Chapter 15
Innovative Energy Access for Remote Areas: "The LUAV-Light up a Village" Project

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Abstract The Light-up a village (LUAV) program is a rural development initiative designed to improve access to modern energy solutions in remote areas of developing countries. The initiative addresses the challenge of Pico PV market penetration by empowering rural communities to actively participate in lighting up their own villages using micro-solar systems. The LUAV business model was designed by an energy company, Barefoot Power (BFP), which began the LUAV field in 2012 in Uganda. The program incorporates local SACCOs and Community Based Organizations (CBO) as well as local governmental bodies in the identification and recruitment of participants. A LUAV program is designed to involve at least 100 households per community by providing each home with its own power generation solar system to run lighting and mobile device charging services. The participating households are given the option to either pay for the micro solar power system upfront or to pay for it in 3–12 monthly installments. For this pilot program, BFP sourced for funding from private investors to operate a revolving fund which is managed the SACCOs and CBOs who have the mandate to manage debt recovery

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and keep the revolving fund active. Through this business model, 18 LUAV projects were implemented in Uganda during the 18 month trial period providing lighting and mobile charging services to 3,000 plus households. The program's success has a growing interest and plans are underway to replicate it in South Sudan, Rwanda and Kenya in 2014. According to the latest count more than 7,000 households have adopted the micro-system through LUAV.

Keywords Micro-Solar systems · Rural village electrification · Revolving fund

Introduction

In East Africa, the majority of the rural population (80–90 %) (Asamoah 2013) has no access to electricity. People light their homes with kerosene or candles, which produce inefficient light quality with poor illumination levels of about 1–10 % the recommended levels; in addition, these light sources pose several health risks to the user such as burns, respiratory ailments and blurry vision among others (Mills 2012).

Furthermore, it was found that the fuel based lighting systems are an expensive source of light (Miller et al. 2013) with some studies reporting savings of up to 400 % in households that completely replace their kerosene lamps with solar lanterns (GIZ 2010). Finally, in most rural communities, the people have no means to charge their mobile phones other than through central charging stations, which charge high prices and are often located far from their homes. Introduction of the solar lighting systems with phone charging options not only reduces the user's costs but provides an income generation avenue by charging the neighbors to use the service which was the case with about 70 % of the users in a study carried out in Uganda (GIZ 2010).

Solutions for these energy related problems have emerged in recent years. Solar powered LED home lighting and phone charging equipment is available throughout East Africa although rural penetration is about 4 % (Lighting Africa 2012). These products provide a safer, more cost effective alternative for rural communities over the typical energy sources mentioned above. However, there are three main challenges limiting the accessibility and uptake of these energy solutions by rural off-grid communities;

- Affordability: The modern energy products have high upfront costs.
- Consumer Awareness: Lack of trust and knowledge about the benefits of good quality solar products.
- Technical Expertise: Good quality installation and continued product service is not available.

Research Objectives

The LUAV program has been designed as response to three main challenges experienced when supplying lighting solutions to rural off grid populations as mentioned in the introduction of this document.

The main research question in this study would be *to find out whether installing community micro-solar lighting/charging systems is a viable way to increase electricity penetration in rural villages. Specifically the study aims at*:

1. Evaluating the willingness and ability to pay for solar lighting systems when presented as a community project as well as preferred payment period/method
2. Evaluate viability and scalability of the revolving fund in providing upfront capital for system installations.
3. Evaluating the receptiveness of the people to the technology and ease of awareness dissemination in the community setting.
4. To evaluate whether technical support is easier to deliver through community members or by technicians from BFP.

Additional Research

The Strathmore Energy Research Centre, SERC, is currently working with development partners to carry out additional research into the sustainability and scalability of the LUAV business model. In this, the long term socioeconomic impact of each LUAV as well as the opportunities and potential for replication in other developing countries is the main focus. As a result of the positive uptake of the LUAV in Uganda, SERC is working closely with BFP, the energy company, in its venture to replicate the program in South Sudan, Rwanda and Kenya in 2014. The main questions for research in addition to the current existing questions are listed below:

1. To evaluate the socioeconomic and lifestyle changes of residents within the successful LUAVs by comparing those who took up the system and those who did not participate in the program.
2. To evaluate the replication and scalability of the LUAV model by comparing the experience in Uganda with Kenya, Rwanda and South Sudan.
3. To measure the impact of capacity building as regards local technicians to repair and maintain the solar systems in the long run. This is an important aspect as in many cases before the trained technician would abandon the task because few systems would fail and thus for economic reasons the person decided to dedicate himself/herself to another kind of job (Fig. 15.1).

Fig. 15.1 Installation of LUAV micro-solar systems in a village by Barefoot Power Uganda

Specific Details of the Program

One of the main challenges of Pico PV market penetration in rural Africa is the lack of consumer awareness (Asamoah 2013). The first step in **awareness creation** for the LUAV program involves the identification of local NGOs, CBOs, SACCOs, community members, community associations and local government bodies or officials who will be willing and able to partner with the energy company in the implementation of the LUAV program. BFP evaluates each group and negotiates mutually beneficial partnerships towards the implementation of LUAV programs. Thus the awareness campaign is meant to address not only the targeted market of end users but also the government officials from the ministry of energy and the regulatory bodies which in the case of Kenya and Uganda are ERC—Electricity Regulatory Commission and the REA—Rural Electrification Agency and all the other above mentioned partners in the LUAV venture.

These partnerships are developed with the aim of raising support to recruit a minimum of 100 households per community who are ready to reduce or stop kerosene usage for lighting within the community by purchasing a micro solar system. It has been reported that local authenticity is one of the main success factors for new businesses in Africa (Accenture 2009). Local authenticity is developed by investing in local expertise and training the local people to run the activities on the ground. The partnerships with local CBOs and SACCOs increases local acceptance and makes the people more receptive to the product and the LUAV program.

Once a community has been educated and is ready to take up a LUAV project, the energy company revaluates the participating CBOs or SACCOs within the community to determine which one is most suitable to carry out the project implementation tasks and trains the members in the project procedures. Next, the energy company makes arrangements to finance the LUAV; in the early stages, BFP financed the venture by putting together a revolving fund from private investors, who initially believed in the concept. Today this process involves multiple stakeholders such as the SACCO member's deposits, NGOs donations, crowdfunding, and savings groups.

The identification of a credible and reliable CBO/ SACCO is crucial to the success of the project. This is because the CBO or SACCO plays the important roles such as managing community promotional campaigns, registering participating households, identifying community entrepreneurs, planning installations, and coordinating product repayment. This is done so that the energy company can focus on its main role of provision of reliable and relevant products, development of awareness campaigns and marketing strategies, continual evaluation of the CBO competence and training of users and local technicians to participate in product installation and maintenance.

The question of product affordability is addressed by the development of financial models that will allow the program participants to pay for the micro solar systems in installments. Although the financial models vary from case to case; the basic structure is that the systems are to be paid for upfront by the SACCO/CBO who thereafter collects the payment from LUAV participants.

In the case where a revolving fund is raised by an outside source, the community has to return it within an agreed time period (normally 12 months). Though, in some cases the source of the funding may allow for it to be utilized as a revolving fund to continue the initiative. The CBO is controlled by a clear MOU that ensures the funds are exclusively used for the LUAV. The CBO will manage the collections of the monthly installments of the households. After 12 months, all collections of installments will have regenerated the revolving fund at the CBO level, ready to finance the next LUAV. The products will also be priced to with 10–20 % margins required for sustainability. This margin can be used to pay incentives to the SACCO personnel in charge of debt collection.

To ensure that the CBO is successful in the initiative, they share in the profit margin to pay for the management of the initiative. This money can be shared among group members or utilized to buy assets for the group.

In May 2013, BFP was able to partner with, a crowdfunding organization to be a financing partner for the revolving fund. This loan is interest free and the borrower has 14 months to pay back. These funds will enable BFP to scale up the LUAV program to three countries.

Once the financial aspects and payment collection processes have been set in place for the LUAV implementation, the CBO will register the participating households, upon which BFP values the systems and deploys technicians to install the micro-solar systems on the houses of each participant. The installation is carried out in parallel with a technician training program to make technical assistance available to the LUAV participants. The local technicians will handle basic questions and trouble shooting of system challenges and the BFP technicians would visit the LUAV only to deal with major faults. One important detail here is the selection of the people to be trained as technicians for the micro system; they have to have already some basic skills such as repairing phones or TV set, etc. In the absence of this they may fail to raise a living from the support to the LUAV systems and thus give up the role of technicians.

Results

The LUAV program relies heavily on partnership building within the local eco-system as well as national and global partnerships. In the beginning, partners were difficult to engage without a proven model. On the other hand, communities were willing and enthusiastic to engage with Barefoot Power to take on the eradication of kerosene and supporting renewable energy as the main source of energy in their community. Over the last two years new partners have committed upon seeing the preliminary positive results. Currently LUAV is actively engaged with partners such as WWF, CARITAS and GIZ and national governments to expand to new countries such as Rwanda, Kenya and Ghana.

At the end of 2012/2013 trial period, BFP had completed 18 LUAV projects. These projects resulted in 3,000 plus households purchasing solar home systems.

These 18 completed projects counted on the support of partnerships with 11 NGO's, 3 SACCO's and one faith based organization. Furthermore, the initiative was supported by the Ugandan Rural Electrification Authority (REA) and the local governments in each village.

It was found that only one out of the 18 projects had not completed repayment of their micro solar systems within the stipulated 12 months and the default were due to the unreliable services of the CBO involved in that particular LUAV.

Although the projects were designed to cater for at least 100 households per community some projects had as low as 28 households while others exceeded the expectations and had up to 500 households signing up and successfully paying for the systems. Table 15.1 shows a summary of the results obtained from the first 14 LUAVs installed in Uganda, all payments were collected in duration of 12 months.

The product of choice in the LUAV program, shown in Fig. 15.2, is known as the Connect 600 from BFP. It consists of a 6 Wp polycrystalline panel with a 4 Ah AGM sealed battery and 4 LED lights which give light for a minimum 6 h once fully charged. Additionally two USB output allows for charging mobile devices such as phones and tablets. A 12 V output provides for radio or fan powering. Every unit comes with a standard two year warranty. The systems currently retail for about 130 USD.

The year of 2014 has seen the advent of more equipment in the market which can be powered by such micro system. One of such is a flat screen television which some smart feature which could play the role of a gateway to internet and thus completely change the level of awareness to the modern world in rural Africa.

Findings

The LUAV program has proven its success in Uganda due to the low delinquency rate and number of successful LUAVs. The findings of the research are currently being used to evaluate the expansion options into the neighboring countries of Kenya, South Sudan and Rwanda. Through the LUAV program, the research team reported the following findings;

Table 15.1 Summary of the results for the first 14 LUAVs installed in Uganda

	Name of project	Partner and/or CBO	No of HHs	Month started
1	Kiprotich village—Kapchorwa	BFPU/MESICS	100	July-12
2	Buswiriri LUAV—Bugiri	CARITAS-JINJA/MESICS	120	July-12
3	Kasese (LUAV)—Kasese	Karambi Sacco/WWF/MESICS	70	Dec-12
4	Kyabarungira Sacco—Kasese	Kyabarungira SACCO	90	Dec-12
5	Kalalu—Iganga	Mivule/solar links	162	Dec-12
6	Friends of nature—Kasese	Friends of nature/WWF	28	Dec-12
7	Okabi—Arua	GIZ/barefoot/community	130	Feb-13
8	Fofo—Nyo	GIZ/barefoot/community	132	Feb-13
9	Tororo LUAV1—Mbale	CARITAS-tororo/mesics	500	Jun-13
10	Tororo LUAV2—Mbale	CARITAS-tororo/mesics	500	Jun-13
11	Kiwani—Iganga	Mivule/solar links	140	Aug-13
12	Maddo LUAV-Masaka	CARITAS-masaka/MESICS	300	Sept-13
13	Kiyinda LUAV—Mityana	Kiyinda-Mityana diocese	200	Sept-13
14	sos children's village—fort portal	SOS children's villages	100	Nov-13
	Total		*2,572*	

Fig. 15.2 BFP Connect600 which is the micro system utilized in the LUAV project

- A 12 month payment period for micro solar systems is considered affordable in rural Uganda. The payments were between 10 and 20 USD per month and the delinquency rate was less than 10 %.
- Community Based Organizations (CBO's) play an important role in facilitating the projects. The sustainability of such a project has been found to depend

heavily on the CBO's ability to manage the local aspects of the project including addressing the community concerns and managing the finances involved at the community level (Da Silva et al. 2011).

- Offering installation services in addition to the technology reduces failure rate of systems and provides an opportunity to build local technical capacity.
- Local partnerships build brand trust and loyalty in African markets. The element of local authenticity helps to overcome the adverse effects of market spoilage and other challenges such as cultural relevance, product education and peer influence (Savannah Fund 2013).
- Financing partners, institutions were more willing to fund the project once it was clear that they would be dealing with groups of users, SACCOs and CBOs rather than individuals. This makes it easier for accountability, to follow up payments and provides better control mechanisms such as the tracking and documentation of the project's success rate.
- The project yielded low default rates as the members of the group encourage each other to complete payments through peer influence consequently reducing the risk of delinquency due to the individual human factors. As a result, only one out of the 18 LUAV projects launched had cases of delinquency.
- Strict criteria are necessary when selecting the CBO that will partner with the energy company to carry out the project implementation. Criteria of competence must be established by the energy company for each case. This is necessary because each community is different in terms of socioeconomic activities, cultural tendencies and social make-up.
- In the LUAV trial period the collection of payments by the CBO proved to be a major bottle neck in the project development. There is need to consider the implementation of a Pay As You Go technology which would support, manage and track the revolving funds without incurring extra man power expenditure especially with the rapid increase in number of CBOs, SACCOs and villages that stand to take up the LUAV program.
- The efficiency of the solar technicians trained under the LUAV program will not be fully measurable until the two year product warranty period expires. It is worth noting that there are currently no accreditation criteria or institutions for solar technicians in East Africa. However, once the criteria have been established, the energy regulatory bodies and certifying authorities will be able to extend training services in remote areas through the existing LUAVs.

Scaling up

The LUAV builds on the BFP Reverse Rural Electrification Model described by Da Silva and Sloet (2012) and promotes the notion of decentralized energy generation and distribution. This will have major long-term implications on the considerations of energy policy makers.

To ensure scalability of the LUAV program, BFP developed strategic partnerships with local governments which in turn led to the rapid adoption of the LUAVs in Uganda. These partnerships were set up to gain the authorization, endorsement and support of community leaders who would assist in the mobilization of the community to participate in the program. Led by enthusiastic government officials and popular community leaders, the recruitment of new members went beyond the initial expectations resulting in the recruitment of up to 500 participant households in some LUAVs such as Tororo LUAV 1 and LUAV 2.

The next initiative currently in its initial stages is to partner with local telecommunication companies in the marketing and promotion of the LUAVs as well as financial support. The telecommunication companies have an interest in the penetration of mobile phone charging technologies for rural areas in Africa as these technologies would increase the use and penetration of mobile phones. Leveraging the interest of telecommunication companies and mobile phone service providers is expected to improve the LUAV uptake rate further in remote areas.

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