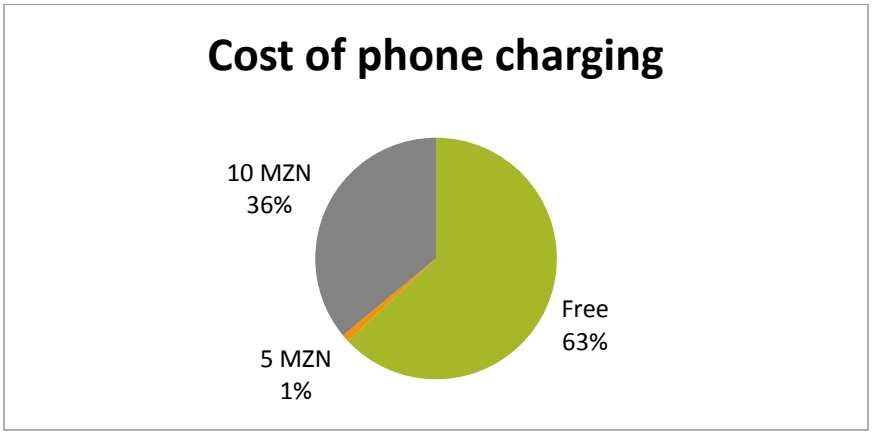


Figure 3.10- Frequency at which households charge their mobile phones

Most households charge their phones for free (63%), using solar energy or electricity in the neighbouring town; however 36% pay 10 MZN (0.17 USD) per charge, and 1% pay 5 MZN (0.08 USD).



F**igure 3.11-** Cost of charging the mobile phones

Box 7: Focus group results corresponding to mobile phone charging

FGD Results
"Many people need to travel to town to charge their phones. It is not only the money per charge that we spend, but also the money for transport to town"
"Sometimes people who have solar panels charge our phones in the village"
"It is time consuming and expensive to charge the phones in the market"

3.3. Mobile Service And Payment Usage Data

As mentioned before, 95% of households own mobile phones. An average of 2 mobile phones are owned per household. With regards to services used by households on their mobile devices: 49% of respondents use mobile credit transfer facility to send credit to friends or family members. 12% of respondents use mobile money such as M-Pesa or M-kesh, while 11% of respondents use internet on their phones. In terms of transaction values: those using mobile money services transact on average 91 MZN (1.5 USD) per week. Those using credit transferservices transact an average of 52 MZN (0.9 USD) per week. These are most commonly used within the respondents' social networks, rather than for commercial purposes. Those which use mobile internet spend on average 39 MZN (0.65 USD) per week.

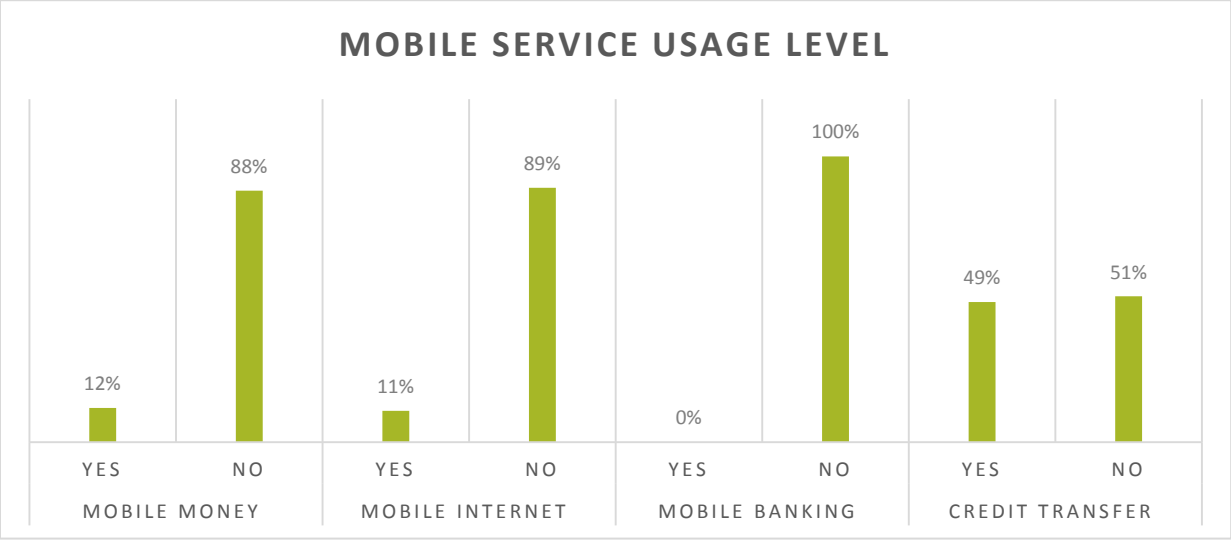


Figure 3.12- Different mobile services used by households

Table 3-11: Average weekly transaction value for mobile services

Mobile service	Average weekly transaction value
Mobile money (M-kesh or M-pesa)	91 MZN
Mobile internet	39 MZN
Mobile credit transfer	52 MZN

Box 8: Focus group results corresponding to mobile money

FGD Results

- Only 2/8 FGD participants knew about M-Pesa or M-Kesh
- It was complicated for them to understand the concept from a simple explanation

"I have seen the M-Pesa logo at the Vodacom shop in town"

3.4. Solar Energy Awareness Level

Only 16% of those surveyed did not know what solar energy was. The enumerator team followed with an explanation about solar energy and how solar system function. Of those who already don't have a solar system, all but 1% mentioned that they would like to own one. The

enumerators further explained how the M-KOPA system works and its benefits. 89% of respondents said they would like to purchase an M-KOPA system, while 5% responded "Maybe".

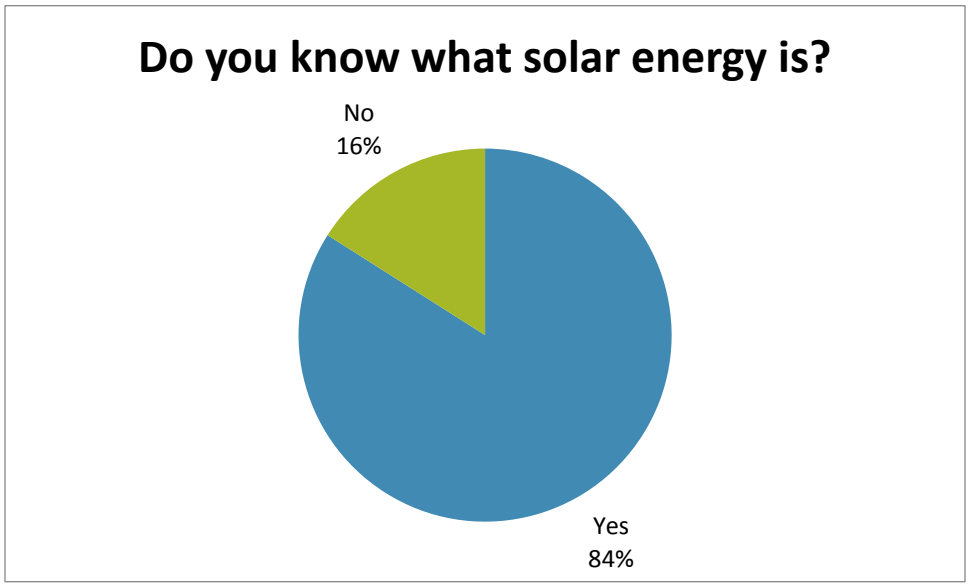


Figure 3.13- Awareness levels about solar energy among households

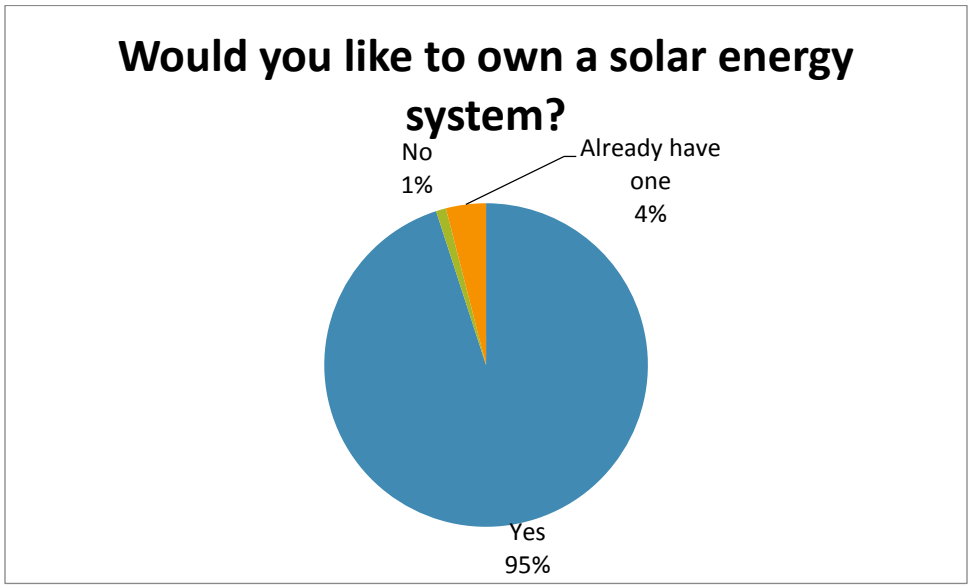


Figure 3.14- Willingness to acquire a solar system

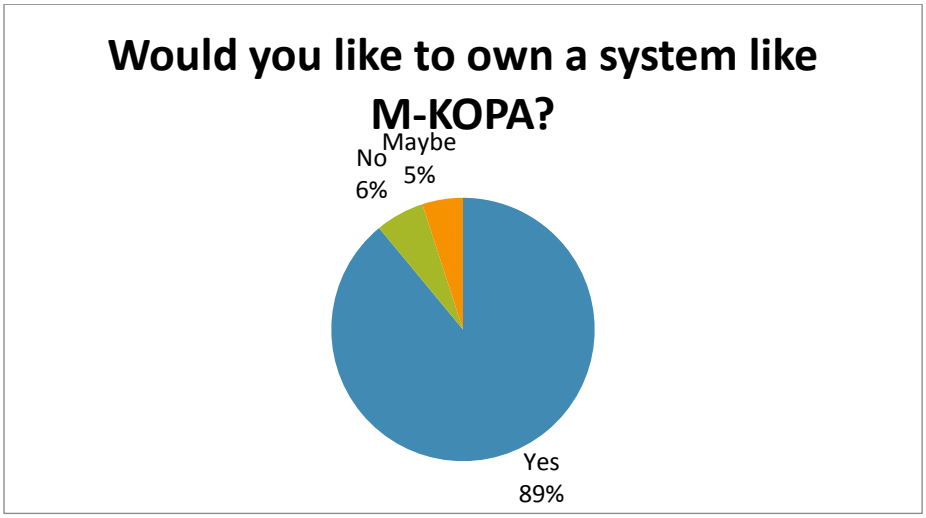


Figure 3.15- Willingness to acquire the M-KOPA solar system

Box 9: Focus group results corresponding to solar energy awareness

FGD Results

- 1/8 FGD participants did not know about solar energy
- FGD participants associated solar energy with lighting and mobile phone charging
- No one mentioned challenges and disadvantages associated with solar energy

"For us solar energy is not only important for illumination – it should also be able to run a fridge and tv"

"people have not yet bought solar systems because they don't have access to them. If someone would sell in his villages – many would buy"

"it is not because of lack of money that people in this community don't use solar energy. It is because of availability and awareness".

3.5. Market Willingness To Pay For M-KOPA System

With regards to the deposit cost of 1.750 MZN recommended by M-KOPA, 67% of respondents agreed that it was a fair price to pay, and that the proposed deposit is within their budget

limits. Another 13% said that they would maybe consider buying the system for the suggested deposit price. 20% are not willing to pay 1.750 MZN.

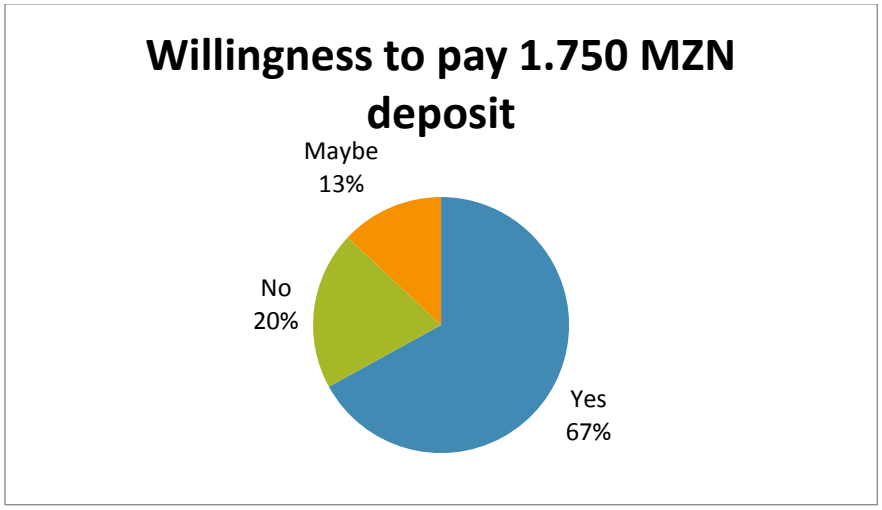


Figure 3.16- Respondent willingness to pay recommended deposit price for M-KOPA system

Those which were not willing to pay 1.750 MZN as deposit price were further asked what the maximum value they were willing to pay was. The graph bellow shows the price which households are willing to pay. 40% are willing to pay above 1000 MZN (16.7 MZN) while the rest can only pay bellow that value.

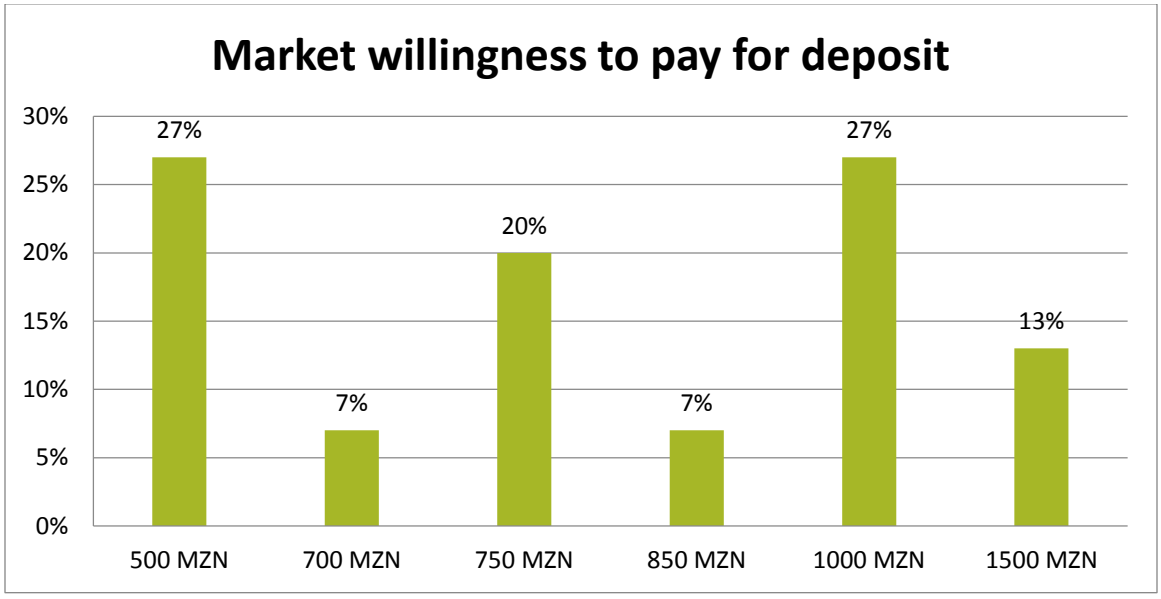


Figure 3.17- Market willingness to pay as deposit for M-KOPA system

With regards to the daily payment fee of 25 MZN; 80% of respondents were comfortable to pay. Another 13% suggested that they would "maybe" pay. Only 7% said it was too expensive.

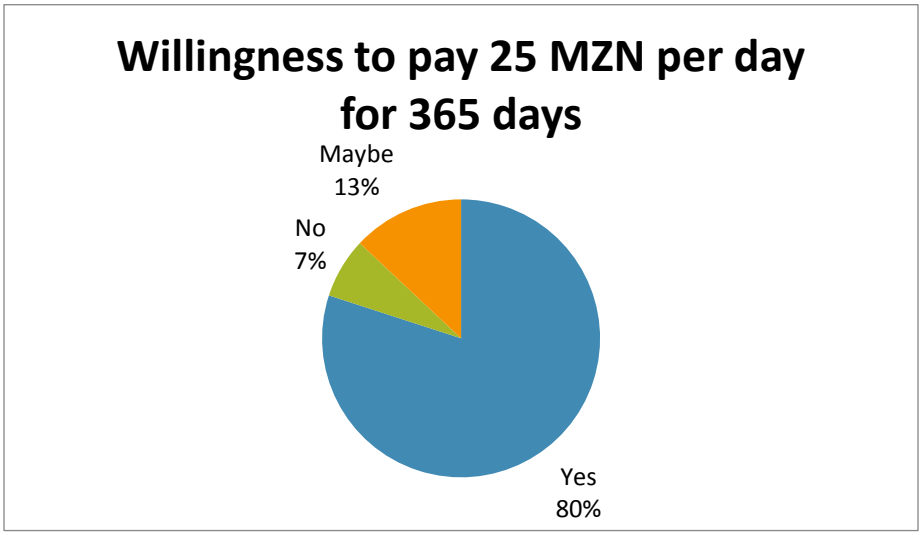


Figure 3.18- Respondent willingness to pay recommended daily price for M-KOPA system

The graph bellow shows the amount of money which respondents are willing to pay as daily fee for the M-KOPA system. 40% are able to pay 5 MZN, another 40% are willing to pay 10 MZN, while 20% are willing to pay 20 MZN per day.

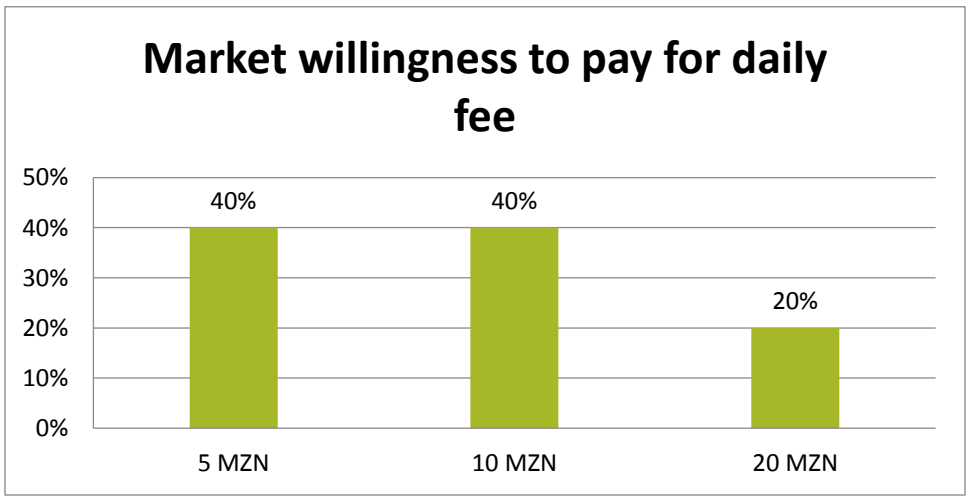


Figure 3.19- Market willingness to pay as daily fee for M-KOPA system

With regards to the awareness level about M-PESA, as much as 43% of respondents did not know about this mobile payment service. Once the respondents were explained what M-PESA was, they were asked whether they would be open to using this mechanism to pay for their M-KOPA solar system. 91% of respondents are willing to use M-PESA to pay, while 9% were unsure.

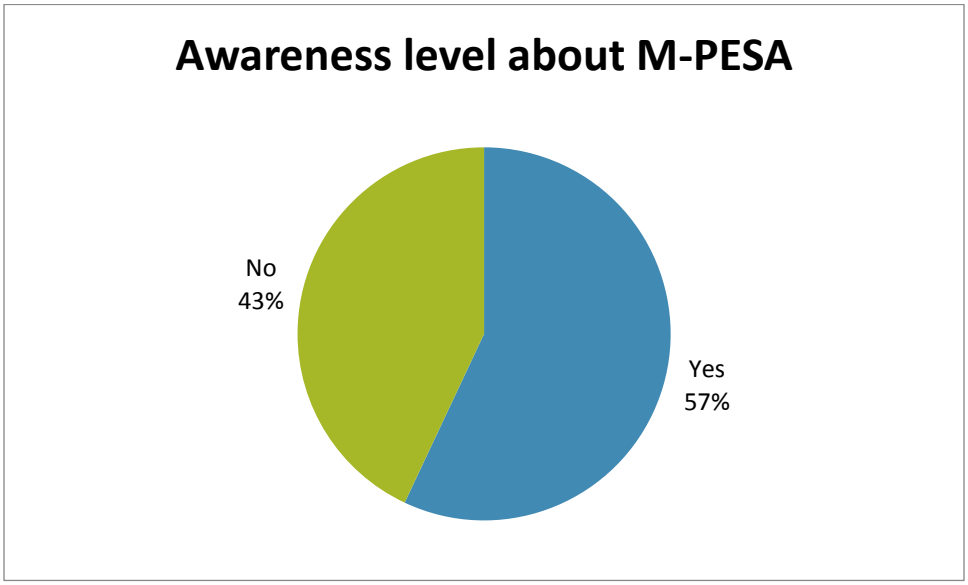


Figure 3.20- Awareness level among households about M-PESA

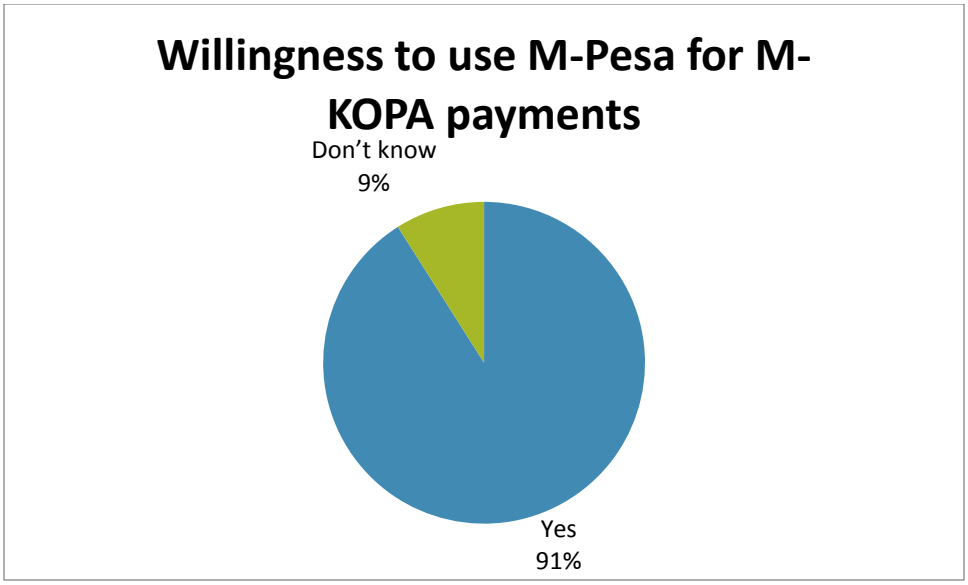


Figure 3.21- Willingness to use M-PESA for the payment of M-KOPA

Box 10: Focus group results corresponding to M-KOPA system demo

FGD Results

- FGD participants were in agreement that households in the community would like to acquire an M-KOPA system;
- The quality of the system was appreciated;
- The Radio function and additional torch were seen as different to ordinary solar kits;
- The price of the M-KOPA system was seen as high. However the participants were shure that people would still be able to buy the system for the suggested price. A request to reduce the price was however stated several times – especially by the traditional leader.
- The daily payment system was considered to be positive and would allow even households with less income to be able to own a system;

"This product is very good. When will it come? We need it!"

"The price is alittle too high, but people will still be able to pay because they need this"

"Can this also run a fridge and tv?"

"People need to know some time in advance that the solar system will be sold. This is because we need time to save money for the deposit"

"Can the payment tern be extended to two years as to lower the daily payment fee?"

4. DISCUSSION AND CONCLUSION

The household energy survey and focus group dicussion have given a rich insight into the energy use practices of rural households in Moamba district. The results have allowed for the analysis of the comercial viability of the M-KOPA business model in rural Mozambique.

With regards to the socio-economic data, the majority of households earn bellow 167 USD/month with 43% of them earning bellow 83 USD/month. As such, the community is price sensitive and requires credit faciltites such as the M-Kopa payment plan.

The chosen survey site has no access to the electric grid. 65% of the population makes use of battery operated torches for basic lighting needs. The next common source of light (used by 15%) is kerosene lanterns. Only a few of the surveyed households own a diesel generator or a

solar energy system. Monthly costs associated with lighting are 221 Meticias (4USD) for battery torch users and 388 Meticais (6.5 USD) for kerosene users. Purchase location for batteries and kerosene is often distant from users (in nearby Moamba town) and is seen as a time based inconvenience for households. As such, the M-KOPA system could provide an added convenience as well as multiple points of illumination (2 lights and one torch).

35% of households make use of battery operated radios in their homes. Battery expenditure for these households is an additional 268 Meticais (4.5 USD) per month. During the focus group it was discussed that more people would be interested to own a radio, if battery costs were not as high. This is an additional benefit of the M-Kopa system which has a radio included in the package.

Mobile phone access is at 95% in the sampled community. Each household has an average of two mobile phones. 37% of the households pay up to 10 Meticais to charge their mobile phone batteries on average three times a week. It is estimated that the monthly expenditure on mobile phone charging per household is 200 Meticais. Households also need to travel an average of 40 minutes to access phone charging stations which are usually private individuals in the nearby town who have access to electricity or those with solar systems. The phone charging function of the M-Kopa system was considered very important during the focus group discussion.

Adding up the expenses related to energy use (lighting, radio and mobile phone), it is estimated that an average household spends around 689 meticais (11.5 USD) per month. This figure is close to the monthly payment requirements for the M-Kopa system (set at 750 Meticais per month). The additional benefit of time savings and convenience associated with the M-Kopa system compared to current energy use practices is an added benefit to the potential clients.

With regards to market willigness to pay (MWTP), positive results were obtained from both the surveys and focus group discussion. 80% of households were willing to consider the purchase of the M-Kopa system with a deposit cost of 1.750 Meticais (30 USD). Furthermore, 80% of households were comfortable with the daily payment fee of 25 Meticais (0.42 USD) while an additional 13% would “maybe” consider acquiring the system with the suggested daily payment plan. The results point to both a demand for pay-as-you-go solar systems as well as willingness and ability to pay for them.

With regards to the mobile payment functionality, as mentioned previously, 95% of households own a mobile phone. 49% of households surveyed already have experience using mobile credit tranfer services (airtime). 12% have direct experience with mobile money services such as M-Pesa and M-Kesh and a total of 57% are aware of the M-Pesa mobile money platform. The growing experience with mobile money servies and increasing awareness level amongst households of its functionality allows a more facilitated introduction of the M-Kopa mobile phone based payment model. The survey concluded that 91% of households were willing to use the M-Pesa mobile payment platform to pay for a M-Kopa solar system.

ANNEX 1: QUESTIONNAIRE

Secção 1: Perguntas gerais sobre o agregado familiar	
Data de inquérito	
Nome do inquirido	
Género	1) Homem (2) Mulher
Idade do inquirido	
Qual é o nível académico mais alto que o seu Agregado Familiar atingiu?	1) Sem escolaridade (Não estudou) 2) Ensino primário 3) Ensino secundário 4) Ensino superior (universidade) 5) Ensino técnico 6) Não responde/não sabe 7) Outro _____
Endereço – Província	
Endereço – Distrito	
Endereço – Comunidade	
Endereço – bairro	
Endereço – número de casa	
Número de pessoas que residem na casa inquirida?	
(Quantas pessoas vivem nesta casa?)	
Quantas divisões têm a sua casa?	
O chefe do agregado familiar possui outra casa?	1) Sim 2) Não 3) Não sabe / Não responde

Qual é o tipo de material das paredes da casa?	1) Pau a pique 2) Alvenaria – Blocos de cimento 3) Tijolos de argila/adobe 4) Caniço/bamboo 5) Tijolo de argila queimado 6) Outro_____
Secção 2: Perguntas sobre consumo energético	
Tem energia eléctrica na sua casa? *mesmo se for gerador, solar ou outra fonte.	1) Sim Continua 2) Não Vai para 3 3) Não sabe/Não responde Vai para 3
Se sim, qual é a fonte da energia eléctrica?	EDM Vai para 4 Gerador a diesel Bateria grande (de carro) Energia solar (painel solar) Energia eólica (do vento) Outra _____
Quando espera a EDM instalar rede na sua casa	Este ano Próximo ano De aqui a 2-3 anos De aqui a 4-5 anos Mais de 5 anos Não sabe Nunca Não quer energia da EDM
Qual é a sua fonte principal de iluminação em casa?	Lâmpada (gerador diesel)

(a que usa mais)	Lâmpada (gerador gasolina) Lâmpada (Solar) Lanterna com pilhas Lanterna solar Lanterna com manivela Petróleo de iluminação Vela Lenha 9) Outro _____
Se usa gerador – com que frequência compra Gasóleo (diesel)?	1) Todos os dias 2) Varias vezes por semana 3) Uma vez por semana 4) Duas vezes por mês (cada duas semanas) 5) Uma vez por mês 6) Nunca 7) Outros _____
Quantas unidades desta fonte usa diariamente? (Numero de lâmpadas/lanternas/candeeiros que usa)	
Se usa gerador – quanto dinheiro gasta em cada compra de gasóleo(diesel)?	_____ Mtn
Gasto Mensal para gasóleo (diesel):	_____ Mtn
Qual e o preço por litro de diesel que compra?	_____ Mtn

De onde compra o gasóleo (diesel)?	Mercado local Mercado numa outra localidade De um privado nesta vila De um privado numa outra localidade De um posto de abastecimento (bomba) Outro_____
Quanto tempo demora a ir comprar o gasóleo (diesel)? – Escreve em minutos (1 hora=60 minutos)	
Se usa gerador – com que frequência compra Gasolina?	1) Todos os dias 2) Varias vezes por semana 3) Uma vez por semana 4) Duas vezes por mês (cada duas semanas) 5) Uma vez por mês 6) Nunca 7) Outros _____
Quantas unidades desta fonte usa diariamente? (Numero de lâmpadas/lanternas/candeeiros que usa)	
Se usa gerador – quanto dinheiro gasta em cada compra de Gasolina?	_____ Mtn
Gasto Mensal para Gasolina:	_____ Mtn
Qual e o preço por litro de diesel que compra?	_____ Mtn

De onde compra a Gasolina?	Mercado local Mercado numa outra localidade De um privado nesta vila De um privado numa outra localidade De um posto de abastecimento (bomba) Outro_____
Quanto tempo demora a ir comprar o Gasolina? Escreve em minutos (1 hora=60 minutos)	
Se usa painel solar – quanto custou o seu sistema solar? (se aluga – por quanto aluga e durante quanto tempo?)	_____Mtn ( ) Se Aluga _____ Mtn /(dia/semana/mês) ( ) Prenda
Qual é o tipo de sistema solar que tem na sua casa?	Painel fotovoltaico grande com bateria Painel pequeno com lanterna/luz sem carregador de telefone Painel pequeno com lanterna/luz e carregador de telefone Carregador de telefone solar Outro _____ Não sabe Não responde
Se usa pilhas para iluminação, com que frequência compra as pilhas?	Todos os dias Varias vezes por semana

	Uma vez por semana Duas vezes por mês (cada duas semanas) Uma vez por mês Nunca Outros (por favor especifique) _____
ANTES DA PERGUNTA POR A IMAGEM	AAA
Que tipo de pilhas e que compra para iluminação?	AA C D Outras _____
Quantas pilhas compra de cada vez para iluminação?	
Quanto dinheiro gasta em cada compra de pilhas para iluminação?	
Se usa petróleo de iluminação – com que frequência compra petróleo?	1) Todos os dias 2) Varias vezes por semana 3) Uma vez por semana 4) Duas vezes por mês (cada duas semanas) 5) Uma vez por mês 6) Nunca 7) Outros (por favor especifique)_____
Se usa petróleo de iluminação – quanto dinheiro gasta em cada compra de petróleo?	_____ Mtn /_____ Litros
Gasto Mensal para compra de petróleo:	

Onde compra o petróleo de iluminação	1) Do mercado na vila 2) Do mercado numa outra vila 3) De um privado local 4) De um privado numa outra localidade 5) Do posto de abastecimento de combustível 6) Outro_____
A que distância de casa fica o ponto de venda de petróleo de iluminação? (Em minutos)	
Quanto custa um litro de petróleo de iluminação?	
O preço tem subido nos últimos anos?	1) Sim 2) Não 3) Não sabe / Não responde
Sabe se o fumo do petróleo de iluminação prejudica a saúde?	1) Sim 2) Não 3) Não sabe / Não responde
Se usa velas – com que frequência compra as velas?	1) Todos os dias 2) Varias vezes por semana 3) Uma vez por semana 4) Duas vezes por mês (cada duas semanas) 5) Uma vez por mês 6) Nunca 7) Outros (por favor especifique)_____
Se usa velas – Quanto dinheiro gasta na compra das velas?	_____ Mtn

Quantas velas compra de cada vez?	
Gasto Mensal para uso de velas:	
Qual e a sua outra fonte de iluminação em casa? (fonte secundária)	1) Lâmpada gerador (Diesel) 2) Lâmpada gerador (Gasolina) 2) Lâmpada (solar) 3) Lanterna com pilhas 4) Lanterna solar 5) Lanterna com manivela 6) Petróleo de iluminação 7) Vela 8) Lenha 9) Outro _____ 10) Não usa outra fonte
Quantas unidades desta fonte use diariamente? (Numero de lâmpadas/lanternas/candeeiros que usa)	
Para que atividade precisa mais de iluminação?	Anoite dentro de casa Anoite fora de casa Anoite dentro e fora de casa Para estudar Para o negocio Para machamba Para segurança Outro_____
Quantos telefones são usados neste agregado? Incluindo o do respondente?	

(quantos telefones tem em casa?)	
Aonde carrega a bateria do telefone?	Na própria casa Na casa de uma outra pessoa No mercado De um comerciante Outro_____
Com que frequência carrega a bateria do telefone?	Todos os dias Cada dois dias Cada três dias Cada quatro dias Cada cinco dias Cada seis dias Cada sete dias (cada semana) Outro _____
Quanto custo carregar a bateria de cada telefone?	
A que distancia fica o local para carregar o telefone da sua casa? (em minutos)	
Usa rádio com pilhas?	Sim 2) Não
Se usa pilhas para o rádio, com que frequência compra as pilhas?	Todos os dias Varias vezes por semana Uma vez por semana Duas vezes por mês (cada duas semanas) Uma vez por mês Nunca Outros (por favor especifique) _____

ANTES DA PERGUNTA POR A IMAGEM	AAA AA
Que tipo de pilhas é que compra para o radio?	C D Outras _____
Quantas pilhas compra de cada vez para o radio?	
Quanto dinheiro gasta em cada compra de pilhas para o rádio?	
Gasto mensal para compra de pilhas (para todas as fontes):	
Onde compra as pilhas?	1) Do mercado na vila 2) Do mercado numa outra vila 3) De um privado local 4) De um privado numa outra localidade 5) Do posto de abastecimento de combustível 6) Outro_____
A que distância de casa fica o ponto de venda de pilhas? (Em minutos)	
Secção 3: Perguntas sobre energia solar	
Conhece energia solar? (se não conhece depois explica oque e energia solar)	Sim Não
Gostaria de ter um sistema de energia solar em casa? *Se (4) não responde pergunta numero 48.	Sim Não Talvez

	Já temSalta para 49
	Outro_____
Porque ainda não tem um sistema de energia solar?	Não conhece os benefícios de energia solar
	Não sabe oque deve comprar para ter energia solar em casa
	Não tem dinheiro para comprar um sistema
	Não tem aonde comprar um sistema
	Outro _____
Se existisse um sistema solar com os seguintes benefícios – podia querer ter?	Sim
	Não Salta para 54
Painel e bateria	Talvez
Duas lâmpadas com fio e uma lanterna que pode também carregar com energia solar	Depende do preço
Um radio	
Pagamento em prestações diárias de 365 vezes – depois de completar os pagamentos o sistema fica para si.	
Podia pagar um deposito inicial de 1750 Meticais para este sistema?	Sim Salta para 52
	Não Continua
	Talvez Salta para 52
	Prefere pagar o sistema logo de uma vez 54
Se não – quanto no máximo esta disponível a pagar como taxa inicial?	
Podia pagar um valor diário de 25 meticais para ter acesso a energia deste sistema?	Sim Salta para 54
	Não Continua

*são 365 pagamentos de 25 meticais. Depois de completar o sistema fica para o cliente.	Talvez Salta para 54 Prefere pagar o sistema logo de uma vez?Salta para 54
Se não – ate quanto esta disponível a pagar cada dia para ter acesso a energia solar?	
Já ouviu falar do sistema de pagamento através do telefone chamado M-PESA?	Sim Não (explicar o sistema M-PESA) Não Sabe
Podia usar este sistema de pagamento para pagar o valor diário para usar a energia solar?	Sim Não / prefere usar outra forma de pagamento Não Sabe
Quais dos seguintes serviços usa através do seu telemóvel? (escolha múltipla)	M-Kesh ou M-Pesa Internet do telemóvel Serviços bancários (izzy) Transferências de credito para amigos/família/terceiros
Quanto gasta por semana para este serviço? (Para cada um)	
Secção 4: Rendimento familiar	
Quantas pessoas residentes nesta casa trabalham?	
Qual é a actividade económica principal da sua família? *aponte só uma opção	Comércio Administração pública Agricultura Gado Pesca Trabalho formal

	Trabalho informal Outro_____
Qual é a actividade económica secundária da sua família?	Não trabalham Comércio Administração pública Agricultura Pesca Gado Trabalho formal Trabalho informal Outro_____ Não trabalham
Quanto dinheiro gasta mensalmente para compra de combustível para cozinha? (todos tipos)	_____ Mtn ( ) Não compra combustível ( ) Não sabe ( ) Não responde
Quanto dinheiro gasta mensalmente na compra de comida e outros alimentos?	_____ Mtn ( ) Não compram comida ( ) Não sabe ( ) Não responde
Quanto dinheiro gasta mensalmente para despesas de medicamentos ou hospital? (de todos membros da casa)	_____ Mtn ( ) Não sabe ( ) Não responde
Quanto dinheiro gasta mensalmente para pagar transporte (de todos membros da casa)?	_____ Mtn ( ) Não sabe ( ) Não responde ( ) Não usa transporte

Quanto dinheiro gasta mensalmente para recarregar crédito nos telefones da sua família?	_____Mtn ( ) Não sabe ( ) Não responde ( ) Não tem telefone
Quanto dinheiro gasta mensalmente para carregar bateria do telefone?	_____Mtn ( ) Não sabe ( ) Não responde ( ) Não tem telefone ( ) Não paga para carregar telefone
Quanto dinheiro gasta mensalmente para pagar escola e material de escola para as crianças?	_____Mtn ( ) Não sabe ( ) Não responde ( ) Não paga escola
Quanto dinheiro gasta mensalmente para pagar bebidas alcoólicas?	_____Mtn ( ) Não sabe ( ) Não responde ( ) Não bebe
Qual é o rendimento total mensal (salários e outras fontes juntas)?	_____ Mtn ( ) Não sabe ( ) Não responde

ANNEX 2: FOCUS GROUP DISCUSSION LEADING QUESTIONS

1. Can everyone please introduce themselves
    a. Name, occupation, how many years have lived in this community? (first round)
    b. What sources of energy do you use for light and how do you charge your phones? (second round)
2. Can we discuss the benefits and challenges with the different sources of energy for light?
3. How much does it cost for an average family to use _____Every month?
4. Why is it that there is no electricity in this community?
5. What are the challenges of not having access to electricity?
6. Do people here want electricity? Can they pay for it?
7. When will the grid arrive in this community?
8. Have you heard about solar energy?
9. If so, what is it? How does it work? From where did you hear about it? (If not, explain what solar energy is)
10. What are the benefits about solar energy?
11. What are some of the disadvantages which you know about solar energy?
12. Who has a solar system – if not – why don't you have one yet?
13. What do you think about this M-KOPA solar system?
14. Is it something which you want to buy?
15. Can you pay 10.500 MZN for this system? Or do you prefer to pay in installments?
16. Do you think people can pay 1750 MZN as deposit for the system and the rest little by little?
17. Do you think that a daily fee of 25 MZN is affordable for 365 payments (1 year)?
18. If not – how much?
19. Do you like the size of the system
20. Do you like the functionality (number of lights, radio, charging and torch function)
21. What would you like to see different on this system?
22. Will you use all the functions of this system? If not – which ones will you not need?
23. Do you know about M-Pesa? Or other mobile payment system?
24. Have you used this system or will you be interested to use it?
25. Do you agree with the option to pay for the M-Kopa through M-Pesa?
26. Do you have any concerns or questions for me?

ANNEX 3: LIST OF SELECTED SAMPLE HOUSEHOLDS (AS PER ID)

Número de Ordem dos Agregados Familiares	Nome da Comunidade	Estado	Total de Agregados Familiares das 3 Comunidades
			N=200
1	Lizuve	Seleccionado	1
2	Lizuve	Seleccionado	3
3	Lizuve	Seleccionado	5
4	Lizuve	Seleccionado	6
5	Lizuve	Seleccionado	7
6	Lizuve	Seleccionado	8
7	Lizuve	Seleccionado	11
8	Lizuve	Seleccionado	14
9	Lizuve	Seleccionado	16
10	Lizuve	Seleccionado	17
11	Lizuve	Seleccionado	18
12	Lizuve	Seleccionado	21
13	Lizuve	Seleccionado	22
14	Lizuve	Seleccionado	25
15	Lizuve	Seleccionado	27
16	Lizuve	Seleccionado	28
17	Lizuve	Seleccionado	30
18	Lizuve	Seleccionado	32
19	Lizuve	Seleccionado	34
20	Lizuve	Seleccionado	35
21	Lizuve	Seleccionado	37
22	Lizuve	Seleccionado	42
23	Lizuve	Seleccionado	45
24	Lizuve	Seleccionado	49

25	Lizuve	Seleccionado	50
26	Lizuve	Seleccionado	51
27	Lizuve	Seleccionado	55
28	Lizuve	Seleccionado	58
29	Lizuve	Seleccionado	59
30	Lizuve	Seleccionado	60
31	Lizuve	Seleccionado	61
32	Lizuve	Seleccionado	62
33	Lizuve	Seleccionado	66
34	Lizuve	Seleccionado	67
35	Lizuve	Seleccionado	68
36	Lizuve	Seleccionado	72
37	Lizuve	Seleccionado	74
38	Lizuve	Seleccionado	75
39	Lizuve	Seleccionado	77
40	Lizuve	Seleccionado	79
41	Muchia	Seleccionado	82
42	Muchia	Seleccionado	85
43	Muchia	Seleccionado	91
44	Muchia	Seleccionado	94
45	Muchia	Seleccionado	98
46	Muchia	Seleccionado	102
47	Muchia	Seleccionado	105
48	Muchia	Seleccionado	109
49	Muchia	Seleccionado	114
50	Muchia	Seleccionado	119
51	Muchia	Seleccionado	123
52	Muchia	Seleccionado	127
53	Muchia	Seleccionado	130
54	Muchia	Seleccionado	134

55	Muchia	Seleccionado	138
56	Muchia	Seleccionado	141
57	Muchia	Seleccionado	144
58	Muchia	Seleccionado	148
59	Muchia	Seleccionado	150
60	Muchia	Seleccionado	155
61	Nhoquene	Seleccionado	163
62	Nhoquene	Seleccionado	166
63	Nhoquene	Seleccionado	169
64	Nhoquene	Seleccionado	172
65	Nhoquene	Seleccionado	173
66	Nhoquene	Seleccionado	174
67	Nhoquene	Reserva	176
68	Nhoquene	Reserva	177
69	Nhoquene	Reserva	179
70	Nhoquene	Reserva	181
71	Nhoquene	Reserva	183
72	Nhoquene	Reserva	186
73	Nhoquene	Reserva	188
74	Nhoquene	Reserva	189
75	Nhoquene	Reserva	191
76	Nhoquene	Reserva	194
77	Nhoquene	Reserva	195
78	Nhoquene	Reserva	197
79	Nhoquene	Reserva	198
80	Nhoquene	Reserva	200