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Final Report

MARKET ASSESSMENT OF MODERN OFF GRID LIGHTING SYSTEMS IN UGANDA

Produced for Lighting Africa

December 2014

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LIST OF ABBREVIATIONS

ARSO	Africa Regional Organization for Standardization
BMZ	German Federal Ministry for Economic Cooperation and Development
BoP	Base of the Pyramid
CAPI	computer assisted personal interviews
CREEC	Centre for Research and Energy Conservation
EAC	East African Community
EEP	Energy and Environmental Partnership
ERA	Electricity Regulatory Authority
ERTP	Energy for Rural Transformation Program
FESL	Ferdsult Engineering Services Limited
FIs	Financial Institutes
GIZ	Gesellschaft für Internationale Zusammenarbeit
GVEP	Global Village Energy Partnership International
GVEP	Global Village Energy Partnership
IFC	International Finance Cooperation
IFC	International Finance Corporation
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
KfW	German Development Bank
kWh	Kilowatts-hour
LED	Light Emitting Diode
MDI	Micro Finance Deposit Taking Institution
MEMD	Ministry of Energy and Mineral Development
MFI	Microfinance Institution
MoU	Memorandum of Understanding
PREEEP	Promotion of Renewable Energy and Energy Efficiency Programme
PV	Photovoltaic
PV	Photovoltaic
RE	Renewable Energy
REA	(Uganda) Rural Electrification Agency (sometimes the acronym UREA is used)
REB	Rural Electrification Board
RESP	rural electrification strategy and plan
RETs	Renewable Energy Technologies
SACCO	Savings and Credit Cooperative Societies
SEMA	Sustainable Energy Market Acceleration (project)
SHS	Solar Home System
SME	small and medium-sized enterprise
TA	Technical Assistance
TP	Technical Providers
UECCC	Uganda Energy and Credit Capitalization Company
UETCL	Uganda Electricity Transmission Company Limited
UGX	Ugandan Shilling
UNAAC	Uganda National Alliance for Cleaning Cooking
UNBS	Uganda National Bureau of Standards
UNREA	Uganda National Renewable Energy Association
VSLA	Village saving and loan association
W, Wh, Wp	Watts, Watts hour, Watts peak
WB	World Bank
WENRECO	West Nile Rural Electrification Company Limited
WWF	World Wildlife Fund
WWF-ESARP	WWF-Eastern and Southern Africa Regional Programme
WWF-UCO	WWF Uganda Country Office

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SUMMARY

Lighting Africa, a joint IFC and World Bank program, catalyses and accelerates development of commercial off-grid lighting markets in Sub-Saharan Africa as part of the World Bank Group's wider efforts to improve access to energy. Lighting Africa is mobilizing the private sector to build markets that provide affordable, modern off-grid lighting products to communities across Africa that are not connected to grid electricity.

Enclude was contracted to conduct an off-grid lighting market assessment in Uganda, with the overall objectives to:

(i) offer insight on how the Lighting Africa program can add value and support market players in order to grow the market for modern off-grid products that meet the Lighting Global Quality Standards;

(ii) offer insight that can be used by current and potential market players to grow their business.

To achieve this objective the market assessment addresses demand, supply and key institutions involved in the off-grid lighting market in Uganda.

Approach

The market assessment consists of a demand survey of 845 households; a supply survey of 103 retailers; and interviews with main importers/distributors and with institutions and market influencers in all four regions in Uganda. For the demand survey, quota sampling was used to ensure that at least 20% of the households interviewed were grid connected and 20% owned solar products to assess satisfaction levels. In addition, a balanced split was made to ensure sufficient representation of urban, peri-urban and rural households in two preselected districts in each of the four regions of Uganda.

For the supply survey, quota sampling was also used to ensure that the retailers interviewed in the supply survey were evenly distributed over the eight selected districts. The 10 interviewed importers and the 10 interviewed market influencers were selected in consultation with the Ugandan Rural Electrification Agency (REA).

Key findings

The solar market in Uganda is immature and dispersed, consisting of a multitude of relatively small companies, with hardly any large (multinational) corporations active in the sector.

Findings indicate that the solar product end users are generally more aware and more convinced of the quality of solar energy than the market players, institutions and NGOs/donors realise. End users are also quite convinced of the benefits that solar products can bring them. The need to charge cell phones seems to be increasingly prevalent. Eighty three percent (83%) of the households surveyed own one or more cell phones.

Eighty percent of households that own a solar product would like to have a larger system (more than 20 watts peak). The demand of the households that do not own a solar product is more diverse, but they predominantly demand large solar home systems (SHS) and mobile solar systems with a phone charger and with more than one light.

The off-grid lighting market in Uganda faces the following key challenges:

- ***Limited solar purchasing points and brand awareness; households need support to make an informed decision***

  Although 86% of the surveyed households are aware of what solar is, and 90% also trust solar products, only 65% of the households (especially in the Central and Eastern regions) actually know where to buy solar products. In addition, 85% of the households could not mention any type of solar brand. Of those that did, most mentioned SolarNow, D-light and Barefoot. SolarNow was also the most owned brand, with 33% of the households owning such a system. Even for households owning a solar product, 20% didn't know the brand of their product; this was particularly evident in the Central region.

- ***Retailers & solar companies fear solar products have a bad name***

Institutions, importers and solar companies believe that consumers have doubts on the quality of solar products – mainly due to imports of low grade, cheap Chinese products sold through "dubious hardware shops". This assumption about consumer perceptions is not confirmed by this research. Solar products are bought predominantly at electronic/ hardware shops (55% of SHSs and 38% of mobile systems). About 65% of the solar owners were very satisfied with their solar device, and 80% want to purchase other solar products. Current lighting sources used – mainly candles, kerosene lamps and torches – are considered to be unreliable by 56% of the surveyed households, especially in rural areas (68%). Ninety percent of solar equipment owners consider it to be reliable. In terms of satisfaction levels, 60% of households are not satisfied with their kerosene lighting source, and 95% of fixed solar home system owners are satisfied.

- ***Limited availability of maintenance & aftersales services – 'deeper' distribution networks required***

  Only 15% of retailers in Uganda offer warranties and only 6% offer aftersales services to their customers, for both mobile and fixed solar systems. Four main distribution models are prevalent: the direct sales model; the traditional distribution model (through independent 3rd parties); the (branded) franchise/ agent model; and the relatively new MFI/SACCO model. Most suppliers, however, use a mix of two or even all four distribution models in an effort to get the product to the 'last mile' consumer. More than 45% of solar products are sold through multiple parties in the supply chain, each earning a margin, and thus driving up costs of the products. Nonetheless, end-users value direct contact and warranties. Correlations between ownership and presence of solar in the community (neighbours, schools, clinics) suggest that local presence – and hence 'deeper' distribution networks – increase solar product uptake.
- ***High investments required to obtain solar products; working capital & affordable lending are needed***

  Lack of money and other financial priorities were the main reasons that households cited for not having purchased a solar product yet. Since, on average, over 38% of the sample households' disposable income is spent on school fees, there is little room for other expenditures, including energy. Currently, less than 5% of the household income is spent on energy, and on average UGX 1,910 (US$0.70) per week is spent on kerosene. However, household investments in solar products could be earned back within 6-12 months for small systems and 2.5-3 years for large systems, based on current energy usage. Distribution is further limited by the fact that Importers, suppliers, franchisees and agents are often not able to pre-finance stock, which limits their growth. Interviewed importers indicated loan conditions are unfavourable and interest rates too high.
- ***Importers and retailers have high margins, which banks and other stakeholders feel are not justified***

  Retailers, on average, add a 40% margin onto the wholesale price of solar products (both for fixed and mobile systems). However, they generally cover all distribution costs, including the transport needed and corresponding costs of getting the products from the supplier to the 'last mile' consumer.
- ***High perceived default risk, when pre-financing products***

  Although high default rates on pre-financed products have been evident in the past, several companies currently have a 90% payback rate after the first two years of pre-financing solar products to end-users. However, high default risk accompanied by pre-financing is still a prevailing perception among market players (both private and public).

The challenges above cannot be considered independently from each other and seem to be linked in a vicious cycle: financial institutions are reluctant to provide loans (to suppliers, retailers and/or to end-users) → therefore, cash-poor suppliers & retailers can only sell on a cash basis and can only provide limited service & maintenance infrastructure → therefore, customers do not buy, resulting in a limited, high risk market that financial institutions are reluctant to finance.

A number of initiatives have acknowledged these interrelated issues and are working to solve them. Programs working to address the problems include the Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP) by GIZ and ENdev; FINCA Plus by FINCA, REA and MEMD; Sustainable Energy Market Acceleration (SEMA) by Enclude; and the Champion District Initiative by WWF, MEMD, REA, GIZ and CREEC.

In addition to the challenges, this study identified a number of key opportunities for increased solar product uptake in Uganda.

- ***Households need working solutions for charging their mobile phones:*** Nearly every rural household (73%) owns a mobile phone. Seventy percent of these households charges their phone outside the home, usually at a kiosk of some sort, and spends on average UGX 1,000 (US$ 0.40) per week to do so.
- ***Households spend valuable time accessing energy:*** Rural households spend 26 minutes per week travelling to collect and purchase lighting products. Peri-urban residents spend 21 minutes, and urban dwellers spend an average of 15 minutes per week on collecting and purchasing lighting products.
- ***Increase retailer awareness on financing options:*** Seventy five percent of solar retailers don't have a loan, and 30% of them never even thought of credit as an option. Increasing uptake of financing options would increase capital in the supply chain.
- ***The solar market is young but growing quickly:*** Of the solar-owning households interviewed, 60% own a SHS and 40% own a mobile system. However, 50% of these mobile systems were bought within the last 12 months, whereas over 60% of the SHS were bought more than a year ago. The total market size for solar products is estimated to be between UGX 32 and 37 billion (US$ 115K – 130K) annually, and grows at a rate of 10-50% per year.

Intervention recommendations

To improve access to energy in the Sub-Saharan region, Lighting Africa can consider the following interventions to accelerate the development of commercial off-grid lighting markets in Uganda.

To break the vicious cycle hampering solar market players in Uganda, there is a need to support, create and fund fee-for-service or pay-as-you-go business models (with financial institutions, suppliers and retailers). We suggest the following market interventions:

- **Solar Companies:** Set-up and strengthen distribution and aftersales networks; Increase customer care and services (including after-sales); Increase informal marketing; and provide/facilitate warranties. These types of interventions are capital intensive for solar companies, hence strengthening the working capital position of these companies is key.
- **Financial Institutions (FIs):** Provide technical assistance (TA) to FIs, by training loan officers and developing specific marketing programs; provide a loan guarantee fund to participating FIs; provide partial risk guarantees to allow FIs to finance solar companies; provide technical assistance on default and bad debt management; and provide TA, seed money and/or guarantees to standardised and simplified loan appraisal systems. These measures will add more capital to the supply chain, thus accelerating growth.
- **Government and development institutions:** *Government institutions:* Radio awareness campaigns promoting solar versus kerosene to strengthen the solar market, with a focus on where to buy solar products; *MEMD (supported by Lighting Africa):* Enforce standards, strengthen UNBS (Uganda National Bureau of Standards) to further increase market trust; *Lighting Africa (supported by UECCC and MEMD):* Create a guarantee fund to increase working capital throughout the supply chain; *MEMD (supported by Lighting Africa):* Create warranty legislation to mature the market; extend working capital to solar companies; promote solar through school programs; and subsidise awareness campaigns to support solar companies and retailers. These measures will strengthen the solar market and build further product trust.

1 INTRODUCTION

1.1 OBJECTIVE OF THE STUDY

This market assessment is conducted as part of the Lighting Africa program. Lighting Africa, a joint IFC and World Bank program, catalyses and accelerates development of commercial off-grid lighting markets in Sub-Saharan Africa as part of the World Bank Group's wider efforts to improve access to energy. Lighting Africa is mobilizing the private sector to build markets that provide affordable, modern off-grid lighting products to communities across Africa that are not connected to grid electricity. Improved lighting provides significant socio-economic, health and environmental benefits, such as new income generation opportunities for small businesses.

Lighting Africa carries out ongoing discussions with the Government of Uganda and preliminary background work in preparation for a possible integration of its activities into the Uganda Energy for Rural Transformation Phase III project, an upcoming project under supervision of Uganda's Rural Electrification Agency (REA).

Lighting Africa contracted Enclude to conduct this market assessment in Uganda. Enclude was supported by Friends Consult Ltd. Uganda for survey implementation and coordination, and the Ugandan energy expert, Bobby Namiti.

The overall objectives of this assignment are to:

(i) offer insight as to how the Lighting Africa program can add value and support market players in order to grow the market for modern off-grid products that meet the Lighting Global Quality Standards; and

(ii) offer insight that can be used by current and potential market players to grow their businesses.

To achieve this objective the market assessment addresses the demand, supply and key institutions involved in the off-grid lighting market. These off-grid lighting products include both fixed systems (solar home systems, or SHS) and mobile or portable systems (lanterns and plug and play systems). More specifically, this study has three specific objectives:

1. On the **demand side:** Analyse consumption and purchase patterns related to household lighting and determine urban and rural consumers' willingness/ability to pay for modern off-grid products that meet the Lighting Global Quality Standards;
2. On the **supply side:** Analyse the modern off-grid lighting market including market size, distribution models and growth on national as well as regional levels, etc., and map the actors in the supply chain.
3. On the **institutional** side: Identify **institutions**, both in the public and private sector and from the policy to retail levels which can influence the sub-sector and prospective actors entering the modern off-grid lighting market. Analyse their current and prospective roles in the sub-sector.

1.2 RESEARCH METHODOLOGY

1.2.1 Approach

This market assessment examines which Lighting Africa interventions and activities can best add value and support both existing market players (operating for 5-20 years) and new market entrants. This report includes suggested activities for Lighting Africa to further grow the market, and spur investment in scaling up successful approaches and innovations in the off-grid lighting market in Uganda.

The section below elaborates the methodologies employed to develop conclusions and execute research activities.

1.2.2 Data Collection

The data collection consisted of:

- a quantitative demand survey of 845 households;
- a quantitative supply survey of 103 retailers of off-grid lighting products
- qualitative interviews of 10 importers or distributors of modern off-grid lighting products; and
- qualitative interviews of 10 key market stakeholders, including public and private institutions.

Demand survey

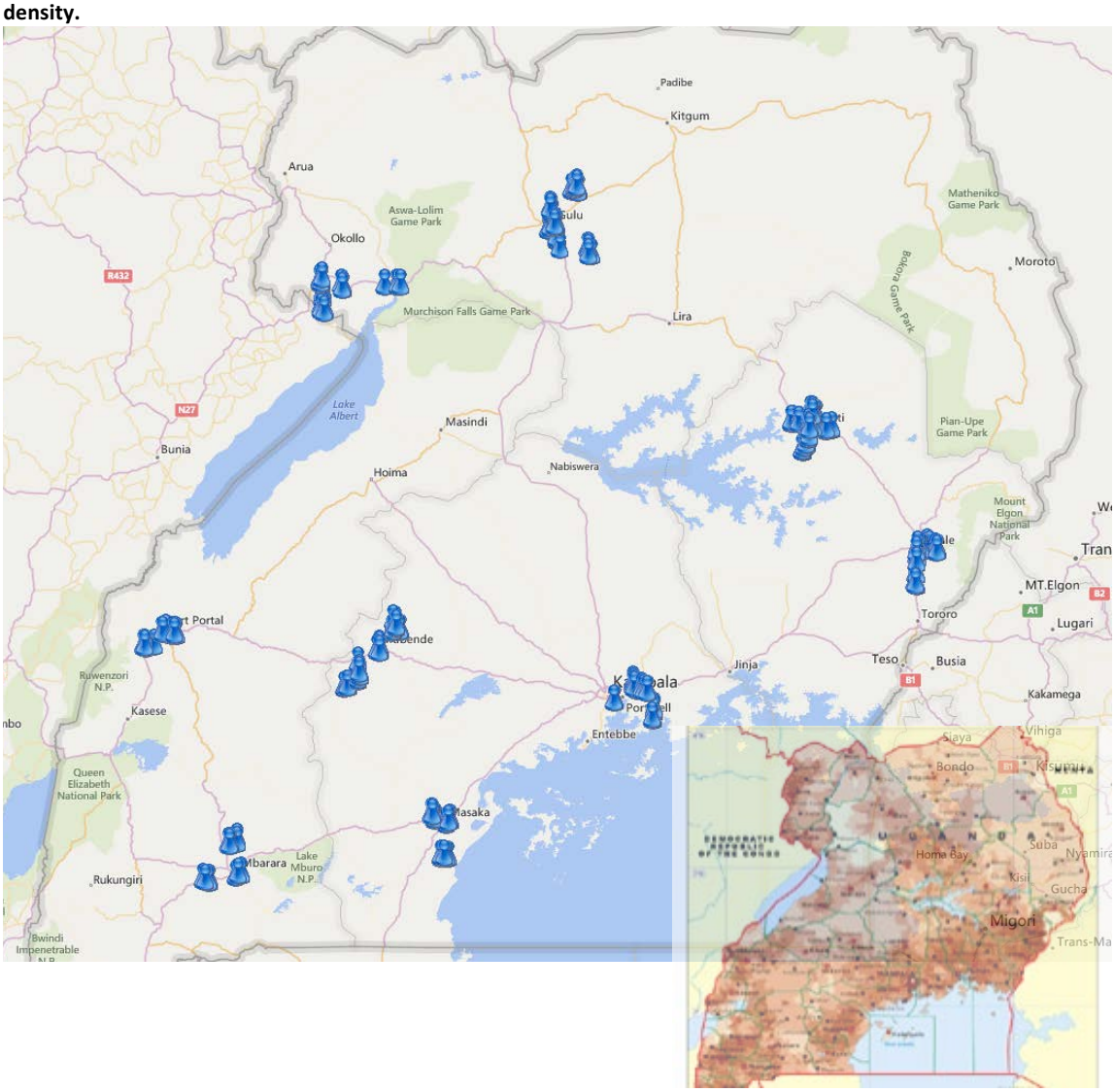
To get a well-balanced perspective of the effective demand for high quality solar lanterns in urban, peri-urban and rural areas, the survey covered all four regions of Uganda, and two districts per region. Quota sampling was used to come to the sample of grid connected and non-grid connected households in Uganda. A quota was also set to include approximately 20% grid-connected households, to assess the extent to which off-grid lighting products complement grid-connected electricity services. Another quota was set to include approximately 20% solar-owning households, to gain insight into current product use and user satisfaction.

The table below highlights the make-up of the stratified household sample in more detail (see Annex 4 for the actual survey sample). Figure 1 provides an overview of the survey locations.

Table 1: Random stratified sample demand survey (households)

Regions	Sample size per region	Urban/rural split	Energy source	Districts proposed
Northern region	175	35 urban 70 peri-urban 70 rural	Min. 35 grid-connected Min. 35 solar-owning	Nebbi, Gulu
Western region	175	35 urban 70 peri-urban 70 rural	Min. 35 grid-connected Min. 35 solar-owning	Mbarara, Kabarole
Eastern region	175	35 urban 70 peri-urban 70 rural	Min. 35 grid-connected Min. 35 solar-owning	Soroti, Mbale
Central region	175	35 urban 70 peri-urban 70 rural	Min. 35 grid-connected Min. 35 solar-owning	Mubende, Masaka
Total	**700**	**140 urban** **280 peri-urban** **280 rural**	**Min. 140 grid-connected** **Min. 140 solar-owning**	
Indicative target for distribution of gender of respondents			*70% male* *30% female*	

Figure 1. Overview of actual locations where demand surveys were taken (see also Annex 3). Insert: population density.



Supply survey

The supply survey was conducted among 100 retailers of off-grid lighting products, spread evenly over the four regions and 8 districts chosen in Uganda (see Annex 5 for the sample distribution by region). The survey includes a range of different suppliers and retailers: general shops, electronic/hardware shops, solar specialist shops, and agents and rural financial institutions that retail off-grid lighting products.

Pilot surveys

A pilot survey was conducted to test and improve the demand and supply surveys. Friends Consult provided feedback on local parameters. The following pre-identified stakeholders were invited to comment on the draft demand and supply surveys: Barefoot power, SolarNow, Incafex and REA. Comments were received from the latter two (see Annex 1).

Enclude and Friends Consult ltd. used the pilot survey as field training for the two supervisors and 10 enumerators on using the CAPI (computer assisted personal interviews) survey software for both the demand and supply survey. The pilot took place in the areas of Seeta and Mukono (in central Uganda).

For the demand survey, 40 pilot surveys were conducted, including 20% grid connected, 20% solar owners, and a mix of urban (20%), peri-urban (40%) and rural inhabitants (40%). During the training, the definitions

of urban, peri-urban and rural were presented and discussed in detail[1]. Data from both surveys was evaluated and the surveys were improved where necessary. The final surveys can be found in Annexes 2 and 3.

Importer Interviews

The following 10 importers of off-grid lighting products in Uganda were interviewed:

Table 2: Interviewed importers

Importers	
Barefoot Power Uganda LTD*	B Box
SolarNow	AB Matra
FRES	Azuri / Indigo*
UltraTec*	Gira Solar*
TASS	Small Solutions*
**Pico-PV products that have met the Lighting Global Minimum Quality Standards*	

Market influencer Interviews

The following institutions were identified who are either active in or influence the off-grid lighting market in Uganda. Public and private institutions are included because of current and future roles in the sector, and high potential new market entrants were also interviewed. The following market influencers were interviewed:

Table 3. Interviewed influencers

Market influencers
Government
- Uganda Energy Credit and Capitalization Company
- Ministry of Energy and Mineral Development
- Uganda National Bureau of Standards
- REA
Financial Institutions
- Centenary Bank
- Rwanyamahembe SACCO
Donor/NGO programmes
- GIZ/ENdev
- SEMA project
- WWF
Private sector
- Kilembe Investments Limited

Desk Research

The following served as resource materials to inform research design and analysis:

- GTZ – Target Market Analysis, Uganda's Solar Energy Market (November 2009);
- Enclude - Internal report produced for DGIS/Phillips funded SESA project (Sustainable Energy Solutions Africa) – Solar market assessment Uganda (2013);
- UNCDF/UNDP – Uganda Country Assessment: Clean Start Uganda, Microfinance Opportunities for a Clean Energy Future (October 2012);
- Enclude – Internal report: Market Survey on Possible Co-operation with Finance Institutions for Energy Financing in Kenya, Uganda and Tanzania (2011);
- USAID - Improving Access to financial Services in Rural Uganda (November 2007);
- UNEP Risø Centre - Review of Solar PV market development in East Africa (March 2014).

In addition, Enclude consulted its regional network to obtain local insights into the current market for off-grid lighting products, including information on vendors and distributors already active in Uganda.

[1] Rural: settlements of low density (about 5-10,000 persons total); a space where human settlement and infrastructure occupy only a small share of the landscape; natural environment dominated by pastures, forests, mountains and deserts; Peri-urban: settlements of medium density (about 10,000-50,000 persons); Urban: settlements of high density (more than 50,000 persons); high density of infrastructure (occupying a large share of the landscape); landscape dominated by buildings.

1.3 RESEARCH CHALLENGES AND LIMITATIONS

There are some limitations to how the results presented in this report can be interpreted. First, although we aimed to interview all actors face to face, a few stakeholders were interviewed by phone due to their remote locations and travel time. Although questions in phone interviews were the same as when conducting a face-to-face interview, there might be slight interpretation differences when using this method.

Second, the results show an overrepresentation of solar owners and grid-connected households. As explained in the research methodology, this is deliberate to ensure comparisons could be made between grid connected and off-grid households and between solar-owning and non-solar-owning households. Therefore, not all results can be directly generalized to represent all households in Uganda.

1.4 STRUCTURE OF THE REPORT

Following the introduction and background material, Chapter 2 provides an overview of the current market situation of off-grid lighting in Uganda, including the main players active in the market. Chapter 3 highlights the main findings of the demand survey in respect to products used and households' expenditures for solar products in Uganda. Chapter 4 provides an overview of the key findings of the supply survey and interviews regarding the main distribution and business models of Ugandan retailers and importers. Chapter 5 highlights the key characteristics and activities of market players that were interviewed. In Chapters 6 and 7, the key conclusions and main recommendations of the study are presented.

2 LIGHTING MARKET IN UGANDA

2.1 BACKGROUND ON ENERGY ACCESS AND OFF-GRID LIGHTING IN UGANDA

2.1.1 Energy Access Challenges in Uganda

Historically, Uganda's electrification rate has been quite low. Grid-connected households have grown from 5.6% in 1991 to 9% in 2006 and 10% in 2010. Presently only about five million households are connected to the national grid. This is just under 14% of the country's entire population of 36 million people. The grid is almost entirely focused in urban areas and provincial towns, often only connecting a few thousand people per district[2]. At the same, only about 16% of the population is urbanized. Of the rural population, approximately 4% is grid-connected.

Hydro-generated power is the primary source of power to the national grid and accounts for just over 70% of the 595MW installed generation capacity (2010[3]). Renewable energy sources, e.g. solar PV and biogas produce, contribute a negligible 0.1% of the total national energy supply.

That approximately 31 million people in Uganda live without electricity has significant ramifications for the economy and quality of life. Lack of access to reliable lighting limits the productivity of about 85% of the country, hindering peoples' ability to carry out basic activities at night or in the early morning, including household chores, reading, schoolwork, and business activities. Fuel-based lighting also has health and safety implications: chronic illness due to indoor air pollution, and risk of injury due to the flammable nature of the fuels used. Kerosene lamps emit fine particles that are a major source of air pollution. These implications also have a negative impact on the economy (lower productivity, higher health care costs) and reduced quality of life (lower life expectancy, respiratory issues).

2.1.2 The Ugandan Solar Market

The solar PV market in Uganda has steadily grown over the last 15 years with new players entering the market, including foreign investors. While ten years ago there were a handful of solar companies mainly engaged in institutional solar PV installations, currently a number of companies are involved in the solar PV and even solar thermal businesses. The market is in transition, however, and different players are struggling to find their optimum servicing levels, particularly regarding last mile distribution.

The historical growth of solar in the Ugandan market is accounted for by five key factors:[4]

- Conducive regulatory policies, including the Ugandan energy and renewable energy policies that encourage investment and trade in the solar sector by providing financing (credit) mechanisms and by aiming to diversify the energy supply sources and technologies;
- Government projects that specifically promote the use of solar in rural electrification;
- The demand for reliable electricity and modern energy services by an expanding middle-income society;
- The growth in the telecommunication sector;
- National awareness programs facilitated by donor support.

Uganda has an average solar insolation of 5-6 kWh per square meter per day. Throughout the year, it has an average of 8 sunshine hours per day. This provides an excellent potential for solar energy use. Solar energy

[2] IRENA – Country profile Uganda 2011 (http://www.irena.org/REmaps/countryprofiles/africa/Uganda.pdf#zoom=75); Reegle – Country profile Uganda 2011 (http://www.reegle.info/countries/uganda-energy-profile/UG).
[3] Enclude - Internal report produced for DGIS/Phillips funded SESA project (Sustainable Energy Solutions Africa) – Solar market assessment Uganda (2013); Uganda Bureau of statistics, statistical abstract 2013; www.era.or.ug; REA - The Renewable Energy Policy for Uganda 2007.
[4] GTZ – Target Market Analysis, Uganda's Solar Energy Market (November 2009)

is currently used primarily for off-grid electrification for rural communities, as well as for water heating and powering public buildings, including hospitals. In 2009 an estimated 1.1 MW of solar PV power was installed nationwide[5], including both institutional and home systems. The SHS market is regarded as one of the biggest areas in Uganda for commercially driven solar PV business, and considered to have high potential.

Despite its growth and promising potential, according to previous research the market for solar is still nascent and hampered[6] by the following main challenges:

- **Cost of solar PV systems:** Solar systems are expensive to buy both from an upfront investment perspective and in absolute cost terms. Even where a credit scheme is provided, the ultimate cost of a solar system is still high, mainly due to the high margins of middle-men and interest rates charged by financial institutions in Uganda (typically 2.5-4% per month flat rate).
- **Quality of solar PV products, systems and system components:** Quality control is low both at importation and local production levels (for local components), as well as in installations of the systems. The high market potential has resulted in an influx of dealers selling low quality products or installing systems incorrectly, especially in the case of solar lanterns. Rural customers are more concerned with the price of systems while relatively uninformed about how to determine the quality of systems.
- **Last mile distribution:** Rural commercial marketing and distribution networks for solar are largely absent. The solar companies in Uganda are stuck at a low level equilibrium of low sales volumes and high prices with large unit margins. The companies are small and entrepreneurial, with limited financial capabilities. They have neither the resources nor the risk appetite for major investments on their own in rural marketing and last mile distribution.
- **Financial risks:** Because of the high capital outlay, solar is considered by both cash and credit buyers to be a risky asset. Financial Institutions, including micro finance institutions and Savings and Credit Cooperatives (SACCOs) often assume that financing solar products carries a high credit risk, particularly because it is a new product of which the technical aspects are generally unknown.
- **Service and after-sales service:** There is inadequate rural presence of solar equipment and service providers and thus service and maintenance is often out of reach. As a result, solar consumers experience a lack of technical support on the ground.

The above challenges were taken as hypotheses and further assessed in this study.

[5] Reegle – Country profile Uganda 2011 (http://www.reegle.info/countries/uganda-energy-profile/UG); GTZ – Target Market Analysis, Uganda's Solar Energy Market (November 2009).
[6] Enclude - Internal report produced for DGIS/Phillips funded SESA project (Sustainable Energy Solutions Africa) – Solar market assessment Uganda (2013); GTZ – Target Market Analysis, Uganda's Solar Energy Market (November 2009).

3 DEMAND ASSESSMENT OF THE MODERN OFF-GRID LIGHTING MARKET

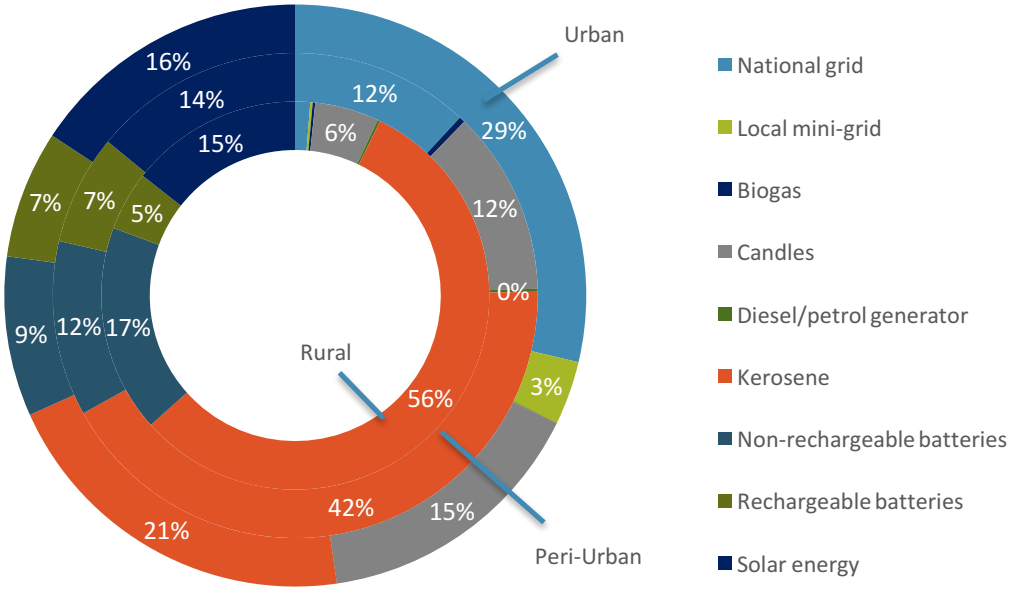
The enumerators conducted 845 demand surveys with households in all four regions, and eight districts in Uganda. The surveys consisted of 70 questions on off-grid lighting use, awareness, satisfaction and demand. See Annex 2 for the full survey. The main results are summarized below.

3.1 CONSUMPTION AND PURCHASE PATTERNS OF OFF-GRID LIGHTING

3.1.1 Current access to and use of energy sources

The main energy source used by surveyed households is kerosene, particularly in the rural areas. On average, 40% of households use kerosene, and 18% use candles. In the rural areas, over 56% of households use kerosene, whereas in urban areas the figure is 21%.

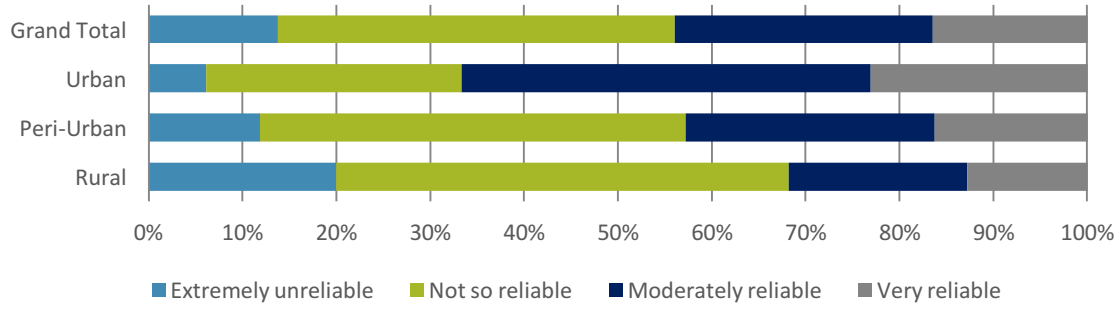
Figure 2: Answers to the question 9: 'What sources of energy does your household use?'



Note: Because of the stratified/quota sampling method used, grid-connected households and households using solar energy are overrepresented.

The Ugandan households surveyed consider the energy sources used to be very unreliable. Particularly in rural and peri-urban areas, almost 70% and 55% of respondents said their energy source was 'extremely unreliable' to 'not so reliable'. This is primarily the case for households using basic energy sources including kerosene, candles and non-rechargeable batteries, and far less prevalent for grid-connected households (either national or local) and solar-using households. Urban households find their energy source most reliable (67% say it is 'very' or 'moderately' reliable).

Figure 3: Question 10: 'How reliable are your current sources of energy?'



When comparing the reliability of the different energy sources (see Figure 4 below), it becomes clear that solar energy is perceived as quite reliable, whereas kerosene and non-rechargeable batteries are seen as unreliable. About 90% of the households indicated that they trust solar products and three quarters see solar as the introduction to a modern household.

Figure 4: Question 10: 'How reliable are your current sources of energy?' as perceived by Ugandan households (n = 1249; multiple responses per household were possible)

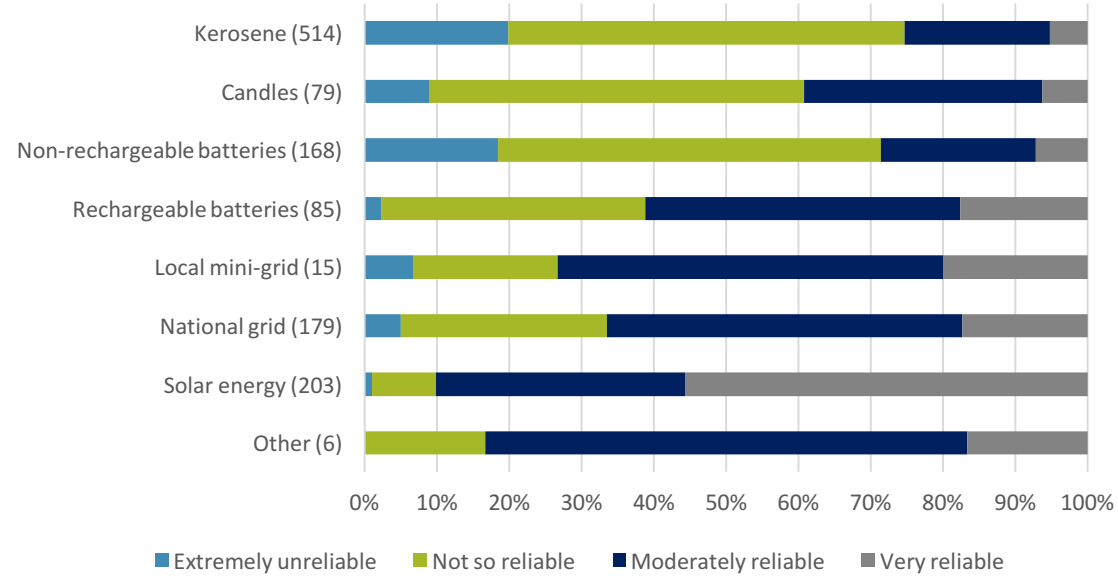
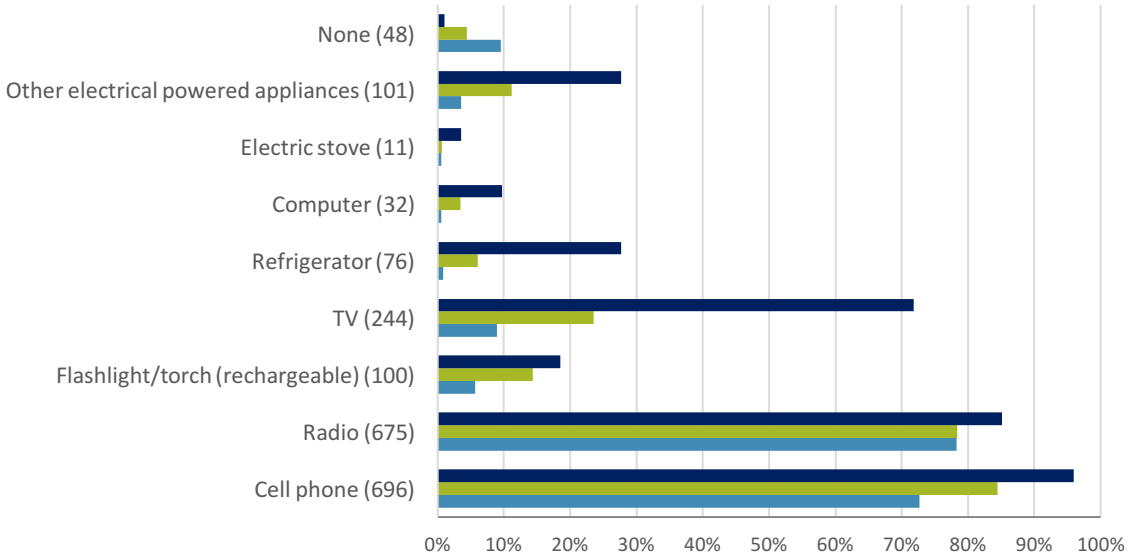


Figure 5 shows which appliances are used by the surveyed households. The majority of the households own a cell phone, radio and flashlight/torch (using dry cell batteries), particularly in the rural areas. The households in urban areas also typically own TVs, refrigerators and electric cookstoves.

Figure 5: Question 11: 'Which of the following appliances does your household have?'



	Cell phone (696)	Radio (675)	Flashlight/torch (rechargeable) (100)	TV (244)	Refrigerator (76)	Computer (32)	Electric stove (11)	Other electrical powered appliances (101)	None (48)
Urban	96%	85%	18%	72%	28%	10%	4%	28%	1%
Peri-Urban	84%	78%	14%	24%	6%	4%	1%	11%	4%
Rural	73%	78%	6%	9%	1%	1%	1%	4%	10%

3.1.2 Current Access to and Use of Off-grid Lighting Products

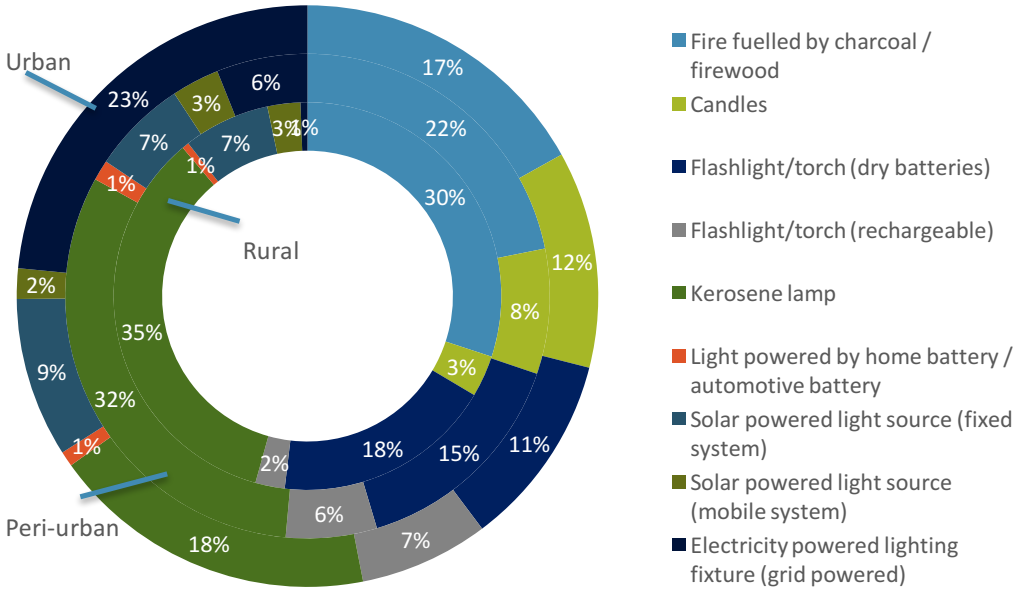
Kerosene lamps (also known as tadooba) are used by 28% of the surveyed households as the main source of lighting in the home. In addition, the light from fire fuelled by charcoal or wood (23%) and from flashlights using dry cell batteries (15%) are also widely used, particularly in the rural and peri-urban areas.

Figure 6. Examples of the Kerosene lamps (tadoobas) used

Figure 7 demonstrates that the more remote (or rural) the household, the more it relies on basic energy sources such as kerosene, wood and charcoal fire, and candles. Notably, although nearly 24% of the households in urban areas are grid-connected (either national or local grid), almost 50% still use basic sources for lighting the home, generally as a back-up during power cuts.

The majority (about 57%) of surveyed households use these lighting sources for less than 2 hours a day. Others use the lighting source between 2 to 4 hours a day.

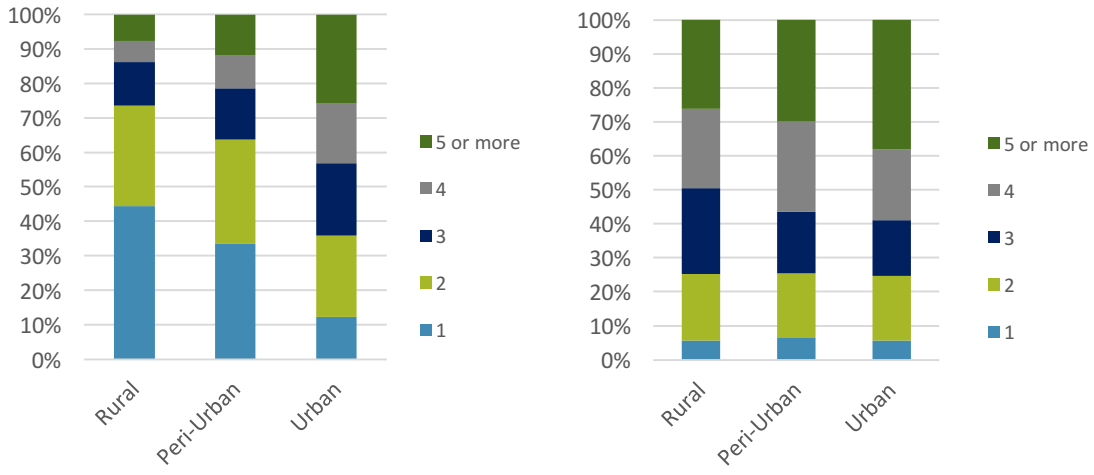
Figure 7: Question 13: 'What are the current lighting source(s) used by your household?'



Note: Because of the stratified sampling method used, grid-connected households and households using solar energy are overrepresented.

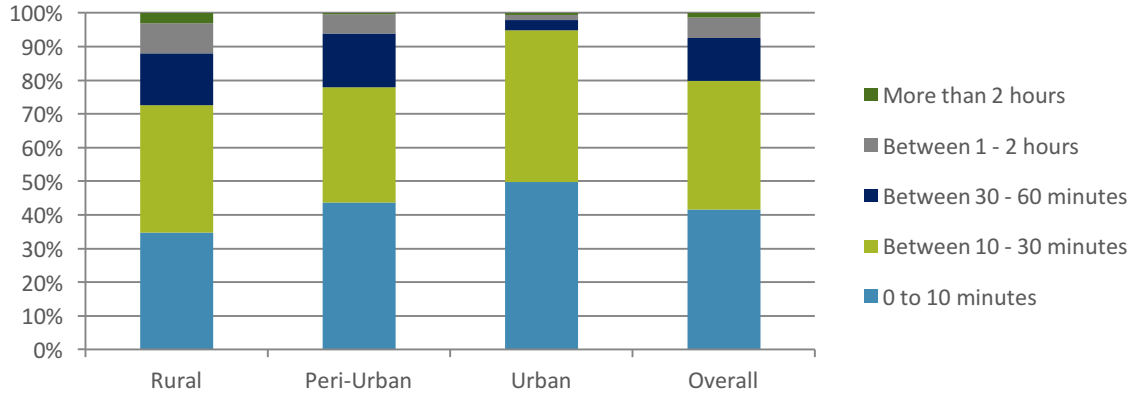
The figure below indicates the current lighting use, by rooms currently lighted, and the demanded lighting. In rural areas, 73% of the households have 1 or 2 rooms lit while they would want 3 or more rooms lighted (74%). In peri-urban areas, 63% of the households have 1 or 2 rooms lighted but would want 4 or more rooms lighted (56%). In urban areas the number of rooms currently lighted shows a diffuse picture, however 38% indicates to desire to have 5 or more rooms lighted.

Figure 8: Left: Questions 15: 'How many rooms in your house are currently lighted?' Right: Questions 16: 'How many rooms would you like to have lighted?'



A rural household from our sample spends on average 26 minutes per week travelling to purchase their lighting source. In peri-urban and urban areas this is respectively 21 and 15 minutes per week.

Figure 9: Question 21: 'On average, how much time does it take to travel to pay for electricity or purchase lighting products per week?'



3.1.3 Degree of Satisfaction with Off-grid Lighting Products

Rural and peri-urban households showed high levels of dissatisfaction towards the basic off-grid lighting sources used, 67% and 55% respectively (see figure below). Dissatisfaction is far less prevalent in the urban areas where a larger part of the households are grid-connected (24%) and own solar home systems (8%). About 96% of solar users are satisfied versus 35% of kerosene users.

Figure 10: Question 17: 'How satisfied are you with your current lighting source?' as perceived by Rural/Peri-Urban/ Urban Ugandan households

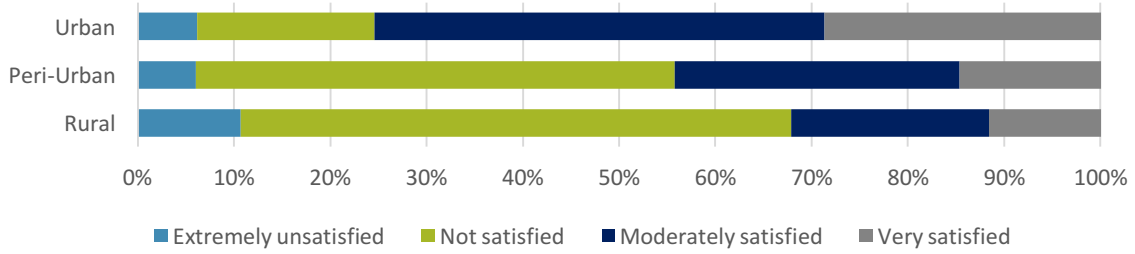
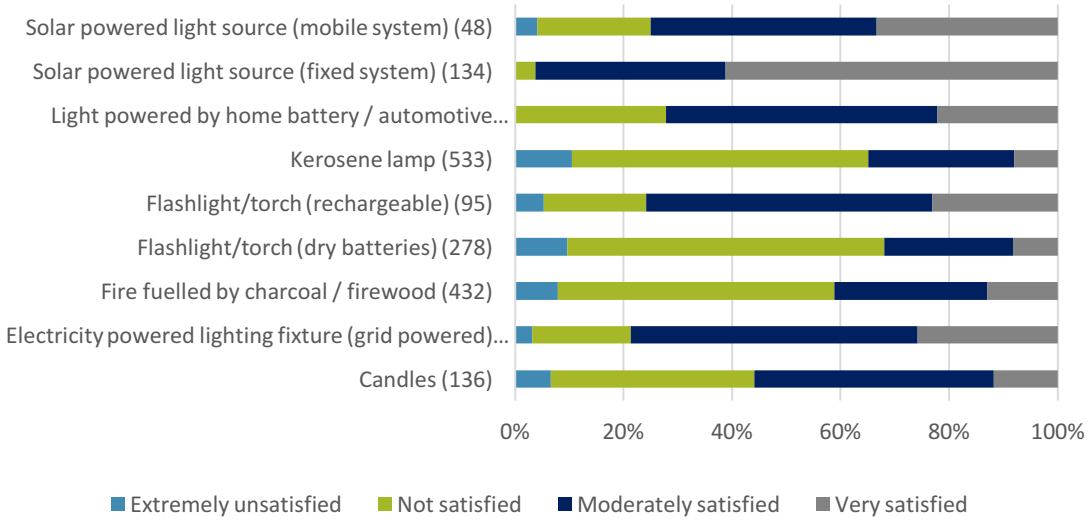


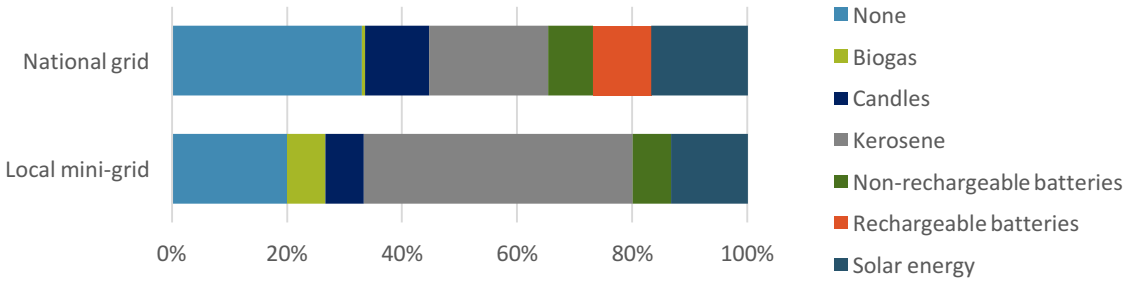
Figure 11: Question 17: 'How satisfied are you with your current lighting source?'



3.1.4 *Complementary Off-grid Lighting Products and Electricity Services*

Seventy percent of the grid-connected households make use of complementary lighting sources, of which the main complementary source is kerosene (23%) and to a lesser extent solar energy (16%). Households connected to a local mini-grid make use of a complementary lighting source more often than households connected to the national grid (see Figure 12). This could indicate that the unreliability of the local mini-grid requires households to use complementary products.

Figure 12: Question 9: 'What [other] sources of energy does your household use?' Complementarity off-grid products and electricity (n=194)



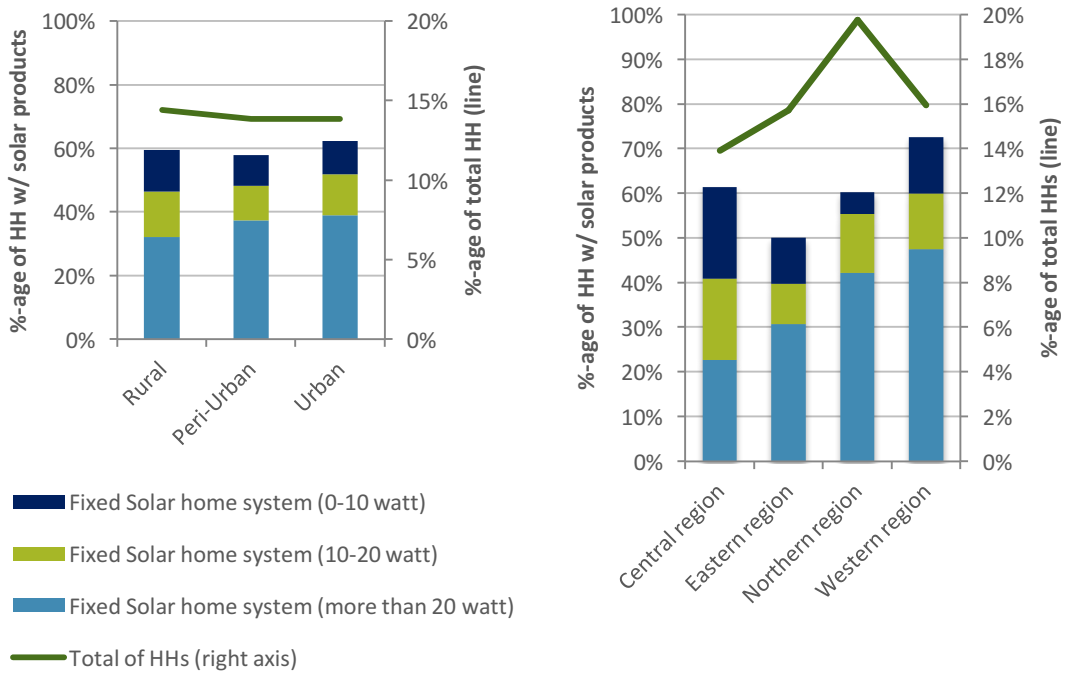
3.1.5 *Types of Solar Systems*

In general, households use fixed solar systems more than mobile solar systems, particularly the fixed solar home systems of more than 20 watts (see Figure 14). A probable reason for high fixed system use is the government subsidies provided for fixed solar systems only, provided through the PVTMA (Solar PV Targeted Marketing Approach) as part of the World Bank financed Energy for Rural Transformation (Phase II) programme, and the strong marketing efforts of SolarNow (offering fixed systems), using agents all over Uganda.

Figure 13. Examples of solar PV installations.

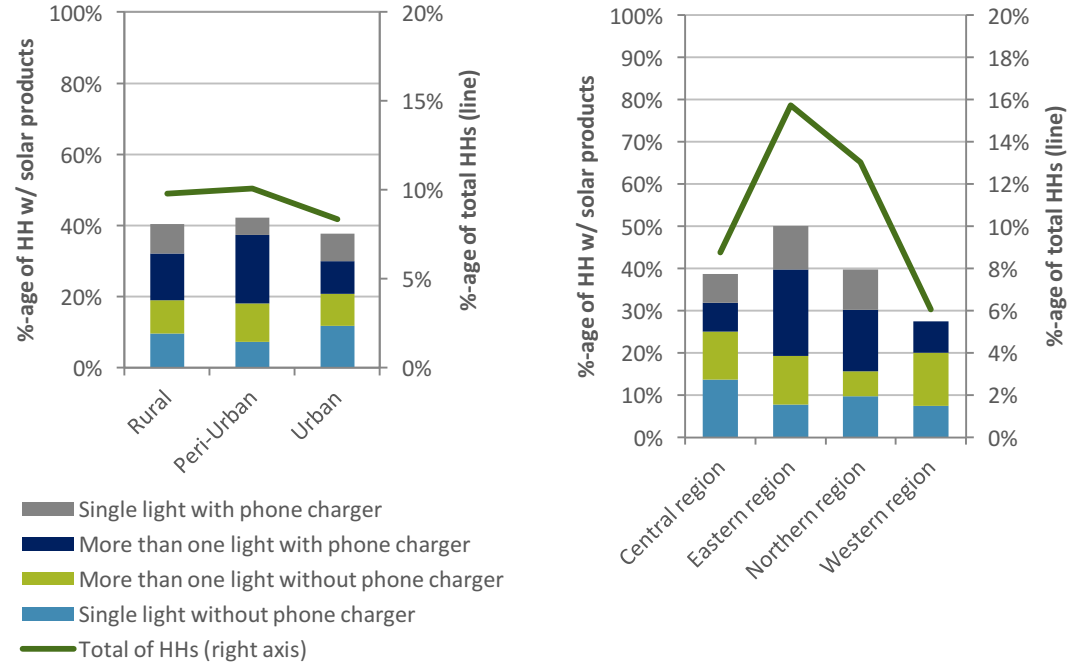
In the Central region, the smaller solar home systems (of 0-10 and 10-20 watts capacities) are also owned in large numbers, while in the Eastern and Northern regions, mobile systems (more than one light with phone charger) rank second (see Figure 15).

Figure 14: Question 35: 'What kind of solar product(s) do you have?' Solar Home System owners only. Left: per location; Right: per region.



Note: The percentage on the right axis is the percentage of the total sample (e.g. 14% of Urban households interviewed own a SHS system).

Figure 15: Question 35: 'What kind of solar product(s) do you have?' mobile solar systems only. Left: by location; Right: by region.



3.1.6 Which Solar Systems are Used for What

Solar products are mainly used to light the home (32%) or charge phones at home (26%). Also studying for children is often mentioned (20%). TV watching is particularly mentioned for SHS system users.

Figure 16: Question 36: 'What are the main uses of your solar product(s)?' by area type.

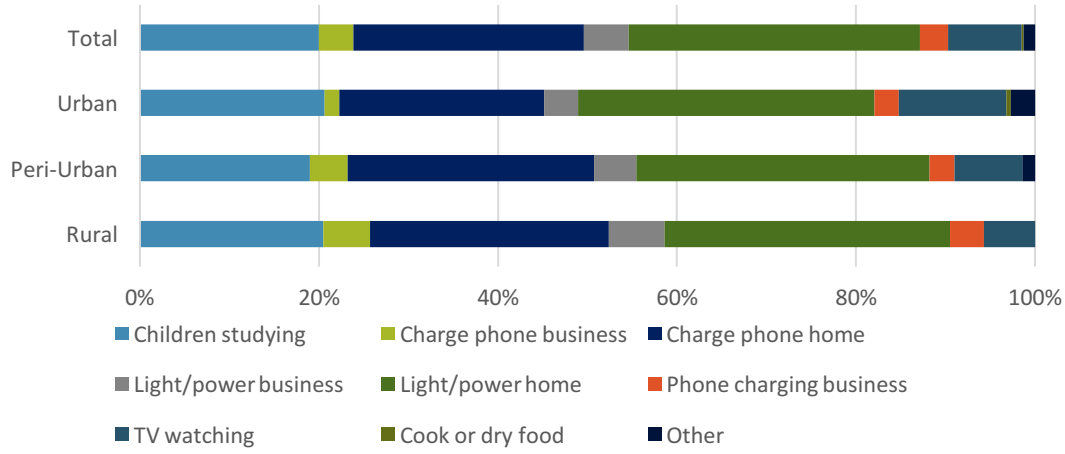
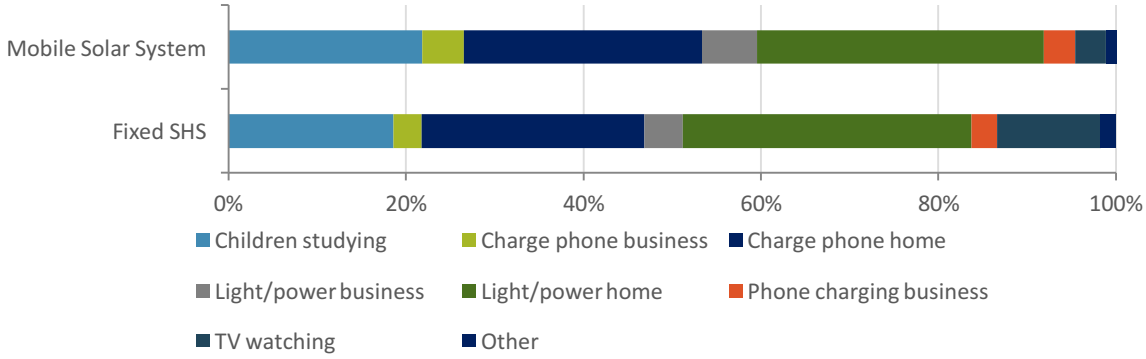


Figure 17: Question 36: 'What are the main uses of your solar product(s)?' by product type.

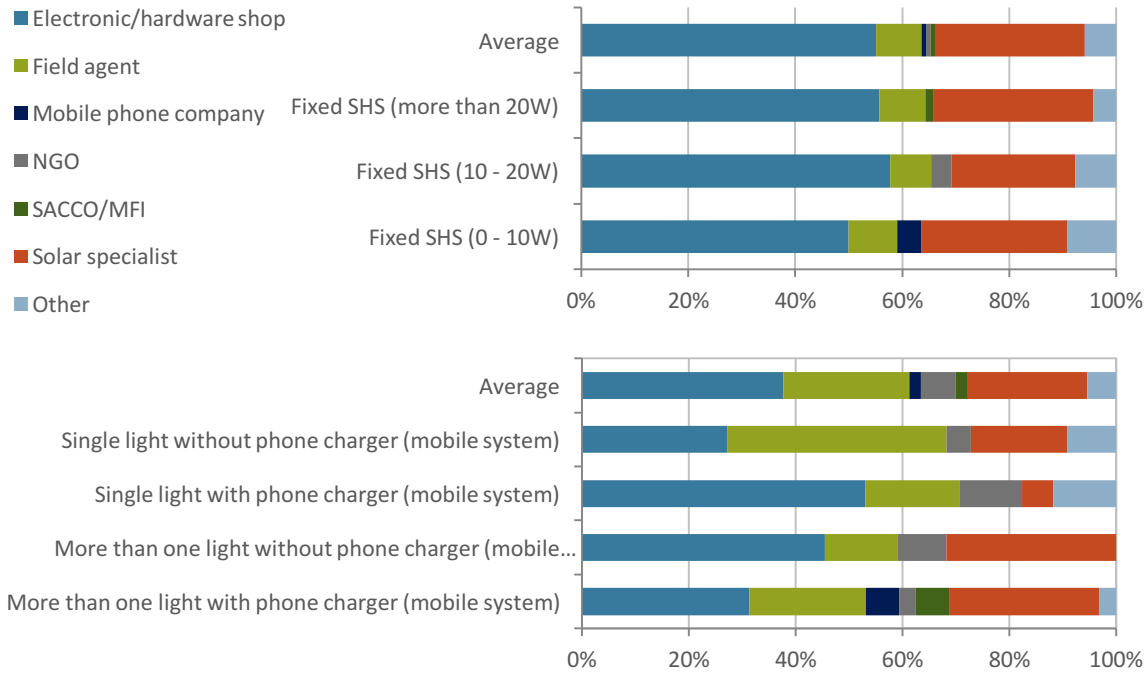


Note: Difference between "Charge phone business" and "Phone charging business": "Charge phone business": Respondent charges his/her phone at his/ her work; "Phone charging business": The respondent uses the product to earn an income charging mobile phones as a business.

3.1.7 Source of Purchase and Product Satisfaction

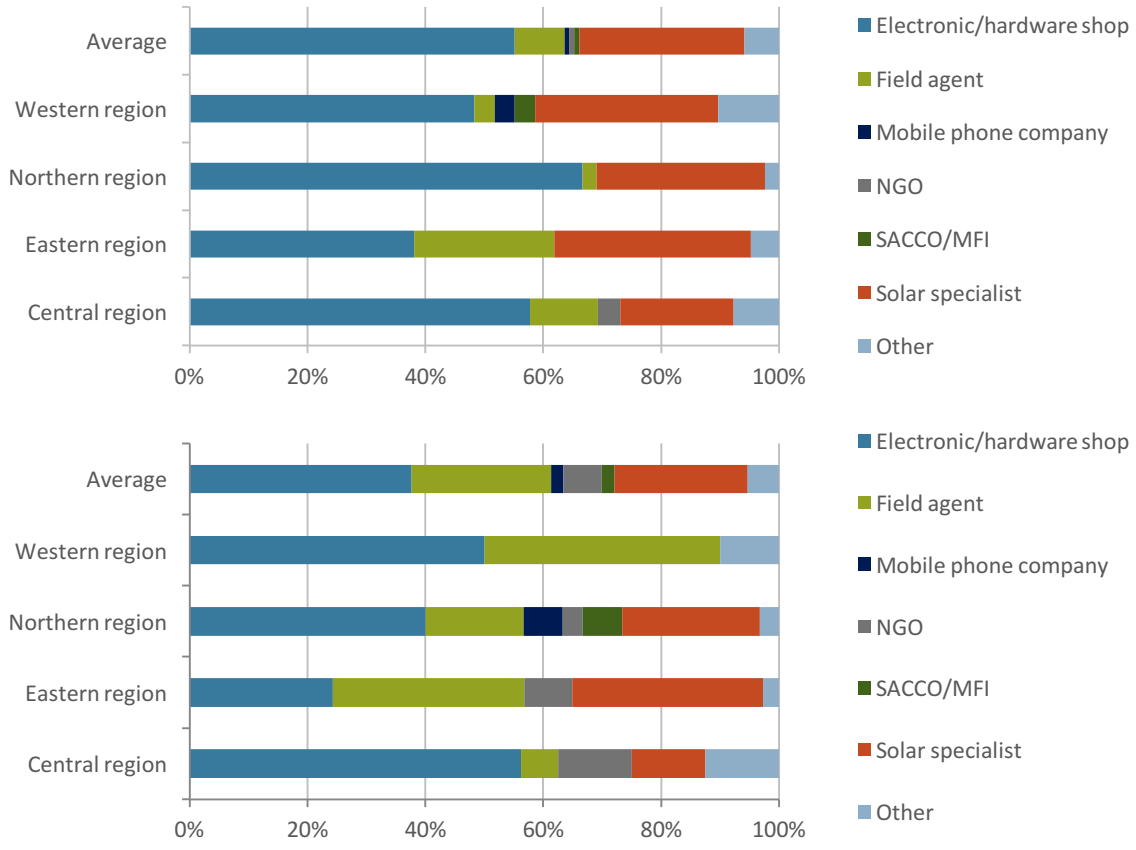
Solar products were mainly bought at electric/hardware shops (55%). Only around 1.5% of the households purchased their solar product through a SACCO or MFI.

Figure 18: Question 38: 'Where did you buy your solar product?' top: fixed solar systems, bottom: mobile systems



When looking at regional purchasing patterns, it is clear that particularly households in the Central, Northern and Western regions buy their solar products at hardware shops. Only households in the Eastern region frequently bought their solar products at a solar specialist (34%) or a field agent (29%).

Figure 19: Question 38: 'Where did you buy your solar product?' Solar Home System owners (top graph) and mobile system owners (bottom graph)



Between 24% and 29% of the households bought their products between 1 and 2 years ago, particularly in the rural areas. The majority of the solar products owned still work well.

Figure 20: Question 39: 'When did you buy the solar product?'

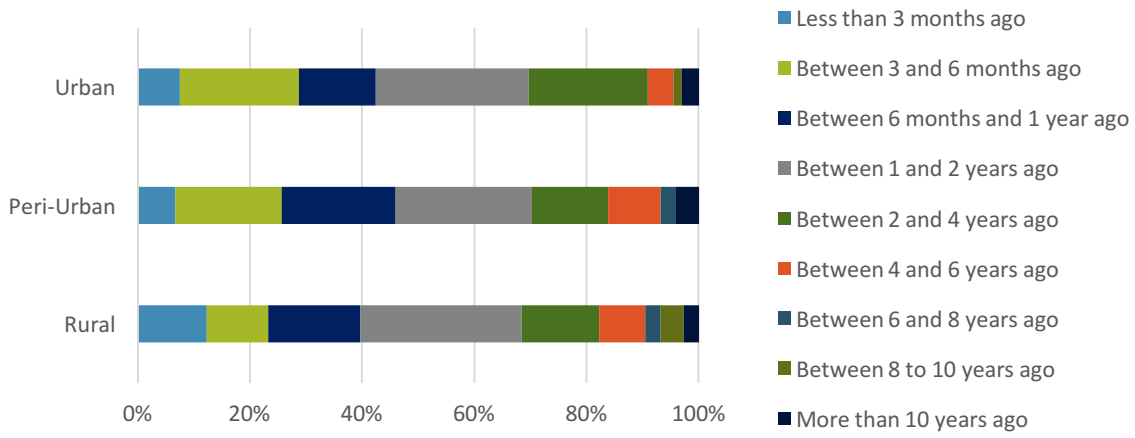
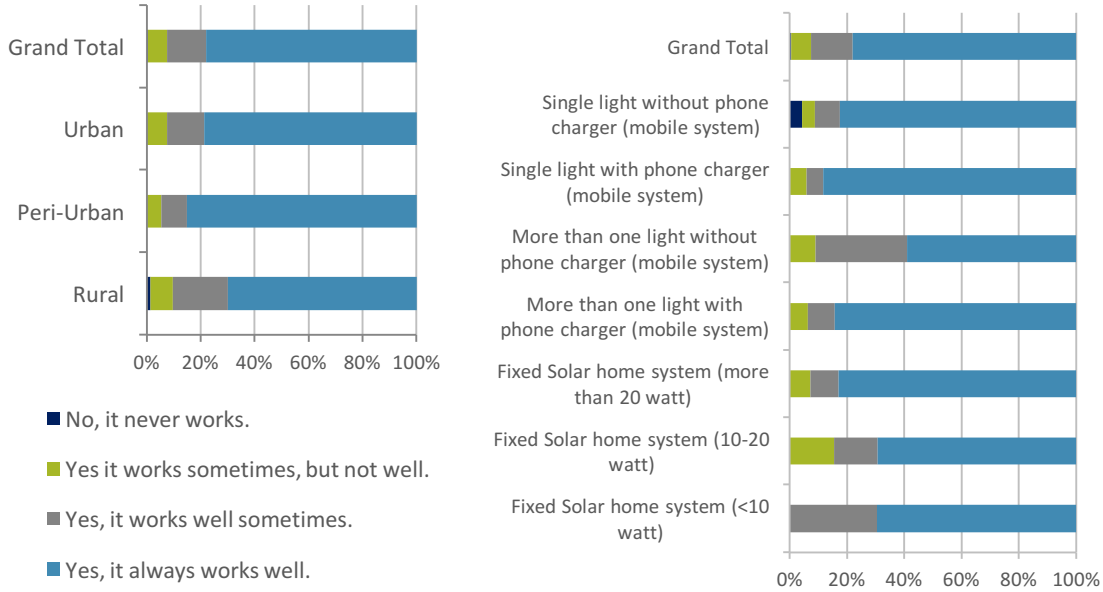
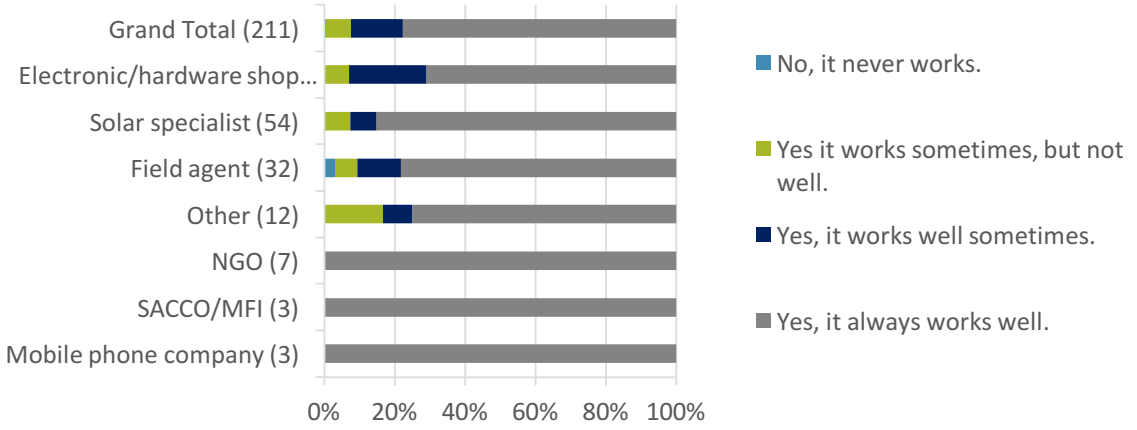


Figure 21: Question 40: 'Is your solar product still working?'



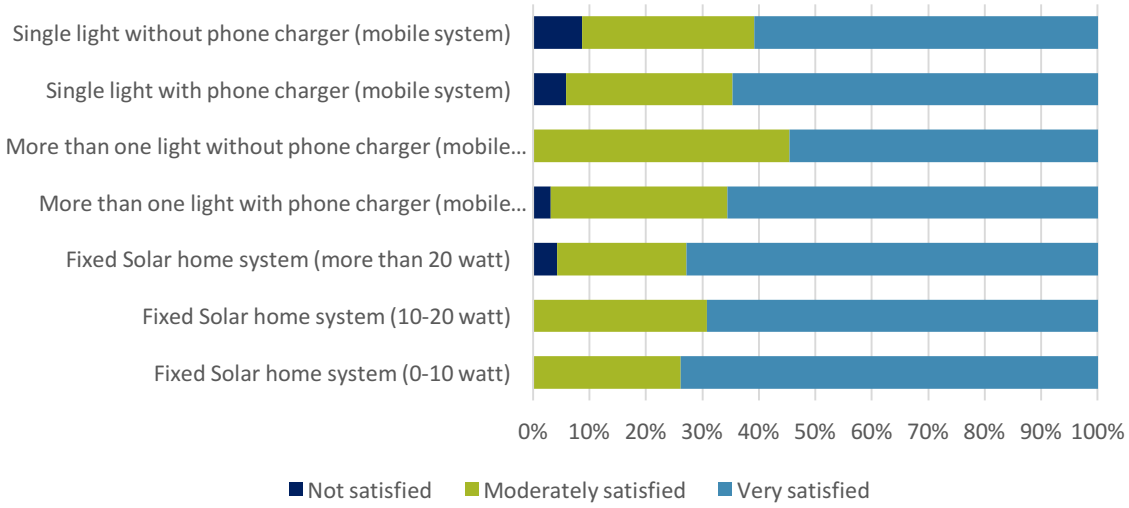
Households do not seem to experience quality issues with their solar products, which is contrary to the perception of other stakeholders such as suppliers, financial institutions (Banks) and donors/NGOs. The small number of households that indicated they were not satisfied, primarily cited difficulty in use (for a single light without phone charger system), power unsuitable for lighting (for more than one light with phone charger & fixed SHS of more than 20 watts), or power unsuitable for other appliances (single light with phone charger & fixed SHS of more than 20 watts).

Figure 22: Questions 38 combined with Question 40: 'From whom did you buy your solar product and is it still working?'



Of the two respondents whose solar systems were broken, one got it fixed by a solar specialist and the other did not.

Figure 23: Question 47: 'How satisfied are you with your current solar product?'



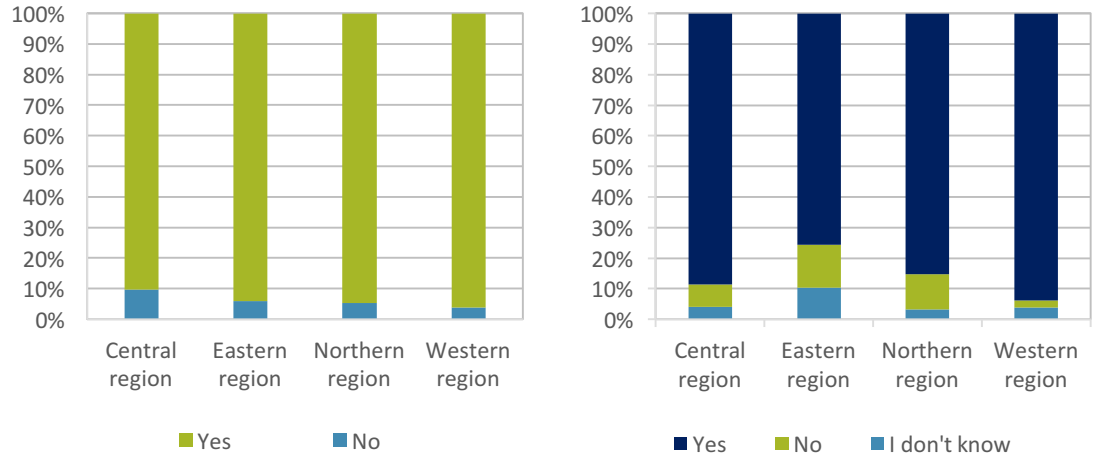
The respondents that gave a reason for not being satisfied with their solar systems mentioned the following:

- The light was too difficult to use (solar lantern owner);
- It didn't work anymore (a >20W SHS owner);
- The power was not reliable for lighting (a mobile system with charger owner and a >20W SHS owner); and
- The power was not reliable for other appliances (a SHS >20W owner and a solar lantern owner).

Between 78% and 82% of all solar-owning households would want to own more solar products, particularly in the rural areas and particularly for households owning a single light system with a phone charger (mobile system); more than one light system with phone charger (mobile system); or a fixed SHS of 10 to 20 watts.

In terms of trust in solar products and whether solar is seen as an indication of the modern household, responses are extremely positive. Over 90% of the households in all regions in Uganda trust solar products, and between 76% and 94% feel it is an indication of a modern household.

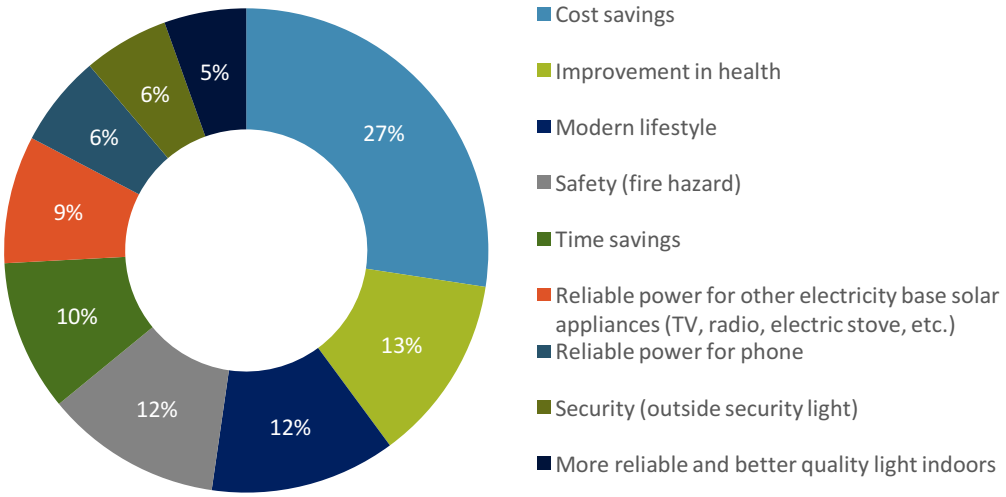
Figure 24. Left: Question 30: 'Do you think solar powered products can be trusted?' Right: Question 31: 'In your opinion is having a solar product an indication of a modern household?'



3.1.8 Demand Drivers of Off-grid Lighting Products

The most appealing benefit of off-grid lighting products for Ugandan households without a solar product is cost savings, followed by improvement in health, modern lifestyle and safety from fire hazard (see figure 25).

Figure 25: Question 27: "Which of the following benefits of modern lighting are most appealing?" (n = 568)

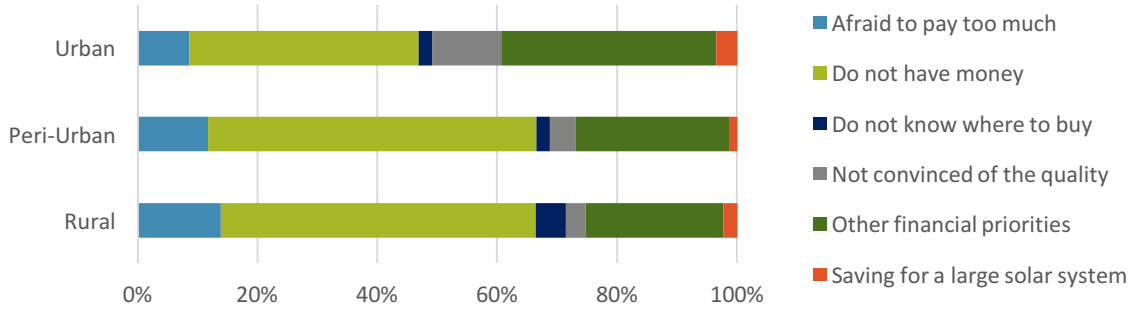


Surveyed rural households spend, on average, 26 minutes per week travelling to collect and purchase lighting products. Peri-urban residents spend 21 minutes, and urban dwellers spend an average of 15 minutes per week on collecting and purchasing lighting products.

Non-solar owners indicated the main reason for not having purchased a solar product has to do with not having the money (51%), followed by 'other financial priorities' (26%) (Figure 26). Interestingly, about 12% of the households in urban areas were not convinced of the quality of solar products, which does not seem to be an issue in rural and peri-urban areas.

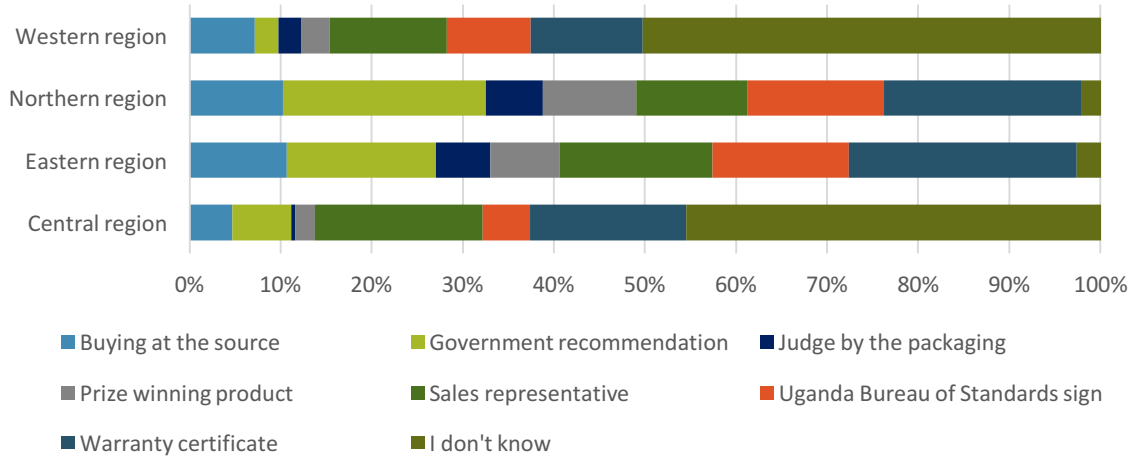
This lack of financing among these households points to a clear need to explore the potential for end-user financing solutions. Forty-five percent of the non-solar owning households indicated they would be more interested in buying solar if provided a loan, particularly in the urban areas.

Figure 26: Question 55: 'Reasons for not purchasing a solar product till now' (n=568).



Non-solar owning households generally consider the solar product warranty as an indicator of the quality of the product (21%). However, a large part of the households do not know how to assess the quality of a solar product, especially in the Central and Western regions in Uganda (45% and 50%) (see figure below). Only a small percentage indicates the lack of quality might be an issue.

Figure 27: Question 29: 'What convinces you of the quality of a solar product?' (n = 568)

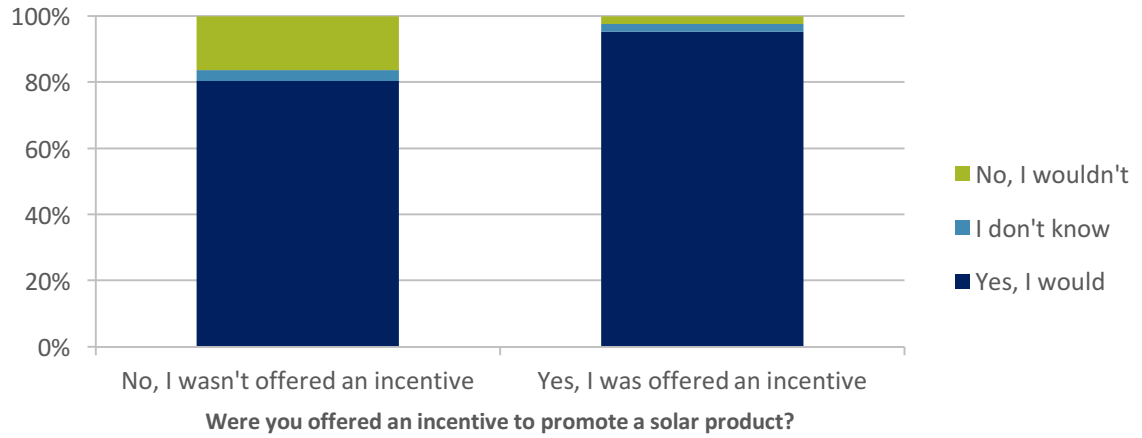


In all regions, more than 90% of households indicate that solar products can be trusted (Northern: 95%, Eastern: 94% Western: 96%, Central: 90%). The confidence in solar products is strongly driven by a warranty, the Uganda Bureau of Standards (UNBS) mark or by Government recommendation. This is particularly evident in the Northern and Eastern regions.

3.1.9 Demand Drivers of Solar Owners

Although the majority of the solar owners were not offered an incentive when buying their solar product (71%), the large majority indicated that they would be willing to promote solar products (by word of mouth, for instance to neighbours and relatives) when offered an incentive to do so (81% on average). Ninety-five percent of the households that had been offered an incentive in the past were willing to promote the product again when offered an incentive.

Figure 28: Question 29: 'Would you be willing to [promote solar products] if you were offered an incentive?' (n = 213)

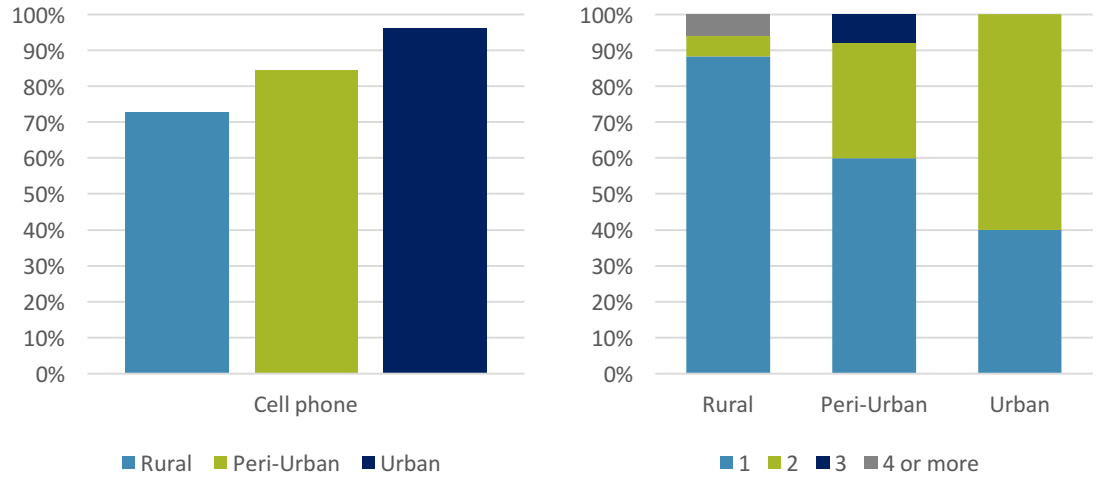


3.2 CONSUMPTION AND PURCHASE PATTERNS OF MOBILE PHONES

3.2.1 Current Use of Mobile Phones

The majority of the surveyed households own at least one mobile phone, ranging from 73% in rural areas to 96% in urban areas. A large part of the households in peri-urban and urban areas generally own 2 or sometimes even 3 mobile phones.

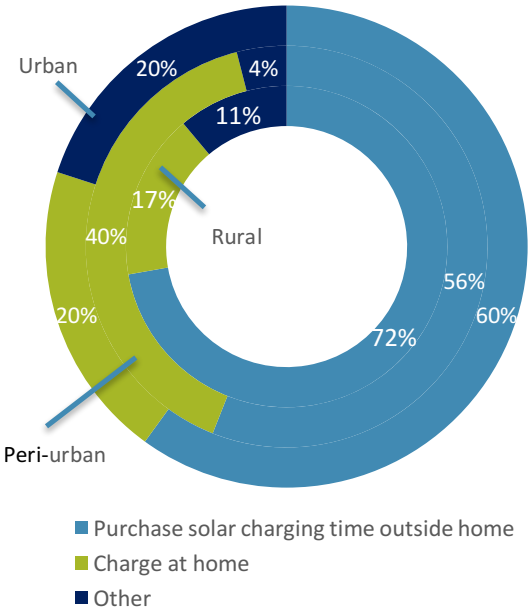
Figure 29: Left: Question 11: 'Which of the following appliances does your household have?' (Answers for cell-phones only) (n=845), Right: Question 12: 'How many cell phones does your household have together?'



As figure 30 indicates, mobile phone charging is done by almost 70% of the households by purchasing time outside the home. The majority (60%) of the households spend less than 1000 UGX (US$ 0.40)[7] on mobile phone charging per week. About 11% of the households are able to charge their phones either through the grid they are connected to and 17% through the solar product they own.

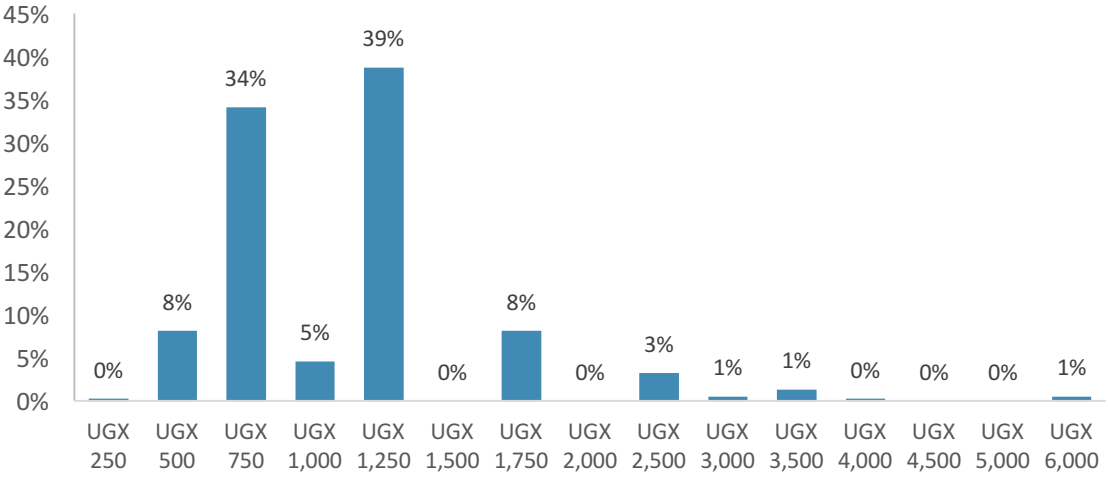
[7] Exchange rate was used throughout the report (1 US$ = 2,500 UGX) is the average of UGX 2,500 per US Dollar exchange rate for the first half year of 2014. This is the rate assumed in this report.

Figure 30 Question 22: 'What is (are) the current cell phone charging source(s) used by the household?'



Average phone charging costs	UGX/ week	US$/ week
Central region	1,083	0.43
Eastern region	964	0.39
Northern region	920	0.37
Western region	1,025	0.41
Rural	1,098	0.44
Peri-urban	857	0.34
Urban	1,071	0.43
Average	1,000	0.40

Figure 31: Distribution of mobile phone charge costs (based on Question 19: 'How much do you spend on average for each, per week?')



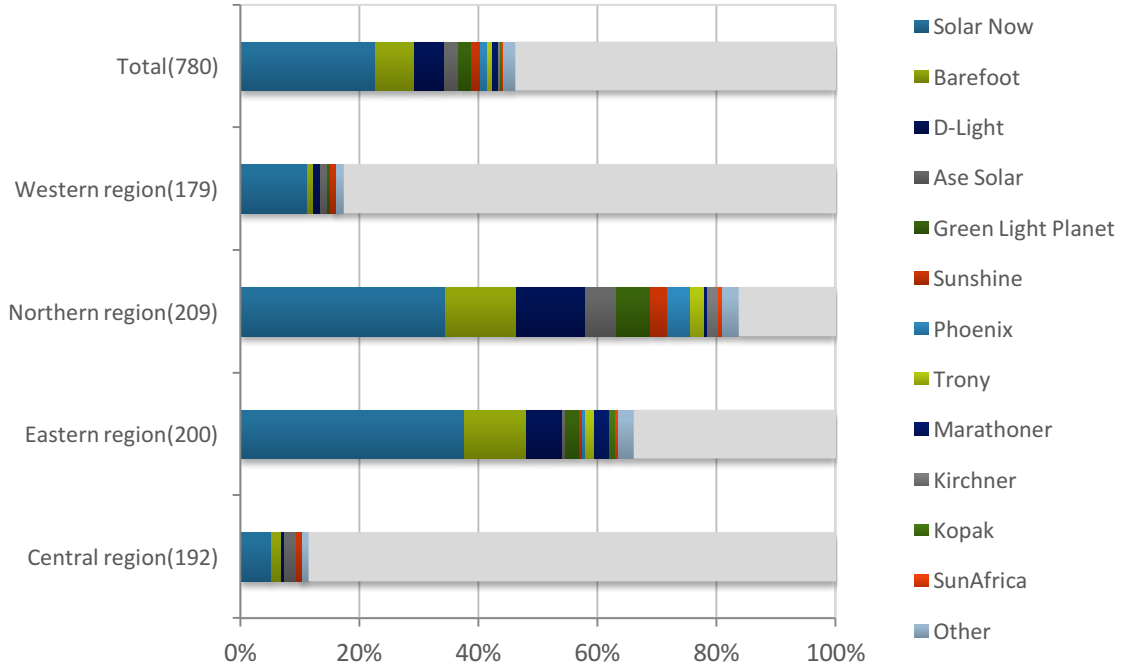
As is seen in Figure 16 (page 27), the main use of solar products is for charging mobile phones, particularly the smaller mobile and fixed solar systems are used for charging mobile phones.

3.3 SOLAR BRANDS

3.3.1 Brand Awareness Amongst Households

Brand awareness is lowest in the Central and Western regions, where 89% and 83% of the households couldn't mention any brand. SolarNow is the most well-known brand, especially in the Northern and Eastern regions where respectively 34% and 38% of the households knew the brand.

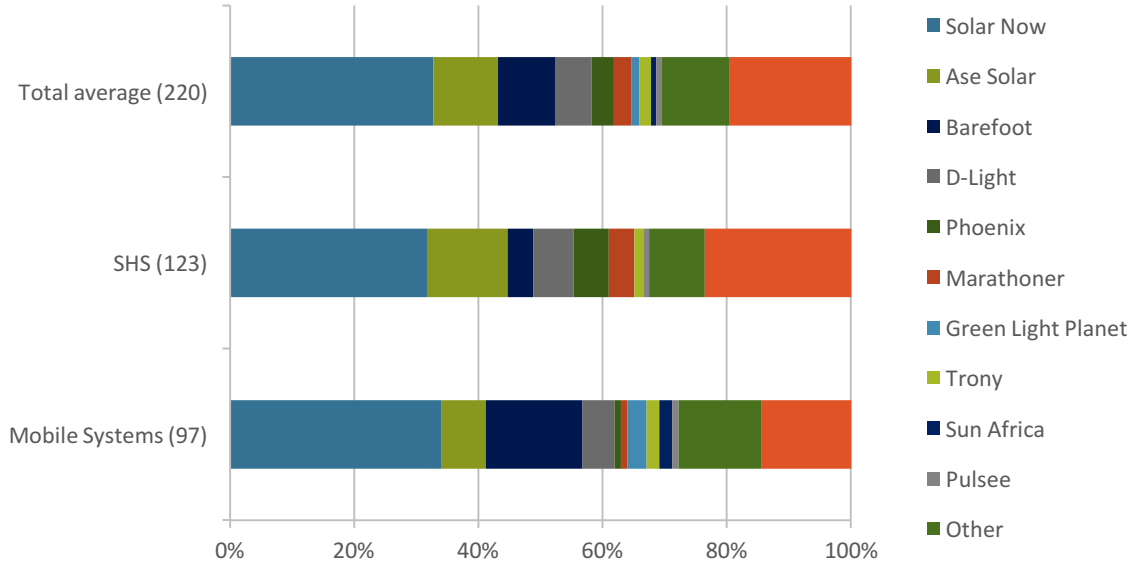
Figure 32: Question 28: 'Which solar brands have you heard of?' National total and by region.



3.3.2 Brand Awareness Amongst Solar System Owners

The most common brands of solar products that respondents own are SolarNow (close to 33%), Ase Solar (10%) and Barefoot (7%). About 24% of the households that own a SHS product did not know or remember the brand that they were using versus 14% of the mobile solar system owners.

Figure 33: Question 37: 'What brand is (are) your solar product(s)?' National total and by system type.



From a regional perspective, most households in the Central region don't know the brand of their solar system (57%). In the Eastern region, 54% of the solar owners surveyed mentioned they have SolarNow systems. Ase Solar systems are owned by 20% of the households in the Northern region.

3.4 HOUSEHOLD SPENDING

On average, a Ugandan household (from our sample) spends 4.8% of its disposable monthly income on energy and fuel, or about UGX 25,000 (US$ 10). Main household expenditures are on food (18.5%) and school fees (38%). Expenditures on energy and fuel are clearly low, while expenditures on school fees, food and rent make up 60-75% of disposable income. This explains why over 50% of the households do not feel that a significant share of their household income is spent on lighting and phone charging. The figure below provides a breakdown of household expenditures by region type (rural, peri-urban and urban).

Figure 34: Question 63: "How much of your household income do you spend on the following items on a monthly basis?"

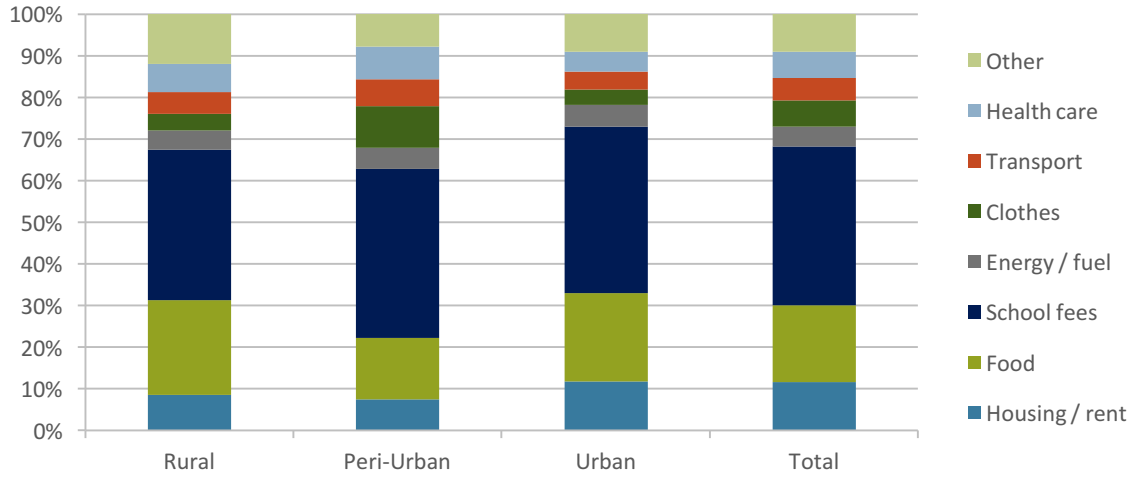
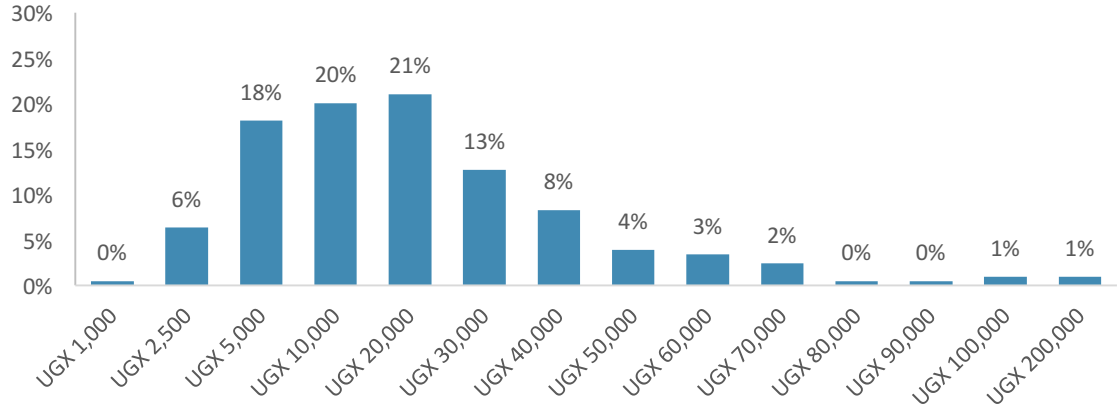


Figure 35: Distribution curve for monthly household's energy expenditures Question 63: "How much of your household income do you spend on the energy on a monthly basis?"



Almost 40% of surveyed households' weekly lighting expenditure is on kerosene, amounting on average to UGX 1,910 (US$ 0.76) a week[8]. Average expenditures on off-grid lighting products are higher in urban areas. The districts Kabarole and Soroti, in the Western and Eastern region show highest expenditure levels, while Nebbi and Gulu in the Northern region show lowest levels (see figure 38).

Figure 36: Question 19: 'How much do you spend on average for each lighting source, per week? (Recurring costs)

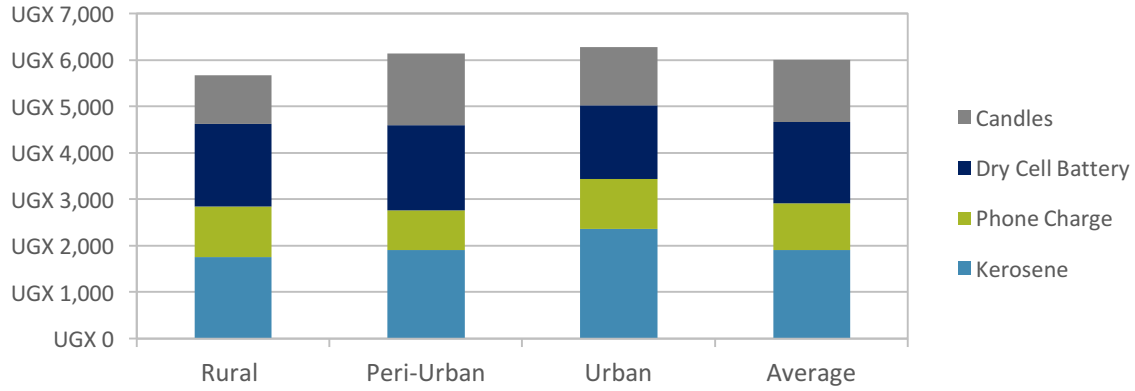
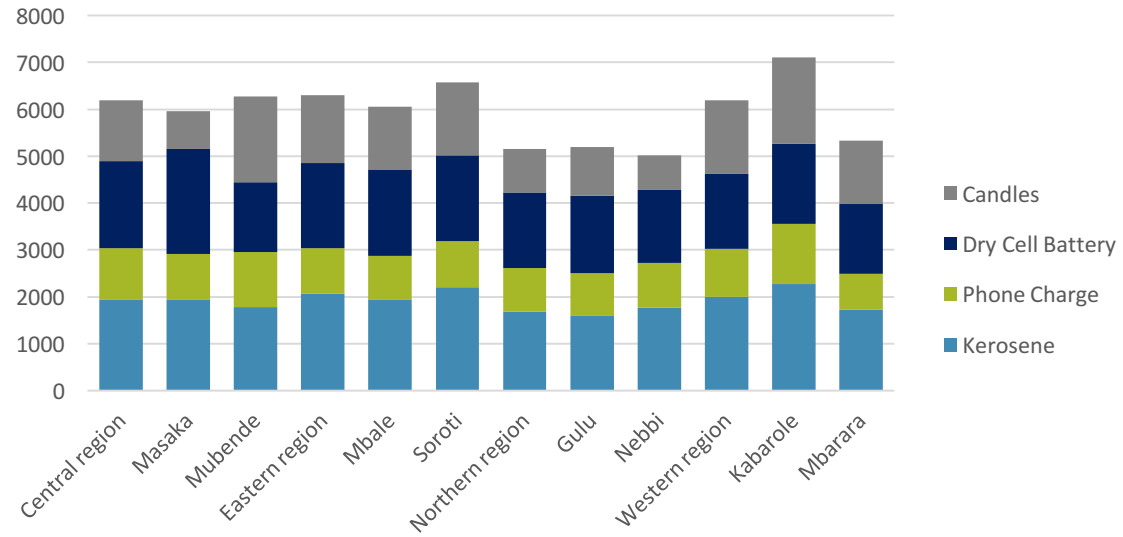


Figure 37: Question 19: 'How much do you spend on average for each lighting source, per week? (Recurring costs) per region and district.



[8] In spring 2014 the tax on kerosene was increased by UGX 200 (~ 11% price increase) per liter. This, this is not represented in the number above.

The average spending on recurrent costs might indicate how much households could pay under pay-as-you-go schemes. These expenditures indicate that the average surveyed household could afford to spend UGX 6,000 (US$ 2.40) on solar services for mobile phone charging and lighting per week.

Figure 38: Distribution of off-grid lighting (including phone charging) weekly expenditure (based on question 19: 'How much do you spend on average for each, per week?)

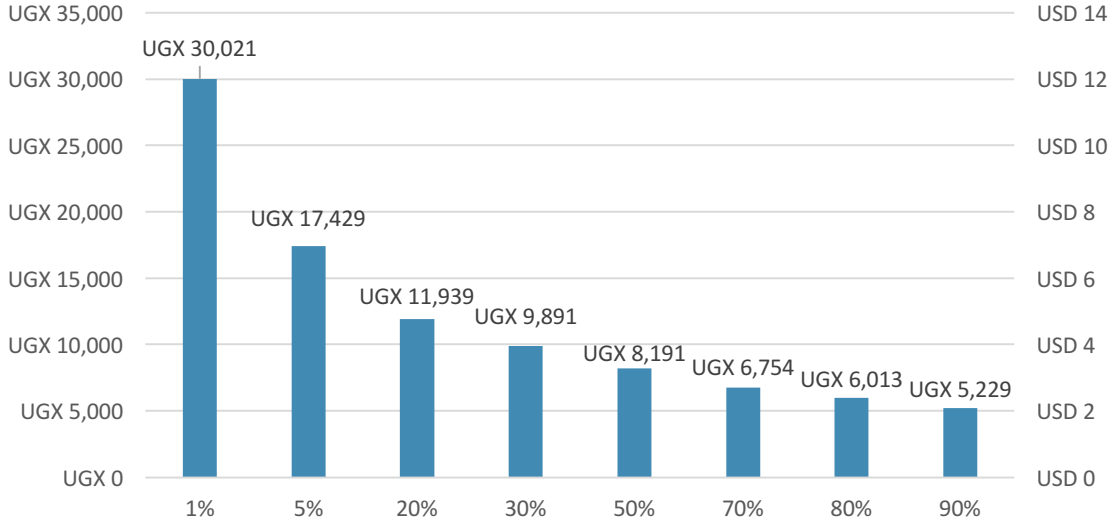
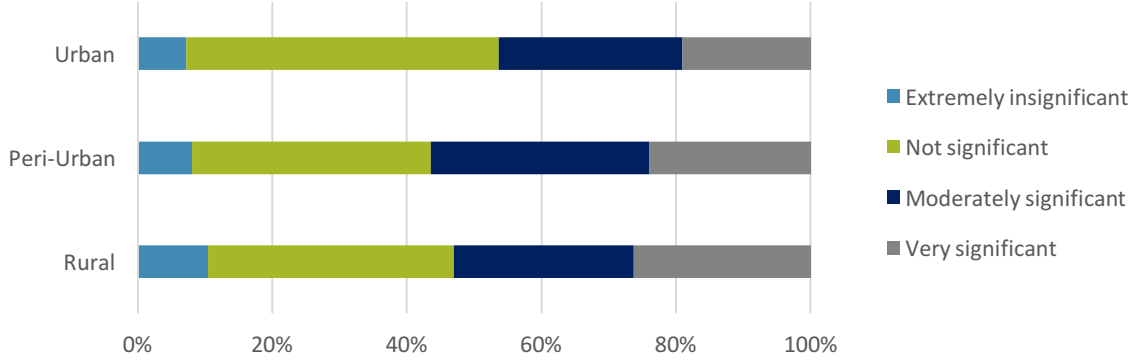


Table 4. Average fixed costs of traditional lighting products.

Item	Average Fixed Cost (in UGX)	Average Fixed Costs (in US$)	Recurring costs per month (in UGX)	Recurring costs per month (in US$)
Candles	-	-	7,843	3.14
Kerosene Lamp - large	12,000	4.80	8,279	3.31
Kerosene Lamp - medium	8,000	3.20	8,279	3.31
Kerosene Lamp - small	5,000	2.00	8,279	3.31
Torch - rechargeable	4,000	1.60	7,669	3.06
Torch - dry cell	3,000	1.20	7,669	3.06
Torch - small dry cell	1,000	0.40	7,669	3.06
Tadooba with wick	1,000	0.40	8,279	3.31
Tadooba without wick	600	0.24	8,279	3.31

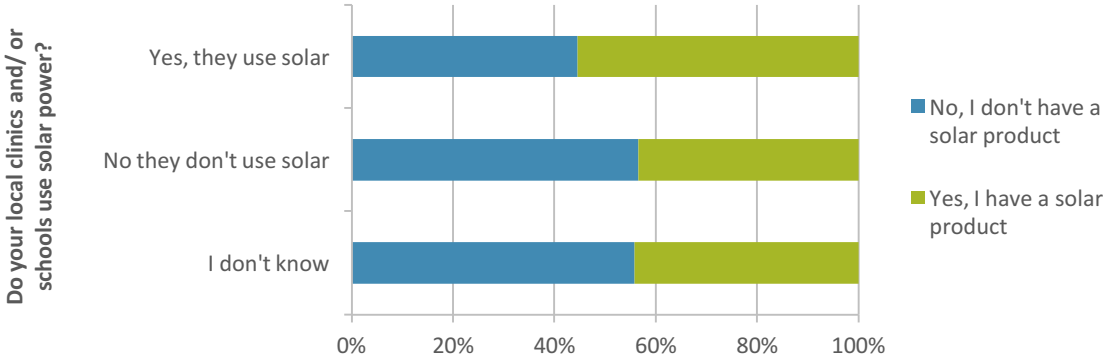
Most surveyed households felt that expenditures on off-grid lighting and phone charging represented an insignificant to moderately significant share of the total household income. However, in rural areas over half of the households feel that these expenditures take up a significant share of their total expenditures.

Figure 39: Question 20: 'Do you feel that a significant share of the household income is spent on lighting and phone charging?'



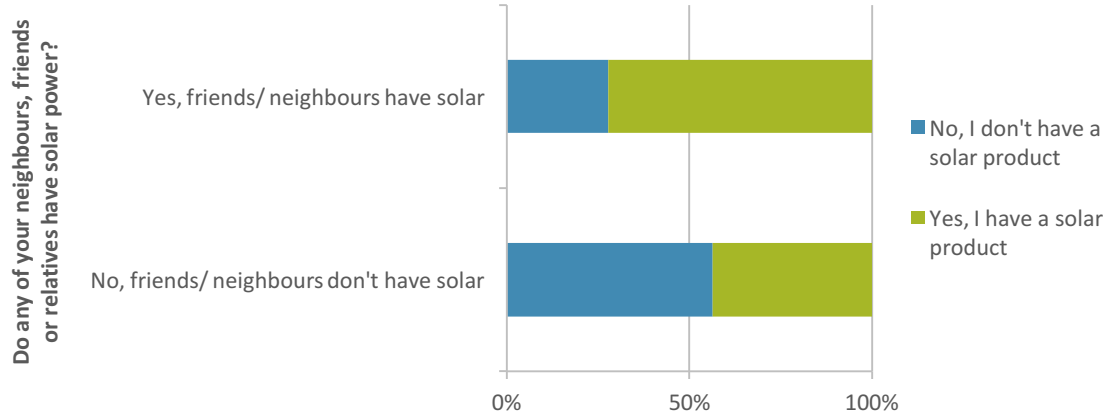
In rural areas the relative expenditures on kerosene and dry-cell batteries are highest, while in urban areas the expenditures on diesel and petrol are among the highest.

Figure 40: Correlation between Question 32 and Question 34 shows that when a school or clinic uses solar power, 45% more households have power too (32% vs 22% non-solar owners).



A positive correlation exists between schools and clinics using solar power and the proportion of solar owners in the area. There is also a positive correlation between solar owners who have neighbours, friends and/ or relatives that also own a solar product. A causal effect however cannot be determined based on this survey.

Figure 41: Correlation between Question 32 and Question 33 shows that when neighbours, friend or relatives own solar power, 45% more respondents also use solar power (32% vs 22% non-solar owners).

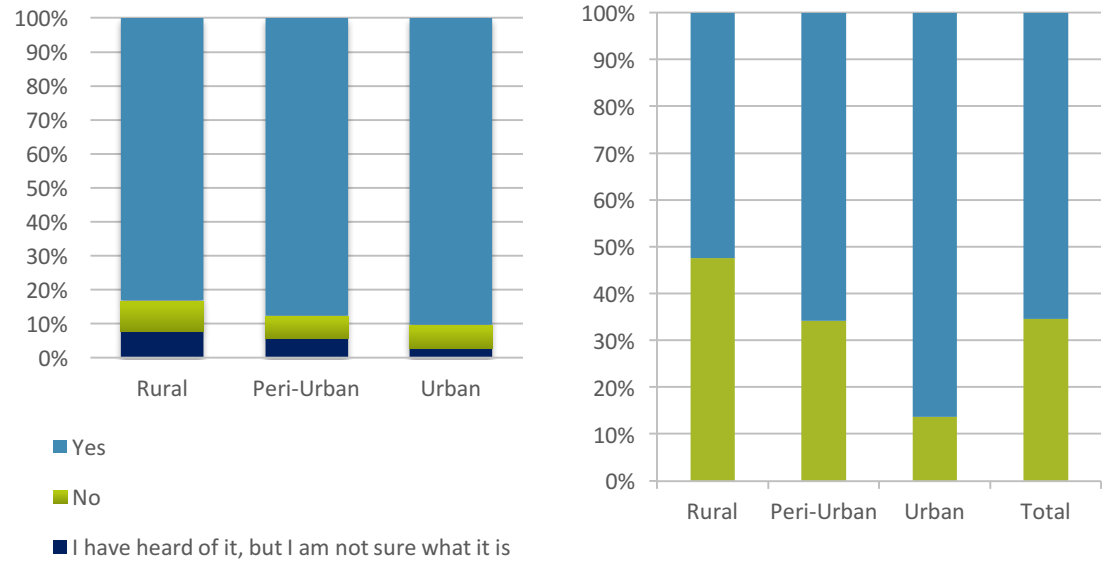


3.5 CURRENT DEMAND AND CONSUMER SPENDING TRENDS

3.5.1 Awareness of Off-grid Lighting Products

The awareness on solar power among households in Uganda is generally high, as 86% of surveyed households know about solar power. In the Eastern and Northern regions, however, awareness is lower; in these areas, 12-14% of the surveyed households didn't know what solar power is.

Figure 42: Left: Question 25: 'Do you know what solar power is?' and Right: Question 26: 'Do you know where to buy solar products?'



Although over 86% of the Ugandan households are aware of solar, awareness of where to buy solar products is less evident. Particularly in the Central and Western regions, a large part of households surveyed (between 36-50%) did not know where to buy solar products. Awareness was generally low in rural areas as well, where only 52% knew where to buy solar products.

3.5.2 Willingness to Pay

In general, solar owners are willing to pay 28% more for a solar product than households which do not own a solar product (see figure below). Interestingly, both types of households are willing to pay significantly more than the actual average retail price, with the exception of a single light without phone charger system. The biggest difference between the retail price and price households are prepared to pay is for larger SHSs (<20W).

Figure 43: Question 54: Willingness to pay for a solar product, in UGX

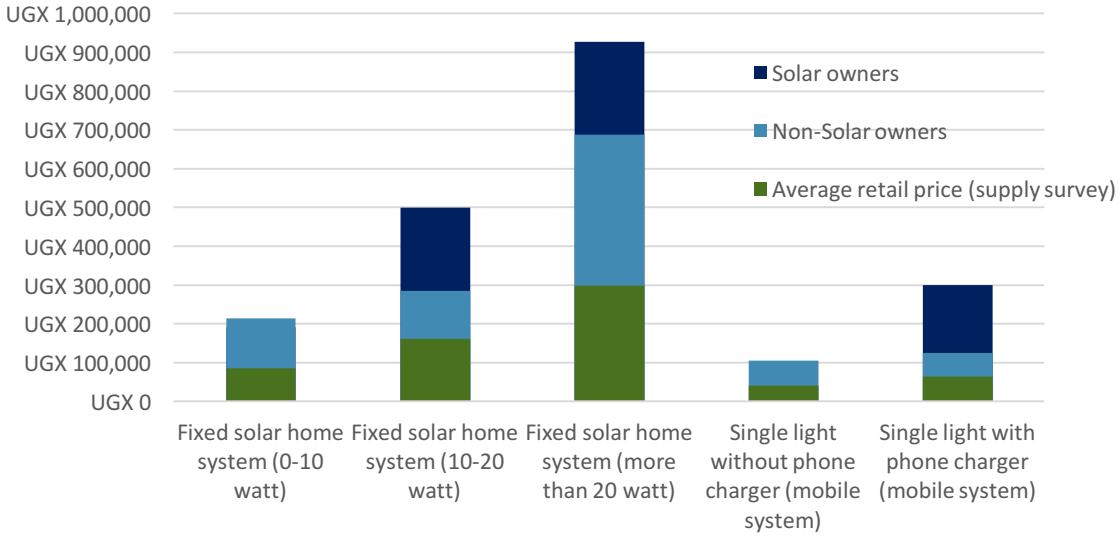
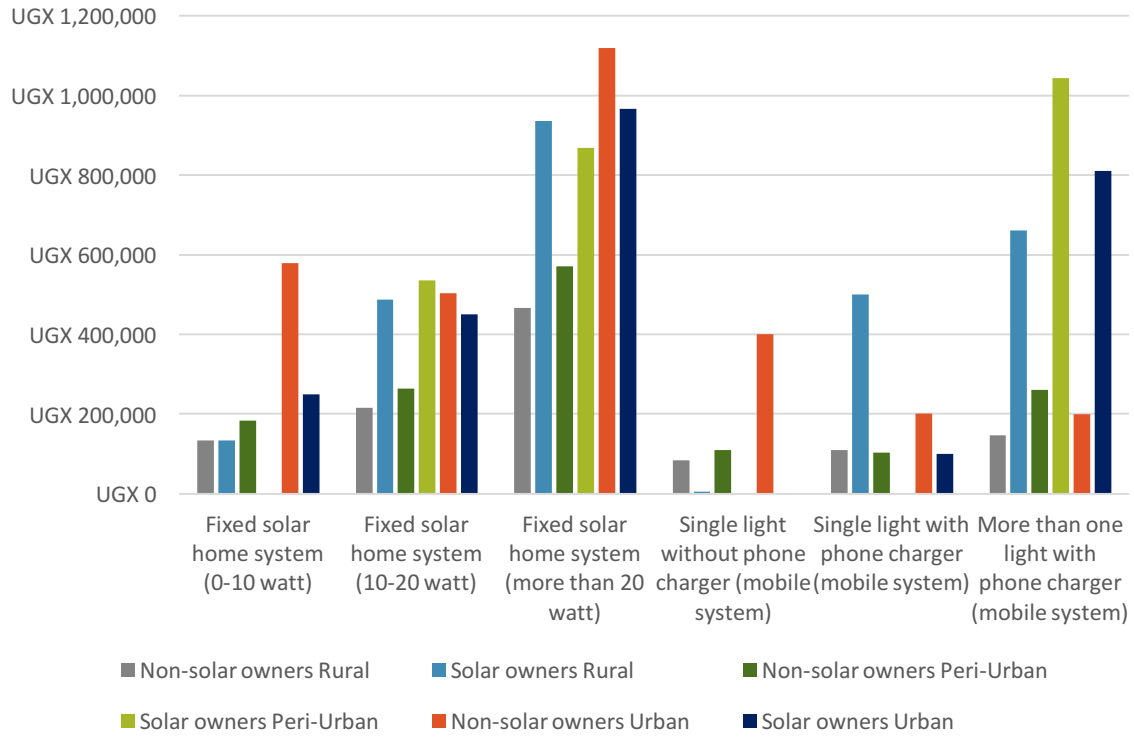
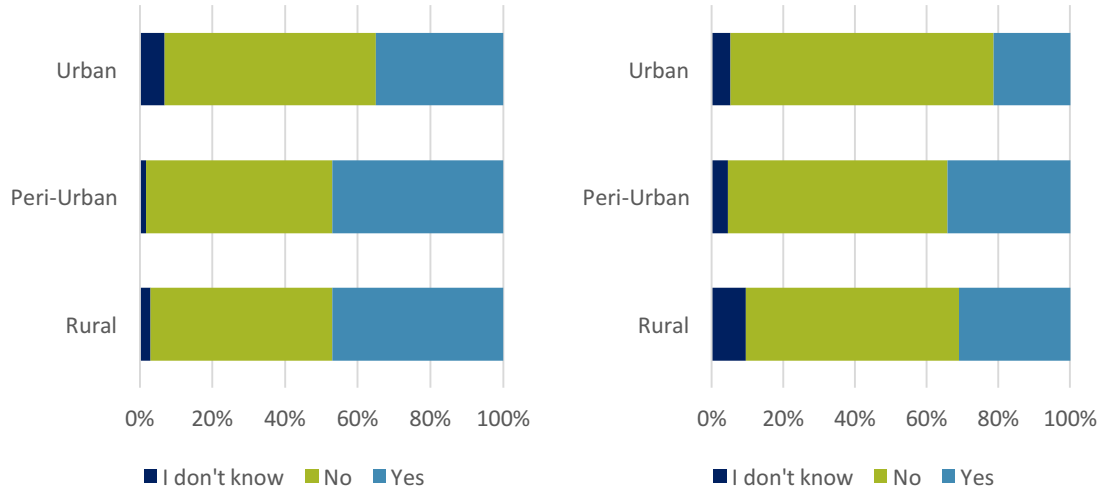


Figure 44: Question 51 and Question 54: 'How much would you be willing to pay for the chosen product? (non-solar-owners)



Forty-five percent of the non-solar-owning households indicated they would be more interested in buying solar if offered a loan, particularly in the urban areas. When asked the same question for a lease, only 30% showed interest.

Figure 45: Left: Question 56: 'Would you be (more) interested in buying solar products if you were able to take out a loan to finance the purchase?' Right: Question 57: 'Would you be (more) interested in solar products if you were able to rent or lease them?'



3.5.3 Ability to Pay

To determine the ability of households to pay for solar systems, the income levels and sources were examined in more detail. In Annex 6, the income distribution by main income source is presented. There is a clear breakdown within these market segments based on how households obtain their income and whether they do so through formal or informal employment.

Figure 46: Left: Breakdown source of income (Q58) by profession, and Right: district/ region.

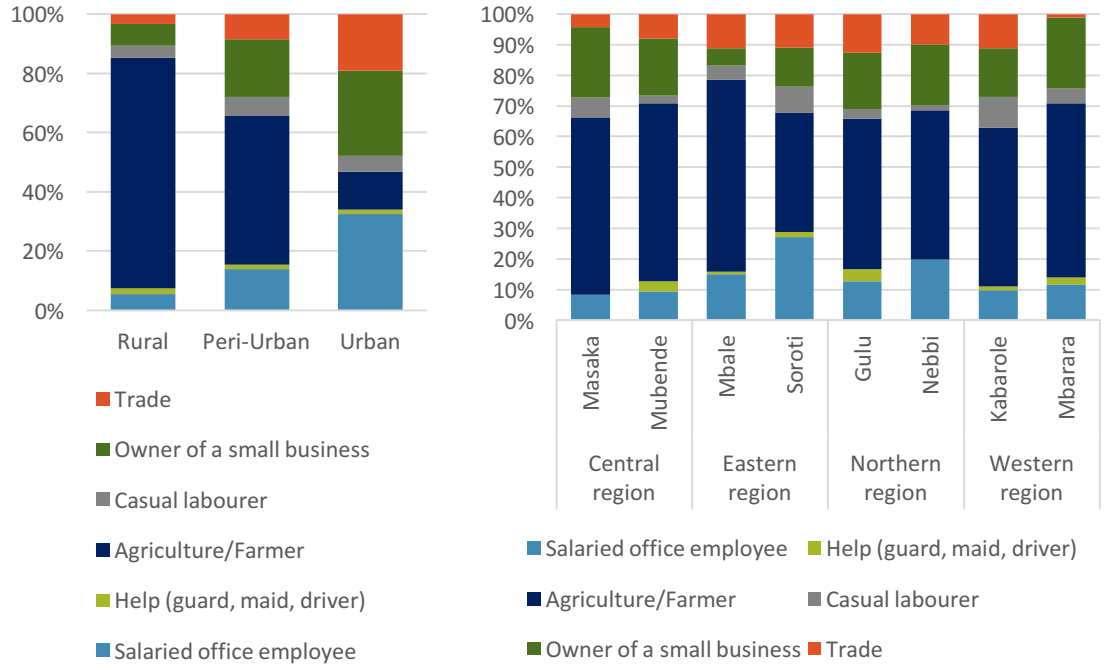
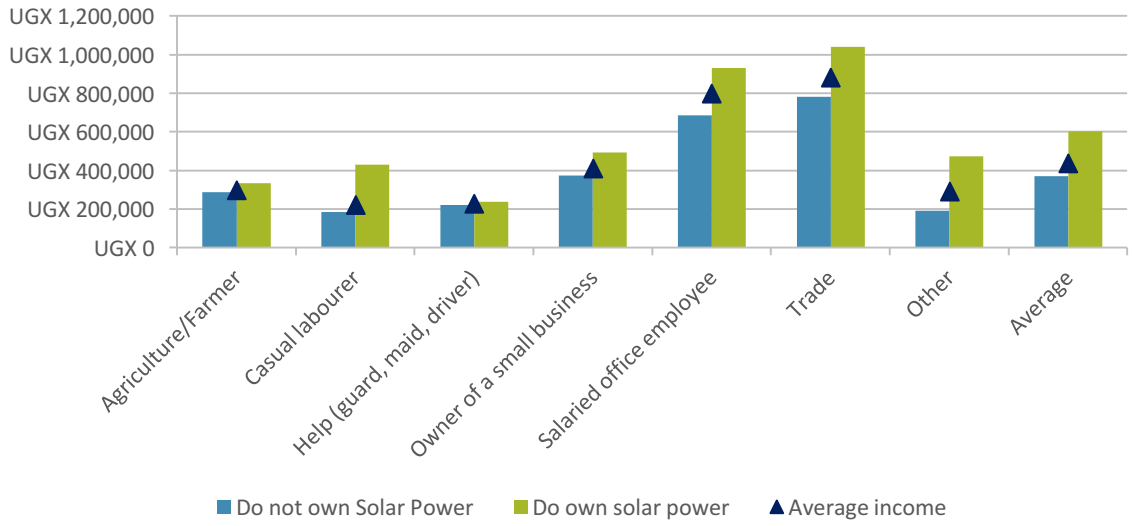
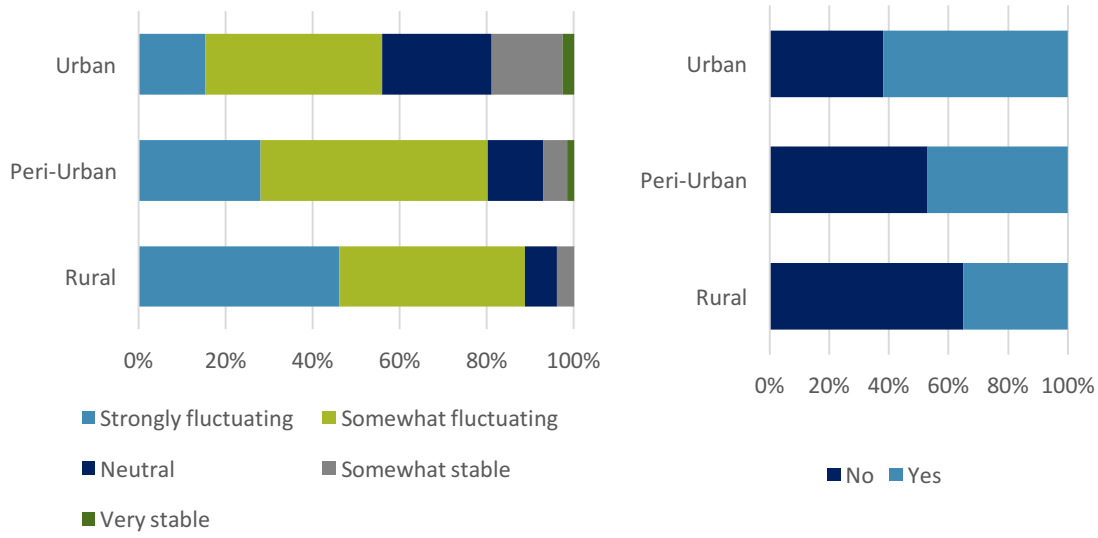


Figure 47. Monthly income by income source. Blue triangle = average income of solar power owners and non-solar power owners. (Data based on Question 55 and 56 sorted per main source of income)



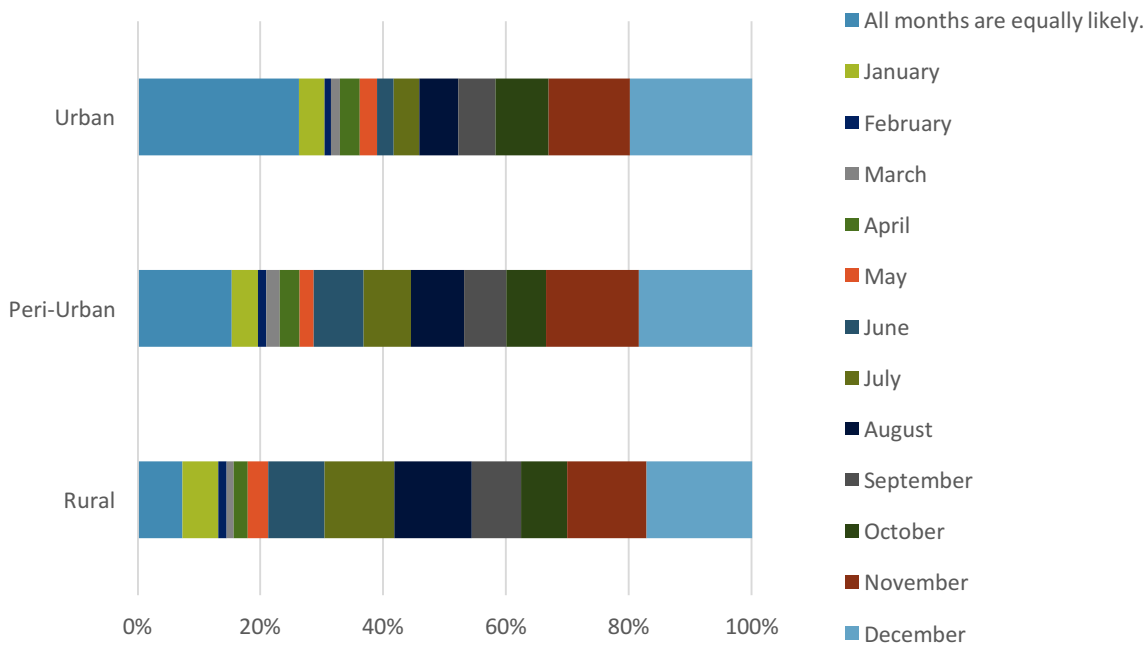
For off-grid rural households, agricultural cash crops are a key source of income. Respondents indicated that household incomes often fluctuate due to the seasonal nature of these livelihoods. In rural areas the majority of the households rely on one source of income, while in urban areas households generally have multiple income earners.

Figure 48: Left: Question 60: 'Does your household income have strong seasonal fluctuations?', and Right: Question 62: 'Are there multiple income earners in your household?'



The months in which rural households have most income are July/August and November/December, while urban households generally have relatively stable income in all months of the year.

Figure 49: Question 61: 'In which month(s) do you have most income?'



If households would invest in solar energy, the payback time would be between 6-12 months, depending on the size of the product (Table 5). This payback period is based on the expected cost savings resulting from current energy source, or fuel, being replaced by the solar product.

Table 5. Expenditure on traditional light sources and the average pay back time if households would invest in a solar powered alternative (exchange rate: US$1= UGX 2500)

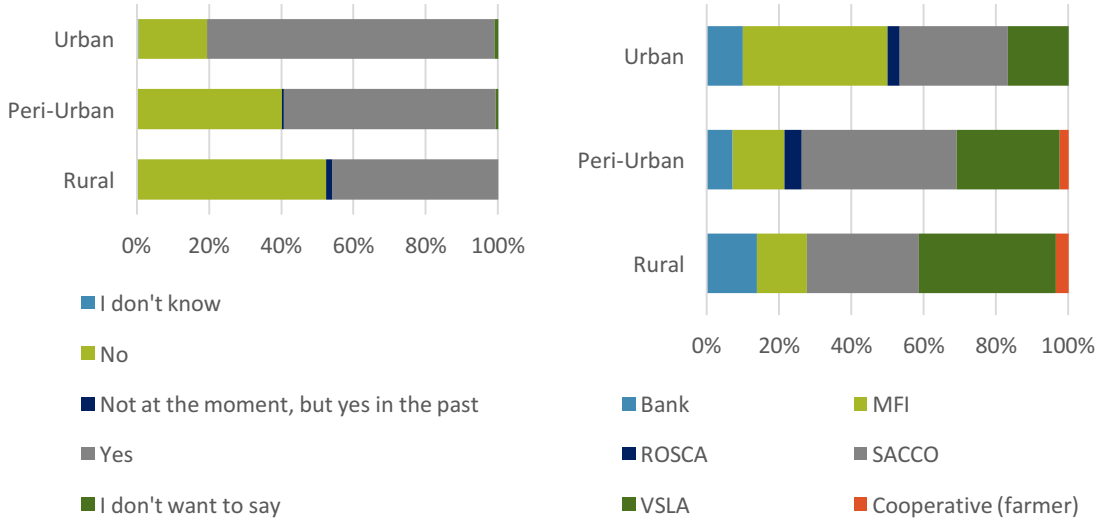
HH Energy (electricity) source	Purchase costs	Lifetime	Recurring costs (per week)	Yearly expenditure	Solar powered alternative	Average price of the alternative	Payback time
Candles	UGX 550 *(US$ 0.22)*	3 hours	UGX 1,800 *(US$ 0.72)*	UGX 94,000 *(US$ 37.44)*	Solar light	UGX 41,500 *(US$ 16.60)*	½ year
Tadooba	UGX 1000 *(US$ 0.40)*	6 months	UGX 1,900 *(US$ 0.76)*	UGX 100,000 *(US$ 39.52)*	Solar light, SHS	UGX 41,500 *(US$ 16.60)*	½ year
Device/ torch powered by dry cell batteries	varying	varying	UGX 1,760 *(US$ 0.71)*	UGX 91,500 *(US$ 36.92)*	Solar light, solar powered devices (radios), solar charger/ power bank	UGX 41,500 – UGX 64,500 *(US$ 16.60-25.80)*	½ - 1 year
Phone Charging	varying	1x per day – 1x per week	UGX 1,000 *(US$ 0.40)*	UGX 52,000 *(US$ 20.80)*	solar charger	UGX 64,500 *(US$ 25.80)*	½ - 1 year
National Grid	-	-	UGX 15,400 *(US$ 6.16)*	UGX 800,000 *(US$ 320.32)*	SHS		
Local Grid			UGX 17,250 *(US$ 6.90)*	UGX 900,000 *(US$ 358.80)*	SHS		

Note: Candles yearly expenditure calculation: UGX 500 purchase costs x average of 3.25 purchases per week x 52 weeks = UGX 94,000 (rounded), Tadooba calculation: UGX 1900 per week on kerosene x 52 weeks x 2 tadooba's per year average = UGX 100,000 (rounded).

Banking Relationships & Loans

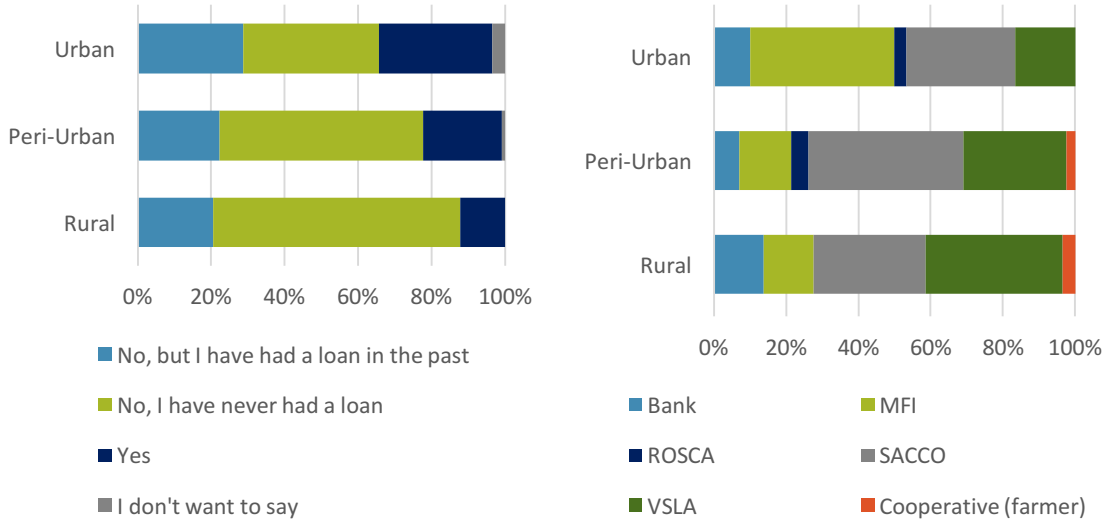
A large number of households already have a banking relationship, even in rural areas. In rural areas, the most households have an account or membership with a Village Saving and Loan Association (VSLA) or Savings and Credit Cooperative (SACCO) while in the urban areas, MFIs and SACCOs were most common.

Figure 50: Left: Question 64: 'Does anyone in the household have a banking relationship?' Right: Question 65: 'With which kind(s) of organizations is this account?'



At the same time, a limited number of households currently have an outstanding loan, particularly in the rural areas. The 12% to 34% of households that had a loan most often received them from SACCOs and VSLAs in rural areas, and from MFIs and SACCOs in urban areas.

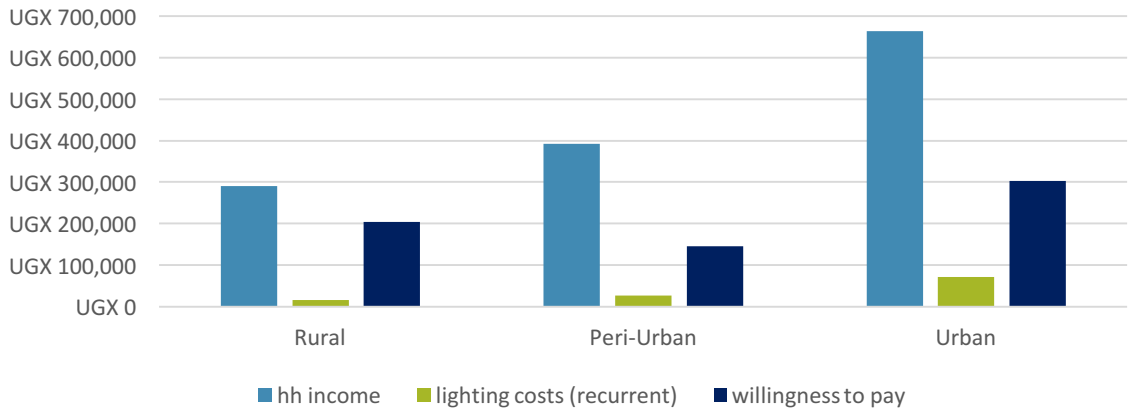
Figure 51: Question 66: 'Do you currently have an outstanding loan?'(left), Question 67: 'With which kind or organization was your loan with?'



3.5.4 Ability Versus Willingness to Pay

Rural households said they are willing to pay much more for the solar product (up to 70% of monthly household income), and are currently paying only 7.5% of what they are willing to pay per month on lighting costs. In peri-urban and urban areas the variance is less extreme, as the amount respondents were willing to pay ranged from 37% to 46% of the household budget.

Figure 52: Willingness versus ability (average monthly household income) to pay.



Households indicate they are willing to pay a substantial amount of their monthly income on a solar system. As seen in paragraph 3.4 most of their income is already spent on school fees, food and housing and in most cases they would not be able to spend the indicated amount all at once.

To study ability to pay, a comparison was made between how much people are currently spending on lighting and phone charging, and what the calculated payback time would be for their preferred system. The average payback time for the preferred system (in all cases a 'Large SHS') is 2.7, 3.6 and 3.2 years for urban, peri-urban and rural households, respectively. Note that because rural households spend more on phone charging than peri-urban, their payback time is shorter.

Table 6. Summary of household's ability and willingness to pay for solar products *

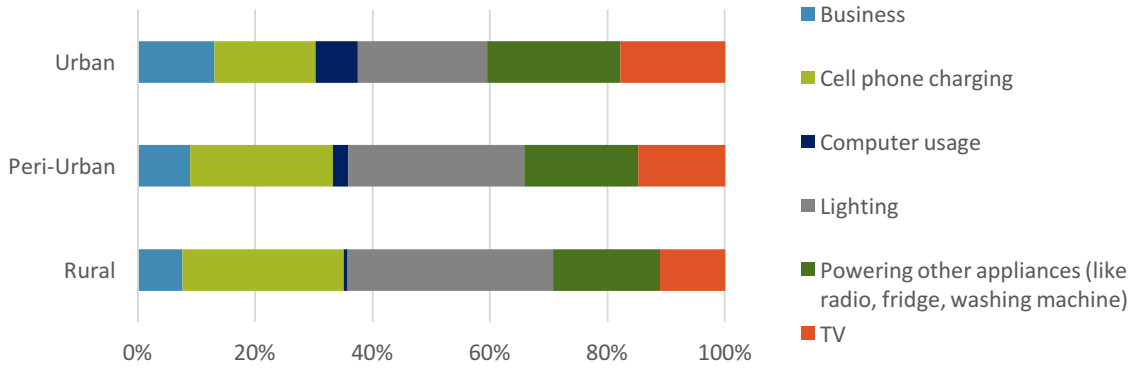
Area	Monthly household income	Income type	Months with most income	Monthly lighting spending	Monthly phone charging spending	Preferred system and average price	Avg. payback time for preferred system (based on lighting & mobile charge spending)*
Urban	UGX 664,308 *(US$ 265.72)*	Salaried officer/ small business owner/ trade	Year round	UGX 4.870 *(US$ 1.95)*	UGX 4.380 *(US$ 1.75)*	Large SHS UGX 300,000 *(US$ 120)*	2.7 years
Peri-urban	UGX 392,148 (*US$ 156.86)*	Agriculture /farmer / small business owner	Partly year round (26%) Partly Nov-Dec (16%)	UGX 3,550 (*US$ 1.42)*	UGX 3.425 *(US$ 1.37)*		3.6 years
Rural	UGX 290,150 (*US$ 116.06)*	Agriculture /farmer	Partly year round (15%) Partly Nov-Dec (17%)	UGX 3.420 (*US$ 1.37)*	UGX 4.400 *(US$ 1.76)*		3.2 years

**These results are based on quantitative analysis. However, it is worth noting that consumers often act differently from what could be expected from such a chart as this analysis does not take aspirational value into consideration. Aspiration often drives consumers to spend considerably more that their income would suggest.*

3.5.5 Willingness and Demand of Non-solar-owners

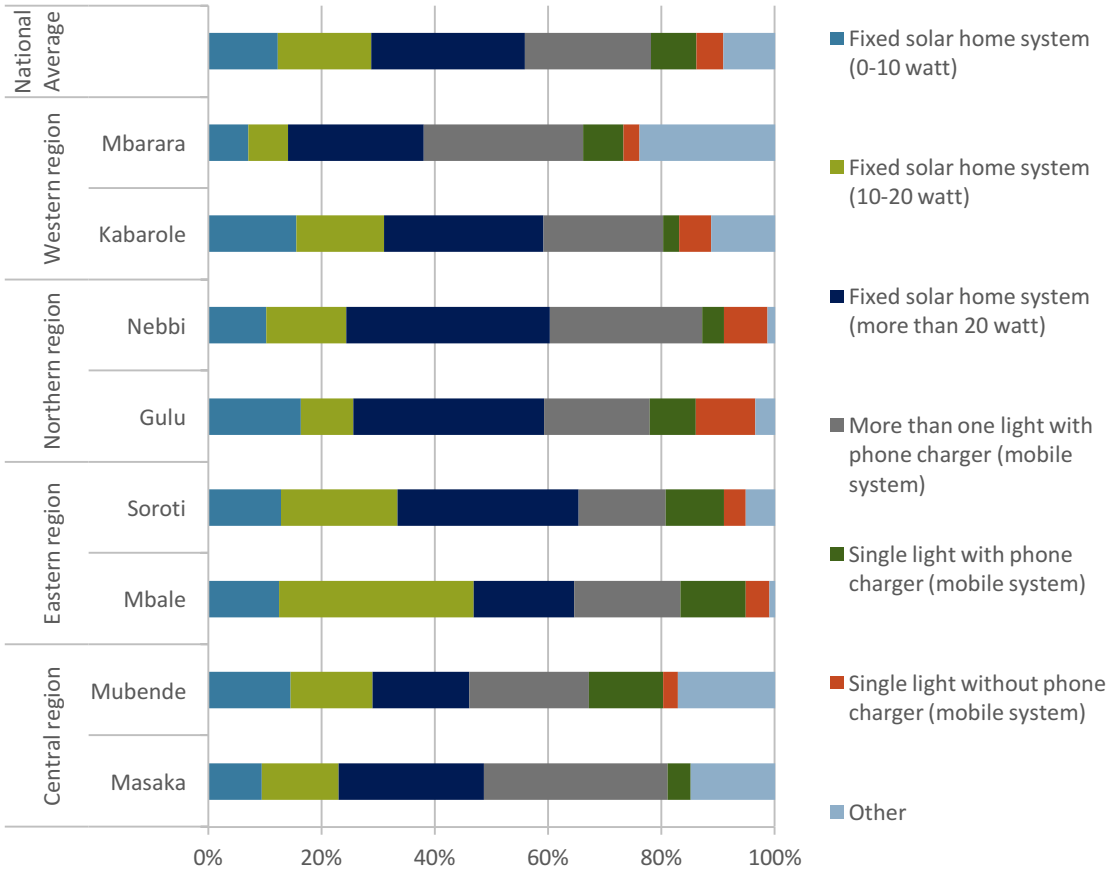
According to respondents, if households' access to energy sources were to increase in the future, the main uses of this additional power would be for charging mobile phones and lighting the home, particularly in rural and peri-urban areas. In urban areas, additional energy sources would largely be used in powering other appliances like a radio, refrigerator and washing machine.

Figure 53: Question 24: 'If you had greater access to energy, what other activities would you use the new energy for?'



The potential demand of households not owning a solar product is particularly high for the larger SHS (20 watts or more) and for the larger mobile systems (more than one light and phone charger), as illustrated in figure 55.

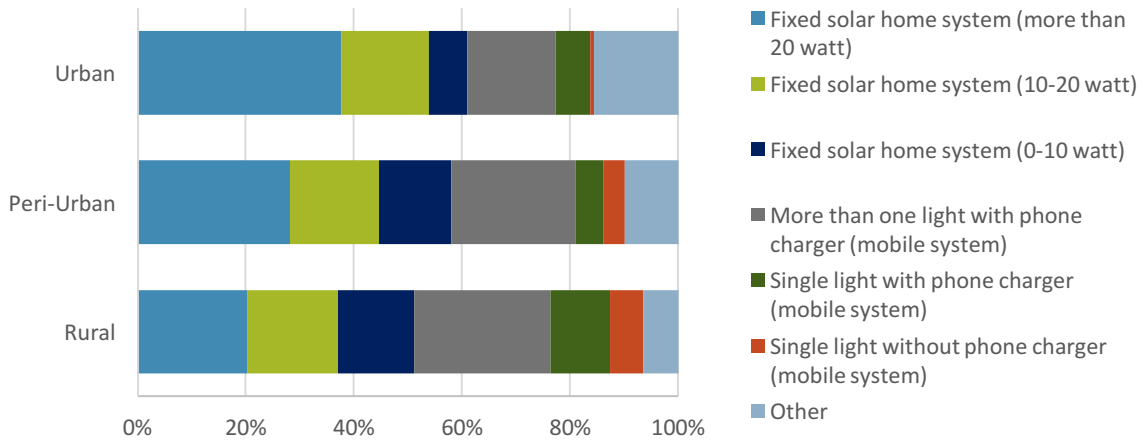
Figure 54: Question 53: 'Which type(s) of solar product(s) would you be willing to buy? by district.



There are some differences by district when it comes to demand for solar products by non-solar- owning households. In Mbale there is a clear demand for SHS of 10-20 watts capacity, while in the districts Soroti, Gulu and Nebbi the demand is much higher for SHS of more than 20 watts. Households in Masaka, Mbarara and Nebbi show a high demand for mobile systems with more than 1 light and a phone charger. The demand for the smaller mobile systems and smaller fixed systems is rather low (compared to the other systems) in all districts.

The demand for mobile systems (with more than one light and a phone charger) is highest in the rural areas, while the demand for fixed SHS (of more than 20 watts) is highest in the urban areas. For all regions, there seems to be a tendency to want larger solar products, whether it is for mobile or fixed systems.

Figure 55: Question 53: 'Which type(s) of solar product(s) would you be willing to buy?' by location.

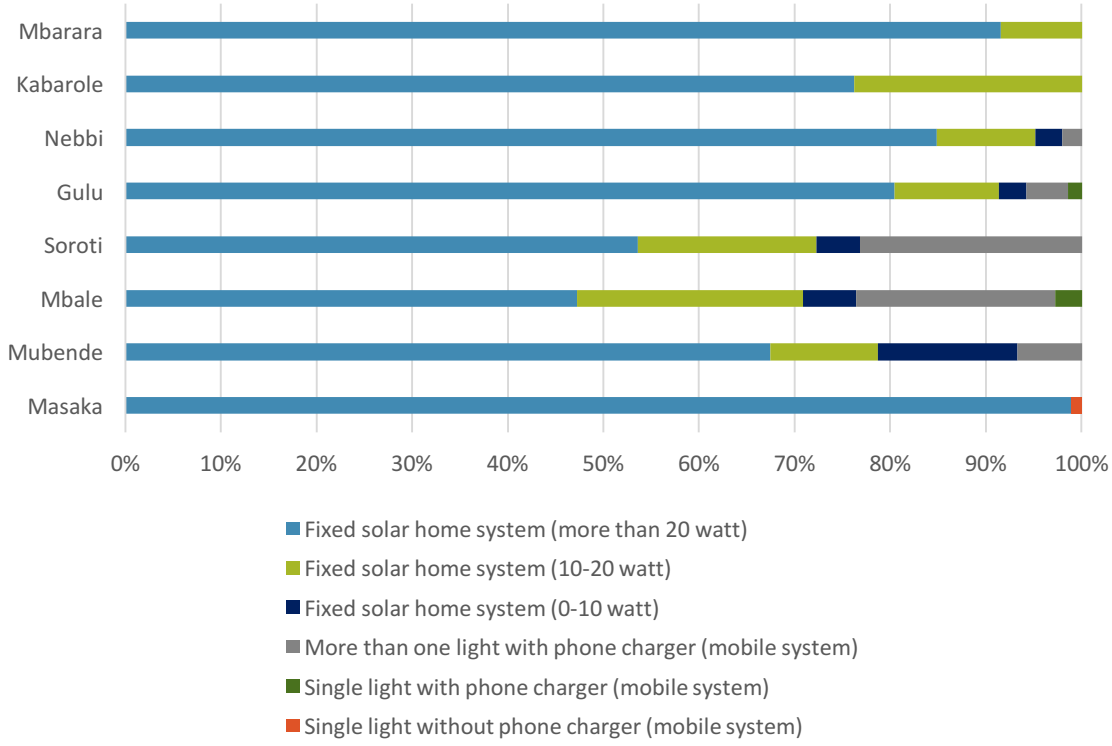


3.5.6 *Willingness and Demand of Solar Owners*

Of the households already owning a solar product, about 80% would be interested in buying another solar product. This is less relevant for households in the Western region, where between 28 – 36% of the households indicated no interest in owning another solar product, even though satisfaction levels with existing products in the Western region are not particularly low.

Most households that own a solar product indicate desire for larger systems. The demand for smaller mobile systems is almost non-existent in all districts.

Figure 56: Question 50: 'What would you buy?'



3.6 CONSUMER SEGMENTATION

3.6.1 *Consumer Segmentation for Off-grid Lighting Products*

The survey showed that demand for off-grid lighting products can be segmented into 4 distinct consumer types: urban grid-connected, urban underserved, off-grid non-remote (peri-urban) and off-grid remote (rural). The main characteristics are based on the current lighting sources used and their costs, how households obtain their income, and whether they do so through formal or informal employment. In the table below, the urban segment has been split into grid-connected and underserved because of their clearly different characteristics (energy expenditure, income, dwelling type).

Table 7: Main characteristics of the identified customer segments

Consumer Segment	Description	Dwelling Type	Average Monthly Energy Spending (UGX)	Months with most income
Urban Based: Grid Connected	• Grid connected, • City based, • Formal employment	Brick, Wood, Fibro	UGX 36,862 *(US$ 14.74)*	Year round

Urban Based: Underserved (Off-Grid)	• Using basic lighting sources (like kerosene, fire and candles), • Settlement based, • Informal urban employment	Metal Sheets, Tin	UGX 12,806 *(US$ 5.12)*	Partly year round (26%) Partly Nov-Dec (16%)
Off-Grid: Non-remote (peri-urban)	• Peri-urban, within 10km of provincial centres, • Farmers, • Formal employment & transportation	Wood, traditional bamboo	UGX 14,222 *(US$ 5.69)*	Partly year round (15%) Partly Nov-Dec (17%)
Off-Grid: Remote (rural)	• Remote rural locations, • Subsistence farmers	Traditional bamboo, mud	UGX 18,431 *(US$ 7.37)*	July-Aug (12%) and Nov-Dec (15%)

Sources of lighting currently used differ substantially among the different market segments. The more remote and poorer a household is, the more likely it is to rely on basic sources of energy such as kerosene, fire and candles for lighting the home. For off-grid households, agricultural cash crops are a key source of income. Because of the seasonal nature of these incomes, household incomes fluctuate. Urban grid-connected households spend more than twice as much on energy than other segments.

Market Characteristics by Customer Segment

All four market segments offer good prospects to manufacturers, distributors and retailers for increased uptake of off-grid lighting products, and specifically solar products. The table below highlights the type of products demanded, most appealing benefits and their uses by consumer segment. This information could guide a targeted approach to each consumer segment.

Table 8: Market segment characteristics

Consumer Segment	Unaware of solar/ Unaware of where to buy	Product of Likely Interest	Own mobile phone (per hh)	Purchasing Point	Need for financing (loan)	Most appealing benefits of off-grid lighting products	Likely use of product
Urban Based: grid Connected	21% / 9%	Larger SHS	40% owns 1, 60% owns 2 mobile phones	Electrical goods retailers, employer schemes	Medium	Cost savings (28%) & safety (14%)	Lighting & other appliances (e.g. fridge) & TV
Urban Based: Underserved (off-grid)	21% / 9%	SHS (20 watts)	40% owns 1, 60% owns 2 mobile phones	Urban based wholesalers and retail outlets	Medium	Cost savings (28%) & safety (14%)	Lighting & other appliances (e.g. fridge) & TV
Off-Grid: Non-remote	31% / 36%	SHS (20 watts), Mobile systems with more than 1 light & phone charger	60% owns 1, 32% owns 2 mobile phones	Urban based retail outlets, agricultural input retailers, trade stores	Medium	Cost savings (29%) & modern lifestyle/time savings (13%)	Lighting & phone charging
Off-Grid: Remote	45% / 53%	Mobile systems with more than 1 light & phone charger	83% owns 1 mobile phone	Agriculture supply chains, CSR initiatives and trade stores.	High	Cost savings (28%) & modern lifestyle/improvement health (15%)	Lighting & phone charging

3.7 CONCLUSIONS FROM THE DEMAND ANALYSIS

Off-grid Lighting Products

- Among the surveyed off-grid rural households, 56% use kerosene as their primary energy source for cooking and lighting. Kerosene lamps are used by 28% of the Ugandan households surveyed as the main home lighting source, followed by charcoal or wood fire (23%) and flashlights using dry cell batteries (15%). Nonetheless, 75% of households find kerosene lamps unreliable while 90% of households that own solar power consider it reliable.
- The average monthly cost of energy and fuel are not high at about 4.6% of household budget. Of this, 40% is spent on kerosene, with a smaller share going to diesel and petrol in urban areas. Travel times to purchase lighting products are no more than 30 minutes.

Solar Products

- Current installed base shows a higher share of fixed SHSs, which constitute 50% of all systems sold.
- Solar products are mainly used for lighting the house (33%), charging the phone at home (26% - particularly smaller mobile and fixed systems) and for children studying (20%). TV watching is particularly mentioned in connection with SHSs (12%).
- Fifty-five percent (55%) of the SHSs and 38% of the mobile systems are bought at electric/hardware shops. Especially in the Eastern region a significant number of households (29%) indicated they bought from a field agent.

Mobile Phones

- The majority of the Ugandan households own at least one mobile phone (86%), and charge their mobile phone by purchasing charging time outside the home (68%), spending on average UGX 1,000 (US$ 0.40) per week.

Quality Perception: Satisfaction and Working Systems

- Rural and peri-urban households expressed high levels of dissatisfaction towards the basic off-grid lighting sources currently used, 67 and 55%, respectively. Solar energy, on the other hand, is perceived as very reliable and trustworthy. Over 92% of solar power owners state that their product works well. Between 78- and 82% of solar owners would want to own more solar products, and 90% of all households interviewed say that solar power can be trusted. Hence, contrary to the perception of suppliers and other stakeholders in the market, households generally do not seem to experience solar quality issues.

Awareness, Willingness and Ability to Pay

- Although over 86% of the surveyed Ugandan households are aware of solar, 35% don't know where they can buy these products. Brand awareness is very low, especially in the Central and Western Regions. SolarNow was most often mentioned (23%), especially in the Eastern Region and in Northern region, where 38% and 34% of households, respectively, have heard of that brand. The next most well-known brand, Ase Solar, was mentioned only by 7%. Approximately eighty-five percent of respondents couldn't name any brand at all.
- Households on average spend only 4.8% of their monthly income on energy/fuel. Main expenditures are food (18.5%) and school fees (38%). The main reasons indicated why households do not consider purchasing solar power are lack of money (51%) and other priorities (26%).
- Although households are very willing to pay for solar products, their ability to pay for the amounts mentioned is very limited. Rural households rely on income from agriculture which fluctuates significantly, and income is highest in July/August and November/December. Households in peri-urban and urban areas are in a far better position to pay for a solar product. Solar owners are willing to pay 28% more for a solar product than households that do not own a solar product. Forty-five percent (45%) of the non-solar owning households indicated they would be (more) interested in buying solar if provided a loan.
- Households currently spend on average UGX 6,000 (US$ 2.40) per week on lighting products and mobile phone charging. This expenditure can be a reference price point for Solar pay-as-you go/

payments and/or fee for service schemes. If households would invest in solar energy, the payback time (based on saved expenses from the replaced fuel) would be between 6 and 12 months for a small system that complies with their need. For a large SHS system the payback would be between 2.7 – 3.6 years.

Demand Drivers

- The most appealing benefit of off-grid lighting products for Ugandan households (without a solar product) is primarily cost savings, followed by improvement in health, modern lifestyle and greater safety/reduced fire hazard. At the same time, lack of funds are an obstacle to purchasing a solar product.
- Households generally do not know how to determine the quality of a solar product. Those that do consider the product warranty as a key indicator.
- Confidence in solar products is strongly driven by warranty, UNBS mark or government recommendation. This is particularly so in the Northern and Eastern regions.
- Offering incentives to promote solar products promote solar products (promotion by word of mouth, for instance to neighbours and relatives) is seen as a large demand driver to buy solar. Eighty-one percent of the households would be willing to promote solar when offered an incentive.

Effective Demand

- The average payback time for the preferred system (in all cases a 'Large SHS') is 2.7, 3.6 and 3.2 years for urban, peri-urban, and rural households, respectively. If the household's access to off-grid lighting sources were to increase in the future, the main uses would be for charging mobile phones and lighting the home, particularly in rural and peri-urban areas.
- In urban areas, additional energy sources would also be used to power other appliances like radio, refrigerator and washing machines.
- The potential demand of households currently not owning a solar product is particularly for the larger SHS (20 watts or more) and the larger mobile systems (more than 1 light and phone charger).

Table 9. Main challenge identified from demand analysis

Main challenges identified	Findings
Product, Quality, marketing – challenges limiting the market pull	
(Lack of) Product awareness; ability to make an informed decision; marketing.	Mainly suppliers and donors/ NGOs mentioned lack of awareness as a challenge. However, the demand survey shows that over 85% of households know what solar Is, awareness in the Northern and Eastern regions and in rural areas is on average lower. Retailers perceive awareness to be lower. Over half of the rural population doesn't know where to buy solar products. Solar awareness might not be the major challenge as perceived by those mentioning it.
Quality issues; reputation of solar products; having a bad name; lack of confidence in solar products	Households using solar find their product reliable and are predominantly extremely satisfied with it (74%), in contract to kerosene, dry battery torch, and candle users who are generally unsatisfied with their current lighting source. Ninety percent trust solar products and three quarters see solar as the introduction to a modern household. People are receptive to warranty certificates, and also government recommendation and the UNBS sign when buying products.
Perceived high cost of solar systems, and high expenditure on costs other than energy (including school tuitions); other priorities	Households spend less on energy than expected. The average household spends less than 2% of their disposable income on kerosene, therefore energy cost doesn't seem to be their main concern. Households spend on average 38% of their disposable income on school fees. Hence, energy costs are not perceived as being high, so investing in solar systems doesn't have a clear financial return and are, thus, a challenge for the industry.

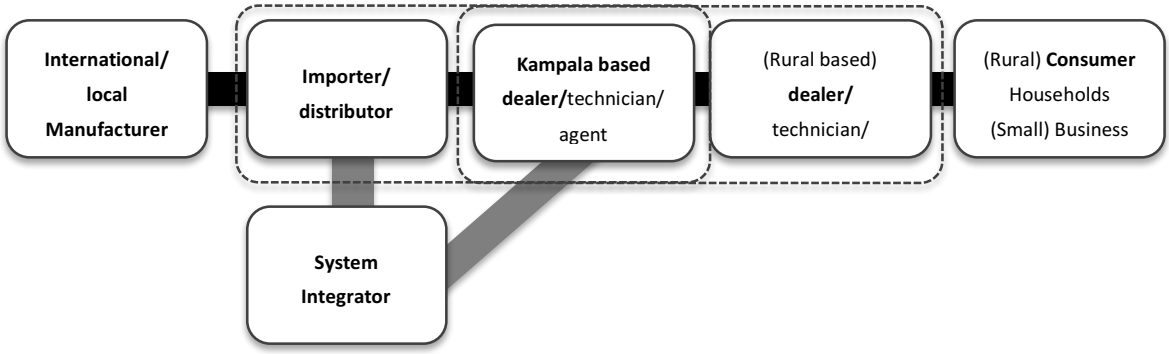
4 SUPPLY ANALYSIS OFF-GRID LIGHTING

Information in this section was gathered through interviews conducted with importers, and through the supply survey of 101 retailers in the whole of Uganda.

4.1 SUPPLY CHAIN ACTORS AND PRODUCTS ON THE MARKET

Uganda, like other East African countries, is struggling to meet existing energy demand with 80%-90% of the population not connected to the grid. While significant efforts are underway to add additional generation capacity and to extend the grid, the majority of the low-income households will still need alternative sources of energy due to the cost of grid power or the respective governments finding it too costly to extend the grid. The current supply chain of off-grid products in Uganda can be visually mapped in the following manner:

Figure 57. General representation of Ugandan off-grid lighting product supply chain.



- **International/local manufacturer:** The manufacturer develops the products, and can be either a local manufacturer (for instance for tadooba and candles) or an international manufacturer, which is the case for solar products and generators.
- **Importer/distributor**: If products are manufactured abroad, the importer imports the products and further distributes them in-country. When products are manufactured in-country, this supply chain actor merely serves as a product distributor.
- **System Integrator:** System integrators are the experts who assemble the solar system components before installing. This actor is not always part of the supply chain, depending on the technical expertise of the importer/distributers.
- **Kampala-based dealer/technical/agent:** The Kampala-based retailers are shops that buy their products from the importers/distributors (or sometimes import themselves) and sell these products to rural based retailers. These Kampala-based retailers are not always part of the supply chain, as there are instances where the importer/distributor supplies directly to the rural based retailers.
- **(Rural based) dealer/technician/franchise agent:** This rural retailer is generally the last link in the supply chain and supplies the off-grid lighting product directly to the end consumer.

The companies discussed in the following section are either importers/distributors, system integrators or rural-based retailers.

4.1.1 Importers & Distributors

There are quite a number of (an estimated 25 companies) importers and distributors active in the Ugandan off-grid lighting market. These importers and distributors are generally small and medium sized enterprises (SMEs) that have been active in the Ugandan off-grid lighting market since 2008 (a couple before 2008). The majority of these SMEs are based in Kampala and generally operate from here. Some have branches (1 or 2) in other areas in the country, and are mainly represented in those areas where population density is highest (including Mbarara, Mbale, Masaka, Arua, Lira). The Eastern Region is slightly under represented.

The companies import and distribute a variety of different types and sizes of solar products, ranging from small plug and play systems (with a single light) to large solar home systems (of more than 20 watt). These products are generally sold to retailers, agents/dealers and households. On average, the total sales of each company is 5,000 units per month (including both mobile and fixed systems) at an average price of UGX 152,000 (US$ 60.80) per unit. A variation of approaches is used in promoting, marketing and distributing their products to their target market, generally involving additional distributors (agents, retailers, financial institutions) before reaching the end users.

Interviews were conducted with a preselected number of importers/distributors that trade in mobile solar systems, SHS, or both. A selection of key importers in the Ugandan market was made based on their longevity in the industry (including both a mix of new entrants and established companies) and current activities in the development of the solar market. This section provides an overview of some of the main importer's characteristics and their products in the Ugandan market.

- ***Barefoot Power Uganda Ltd.:*** Barefoot Power Uganda Ltd is a subsidiary of Barefoot Power Global and registered in Uganda in 2008. The company works to improve community livelihood through the distribution of affordable small solar lighting and phone charging solutions for people at the bottom of the economic pyramid (BOP) all over Uganda.
- ***SolarNow:*** SolarNow evolved from being an NGO in the early 2000's to a fully-fledged commercial business in 2009. An important trend recognized by the company's agents is that BoP customers are moving away from purchasing lanterns to fully wired systems to improve their quality of life. The company currently offers 21 solar PV products from very small (Start Pack) up to much larger systems that are sold to a variety of customers including households and SMEs.
- ***Girasolar East Africa Ltd:*** Girasolar was founded in 2009. The company is an importer and system integrator of solar PV systems. The company imports various solar PV system components including solar modules; batteries; charge controllers; inverters and lights. It also imports a few pico solar PV systems (Fosera) from Germany.
- ***Small Solutions Ltd:*** Small Solutions Ltd started in 2009 as an NGO that provided business development technical support to solar PV entrepreneurs but transformed slowly into a social business in 2010. The company started out using D.light lanterns but now sells two Green Planet brands, the Sun King Lamp and the Sun King Pro. These lanterns are designed in the USA and manufactured in China.
- ***BBOXX:*** Bboxx was established in 2010 and designs, manufactures, distributes and finances innovative plug & play solar systems to improve access to energy across Africa and the developing world. BBOXX engineers products in its London lab, and manufactures them in its factory in China. BBOXX distributes to partners in 14 countries and 30 local subsidiary sales shops in Kenya, Rwanda, Sierra Leone and Uganda where several kits are sold to customers.
- ***AB Matra:*** AB Matra's solar division started operations in 2010 based in Kampala with branches in Jinja, Mbale and Lira. The company trades in quality power generation, agricultural and construction materials. AB Matra specializes in the procurement and sale of imported solar power systems, backup inverters and agricultural as well as construction materials (including chemicals).
- ***UltraTec:*** UltraTec is a local private company that was established in 1999 to serve the needs of the growing energy and telecommunications sectors by supplying products and services. UltraTec's products fall into four categories: renewable energy, lightning & power surge protection, telecommunications and lighting Products. UltraTec is the main distributor of D.light solar products in Uganda.

- ***Trans African Supply Services (TASS):*** Founded in 2002, TASS is a leading solar PV company in Uganda operating in the fields of communication, power, renewable energy & environment, health, education, and science as well as the transport and industrial sectors. TASS sells solar products that range from core solar products to accessories, i.e. solar panels, inverters, batteries, cables, regulators, bulbs, switches, ducts, rooftop and ground arrays.
- ***FRES Uganda:*** FRES Uganda, a subsidiary of FRES International, was officially established in April 2010, and became fully operational in January 2012. FRES Uganda has its head office in Mbarara, and focuses on the Western Uganda districts of Mbarara, Bushenyi, Mpigi, Isingiro and Rukungiri. FRES offers several system categories dependent on the number of lights and watt hours required.
- ***Azuri:*** Azuri serves off-grid electricity consumers in Africa and started operations in Uganda in 2013. Azuri develops, manufactures and distributes Indigo, a 2-light and mobile phone charging system. Indigo customers pay a small amount to get started, and then purchase weekly scratch cards, which provide eight hours per day of light in addition to mobile phone charging. A Swiss-based company manufactures the solar units under contract at two assembly sites in China. A large portion of the components are also sourced in China.

The following tables summarize the main characteristics of the interviewees. The tables are split into mobile solar suppliers, SHS and mixed suppliers.

Table 10. Main characteristics of the interviewed Mobile system importers/ distributors.

Importer	Customer type	Product types (mobile)
Small solutions Ltd 	• MFIs • SACCOs • NGOs	• Sun King Lamp (700mw) • Sun KingPro (2,5W, lamp + phone charging)
Azuri 	• SMEs • BoP clients • Promotion though: distributors, SACCOs.	• Indigo solar PV system (2xlight system and phone charging)
UltraTec 	• Dealers • End users	• D-light (lamp) • D-light (lamp with phone charger)

Table 11. Main characteristics of SHS importers/distributors interviewed.

Importer	Customer type	Product types (fixed)
Solar Now	• Households • BoP customers • SMEs	• Start pack – 25W Power Pack – 50W LED Light Pack • DC LED TV/DVD • AC Pack
AB Mantra	• Retailers • Installers	• 2x light kit • 4x light kit • 2x light kit + 10x phone charging • Solar modules (wpk)
Trans African Supply Services	• Businesses • Government departments/ministries • Individual clients	Solar modules
FRES Uganda	• Households • businesses	• S1A (2x lights) • S1B (1 socket 25W) • S2A (3x lights) • S2B (2x lights and 1 socket 25W) • S3 (3x lights and 1 socket 62W)

Table 12. Main characteristics of the interviewed SHS and mobile importers/ distributors.

Importer	Customer type	Product types (mobile)	Product types (fixed)
Barefoot Power 	• Corporate customers • Financial institutions • NGOs • BoP customers/households • Schools/hospitals • Independent entrepreneurs/ technicians	Firefly (portable lamp)	Go (1/2 lamp, 2wpk-5wpk) Connect
Girasolar East Africa Ltd 	• SMEs (particularly in niche market	Pico solar (Fosera)	Solar PV systems (Victron Energy and Asantys)
BBOXX 	• Installers	• BB5 kit (7W, lamps + phones charging) no longer on the market • BB7 kit (15W, lamps + phones charging) • BB12 • BB17	

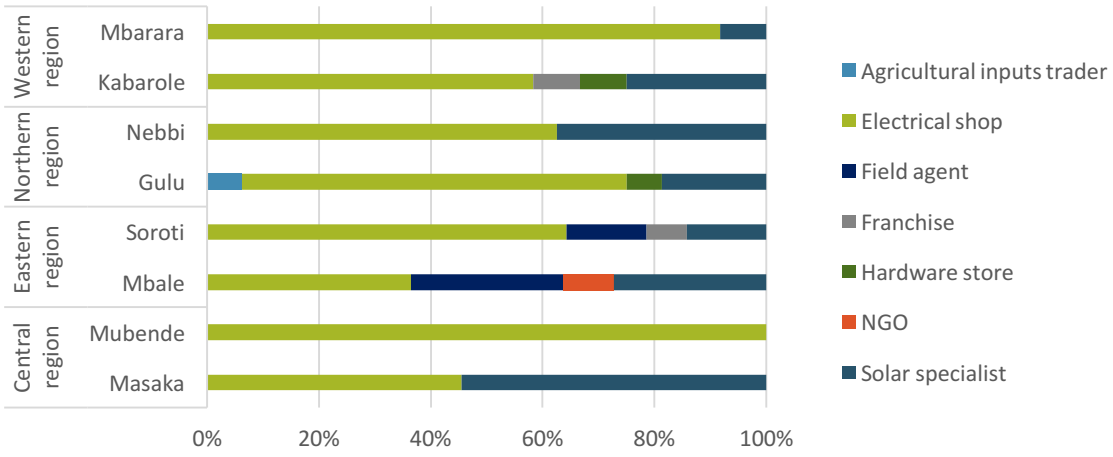
4.1.2 Retailers

The following section provides an overview of the main findings from the supply survey conducted among 101 retailers across Uganda.

Most retailers run an electrical shop

The retailers selling off-grid lighting products in Uganda are primarily electrical shops. Most are small and have less than 6 employees. In some districts, including Masaka (Central region) and Nebbi, (Northern region) there are a large number of solar specialists selling solar products. In the Eastern region, there are also many field agents selling solar products.

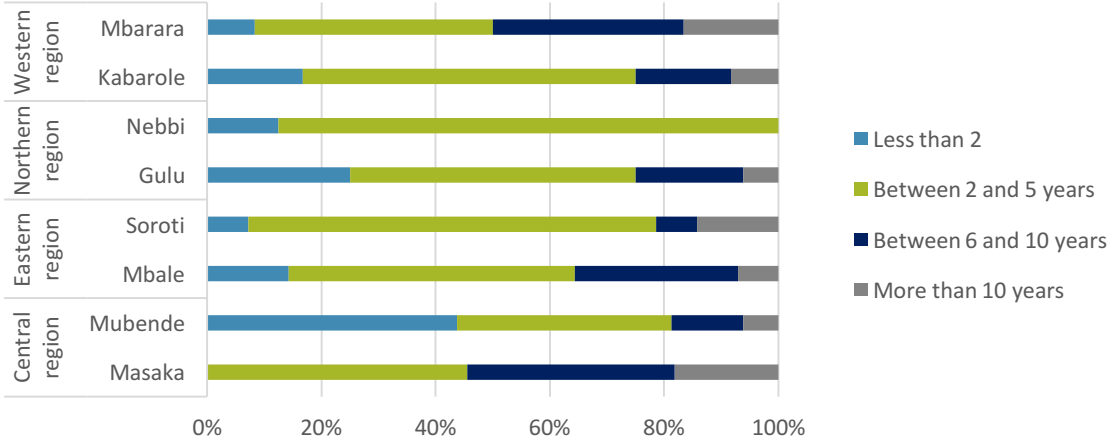
Figure 58: Question 4: 'Which organization best describes the business?'



Retailers are generally small and have existed for less than 5 years

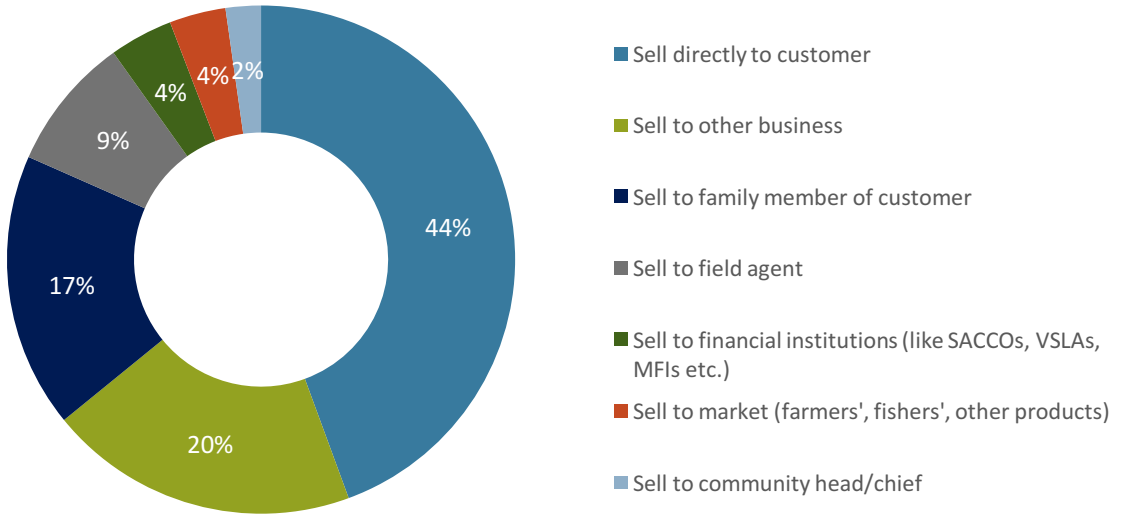
The retailers are generally small businesses with between 1 and 5 employees. The majority (57%) have at least 1 to 2 technicians on call. Over 50% of the retailers surveyed have been in business for just a short time, between 2 and 5 years.

Figure 59. Question S7: 'How many years have you been in business?'



The main customers of the retailers are individuals and households (66%). The least common customers are financial institutions, markets and community heads/chiefs.

Figure 60: Question S33: 'Who are your main customers?'



Of these customers, about 79% are from rural areas, and the retailers claimed overwhelmingly that the majority of their solar customers are male (95%).

Figure 61: Question S34: 'Where does your average solar customer live?' by district and region.

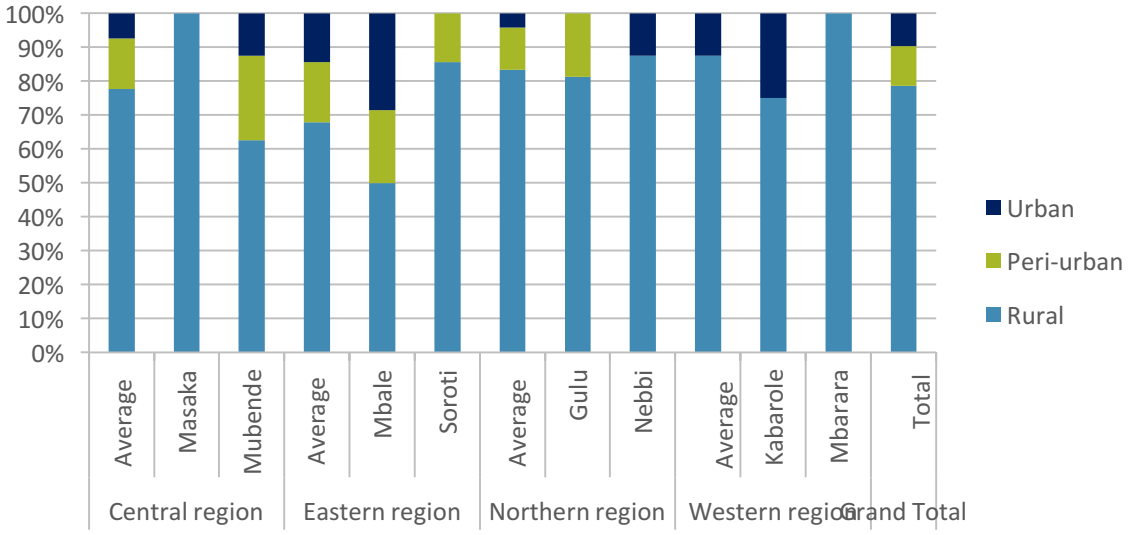
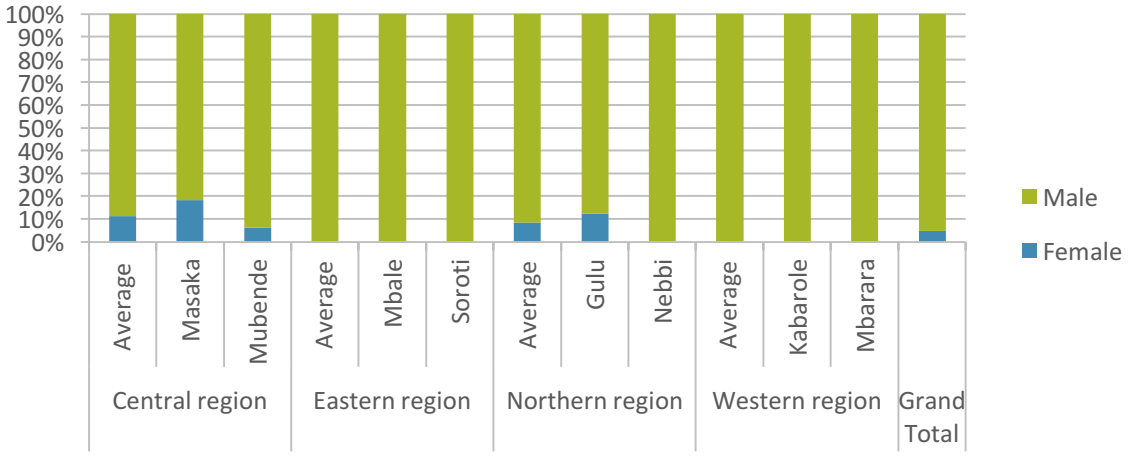


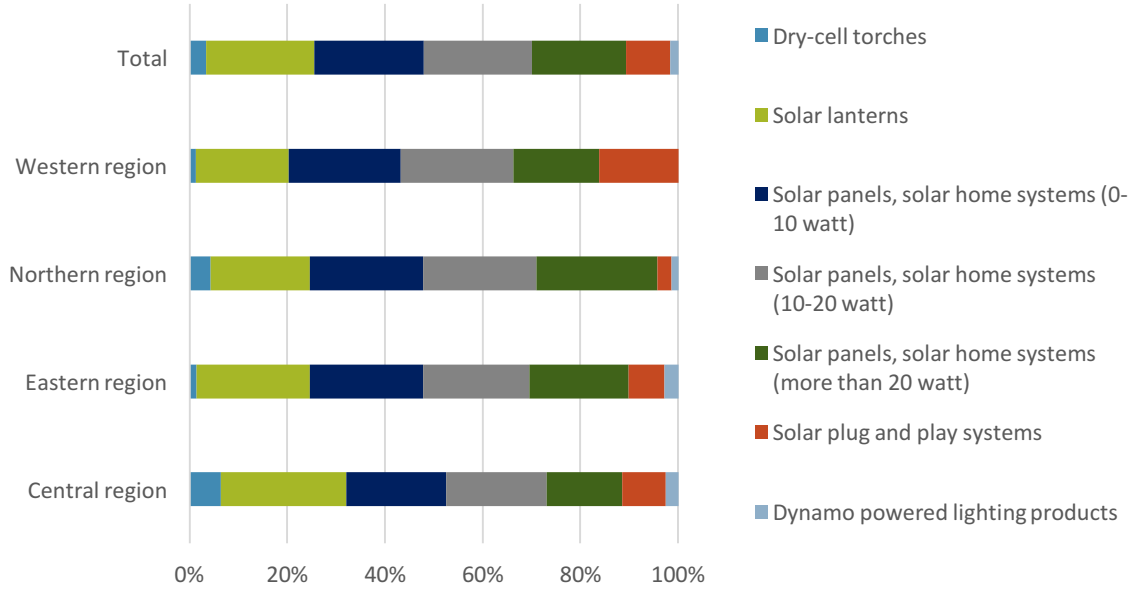
Figure 62: Question S35: 'What is the gender of your average solar client?' by district and region



Retailers in all 4 regions sell similar products but regional 'best sellers' differ

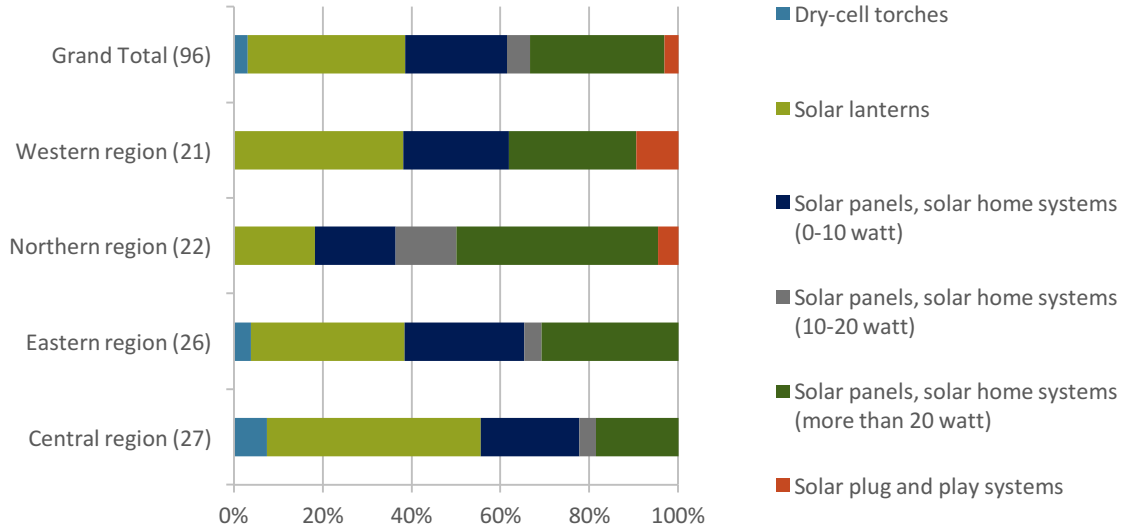
Retailers primarily sell solar lanterns (23%), 0-10W solar panels (22%) and 10-20W solar panels (22%). The figure below shows some regional differences in products sold; retailers in the Western region sell relatively more solar plug and play systems than in the other regions (16% vs. 9% average). About 13% of the retailers indicated they also sell solar chargers and batteries.

Figure 63: Question S10: 'What types of off-grid lighting products do you sell?'



When asked which products sold best in the previous month, some notable regional differences were evident: retailers in the Northern region indicated that SHS of more than 20 watts sold best (45%), while solar lantern systems sold well in the Central region (48%).

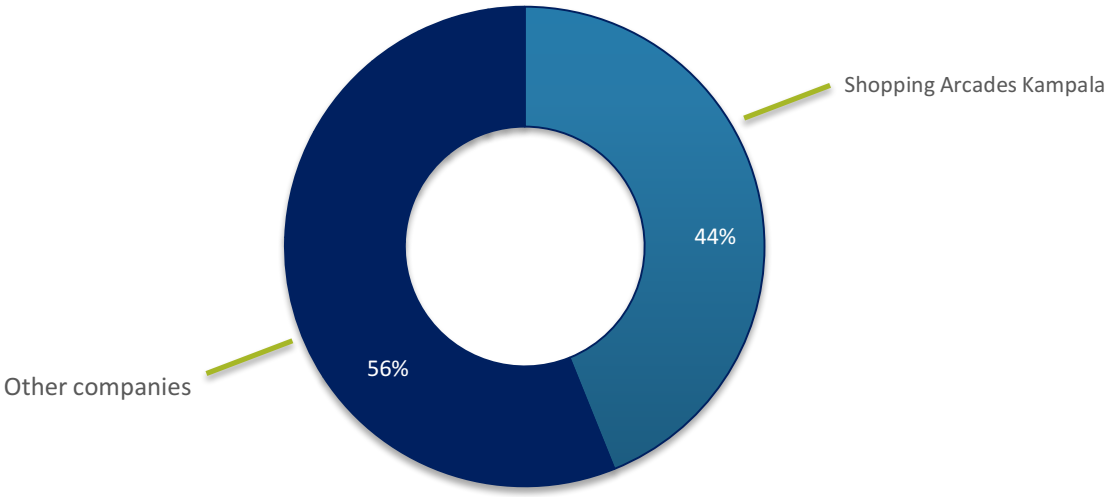
Figure 64: Question S20: 'Which product(s) sold best last month?' Products that sold best in April 2014 by district



Most retailers obtain their stock via the shopping arcades in Kampala

Close to 44% of all solar products were sold via the Kampala shopping arcades. Hence the supply chain generally has not one but at least two retailers, each requiring a profit margin.

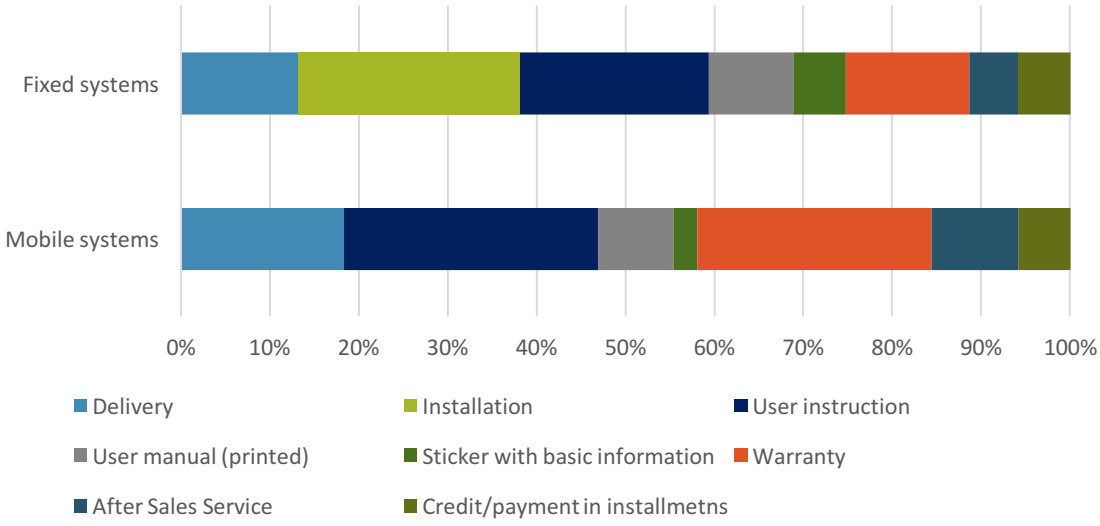
Figure 65: Question S8: 'From which suppliers do you currently get your products?'



Retailers' services might be better aligned with what customers find important

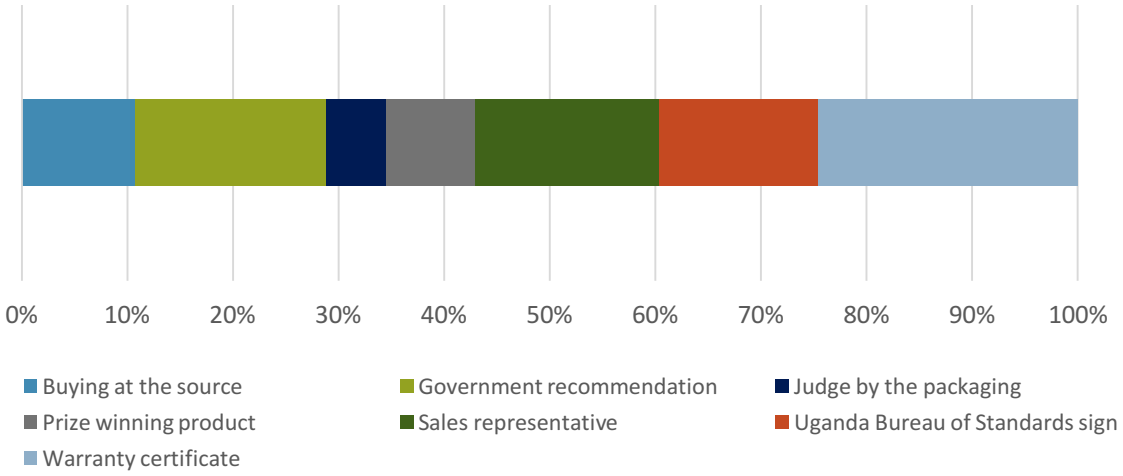
Main services provided by retailers are installation of systems; provision of user instructions; and in some cases, a warranty. After-sales services do not seem to be provided very often.

Figure 66: Question S21: 'Which of the below services do you offer?'



At the same time, respondents to the demand survey said they see warranty, contact with a sales representative and government recommendations as the main indicators of the quality of solar products. Retailers cannot influence government recommendations, but they can address the issue of warranties not being provided and/or followed up on and the direct contact through sales representatives.

Figure 67: Question 29: 'What convinces you of the quality of a solar product?'



4.2 DISTRIBUTION CHANNELS

Solar companies in Uganda use a variety of methods to promote, market and distribute their products. Setting up a distribution network is very expensive and most of the solar companies rely on (i) sales made at the head office through system integrators, or (ii) upcountry entrepreneurs who sell through their own small solar or electrical shops. These individuals act as de facto agents for a majority of the solar companies. They are independent, have little capital and stock, and rely on the goodwill of the client to pay a deposit for sales and installation, sometimes without even seeing the equipment they are buying.

4.2.1 Distribution Channels: Importers and Distributors

Based on the interviews with importers, four distinct distribution models were identified:

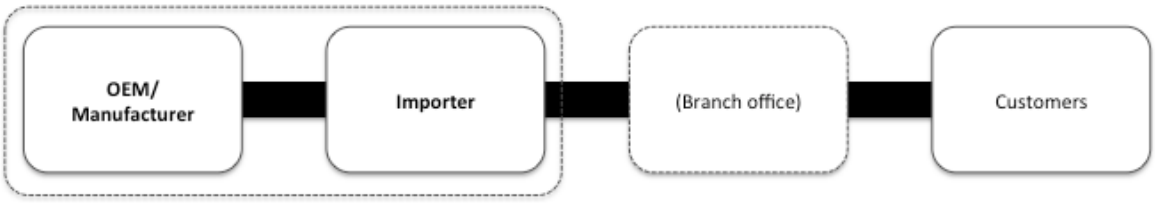
- Direct sales model
- Traditional distribution model
- Franchise/agent model
- MFI/ SACCO model

Most suppliers use a combination of distribution models, and sometimes even use all four. The main characteristics and challenges of each model are discussed below.

Direct Sales Model

Twenty-nine percent (29%) of the suppliers interviewed use the direct sales model. They approach end customers directly, including individuals, corporates, NGOs and financial institutions. Because of the direct relationship with end users, pay plans and credit schemes are often used in this model. The main challenge is that this model is communication- and thus resource-intensive, and therefore costly with limited reach.

Figure 68. Direct Sales model. Direct contact between seller and customer, sometimes through (local) branch offices.

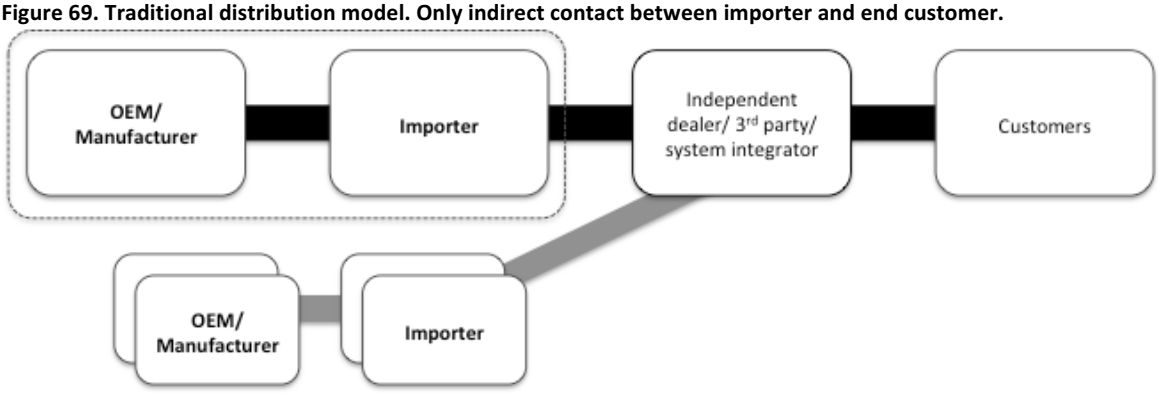


Traditional distribution model

The traditional distribution model is mainly used for larger SHSs. One third of the interviewees use this model for at least part of their operations, wherein the supplier/importer supplies independent third parties – either dealers, traders or system integrators. Only these third parties are in contact with the end user. The independent third party often procures products from other suppliers as well. These can be non-solar products required for the installation (e.g. batteries, inverters), or similar products from competitors.

Under this model, the importer has limited control over the end product and end price and is required to maintain intensive relations with all their off-takers or they run the risk of losing them to the competition. Providing after-sale services and warranties can be a challenge because the importer often doesn't have a local presence. Quality control can also be an issue as the importer doesn't control the work of the independent third party.

Figure 69. Traditional distribution model. Only indirect contact between importer and end customer.

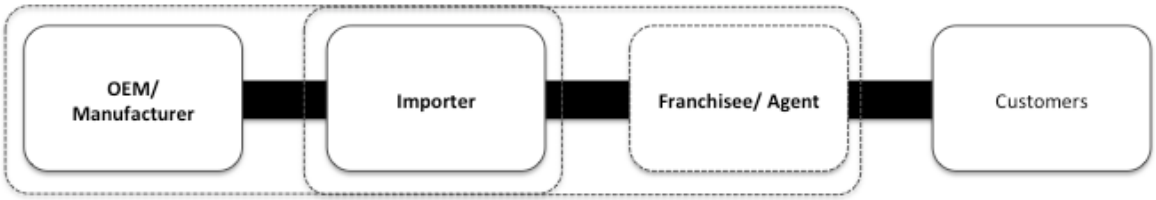


Franchise/agent model

The franchise/agent model is mainly used for smaller mobile and plug-and-play systems. Twenty-nine percent (29%) of importers interviewed said they use this model. Generally the agents/ franchisees are branded and work exclusively for the importer's brand. These agents are often micro-entrepreneurs. This model is often used in combination with a fee-for-service/pay-as-you-go scheme.

The main challenge identified was the rate of attrition of franchisees. In some instances, the importer could only retain 10-15% of trained micro-franchisees. The probable cause for the high attrition rates are the relatively low margins of 10% on the sales price that the agents/ franchisees receive. This model requires large amounts of working capital because the agents/ franchisees often need credit from the importer to hold stock and/or need to provide a form of credit to the customer. Another serious challenge is quality control. The public perceives the agents as representatives of the solar brand. Misconduct by the agent thus reflects on the brand perception.

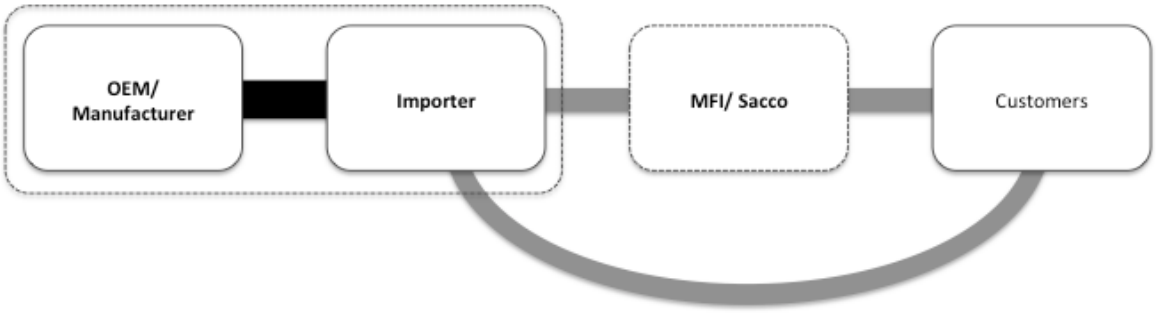
Figure 70: Franchise/agent distribution model



MFI/ SACCO model

Under this model, the importer sells via an MFI/SACCO or closely cooperates with them through joint promotion schemes. This model is relatively new and only 9% of the importers said they use this model type. The importers using the model claimed limited success, mainly due to the limited knowledge of solar products on the part of SACCOs and MFIs.

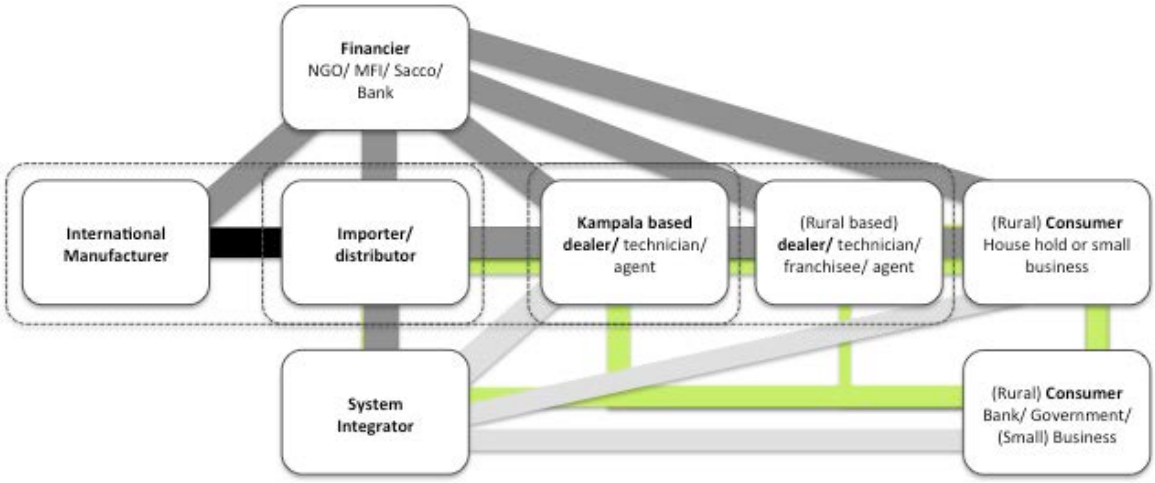
Figure 71. MFI/ SACCO model. Importer sells either via MFI/ SACCO or directly to end-users based on joint promotion schemes with MFIs/ SACCOs



Summary

Most importers use a combination of distribution models, while some importers use a distribution model that looks like the figure below. Importers supply solar products directly or indirectly through (a series of) dealers and / or a system integrator. Financiers can be involved in all phases of the supply chain.

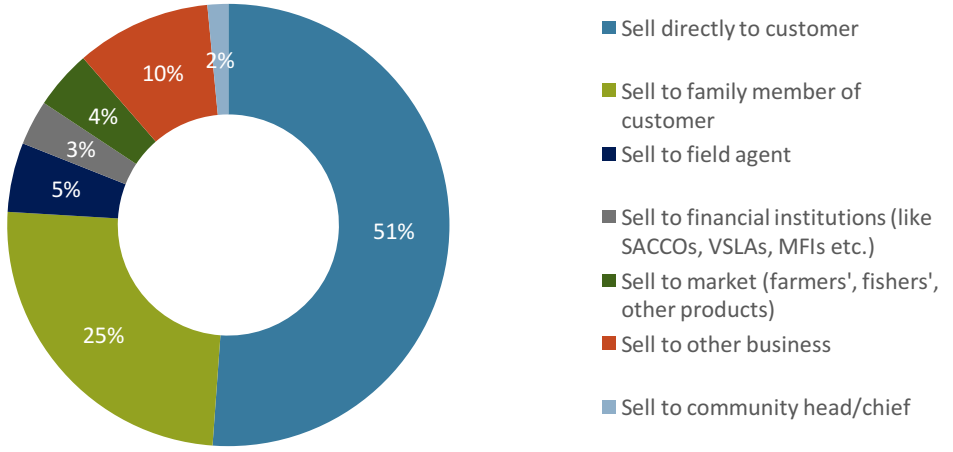
Figure 72. Combination of models.



4.2.2 Retailer Distribution Channels

The main distribution channels used by retailers in Uganda is selling directly to customers (51%) and selling to family members of customers (24%). These are also the channels that are perceived to work best (figure below). In addition, selling to other businesses has proven effective for retailers. Although selling to other businesses is mentioned as the second best distribution channel, by 20% of the retailers, only 10% of the retailers actually do it.

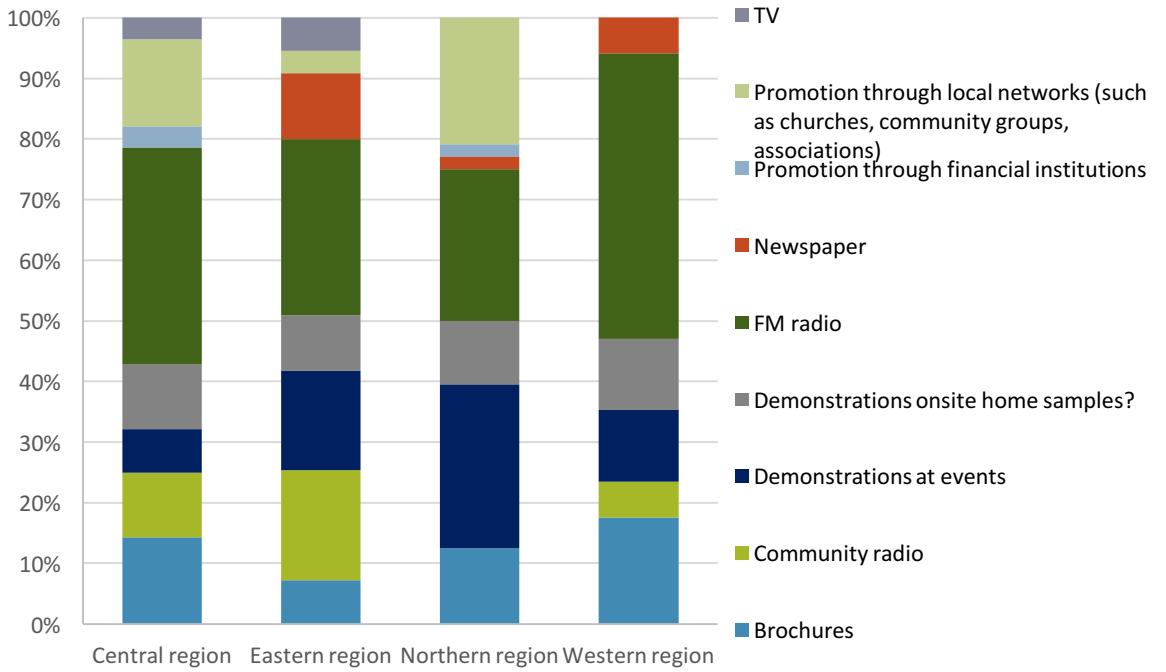
Figure 73: Question S22: 'What type of distribution channels does the business use?'



Main marketing strategy

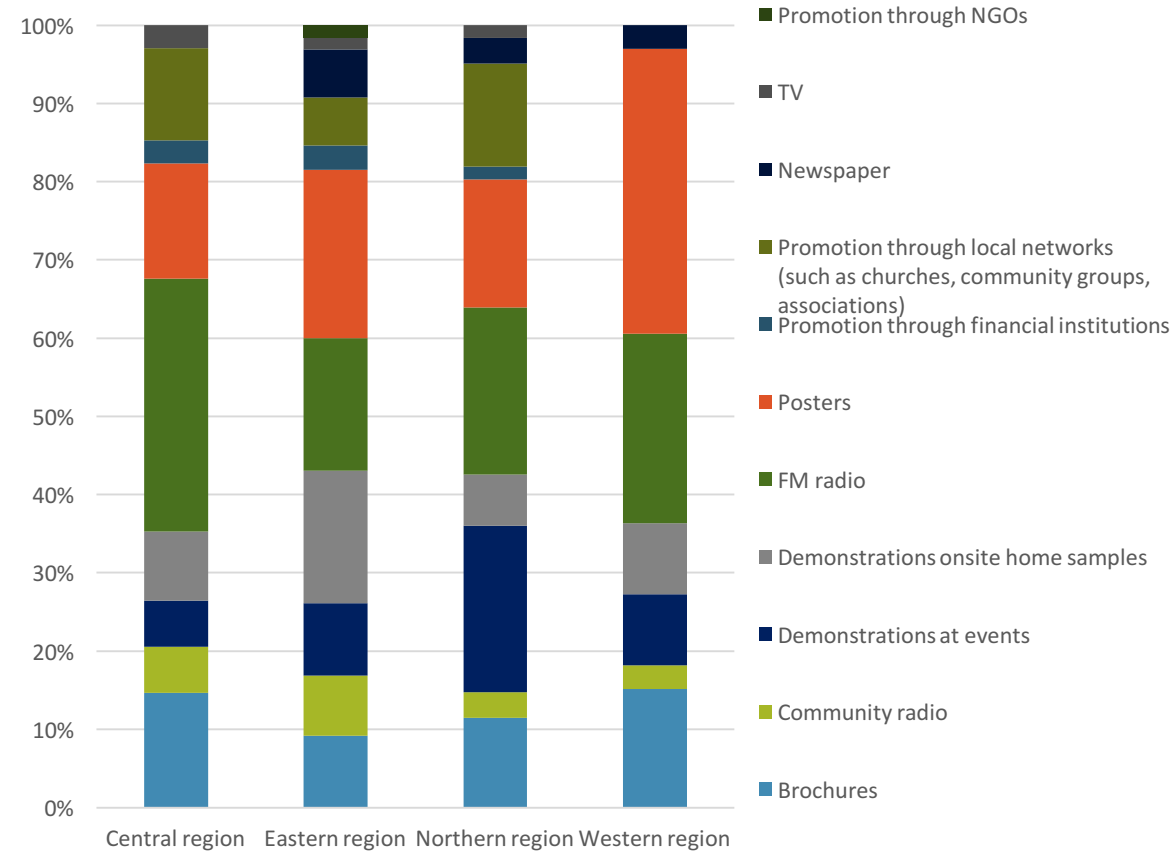
The main marketing strategies used by retailers in Uganda are posters and FM radio (see figure below).

Figure 74: Question S27: 'What kinds of marketing strategies does the business use?'



The largest number of respondents said FM radio is the marketing strategy that works best. Though posters are often used, they are not thought to be very effective.

Figure 75: Question S28: 'What kinds of marketing works best for the business?'



4.3 BARRIERS TO GROWTH

This section provides an overview of the main challenges that both importers/distributors and (rural based) retailers face in the off-grid lighting market.

4.3.1 Importers and Distributors

While Uganda's solar PV market shows great development potential, there are still massive barriers, both structural and fundamental, that need to be overcome before this potential demand can be translated into effective demand.

- **Lack of access to credit (both for fixed and mobile systems):** It is no coincidence that business models that promote a credit element for access to solar systems have been found to be quite successful in Uganda. This is mainly due to the cost at which solar systems have to be sold to make a business case for entrepreneurs. However, a business model incorporating credit comes with a caveat. The initial capital financing burden is with the supplier and the overall capital requirement increases as the rate of deployment grows. Some companies sell systems at 95% credit, leaving the company in a large cash deficit. Companies soon run out of working capital and are unable to import more stock. At over 20% interest, credit from financial institutions is expensive and unsupportable for most companies. Instead, they resort to a cash-based business which limits the sales. Generally low margins on sales, coupled with difficulties in accessing financial credit, makes it difficult for companies to grow.

- **Lower quality competing products:** Due to lack of import controls on solar PV products, a myriad of low quality brands are available in the market and are sold cheaply to the unsuspecting public. These lower quality products, both fixed and mobile, compete fiercely for market share with good quality products and in the end, do not meet expectations and erode the public's trust in solar products.
- **Low disposable income:** About 25% of Ugandans are living below the poverty line. This means there is generally low disposable income among the population. While it is a fact that rural populations are the most in need of solar PV systems, most rural households prioritize food, education and health over lighting in order to fit their needs into their limited budget.

- **Poor infrastructure and the cost of setting up a distribution network**: Setting up a distribution network is expensive. Solar companies have found it difficult to find reliable franchisees, and these must be trained on the job, which is quite costly given the poor infrastructure and transport to many areas. Agents in place in a local area are a key requirement for a continuous local presence to provide after-sales service and carry out promotions. Lack of wide distribution networks, especially in rural areas, impacts the ability to offer after-sales services and limits capacity to supply products when demand peaks.

- **Lack of interest of financial institutions in solar loan products:** Solar PV companies have struggled to convince financial institutions that they can make credible technical partners. A majority of MFIs and SACCOs are not interested in the provision of a solar loan product for either fixed or mobile systems. Out of the 40 that have been approached by SolarNow for example, only 2 have been interested enough to follow up and make some sales. On the other hand, MFIs and SACCOs have also not been able to convince solar PV companies they have the numbers that would merit additional investment in the regions served by the financial institutions. SACCOs found upcountry especially lacks adequate deposits to finance the large upfront costs of solar systems and loans. This could be one of the reasons the financial institutions are reluctant to engage in providing the solar loan product as part of their portfolio. In addition, service and maintenance is out of reach due to inadequate rural presence of solar PV equipment and service providers. Consumers continue to complain about lack of technical support on the ground, and this provides additional cause for financial institutions to be sceptical about the sustainability of a solar PV portfolio.

- **Theft of solar panels:** Theft of panels, especially fixed and SHS, has been reported on several occasions. This has scared off some potential customers, while causing loss of investment for others. There exists no standard insurance package for solar PV systems, and hence theft is a risk for both lenders and buyers.

4.3.2 Retailers

The main growth barriers perceived by retailers in Uganda are the customers' lack of money and low awareness of the benefits of solar products (see figure 80).

Figure 76: Question 45: 'Which of the below factors are the most important obstacles to growing sales of solar products?'

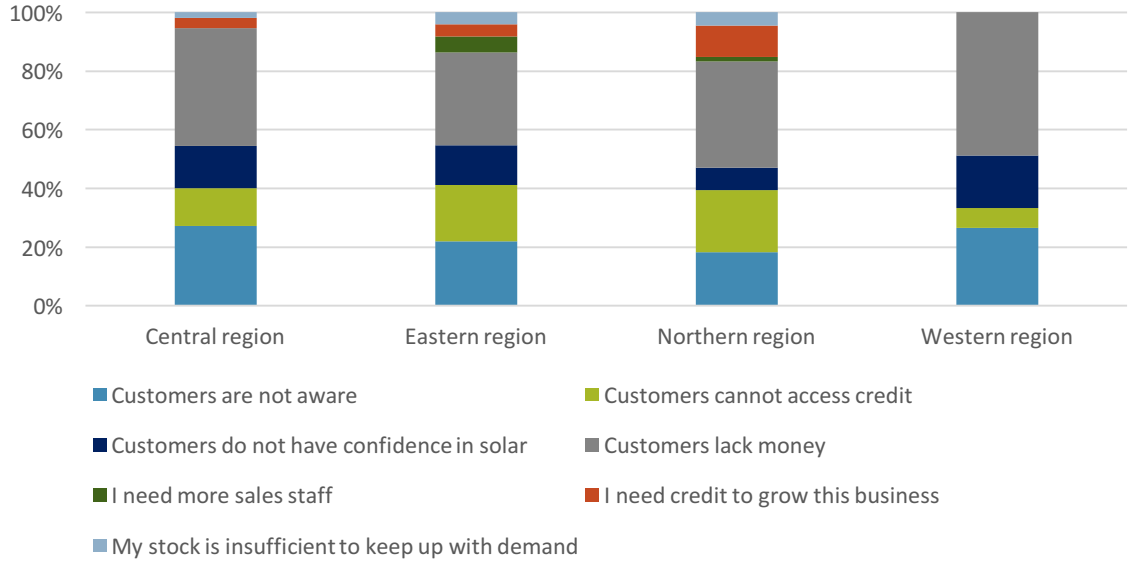
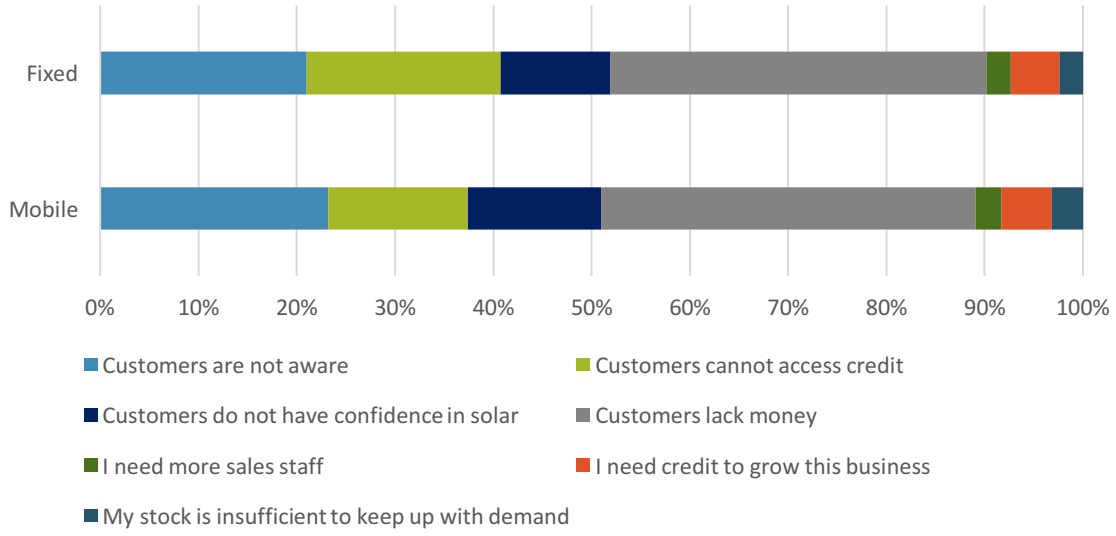


Figure 77: Question 45: 'Which of the below factor are most important obstacles to growing sales of solar products?' by product type



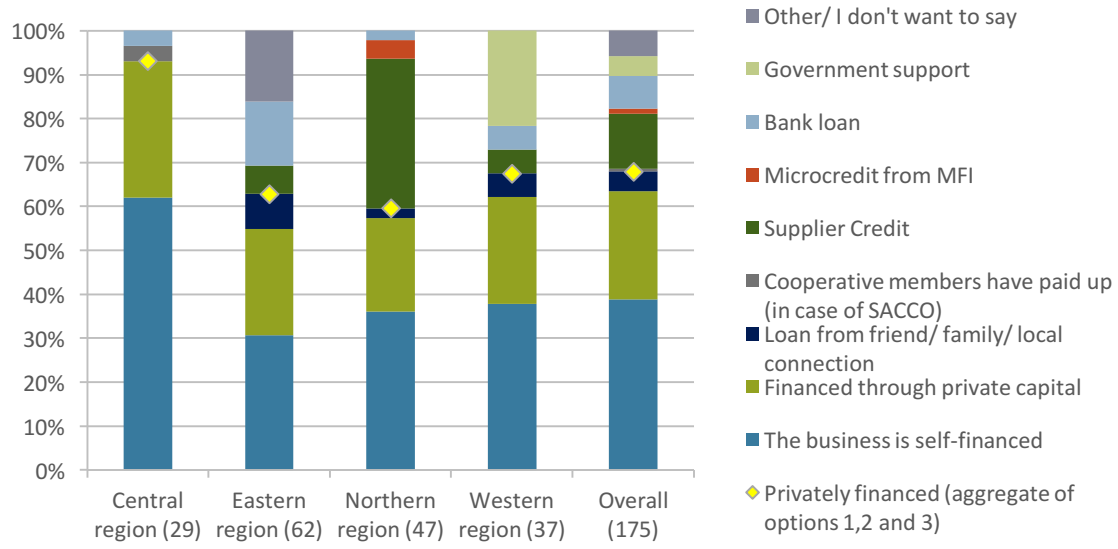
Growth barriers experienced by retailers lie mainly on the customer side and have little to do with the internal operations of the business. Interestingly, main growth barriers cited by retailers do not entirely correspond with what households report. Household respondents believe awareness of solar products is fairly high, retailers believe it is one of the main barriers to growth. Possibly, household awareness of the benefits of solar are in fact relatively low on a population-wide basis, and thus hampering sales.

In addition, 13% of the retailers believed the customers' lack of confidence in solar products hampers sales. However, from the household demand results, we have seen that 94% of the households feel that solar products can be trusted and the reason for not purchasing a solar product is primarily linked to the households' lack of financing or competing financial priorities.

4.4 FINANCE

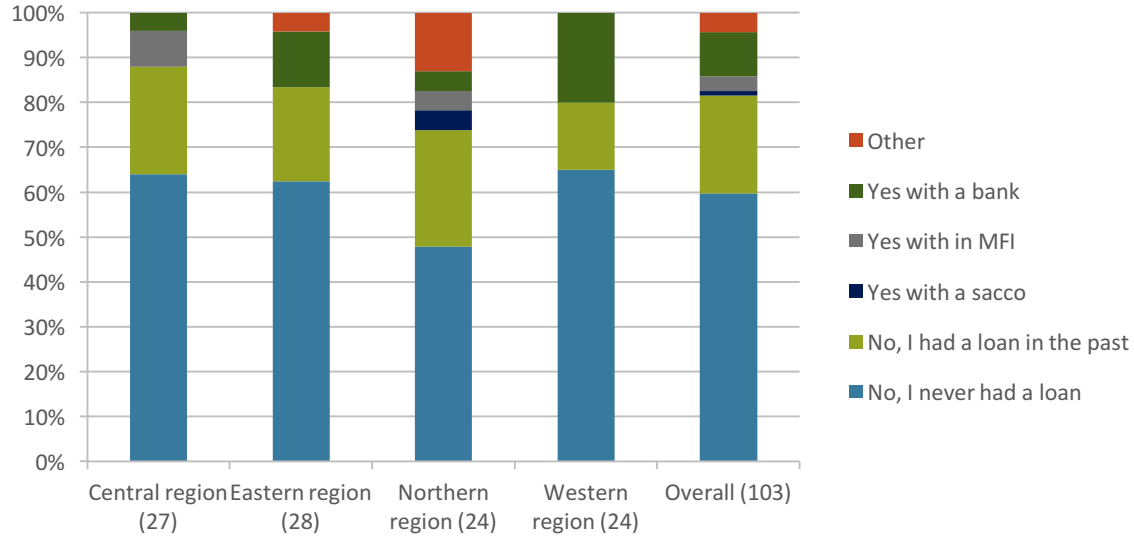
Retailers in the central region are predominantly self-financed (93% said 'There is no external capital', 'Business is financed through private capital' or 'Loan from friend/ family/ local connection'). Of retailers interviewed, 68% are self-financed. Thirty-four percent (34%) of the retailers in Northern region receive supplier credit.

Figure 78: Question S 40: 'How is your business financed?' Multiple answers possible.



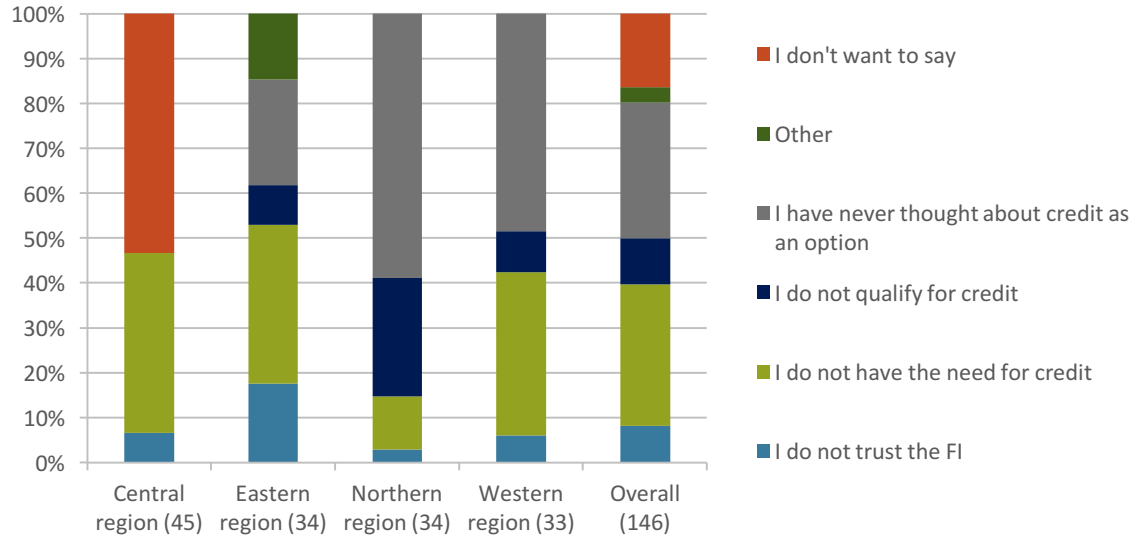
Seventy-five percent (75%) of the retailers don't have a loan or only had a loan in the past. Only in the Northern region did retailers have a loan with a SACCO. Nine percent (9%) of the retailers have a loan with a bank.

Figure 79: Question S 41: 'Do you currently have an outstanding loan for your business?' Multiple answers possible.



When asked why they never had a loan, a majority of retailers in the Northern and Western regions (59% and 48% respectively) said they never thought credit was an option. Thirty-two percent (32%) of the retailers claim they don't have a need for credit.

Figure 80: Question S 42: 'Why have you never had a loan?' Multiple answers possible.



4.5 MARKET SIZE AND GROWTH

4.5.1 Current Household Use of Solar Lighting products

As mentioned in Chapter 3, households in general use fixed solar systems more than mobile solar systems, particularly fixed solar home systems of more than 20 watts (see 14 & 15).

The household survey showed that product interest, use and most appealing benefits differ somewhat by customer segment (see Table 8). If the household's access to energy would increase in the future, the main uses of this energy would be for charging mobile phones and lighting the home, particularly in rural and peri-urban areas. In urban areas, additional power would largely be used in powering other appliances like radio, refrigerator and washing machine. This indicates a clear potential for growth in sales of products providing these types of uses and benefits.

Over 50% of the households purchased their solar product less than 6 months ago, suggesting a doubling of the market in that same period (see figure 20). Households bought relatively more mobile systems in the last year than solar systems (49% vs 38%).

4.5.2 Estimated Sales by Importers.

The 10 importers interviewed estimated total sales of 5,000 units per month (both mobile and fixed systems) at an average price of UGX 152,000 (US$ 60.80) per unit. This amounts to an average annual turnover of UGX 9,110 million (US$ 3.64k). We estimate that our sample constitutes roughly 40%[9] of the entire Ugandan market (or 50% of the official market, given a rough estimate of 20% illegal imports entering from neighbouring countries). Thus, the total wholesale market size would be UGX 23 billion (US$ 9.2 million) per year, and the total retail market size would be UGX 32 billion (US$ 12.8 million), assuming retailers make a 40% margin.

[9] The 40% estimate is based on the interpretation of question 8 of the supplier survey and question 37 of the demand survey. Based on supplier survey, the estimated market share of interviewed suppliers was approximately 37% (NOTE: Based on supplier survey question 37 and not taking into account that products sold through the shopping arcades in Kampala could be branded by one of the importer brands). Based on the demand survey, the estimated market share of interviewed suppliers is approximately 48%. (NOTE: There is a very big difference between each supplier's share of last month sales and installed base)

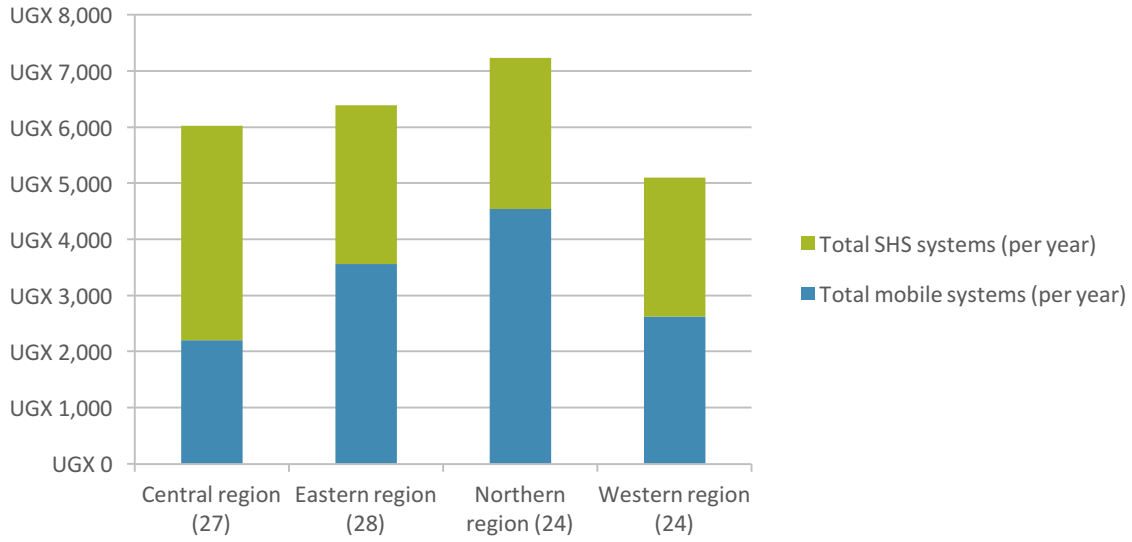
4.5.3 *Market Growth Based on Average Age of Retailers*

Most businesses are between 2 and 5 years old (53%). Just over 17% of the retailers have been in business less than two years. This suggests that the increase in retailers is less than 10% per year (see figure 59).

Estimated Sales by Retailers

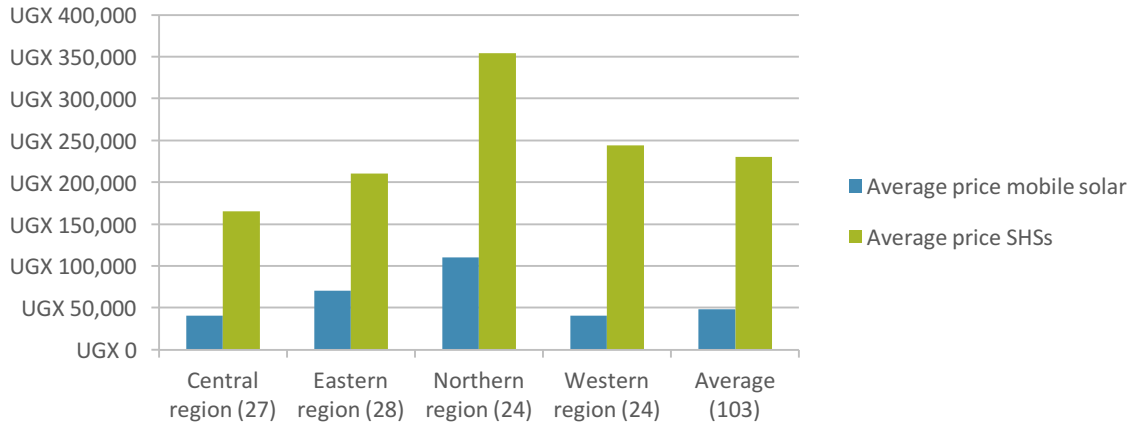
The 101 retailers surveyed indicated they sold 2,050 systems per month, divided almost evenly between mobile systems and SHSs. This amounts to a total of 25,000 units per year. The weighted average price of a mobile system was UGX 55,000 (US$ 22) and the weighted average price of a SHS was UGX 230,000 (US$ 92)[10]. Hence the total turnover of all retailers was UGX 3.8 billion (US$ 1.52 million; average of UGX 37 million or US$ 14.8k per retailer). The graph below shows that the retailers in the north sold relatively more mobile systems, while the retailers in the Central Region sold relatively more SHS systems. However, the average price of a SHS is higher in the Northern Region, hence retailers in this region have the highest average turnover. The 101 interviewed retailers are estimated to constitute less than 10% of the total number of relevant retailers active in Uganda.

Figure 81. Question S 18 and S 19: 'How many fixed/ mobile solar units did you sell overall last month?



Notably, despite the fact that solar units are relatively more expensive in the Northern Region, retailers there also sell the most units. Average prices in the Central Region are lowest.

Figure 82. Question S 12: 'At what price do you sell the products?' Aggregated into mobile solar units and SHSs and split retailers per region (and aggregated for national averages).



[10] To determine average prices, the average price of each type of system was multiplied by the quantity sold per type. This gives a weighted average price for mobile and fixed systems.

Figure 83. Total Annual Turnover of Interviewed Retailers.

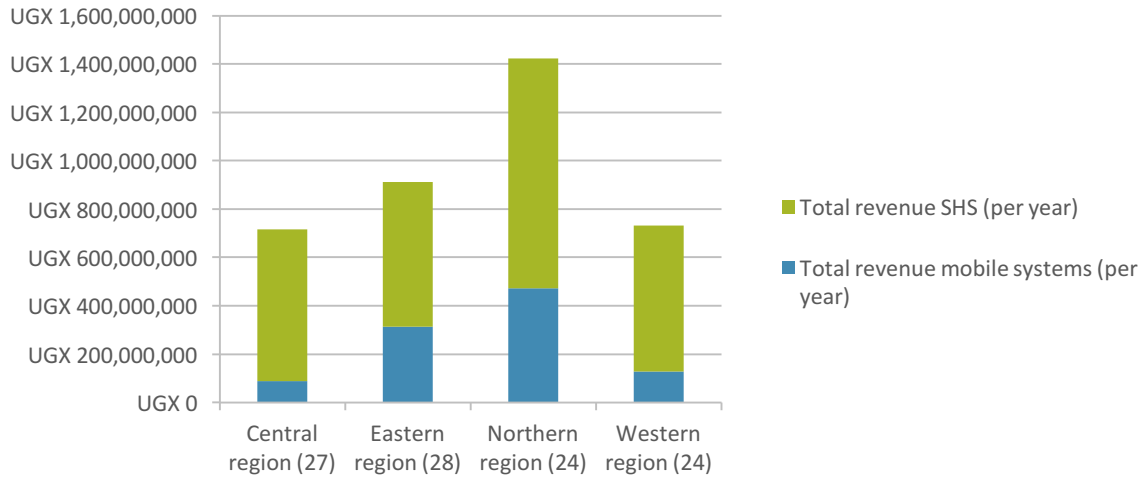
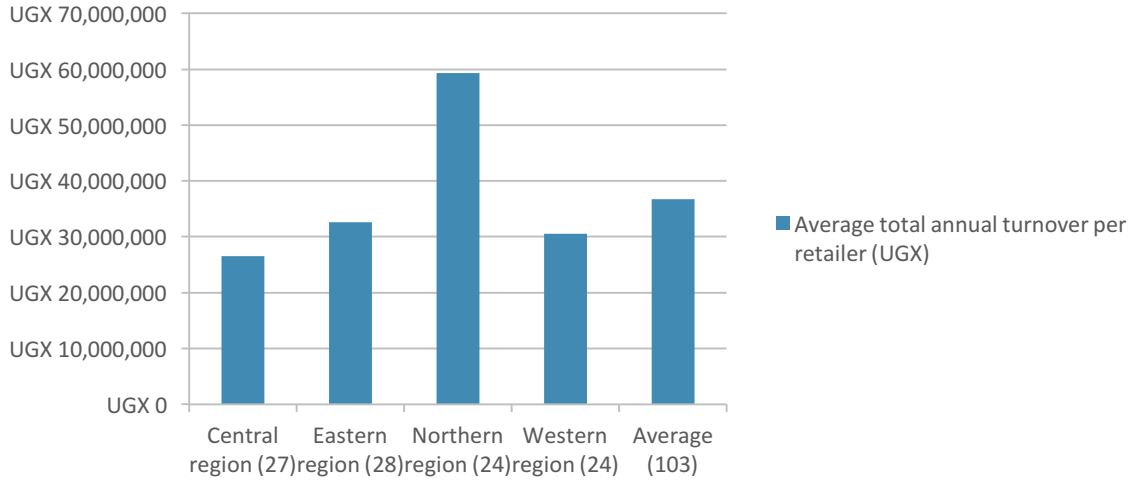


Figure 84. Average Turnover per Retailer.



4.5.4 Market Size and Ability to Pay

In general, solar owners are willing to pay 28% more for a solar product than households that do not own a solar product (see Figure 41). Interestingly, both types of households are willing to pay significantly more than the actual average retail price, except in the case of a single light without phone charger for which owners are prepared to pay less than the actual price. The very big difference between the retail price and the price households are prepared to pay for larger SHSs (<20W) can mean that people wish for larger systems but end up with smaller ones.

Based on the input from importers, suppliers and retailers, the total annual market size is estimated at between 150,000 and 250,000 units and between UGX 32 and 37 Billion (US$ 12.8 and 14.8 million) in retail sales, of which 74% is attributable to the SHS market.

Figure 85. Market Size for Solar Home Products in Uganda.

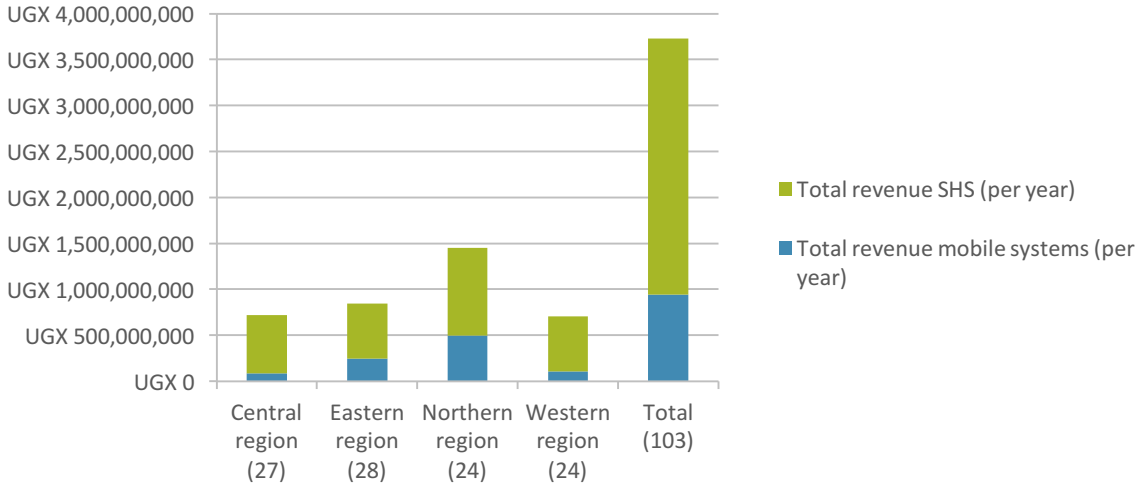


Table 13: Average Estimated Sales per Year, by Product Type, from Importers and Retailers

Market size estimate	mobile units/ year	SHS units/ year	total units/ year	UGX/ year	US$/ year
Based on retailers survey and importer interviews	120,000	130,000	200,000	34.5 billion	13.8 million

The sales numbers of retailers grew no more than 10% per year, but over 50% of surveyed households indicated they bought their product within the last 6 months, which suggests a doubling of the market in that same period.

4.6 FACTORS INFLUENCING DECISION MAKERS

When asked whether or not they were willing to also sell products that meet the Lighting Global Quality Standards, about half of the suppliers interviewed confirmed they were willing to do so. The others either already had products that met the standards, said they had specialist products, or were willing to have their products tested and certified under the program.

Those that were willing to consider including quality products in their portfolios said the following factors influence their decision to introduce new products:

- **Customer feedback and field intelligence:** After an initial product offering is made to a potential market, companies assess satisfaction levels in meeting current energy demands of their clients. This is not standardized and more often than not occurs by default. If customer feedback is positive, companies will then order more of the product and invest a little money in the promotion and marketing of the product.

- **Funding for innovation and subsidies:** Sometimes companies promote a certain product line because of the incentives and subsidies available. The danger with this approach is the likelihood that growth in the subsidised product line will not be sustainable. Companies were open enough to say that if there were substantial subsidies and incentives in promoting products that meet the Lighting Global Quality Standards, then they were prepared to promote and sell these products.

- **Market interest in products and projected sales:** Market interest for particular products is a key driver in adding them to the product portfolio. If a particular product has a huge potential demand and is likely to lead to profitable sales, companies were prepared to add it to their product portfolio as long as it made good business sense.

- **Lead-time for manufacture of products:** A key factor in determining additions to the product line was the lead-time required for manufacturing. If a product was going to take a long time for manufacture and shipping Uganda, this did not interest the solar companies very much since it was likely to tie up their operating capital.

4.7 CONCLUSIONS FROM THE SUPPLY ANALYSIS

Supply chain

- Main products sold are solar lanterns (35%), solar panels (0-10 watts) (23%) and solar panels (more than 20 watts) (30%).
- The supply chain consists of international manufacturers, importers, distributors, importer/ distributor), system Integrators, and Kampala-based or regionally-based dealers, technical services, and agents. The interviewed importers/distributors together have reasonable coverage in the more densely populated areas. In the Eastern Region they are slightly underrepresented.
- The majority (65%) of the 103 surveyed retailers run a small electrical shop and 52% have been in business between 2-5 years. Seventeen percent (17%) have been in business for less than 2 years so annual growth is no more than 9%. Forty-four percent (44%) of retailers say they supply directly to individual customers. They claim that 95% of their customers are male and that 79% are from rural areas.
- Main suppliers of the rural retailers are the shopping arcades in Kampala (44%). Hence the supply chain generally consists of not one but at least two retailers, each requiring a profit margin.
- Main services provided by retailers are the installation of systems (24%), the provision of user instruction (21%) and in some cases a warranty (17%). After-sales services do not seem to be a service provided often (6%). However, customers indicate they value a warranty certificate and direct contact convinces them of the quality of solar products, so retailers could consider putting more emphasis on these services.

Distribution channels importers/distributors

Supply and retail of solar products is done through a variety of channels. The four most prevalent distribution models identified were:

- Direct sales model (29%) – mainly for B2B customers/NGOs/Institutions
- Traditional model / Third party distributor (33) – mainly for larger SHSs
- Franchise/agent model (29%) – mainly for mobile systems. Agents/ franchisees are branded
- MFI/ Sacco model (9%) – relatively new and with mixed success.

Most distributors/importers use a combination of the above, and sometimes even all four models at the same time.

Distribution channels of rural retailers

- The main distribution channels used by retailers in Uganda are selling directly to customers and their families (75%).
- The main marketing strategies used by retailers in Uganda are posters and FM radio. FM radio is considered the most effective.

Prices and Margins

- Very large price ranges have been mentioned in interviews; suggesting a relatively immature market.
- The average margin retailers make on the sales of solar products is 40%. However on SHS of 10-20 watts they only make 13% on average. No clear reason for the low margin on this product group could be determined.

- The margins cited are gross margins required for retailers to bear all costs they incur. Distribution costs are included in most cases as retailers mostly pick up the goods at their suppliers themselves.

Growth Barriers

- Key barriers to growth experienced by importers/distributors are: lack of access to credit, lower quality competing products, low disposable income, poor infrastructure and the cost of setting up a distribution network, lack of interest from financial institutions in the solar loan product, and theft of solar panels.
- End-users, however, generally find solar reliable, said most solar products work well and that they trust solar power. Thus, quality concerns are not confirmed by end-user interviews.
- The main growth barriers perceived by the retailers in Uganda are customers' lack of money and low awareness of solar products. These growth barriers however do not entirely correspond with what household respondents reported. Household awareness of solar products is seen to be very high (94%) said they know what solar is. However, household awareness of where to buy solar is indeed lower, 55% did not know where solar products could be bought), thus hampering sales.

Finance

- Sixty-eight percent of the retailers self-finance and 75% have no loan.
- The majority indicate they never considered loans as an option.

Market size and growth

- Sales of SHS and mobile systems are about equal in terms of units. The fact that the majority of households that have solar products have SHS (60%) suggests that mobile systems have entered the market later.
- Current customers predominantly have larger SHS (> 20W)
- Solar owners are generally prepared to pay 28% more for a system than non-solar owners. Both are prepared to pay more than the average retail price.
- If households would invest in solar, their average payback period would be 6-12 months.
- The market size is estimated at between UGX 32 and 37 billion (US$ 12.8 and 14.8 million) and grows at 10-50% per year

Influencing factors of decision makers

- The key factors influencing market players to introduce new products are the following: customer feedback and field intelligence, funding for innovation and subsidies, market interest in products and projected sales, and lead time for manufacture of products.

Table 14. Main challenges identified from retailer survey and interviews with suppliers.

Challenges	Key findings
(Lack of) Maintenance; (lack of) aftersales service;	Only 15% of retailers offer warranties and 6% aftersales services.
Limited distribution network; limited infrastructure	Distance to end-user is very large. Retailers offer limited services. No maintenance network. Suppliers/franchise concepts (notably Barefoot) suffer from high attrition rates of trained franchisees. Most retailers are small electronic shops or agents (Eastern region). Close to 45% of all solar products are sold indirectly – via the shopping arcades in Kampala – increasing the end-user market price. Small Solutions' regional warehouse managers gave out unapproved credit, hence regional distribution centres were closed. Now there is only 1 centre in Kampala
High (perceived) cost of systems/ High expenditure on costs other than energy (school tuitions!); other priorities	Energy cost doesn't seem to be households' main concern. Households spend on average over 50% of their disposable income on school fees. Azuri and FRES offer fee-for-service ('pay-as-you-go'). FRES had a 90% payment rate after the first two years. Despite end users claiming limited interest in solar lanterns, retailers indicate that these sell best – together with the >20Wp systems.
(Lack of) Access to working capital through-out the distribution chain	Many suppliers indicate that lack of working capital limits their growth prospects. Financial institutions acknowledge this as well. Franchisees and agents often cannot pay for required stock.
(Lack of) Access to cash; high costs of loan or unfavourable loan terms	Loan conditions are unfavourable and interest rates are high. Retailers claim users lack cash or do not have access to loans. MFIs and SACCOs are hardly interested in solar product loans (only 2 in 40 approached by SolarNow followed-up and made sales). Retailers believe lack of money is the main reason customers are not buying. Non-solar owners indicated the main reason for not purchasing a solar product has to do with not having the money.
Defaulting customers/ defaulting retailers; (Perception of) Solar business being a high risk business	Some suppliers (e.g. AB Matra and BBbox) have had major issues with defaulting retailers. This has caused market penetration to slow down and suppliers to shrink their distribution networks. Defaulting also happens when products malfunction as users are reluctant to pay remaining instalments in that the case. FRES has a 10% default rate at the end of their first 2 years of operation. SolarNow only has a 1% default rate, mainly due to careful due diligence by their agents of new customers. High default rates are common in B2B, with lower rates of default by B2C customers.

5 INSTITUTION ANALYSIS

In Uganda, there are several market actors, both public and private, that are active and have influenced the sub sector from the policy to the retail level. This part of the report identifies some of these key actors and analyses their current role in the sub sector.

5.1 GOVERNMENT POLICIES AND INSTITUTIONS

Increasing access to modern energy services through alternative and renewable energy development remains a key priority for the Ugandan government and energy ministry. The Government of Uganda has developed an energy policy (2002) and renewable energy (RE) policy (2007) that both fall under the Electricity Act of 1999. In addition, the government established the independent Electricity Regulatory Authority (ERA) in 2000 to regulate the generation, transmission, distribution, sale, export & import of electrical energy in Uganda, and to guide the liberalization of the electricity industry, manage licensing, rates, safety and other matters concerning the electricity industry. The Rural Electrification Agency (REA) was established to promote both off-grid and grid-connected electricity through private sector-led initiatives in rural electrification[11]. As per the new RESP 2013-2022, the overall responsibility lies with UNREA. REA oversees and coordinates the implementation of this policy by various stakeholders and ensures the effectiveness of these activities.

Within the Ministry, the Renewable Energy Department is responsible for the promotion of RE and RETs (Renewable Energy Technologies) and an Energy Efficiency and Conservation Department is responsible for the promotion of Energy Efficiency and Conservation.

Since 2005, the government of Uganda has removed taxes on solar products and equipment, an initiative aimed to reduce prices of solar PV products and increase access to solar energy for Uganda's population.

The Uganda National Bureau of Standards (UNBS) has played an important role in the development of standards for solar products since the UNDP solar pilot project in 2001. Currently, UNBS is able to produce a unique mark[12], which is on all tested and certified products. However, users need to be educated to look for this mark. While standards have been developed, enforcement is the bigger constraint due to the limited financial and human resources of UNBS.

Furthermore, the Government of Uganda has initiated a programme to test and certify products at source, rather than requiring them all to be tested in Uganda. The programme is working with three international companies, which have a worldwide presence and can ensure products are certified in their country of origin, which will include solar products which are made in China.

Finally, through funds provided by the Office of the President of Uganda, the Centre for Research and Energy Conservation (CREEC) is constructing a solar PV laboratory that will be furnished with state-of-the-art equipment. This laboratory will be used to test various types of solar PV equipment ranging from panels to inverters to lamps. This should become an independent testing and certifying laboratory for private sector importation, marketing and sales of solar PV systems.

5.1.1 Uganda Energy Credit and Capitalization Company

The government-owned Uganda Energy and Credit Capitalization Company (UECCC) facilitates investments in Uganda's renewable energy sector. UECCC's mandate is to provide a reliable framework for pooling resources from various sources like government, investors and development partners and channelling resources to renewable energy projects.

[11] REA - The Renewable Energy Policy for Uganda 2007. www.era.or.ug;

[12] Information about the mark was not found on the internet, indicating that UNBS should make it more readily available so the mark can be used more effectively.

The company's main objective is to provide financial, technical and other support to renewable energy infrastructure development in Uganda with particular focus on enabling private sector participation. UECCC provides technical assistance to projects to overcome barriers to investment as well as financing options like a partial risk guarantee during the construction phase of projects. This facility enables projects to initially access guaranteed cover for cost overruns beyond 15% of the total project cost. UECCC also works to introduce new and innovative financing modalities including credit enhancement instruments directed at reduction of real or perceived risks faced by primary lenders and financial intermediaries. In addition, UECCC offers transaction advisory services and various forms of technical assistance to independent power producers and financial institutions.

UECCC offers a solar refinance facility to participating and regulated micro finance institutions (MFIs) for on-lending to rural beneficiaries, both households and SMEs acquiring solar PV systems. This facility has a ceiling of $300,000 per participating institution. Currently the following three financial institutions use this facility: Centenary Bank ($250,000 see also paragraph 2.2.2), Post Bank and Finance Trust Bank. UECCC is negotiating with a fourth institution. UECCC currently provides refinancing facilities to PFI to mitigate the high cost of funds for energy loans. This initiative has received support from participating financial institutions and there is ongoing work to change the current legislation to support solar companies directly without going through financial institutions.

The company currently has on-going partnerships with the Ministry of Energy and Mineral Development, Ministry of Finance and development partners (BTC, GIZ and KfW). In addition, it coordinates the Orio Mini hydro power and rural electrification project.

UECCC is faced with numerous challenges as the financial institutions lack guarantees for on lending to solar companies while borrowers lack collateral to increase their borrowing capacity.

5.1.2 Ministry of Energy and Mineral Development (MEMD)

The Ministry of Energy and Mineral Development was established in 1995 with a vision of ensuring that the population of Uganda use inexhaustible and environmentally-friendly renewable energy for social and economic development. The mission of MEMD is to increase the use of modern renewable energy in the national energy mix to develop and sustain the economy.

Key functions of the Ministry include:

- To establish and implement policies, strategies, legal and institutional frameworks governing renewable energy resources;
- To promote and develop renewable energy technologies (solar, wind, small/mini/pico hydro, geothermal, and biomass resources);
- To develop technical and managerial capacities to develop and promote renewable energy technologies;
- To set up demonstrations and pilots of renewable energy technologies to encourage adoption;
- To collaborate with the Uganda National Bureau of Standards to establish and implement standards to ensure high quality renewable energy products and systems;
- To collect, assess, and manage renewable energy data and recommend the appropriate renewable energy systems to customers; and
- To establish local, regional, and international cooperation in renewable energy resources.

The Ministry is currently active in the following areas: biomass energy technologies development, biofuels, gasification, biogas cogeneration, hydro (pico and small/mini hydro), wind for water pumping and electricity generation nationwide.

With specific focus on solar PV, the MEMD is currently involved in policy formulation, Solar PV promotion, national standards development and monitoring of stakeholder activities.

Further, the Ministry runs programmes across all sectors including agriculture, health, communication and water supply, and supports private sector enterprise development through Civil Society organizations, the Uganda National Renewable Energy Association (UNREA), Uganda National Alliance for Cleaning Cooking (UNAAC), and the Focal Point for the International Renewable Energy Agency (IRENA). Finally, the Ministry coordinates RE activities within the East African Community (EAC) and the Energy and Environmental Partnership (EEP) Program of Eastern and Southern Africa.

The Uganda Renewable Energy Policy of 2007 sets out the Government's vision for renewable energy in Uganda with the aim of increasing the use of modern renewable energy from the current 4% of total energy consumption to 61% by the year 2017. The policy defines renewable energy as those sources that are replenished continuously by natural processes, including solar energy, hydro power, biomass, wind and geothermal as well as the sustainable use of organic wastes.

Under the Renewable Energy Policy, there are specific measures to support the promotion of solar PV power. These include support to solar PV market development, financing for households and institutions acquiring solar PV systems, and the introduction of a curriculum to train solar PV technicians through technical institutes.

The overall responsibility for policy implementation lies with MEMD. The Ministry oversees and coordinates the implementation of policy by various stakeholders and ensures the effectiveness of these activities through monitoring. Within the Ministry, a Renewable Energy Department has been created to specifically focus on the promotion of renewable energy and renewable energy technologies.

Due to the support being provided to the energy sector by the Ministry, a multiplier effect has been stimulated in the development and adoption of RE technologies. Solar PV growth has evolved from an estimated capacity of over 10MW, compared to 2MW 10 years ago. Adoption of improved stoves has increased from 170,000 in 2007 to 700,000 currently.[13]

5.1.3 Uganda National Bureau of Standards

The Uganda National Bureau of Standards (UNBS) is a statutory organization established by an Act of Parliament in June 1983. It became operational in 1989. UNBS is a member of the International Organization for Standardization (ISO) and also a member of the Africa Regional Organization for Standardization (ARSO). UNBS is a leading institution of international repute in provision of sustainable standardization services whose mission is to provide standards, measurements and conformity assessment services for improved quality of life.

The main objectives of UNBS are to formulate and promote the use of national standards and to develop quality control and quality assurance systems that will enhance consumer protection, public health and safety, industrial and commercial development, and international trade.

UNBS is currently undertaking the following activities:

- Developing and issuing national standards;
- Provision of import inspection services;
- Provision of quality assurance services;
- Testing and certification of imported and locally manufactured products;
- Calibration, checking and measuring equipment in trade;
- Developing standards on ICT, power-lines and poles, petroleum standards and agricultural standards.

While standards have been developed, UNBS is faced with numerous challenges, such as:

- porous borders which allow import of poor quality products without necessary checks and certification;
- lack of adequate staffing to cope with the demand for services;

[13] Data from the Ministry of Energy and Mineral Development

- numerous sectors/areas without standards, since standards are produced on demand; and
- the need to train users on the standards, which is perceived as a costly exercise.

Many times UNBS staff resort to relying on labels and samples to certify products. Labels have been known to be counterfeited and poor quality products have been imported into the country. Further use of E-Tax (internet based tax) services pressurizes UNBS staff to sometimes release products without adequate checks.

5.1.4 Rural Electrification Agency (REA)

The Rural Electrification Agency (REA) was established as a semi-autonomous agency by the Minister of Energy and Mineral Development through Statutory Instrument 2001 no. 75, to operationalise Government's rural electrification function under a public-private partnership. REA is responsible for executing the government's Rural Electrification Programme and functions as the secretariat of the Rural Electrification Board (REB), which carries out the Minister's rural electrification responsibilities, as defined in the Electricity Act of 1999.

REA is mandated to facilitate the government's goal of achieving a rural electrification rate of at least 22% by the year 2022, from 1% at the beginning of the decade as indicated in REA's strategy and plan 2013-2022[14]. REA's mission is "to facilitate the provision of electricity for social - economic rural transformation in an equitable and sustainable manner".

REA is spearheading the energy sector transformation from the use of traditional energy sources (firewood and other basic forms of bio mass) to the adoption of modern energy services (e.g. electricity, petroleum fuels, bio-fuels and improved stoves). REA developed a Rural Electrification Master Plan to guide project design and sequencing to provide appropriate energy services. This Master Plan prioritises projects on the basis of their value in financing the economy (economic growth centres), social well-being, education, health, water supply, and support to local administration.

REA's major responsibilities include: planning and packaging projects for public or private investment in rural electrification and renewable energy power generation; implementation of priority rural electrification projects; administering capital subsidies for private investments; maintaining a national data base for rural electrification; and advising the Ministry of Energy and Mineral Development on policy issues in rural electrification. The Agency has been able to procure private operators to manage 7 rural electrification distribution concessions.

5.2 FINANCIAL INSTITUTIONS

5.2.1 Centenary Bank Ltd

Centenary Bank, founded in 1983, has over 60 branches across the country, with branch locations in most of the key urban centres as well as a vast rural and urban clientele.

In 2011 Centenary Bank signed a Memorandum of Understanding (MoU) with the Government of Uganda to facilitate the Energy for Rural Transformation Program (ERTP) in the rural sector through access to credit. Under the partnership, REA pre-qualifies technical providers and provides the bank with a subsidy component for qualifying rural borrowers.

As mentioned in paragraph 2.2.1, a Solar Refinance facility of US$ 250.000 was also signed with UECCC in July 2012 to access on-lending funds to be applied exclusively to the provision of solar loans to rural households. Centenary Bank has also previously partnered with Global Village Energy Partnership (GVEP International) to access a 50% energy-product loan guarantee fund. The latter was aimed at partially covering losses on loans to purchase cook stoves.

[14] http://rea.or.ug/phocadownload/rural%20electrification%20strategy%20and%20plan%202013-2022.pdf

Demand for solar products has been quite extensive. According to the bank's representative, the typical solar loan customer lives in an off-grid area, has an income from farming or petty trade, and has the ability to spend at least UGX 5,000 (US$ 2.00) on energy (now kerosene) per week.

Typical solar loans are charged 24% interest rate per year with monthly payments on a declining balance system. Other costs in accessing a solar loan include application fees (UGX 15,000; US$ 6.00), insurance (0.45% of loan amount) and a charge of 1% of the loan amount as a processing fee.

The Bank representative identified various challenges in providing solar loans to clients. The bank has formal working relationships with several vendors including Barefoot Power, SolarNow, NacoSolar, Solar Sense and Matrix. These vendors/technical providers are mainly based in urban areas and quite far from their clients, thus making it difficult for clients to access prompt after-sales services. In addition, these technical providers have little capital and therefore are sometimes unable to fund required system installations. Poor quality products on the market are a serious challenge to loan repayment since clients will attempt to stop making payments if the installed systems malfunction.

The risk of lending to households, dealers, retailers, and importers by the bank is minimized by careful appraisal of clients prior to loan disbursal. However, these stringent appraisals mean that fewer and fewer clients are able to access loans from the bank.

A total of 95 solar loan clients have benefited from bank financing, with up to UGX 128,8 million (US$ 51.52k) drawn down which is approx. 48% of the UGX 269 million (US$ 107.6 million) UECCC on-lending facility. Currently Centenary Bank's outstanding energy portfolio is approximately UGX 151 million (US$ 60.4k) with about 87 clients.

5.2.2 FINCA

FINCA was established in 1992 as a legal entity and currently has 25 branches across urban, peri-urban and rural areas. Within its new technologies portfolio, FINCA Uganda Ltd offers solar home systems (since 2008) and is actively considering introducing biogas and energy efficient cook-stoves. The latter are collectively categorized under the institution's renewable energy portfolio. Product development was funded through FINCA's own resources with external technical support from partners such as Micro Energy International (who helped design and pilot the solar energy product). The organization has also benefitted from the Rural Electrification Agency program (for solar energy product subsidy) by disbursing the subsidy on behalf of the Government and using this as a platform to give out loans.

Besides client appraisal and loan disbursement, loan officers are responsible for marketing and sales of the new technology products to potential clients. Lending methodology and requirements are similar to their other business or asset finance loans.

Technical Providers (TP) are currently pre-screened under the Rural Electrification Agency's subsidy program prior to engaging in a formal partnership with FINCA. The most notable TP partner at the moment is Barefoot Power (U) Ltd. Technical Providers are responsible for distribution, installation and after-sales services to FINCA customers that have been qualified for loans. In selected cases, TPs will also undertake joint marketing activities with FINCA staff. FINCA indicates over 2.600 clients have purchased a solar product through this program.

Energy loans (under which solar loans are disbursed) are charged at an interest rate of 2% per month or 26.8% compounded for loan values up to UGX 2.5 million (US$ 1000). Loans above this amount are charged 2.5% per month. Loan repayments are typically up to 12 months with the solar system serving as collateral.

The typical FINCA energy loan customer lives in an off-grid location, can spend between UGX 5,000 ((US$ 2.00) to UGX 10,000 (US$ 4.00) per week on kerosene, and is generally a farmer with seasonal income, or a trader or small business owner.

FINCA reduced default risk of on-lending to households, solar dealers and importers of solar equipment through a rigorous appraisal process for borrowers. FINCA believes that reducing the loan requirements would increase the risk of defaulting on loans.

Six solar installers (NacoSolar, Powercom, BareFoot Power, Solex and Phoenix) are the current installing partners of FINCA.

FINCA indicated they are setting up a new initiative, FINCA Plus, to boost the energy loan product. Under this initiative, FINCA will be positioned to import solar systems in bulk, set up a distribution network, recruit participating entrepreneurs and provide business support services, such as marketing and technical training, to these entrepreneurs. This network of entrepreneurs will serve as the main distribution channel for this new initiative. FINCA also plans to venture into biogas, briquettes and improved cookstoves, as well as sanitization and clean drinking water in the near future.

FINCA representatives identified unfavourable loan terms for clients and limited marketing budget as constraints to the program.

5.3 DONOR / NGO PROGRAMMES

5.3.1 SEMA project

The SEMA project (Sustainable Energy Market Acceleration) is a four-year project (2011-2015) active in Uganda, Kenya and Tanzania. The project is funded by the EU Energy Facility and HIVOS, and is implemented by Enclude (formerly Triodos Facet), Friends Consult Uganda and Integral Advisory Kenya.

The overall objective of the SEMA project is to increase access to affordable and sustainable energy services (solar, biogas and clean cookstoves) for rural low-income people in Uganda and Kenya through small loans. To do this, the project promotes business partnerships between renewable energy enterprises and rural financial institutions.

The starting point of the project is the realisation that, while end-user financing for energy access can be critical for ensuring product affordability, it also introduces complications. Companies providing end-user finance need to develop new skills and back-office structures, and they must have appropriately structured capital backing them. Energy companies that partner with financial institutions need to agree on product specifications, prices, payment conditions, terms of delivery and after-sales services. Also, roles in the partnership need to be clear: who will market and sell the products, who will complete installations, and who will provide repair services? To address these issues, the SEMA project facilitates partnerships and provides technical support to rural energy companies and financial institutions to overcome these obstacles and make energy solutions more accessible to rural households.

In Uganda, the project is active in particularly the northern areas in the country, and has partnerships established with 7 solar companies, including Barefoot Power, Incafex Solar Systems, Kirchner Solar, NACO Solar, Solar Energy Uganda Ltd, MOSET Investments and Solar Energy Distributors. In addition, SEMA works with over 35 financial institutions, particularly Savings and Credit Cooperative Societies (SACCOs) and Micro Finance Institutes (MFIs).

Partnerships between SACCOs and solar companies have required more maintenance and attention than anticipated, resulting in slower uptake and limited success. Some partnerships have taken more time to build than others. Particularly in terms of the capacity building needs of the SACCOs, significant efforts were required to raise awareness of solar products, the benefits solar can bring to households, and the benefits of providing solar (loans) as a SACCO. Other SACCOs were slow in following up on partnership possibilities due to selection of new SACCO boards. The participating solar companies were challenged in their ability to quickly respond to solar product needs from SACCOs located in the rural areas, due to limited distribution centres and after-sales capabilities.

However, the project has been successful in taking on a third party role to effectively facilitate long-term partnerships between financial institutions and solar companies, which has resulted in 3,515 units sold through financial institutions and 1,090 energy loans.

5.3.2 GIZ/ENdev

The Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP) is implemented by GIZ (Gesellschaft für Internationale Zusammenarbeit) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The programme offers support in developing skills, resources and capacities in the fields of energy policy, disseminating modern biomass energy technologies, promoting energy efficiency and rural electrification. This work includes capacity development activities for the Ministry of Energy and Mineral Development, for stakeholders at the national and district levels, and for selected community-based energy suppliers.

GIZ currently offers specific sector support to rural electrification through grid densification, micro hydro installations and promotion of solar PV to households, social institutions, government centres and for productive use in the Lango and West Nile regions (solar PV) and Kiboga, Masaka, and Lwamata (grid densification).

The response to support for rural electrification activities has been very positive. Grid densification has been supported with a 70% subsidy as well as coordination and technical assistance from GIZ. Solar PV activities have been supported by offering solar installers a local subsidy contract with financial support from GIZ.

As a result of PREEEP, more than 120 social institutions (schools, health centres and others) have gained access to electricity through connection to the national electricity grid or off-grid photovoltaic systems. In addition, over 2,800 households and small and medium-sized enterprises (SMEs) have been able to purchase a solar system that generates enough power to light a house, recharge mobile telephones and power a radio or television. These systems are also being used for commercial purposes to run hair trimmers, charge mobile telephones and power small shops, for instance.

The advent of LED lighting has made it possible to increase the number of lights a solar PV system can accommodate. Despite this positive trend, PV systems installed with GIZ support still require donor funding to stay functional since the supported institutions are unable to sustainably maintain them.

In the original plan, GIZ project partners would provide co-funding. But during implementation this happened only to a limited extent. When institutional support programs were being designed, partners in the program were required to contribute to the funding of the program, which was referred to as counter-part funding. However, this counter-part funding has been slow in contributing to project costs and has on occasion resulted in delays in project implementation. As a response to this particular challenge, GIZ provided the necessary financing to overcome the funding gap that was slowing down project implementation.

Other problems faced by the program include unreliable equipment, with batteries and lights of the sponsored systems often failing, leading to a bad reputation for quality.

5.3.3 WWF

WWF Uganda Country Office (WWF-UCO) was established in 2009 by WWF-International to promote its mission in the country as an integral part of WWF's Global mission in East Africa. The Goal of WWF-Eastern and Southern Africa Regional Programme (WWF-ESARP) is to ensure that biodiversity and biological processes in Eastern Africa are conserved in harmony with the aspirations of the East African people, through the activities of WWF-UCO and other sector players.

WWF's sectors of operation include fresh water, forestry biodiversity, and energy and climate. Under the energy and climate program, WWF is running the Clean Energy Champion District program. In this program,

WWF-UCO is supporting the Government of Uganda in increasing access to clean energy alternatives through a district led approach dubbed the "Champion District Initiative".

The initiative is piloted in the Kasese district, where WWF is showcasing tools and approaches for engaging with local stakeholders at the district level, which is WWF's preferred approach to increasing energy access for off-grid communities in Uganda. Focus areas include clean energy for household cooking and lighting, and documenting and sharing lessons learned.

WWF has provided technical assistance, linkages to pre-qualified suppliers and seed funding under the initiative. Kasese District has cooperated with the private sector to provide an enabling environment for solar lighting companies to work in the District by waiving taxes that would otherwise have been paid by the companies to operate in the District. Partners in this program include MEMD, REA, GIZ, CREEC, BareFoot Power, BBOXX and Ugastove.

Market players have welcomed financial initiatives that support credit both at an individual and group level, which have greatly increased access to good quality lighting products. Market trends indicate a growing need for portable lighting for Base of the Pyramid (BoP) customers as grid extension will not reach all areas of the District in the medium term.

There have been a few challenges, however, limiting the impact of the initiative. Uptake of products was slow until the program introduced plans with a 30% upfront payment for lighting products and 4, 6 or 12 monthly payments thereafter. WWF has also noted that multiple actors are trying to provide the same services, which leads to inefficiencies. For growth and efficiency, WWF believes consolidation in the sector is needed.

5.4 PRVATE SECTOR

5.4.1 Kilembe Investments Limited

Kilembe Investments Ltd (KIL) is a public Limited Liability Company, located in Kasese District with branches in Mpondwe and Katerera that has 12 staff members and 1,217 shareholders. The company has a vision of being a competitive clean energy provider for a cleaner environment and a mission of lighting villages for rural transformation to improve the quality of life.

KIL is engaged in the distribution and sale of power from the national grid on a 10-year concession that runs until 2017 with a current customer base of 3,481 customers under the prepaid metering system.

KIL is currently working on a new project to extend the power network to the rural areas of Kasese and surroundings, which is under construction.

KIL works with the local government in Kasese and with Belgium Technical Cooperation. Stakeholders in Kampala include: Electricity Regulatory Authority (ERA), Uganda Electricity Transmission Company Limited (UETCL), Rural Electrification Agency (REA) and the Government of Uganda, through the Ministry of Energy and Mineral Development.

5.5 POTENTIAL ACTORS

An assessment of potential actors interested in entering and scaling up commercial activities in the off-grid sector was undertaken in collaboration with REA. Sources for identifying these organizations included the industry knowledge of REA staff and the research team, who were familiar with sector actors, initiatives, trends and organizations with an appetite for investing in the renewable energy sector in Uganda.

The team assessed different public and private sector actors on their interest and capacity to undertake off-grid commercial activities at scale. Specific criteria to assess capacity were based on the following:

- a strong management team in place;
- local/regional presence;

- capable technical/operations team;
- history of good service delivery;
- strong support structures within communities to provide customer care; and
- demonstrated ability to deliver on contracted services.

Interest on the part of these organizations was established by contacting them directly, or by the fact that they had previously voiced their interest to or were already working with REA. When contacting likely candidates, the research team asked if participation in large scale SHS business was an interesting area for them.

The organizations studied can be divided into three categories:

a) those that had interest and capacity to engage, including Wenreco, Ferdsult and Bundibugyo Energy Cooperative;
b) those with capacity but no interest, including Umeme and Kalangala Infrastructure Services; and
c) those with interest but no capacity, including.

The organisations listed below belong to Category 'a' above. The research team has found them to have the interest and capacity to undertake off-grid commercial activities at scale, and thus deems them the most suitable potential actors. These organizations have a unique standing in the communities and regions in which they operate. They have good management teams in place, have capable technical/operations teams, have a history of service delivery, have strong support structures within the community that provide customer care, and have been able to deliver on the services for which they have been contracted.

The most important attribute these organizations possess, which is very important in undertaking solar activities on a commercial scale, is their presence on the ground and the good reputation that they enjoy within the communities in which they operate. These organisations also mentioned to the research team that they are currently in discussion with the Rural Electrification Authority about engaging in solar distribution activities in the near future.

5.5.1 West Nile Rural Electrification Company Limited (WENRECO)

West Nile Rural Electrification Company Limited (WENRECO**)** is an electricity generating and distribution company in the West Nile sub-region, in Northern Uganda. WENRECO is a subsidiary of Industrial Promotional Services, the industrial development arm of the Aga Khan Fund for Economic Development, and a member of the Aga Khan Development Network.

WENRECO, through competitive bidding, won a concession to generate, distribute and sell electricity in West Nile, which consists of eight districts and is home to an estimated 2.3 million people. WENRECO operates two power stations: WENRECO heavy fuel thermal plant with capacity of 1.5 megawatts, located in Ewuata, Arua District; and Nyagak I Power Station, a 3.5 megawatt mini-hydropower station, located in Paidha, Zombo District. These two facilities are currently the main public electric power sources available to the West Nile sub-region, which is not yet connected to the national grid. Connection to the national grid is expected following the completion of Karuma HEP around 2018. WENRECO has a 20-year concession to supply power to the West Nile sub-region.

WENRECO is the implementer and co-funder of the West Nile Rural Electrification Project, which was initiated in 2013. The Project targeted electrification of 30 health centres, 60 schools, 250 businesses and 6,000 households between 2013 and 2015 through hydro power and diesel gen sets. Funding for the project was provided by the Government of Uganda, the German Development Bank (KfW), WENRECO and the Energy Facility Pooling Mechanism.

Last year, WENRECO began switching the 4,000 customers to pre-paid metering service. The addition of 2,500 new customers increased the number of customers served by the company to 6,500.

5.5.2 Ferdsult Engineering Services Limited

Ferdsult Engineering Services Limited (FESL) was established in 1999 and is one of the leading organizations in maintaining and constructing the high-voltage electricity transmission system in Uganda. The company initially provided engineering services, ranging from construction of tower bases, building & civil engineering, electrical and mechanical works to construction of power lines ranging from 132kV to 0.415kV and installation of optic fibres. The company has since broadened its services to include power distribution.

FESL has successfully executed several projects funded by the government of Uganda, the World Bank, SIDA, NORAD, and JICA. As part of the rural electrification effort being undertaken by both the Ugandan government and the private sector, FESL is involved in maintaining and operating rural power distribution.

As a distribution utility, the company is active in the following electricity distribution concessions: Kakumiro–Kibaale–Kagadi, Rukungiri–Kanungu, Ntugamo–Kitwe–Isingiro, Kyotera–Mutukula–Kansensero, Masaka–Bukakata and Rugombe–Kyenjojo–Katooke.

To date, the total number of consumers (both households and SMEs) connected to FESL power distribution network is over 5,000, all of which are on a pre-payment metering system.

5.5.3 Bundibugyo Energy Cooperative Society:

Bundibugyo Energy Cooperative Society is a 2000-member-strong cooperative. The Bundibugyo Energy and Cooperative Society won the concession to manage the newly constructed power line in the district and was the first cooperative to manage electricity distribution, maintenance of power lines and revenue collection from consumers. It has 1,700 registered members, of which 1,500 have been connected on the national grid.

According to the concession, the cooperative has responsibility for power distribution, maintenance of the power lines, and managing the revenue from power consumers. The cooperative connects electricity to locals at a subsidized fee. As owners of the cooperative, all members have the right of ownership of the income from power tariffs collected from the power line managed by the cooperative.

5.6 CONCLUSIONS FROM THE INSTITUTIONAL ANALYSIS

Key institutional challenges

- The key challenges in the off-grid lighting market in Uganda identified by financial institutions are:
    - vendors/technical providers are mainly based in urban areas, quite far from their clients thus making it difficult for clients to access prompt after-sales services;
    - technical providers have little capital and therefore are not always able to fund system installations;
    - poor quality products on the market are a serious challenge to loan repayment since clients will attempt to stop making payments if the installed solar systems malfunction;
    - available loan terms are unfavourable to clients; and
    - low marketing budgets constrain financial product promotion and uptake.
- The key challenges in the off-grid lighting market in Uganda identified by donors/NGOs are:
    - need for capacity building of the private sector (retailers) and financial institutions involved in the provision of off-grid lighting products;
    - low awareness of solar products and benefits for households;
    - bad quality reputation of some solar systems on the market; and
    - the need for donors and NGOs to provide financial and technical assistance in maintaining solar systems.
- Private sector challenges identified in the Ugandan off-grid lighting market include:
    - underdevelopment of the solar market;
    - need for substantial investment in market awareness campaigns; and
    - low consumer purchasing power.

6 CONCLUSIONS

Demand for Off-grid Lighting Products

The solar market is dominated by several relatively small companies. Hardly any larger (multinational) corporations are active. However, the demand survey indicates that the end users are generally more aware and more convinced of the quality of solar energy than market players, institutions and NGOs/donors think. End users are also quite convinced of the benefits of solar.

The need to charge cell phones is becoming more widespread. Eighty-three percent (83%) of the households own one or more cell phones and spend on average 1000 UGX (US$ 0.40) for phone charging per week. Sixty-eight percent (68%) of the interviewees indicated they purchase charging time outside their home.

Urban-based households who are grid-connected pay on average 2 to 3 times more for their electricity than non-grid connected households. Eighty percent (80%) of (local) grid connected households use a complementary lighting source, mainly kerosene. This implies that even the grid connected market may be an interesting one for solar lighting products.

Eighty percent of households that own a solar product would like to have a large system (more than 20 watts peak). Demand for mobile systems is practically non-existent in this group. The demand of the households who do not own a solar product is more diverse, but they predominantly demand large SHS and mobile systems with charger and more than one light.

Main Challenges Revealed by Surveys and Interviews

Fourteen main challenges can be distilled from the quantitative and qualitative data collected, which in turn can be grouped in four categories:

1. Challenges related to the solar products themselves, namely product quality, marketing and positioning;
2. Challenges related to the market and those that customers face;
3. Challenges related to financing; and
4. Institutional challenges.

Below we discuss the main types of challenges in greater detail, noting that our research refuted some challenges identified by market players.

Main challenges identified	Findings	How to address
Product, quality, marketing – challenges limiting the market pull		
Low product awareness; low capacity to make an informed purchasing decision; insufficient or ineffective marketing.	Mainly suppliers & donors/ NGOs mentioned this, though over 85% of households surveyed know what solar is. Awareness in the Northern and Eastern regions and in rural areas is on average lower. Retailers perceive awareness to be lower than it probably is. Over half of the rural population doesn't know where to buy solar products, but interestingly brand awareness is higher. SolarNow is known by 70% of those interviewees who knew a brand. Awareness might not be the major	**Government Institutions:** Awareness campaigns in remote areas are still required to increase awareness. Radio can be a good channel, as well as below the line (BTL) marketing campaigns, e.g. demonstrations at rural fairs, festivals, and markets. **Suppliers/ retailers**: provide referral incentives and stimulate word of mouth; have local representation; advertise by radio.

	challenge perceived by distributors and other market players.	
Quality issues; reputation of solar products; having a bad name; lack of confidence in solar products; lack of quality control; lack of certification; uneven compliance with standards	Interviewees do find their solar energy source reliable and for the most part, are extremely satisfied with it (74%), in comparison to kerosene, dry battery torch and candle users who are generally unsatisfied with their current light source. Ninety percent of respondents trust solar products and three quarters see solar as the introduction to a modern household. People are receptive to warranty certificates, government recommendations and the UNBS seal when buying products. However, UNBS is said to be understaffed. Suppliers/ importers complain about lax tax control and hence a myriad of low quality products. Limited customs inspections.	**Government Institutions:** strengthen quality control and enforcement. **Retailers:** offer warranties, provide after-sales and return service. **NGOs/ donors:** support suppliers with product certification. **Financial institutions**: only provide loans when products comply with standards.
Lack of maintenance and aftersales service	Only 15% of retailers offer warranties while 6% offer aftersales services. PREEEP requires donor funding.	**Government Institutions:** Guarantee funds, warranty legislation, **Suppliers/retailers:** offer warranties/ extend distribution network; specialize in maintenance; **NGOs/donors:** Technical support & training to retailers and donor funding to help set-up the infrastructure
Customer & market place – challenges limiting the product push		
Limited distribution network; limited infrastructure	Distance to end-users is very large. Retailers offer limited services. No maintenance network. Suppliers/ franchise concepts, notably Barefoot Power, suffer from high attrition rates of trained franchisees. Most retailers are small electronic shops or agents (Eastern region). Close to 55% of all solar products are sold indirectly – via the shopping arcades in Kampala – increasing the end-user market price. Small Solutions' regional warehouse managers gave out unapproved credit, hence regional distribution centres were closed, now only 1 centre in Kampala	Stimulate deep distribution networks. **Suppliers/franchisers:** improve business case/incentives for trained franchisees.
High (perceived) cost of systems; high competing expenditures (school	WWF programme introduced instalments. Kerosene is still the main energy source used by Ugandan households. However,	Stimulate payments in instalment; **Government/ institutes/ NGOs/ donors:** devise payment schemes

tuitions); other priorities	they spend less on energy than expected. The average household spends less than 2% of their disposable income on kerosene, much less than the 12-17% generally assumed. Energy cost therefore doesn't seem to be their main concern. Households spend on average over 50% of their disposable income on school fees. Azuri and FRES offer fee-for-service ('pay-as-you-go'). FRES had a 90% payment rate after the first two years. Despite end users claiming limited interest in solar lanterns, retailers indicate that these sell best – together with the >20Wp systems.	via the school fee budget. Stimulate fee-for-service, pay-as-you-go models. **Retailers:** continue offering smaller systems & solar lanterns.
Financial challenges		
Access to working capital throughout the distribution chain	Many suppliers indicate that lack of working capital limits their growth. Financial institutions also acknowledge this. Franchisees and agents often cannot pay for required stock.	**NGOs/ Donors:** pilot projects with working capital for retailers so they can offer payment in instalments and credit lines
Access to cash; high costs of loans or unfavourable loan terms	Loan conditions unfavourable; interest rates are high. Retailers claim users lack cash or do not have access to loans. MFIs and SACCOs are hardly interested in solar product loans (only 2 in 40 approached by SolarNow followed-up and made sales). Retailers believe lack of money is the main reason customers are not buying. Non-solar owners indicated the main reason for not purchasing a solar product is not having the money.	**Financial institutions:** easier appraisal/due diligence for loans **NGOs/ Donors:** train MFIs and SACCOs to provide TA on solar products. There clearly is a need for investigating the financing opportunities for solar products for households.
Access to financing mechanisms	Market stimulating organisations such as UECCC and PREEEP lack guarantees for on-lending.	Provision of these guarantees for on lending.
Defaulting customers/ defaulting retailers; perception of solar business as high risk	Some suppliers (e.g. AB Matra and BBbox) have had major issues with defaulting retailers. This has caused market penetration to slow down and suppliers to shrink their distribution networks. Default also happens when products malfunction as users are reluctant to pay remaining instalments. One company had a 10% default rate at the end of their first 2 years of operation. Another company only has a 1% default rate, mainly due to their agents' thorough due diligence on new customers. High default rates exist in B2B, and lower rates pertain to B2C customers.	**Retailers/ financial institutes**: learn from previous mistakes made by suppliers when (re-) introducing a solar product using credit. **Retailers:** increase local presence, after-sales service and maintenance services
Institutional challenges		

Lack of business management skills; limited technical & institutional capacity; enforcement of standards and quality	Institutions struggle to improve skills of their teams.	Technical assistance and training, specifically on product use, maintenance and product quality awareness.
Lack of insurance	Retailers note that theft is a risk for both lenders and buyers of solar systems	

These challenges identified above cannot be seen as isolated from each other and seem to be linked in a vicious cycle: financial institutions are reluctant to provide loans, therefore cash-poor suppliers and retailers can only sell on a cash basis and can only provide limited service and maintenance; therefore customers do not buy, limiting the market; therefore it is perceived as a high risk business and financial institutions are reluctant to provide loans.

Figure 86. Identified vicious cycle hampering growth of the solar market.

This market dynamics cycle has also been identified by others and there are a number of initiatives seeking to break the cycle:

- PREEEP, by GIZ/ ENdev, is providing capacity building at different levels in the market and providing subsidies to institutions working to expand the market
- FINCA Plus, together with installers, REA and MEMD, is importing systems in bulk, setting up a distribution network, providing training and marketing to entrepreneurs.
- SEMA, managed by Enclude, Friends Consult, Hivos, EU Energy Facility and Integral Advisory Kenya, brings financial institutions and energy companies together in official partnerships and delivers technical assistance to financial institutions.
- Champion District Initiative, run by WWF, MEMD, REA, GIZ, CREEEC, and commercial partners, provides technical assistance, seed funding, and linkage to pre-qualified suppliers.

7 RECOMMENDATIONS

For Lighting Africa to achieve its objective of improving access to energy in the Sub-Saharan region and accelerating the development of commercial off-grid lighting markets, specific interventions are required. This can be achieved by providing support to specific actors in the lighting market in Uganda. Outlined below is a set of recommendations informing the design and market development of modern off-grid lighting products deployment activities to spur demand.

Based on desk and field research, three different business interventions were identified that could achieve social impact, financial sustainability and potentially scale. These intervention types will be further discussed with the client, Lighting Africa, and upon approval further detailed and researched.

Recommended Interventions

To break the vicious cycle described above, we recommend supporting, creating and funding fee-for-service business models, working with financial institutions, suppliers and retailers. Below we suggest targeted interventions for specific market actors that will strengthen the solar market and further build consumer trust.

Interventions Related to Solar Companies

- Further improve management skills in business development, marketing, promotions and technical skills.
- Focus on setting-up and strengthening distribution and after-sales networks. Create business models which include servicing, thereby adding additional revenue streams beyond initial sales.
- Increase customer care and customer satisfaction by setting up customer feedback systems and improving ability to implement customer service programs.
- Increase informal marketing through incentive offers such as coupons and discounts when family members buy the same product.
- Provide or facilitate warranties, which are demanded by end-users and will improve relationships between retailer and customer.

Interventions Related to Financial Institutions

- Provide technical assistance to FIs in training of loans officers on different lighting products and the benefits of solar energy vs. kerosene (less contaminating, healthier, lower lifetime/ operational costs, increased productivity of the household).
- Improving knowledge of solar products will make loan officers more confident in promoting financial products to fund purchases of solar equipment. Further technical assistance is required in the development of area- and organization-specific marketing programs to improve promotion and uptake of loans for lighting products.
- Provide a loan guarantee fund to participating FIs. Use this fund to reduce interest rates for solar loans, thus making them more affordable to a majority of customers. Limit such loans to prequalified suppliers and to products that comply with the solar product standard of the Ugandan National Bureau of Standards.
- Provide partial risk guarantee to allow financial institutions to finance solar companies. This will also improve the solar companies' position in accessing finance for import of solar products.
- Provide technical assistance on default and bad debt management.
- Provide TA, seed money and/or guarantees to standardised and simplified loan appraisal systems.

These measures will add more capital to the supply chain, thus allowing it to accelerate growth. Default risks can be contained as some market players have proven.

Interventions Related to Institutions

- Government institutions: Radio awareness campaigns promoting solar vs. kerosene to strengthen the solar market.
- MEMD (supported by Lighting Africa): Enforce standards, strengthen UNBS to further increase market trust.
- Lighting Africa (supported by UECCC and MEMD): Create guarantee fund to increase working capital throughout the supply chain.
- MEMD (supported by Lighting Africa): Create warranty legislation.
- Extend working capital to solar companies.
- Promote solar through school programs. School fees are high, as is awareness that solar light stimulates and supports studying. Distribute solar lanterns through school projects or reduce energy costs of schools by providing loans to install solar systems. Reduced energy costs will lower school fees, and children will spread knowledge of solar products to their households.

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