PHOTOVOLTAIC INDUSTRY IN UGANDA; LOCAL MANUFACTURERS OF PV COMPONENTS AND IMPORTED PRODUCTS - EFFICIENCIES AND NATIONAL STANDARDS

Dr. Izael Pereira Da Silva; Edward Kyalimpa
Makerere University; Ministry of Energy and Mineral Development.

ABSTRACT
Energy is a key factor for the development of a country. In many remote areas of the third world with good insolation such as Uganda, photovoltaic is one of the most suitable ways of providing energy to rural areas. The government of Uganda is actually pushing what is called "Rural Electrification, Strategy and Plan" to foster a massive purchase and use of Solar Home Systems. Nonetheless, in order to spread photovoltaic technology, one of the main difficulties of a country is the lack of proper framework for importation of the components, maintenance, and data on technical performance of these components. This paper does a national survey on local manufacturers of deep-cycle batteries, charge controllers, lights and inverters; panels are not available as yet and it won't be in a foreseeable future. Given the importers possibilities, it also does an economic analysis comparing products from China, India, Europe and USA, taking into account the actual governmental position in terms of taxes on photovoltaic products. Some valuable data are presented on the experiences of NGO's and local communities; how successful have they been, problems they face, etc.
The concern about quality and the idea of providing the costumer with a reliable product drove the authors also to analyse the documents of the Uganda National Bureau of Standard establishing national standards and minimal warranty for all components related with solar energy and write some few considerations. Finally, taking advantage of other countries experiences a specific solar home system is designed for Uganda users.

1. INTRODUCTION

Until three years ago only two companies were dealing with PV components and installation in Uganda. Today we have more than 30 PV dealers and the number of Solar Home Systems (SHS) installed in the country is close to 2000.
Solar PV systems are the least cost technology for providing electricity to small, scattered communities. The strategy of the government is to assist the development of the solar PV market to a scale that permits a nation-wide marketing and after sales service network to be established. High subsidies from the Rural Electrification Fund (REF) will be given to the institutional systems (water pumping, health, education) to strengthen the quality of local social services; the SHS market will receive grant support during the initial market build-up phase.
About 4 million households in Uganda do not have access to electricity; about 3.7 million live in rural areas. This means a huge market to be tapped.
The major disadvantage of PV systems is their limited capacity. They are only able to satisfy households, and small commercial requirements (lights, TV, radios, computers, etc). Thus PV systems do not offer the same scope for rural income generation available from grid-based systems (milling, welding, refrigeration).

However, PV may be the only option for isolated social centres (schools, clinics, etc) and for communities that are far from the grid and do not have reliable hydro or biomass supplies.
An inventory/map of comments or settlements that can neither be accessed by the neither grid nor electrification-using mini-grid. These communities or settlements will be candidates for PV electrification.
In line with the Rural Electrification Strategy and Plan, the REF has a provision for grants amounting US$ 7.5m per year for stand-alone systems using renewable energy such as solar home systems.
US$ 800 - PV, 2700 - minigrid, 1500 - grid extension up to 30% for PV.

2. LOCAL MANUFACTURERS:

In Uganda, one willing to buy locally made PV products will find deep cycle batteries made in Kenya; Uganda Batteries Ltd produces, for the time being, only automotive ones, which are also used for PV system purposes by most of the PV suppliers. All other components of a SHS made in Uganda, except for the panels. There are two main manufacturers of voltage controllers, inverters and DC lamps, Lwanga Electrical and Electronic Machines Ltd and Uganda Electronics and Computers Industry Ltd.
The advantages of the locally made products are:

- Warranty given by the manufacturer, not the trader.
- Spare parts always available
- Orders are made easily, procurement is prompt
- The technology is passed to local technicians and after sales support is made easier

- Products are made to serve local conditions
- Saving and earning in foreign exchange
- Job creation
- Provide government does not tax much the cost of the product is lower that any similar imported one.

Nonetheless, two companies are too little. They show how insufficient is still the PV market in Uganda. Besides, to start a company to make those equipment requires experience not only in technical matters but also in business and marketing.
Inexperienced local companies, on the early, part of their learning curve and inadequately supervised, can seriously discredit the technology and set back its dissemination for years.
The first step towards a stronger local manufacturer is to encourage the local assembly of kits. Donor agencies in co-operation with PV companies from their own countries are in strong position to start a process of delegating as much as possible of the assembly and installation work of local companies.
It all depends on the level of development of the industrial infrastructure.
The local products have not been subjected to tests and efficiencies therefore one cannot guarantee its performance, except for the charge controllers which are UL listed.
The imported ones (except the Chinese) are all approved by the international standards (UL listed).

3. THE ROLE OF NGO'S AND OTHER INSTITUTIONS

In order to foster the PV industry in Uganda, four points must be fostered:

1. To promote high quality system design, installation, operation and maintenance practices which meet and exceed the performance and reliability expectations of end-users.
2. To provide technical and other information that removes market barriers to PV technology by identifying promising new markets and developing value propositions for end-users.
3. To promote the growing confidence and increased interest in the economic and environmental value of PV systems among utilities, building owners/operators, and other key end-users.
4. To help to develop a sustainable renewable energy industry with "system-knowledgeable" professionals.

To attain those objectives in Uganda, Makerere University has begun a cooperation programme with the Florida Solar Energy Centre (FSEC) in USA.
This cooperation aims at providing Makerere University with a Distance Learning Centre to train students from Makerere and other tertiary institutions, technicians' from the PV industry and any other interested party.
Another area of cooperation involves the setting up of a Testing Laboratory to test and certify the various equipment and energy technologies. Uganda lacks this facility and therefore this laboratory could also be an income generating facility as the private sector would be required to certify their products according to the standards of the Uganda National Bureau of Standards (UNBS).
The diagram in Figure 1 shows how this cooperation FSEC-Makerere can have a national wide influence in setting the PV industry. Under the caption Government we have UNBS, URA, ERA and District Authorities.
These institutions mentioned in Figure 1 are:
UREA: Umbrella organisation supported by the Ministry of Energy and Mineral Development for all PV companies aiming at private sector promotion. It embodies PV dealers, manufacturers, NGO's, etc. It was created in 1997 to promote the use of renewable energy in Uganda, lobbing for fair taxation, sound competition, quality of the products, etc.
UNBS: Uganda National Bureau of Standards
ERA: Electricity Regulatory Authority; created in the Electricity Act of November 1999, this institution is in charge of managing the Rural Electrification Fund (REF) for the widespread of electricity in the country.
URA: Uganda Revenue Authority, this institution is in charge of tax collection in Uganda and can play an important role in the import duties and taxation on PV products. Other institution also present in Uganda is UPPPRE;
The UPPPRE is a pilot project whose goal is to establish the foundation for the sustainable use of PV technology for rural electrification in areas, which will not be accessed by the national electric grid in the foreseeable future. Its objective is to overcome the financial, social, and institutional barriers that presently exist to the widespread dissemination of the technology within Uganda. The targets of the project are individuals, communities and government services, which have the ability/willingness to pay the real market cost of PV-based services. It is expected that a rapid scaling up of PV-based rural electrification activities will begin on or before the completion of the pilot project.

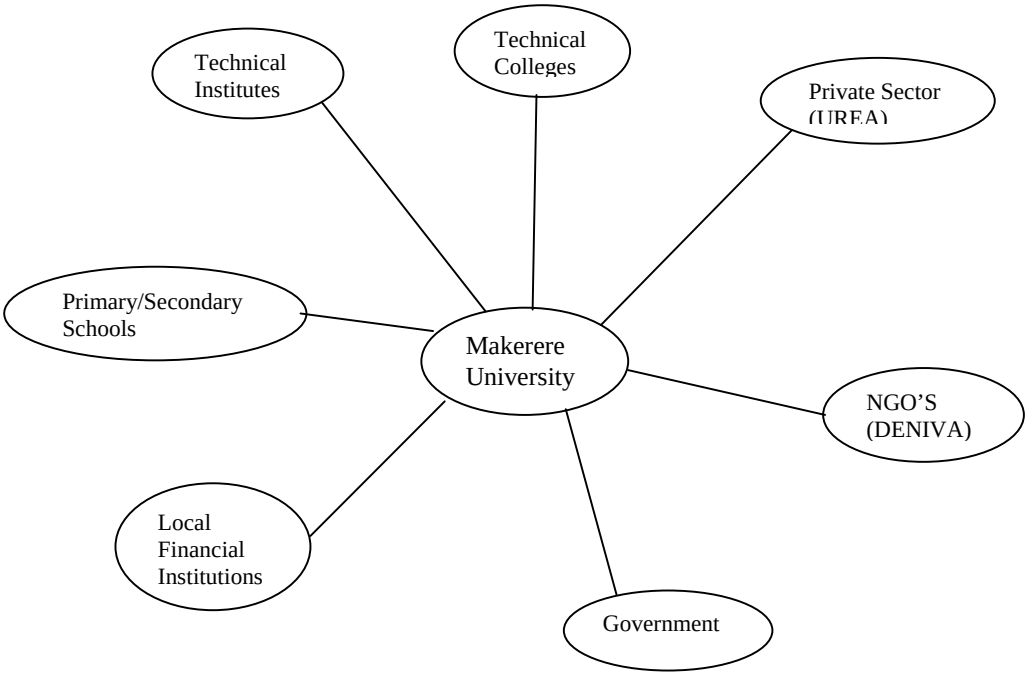

Figure 1 : Proposed diagram for the cooperation FSEC – Makerere University

4. EFFICIENCY AND NATIONAL STANDARDS

PV kits are costly and relatively sophisticated pieces of equipment. It is extremely easy for purchasers to suffer at the hands of incompetent or unscrupulous vendors or installers. Deliberate undersizing of batteries and the area of panels or the omission of charge controllers are common ploys to reduce the costs of installations. Installation is often poorly carried out, with panels facing the wrong way, shaded by trees or buildings, or inadequately fixed to their supports. All of these errors can lead to poor performance or the complete failure of installations.

Government can protect the public by setting standards for PV suppliers and taking measures to ensure they are observed. National standards normally should be based on accepted international standards. Right now in Uganda there is no capacity for testing and certification of products but Makerere University is aiming at playing this role as we have seen in the previous section.

Another effective way of ensuring that standards are set and observed is through the establishment of PV trade associations pledged to their observance. In Uganda this role is played by UREA.

Even though at the moment Uganda cannot provide certification for PV products, at least the UNBS is working on a National Standards and Minimal Warranty for the main products. Table 1 shows a suggested life span warranty for some products:

Table 1: Minimal Warranty for PV products

	Life time (years)
Battery	3
PV Array	20
Charge controller	3
Power Inverter	10
DC luminaries	2000 hours

4.1 Imported Duties and Taxes

One of the most common pleas by promoters and vendors of PV equipment is that import duties and taxes on components and kits should be reduced or abolished. The question is, however, a contentious one. Some government believe that PV equipment should be exempted because it is used for harnessing a renewable energy source and therefore deserves special treatment. Others feel that PV kits, as consumer goods acquired by upper class and middle-class families for consumption rather than production, should bear the full burden of taxes and duties levied on such products.
Removal or reduction of import duties and taxes can certainly encourage PV use by lowering prices. Whether the benefits of achieving this justify the loss of revenue is a matter for detailed assessment by each country, but where substantial subsidies are provided for kerosene or conventional rural electrification, it would appear reasonable for governments to reduce or eliminated taxes and duties on PV's.
In Uganda, the Finance Act passed last year makes that panels and SHS are tax free except for VAT. Though batteries, DC-lamps and others components bought separately are still bound to pay duties and taxes.

5. IMPORTED PRODUCTS

As mentioned before, presently Uganda has around 30 PV suppliers. Those companies commercialise products from USA, Europe, India and China. The cheapest SHS available is a Chinese plug and play 4 W which can be purchased for around US$100. Prices go up as one request for more reliable products. Except for the Chinese ones, all the other imported components are UL listed and are given warranties compatible with the ones listed in Table1. A 20 W SHS can be purchased for around US$ 350 and one 100 W can vary from US$ 1000 to US$ 1500. Makes are MasterVolt, Trace, Sundaya, Labcraft, Triple Junction, Morningstar, Solarex, etc.
The main problem encountered by these companies is the lack of proper financial framework to increase the power of purchasing of the Ugandans living in rural areas.

6. SHS TAILORED FOR UGANDA

Given the UPPPRE experience with SHS being installed for tests in the rural area, some quite interesting points where found and based on that we propose some guidelines for a successful installation of a SHS in Uganda. First it cannot be lower than 20 W. It rules out the smallest Chinese made with only 4 W. More and more Ugandans can afford a mobile phone which needs to be charged, a radio or a B/W TV are also within the reach of almost everybody.
The installation of a small 1 W lamp in the bedroom makes it simpler for a person to wake up I the middle of the night without having to switch on a say 8W lamp for just a couple of minutes. This kind of lamp was installed in some SHS in Brazil and the result was that much less energy was spend after people had gone to sleep.
An external security lamp is also desirable for it gives a psychological feeling of safety.
More and more households in the rural areas are being constructed with bricks in the western style, which means more than one room, and therefore need for at least 3 lamps, apart from the small one for the bedroom.

7. CONCLUSIONS

We are still a long way to go from a nation wide usage of solar PV technology. Many factors are concurring to it: lack of knowledge of the technology by the potential end-users, lack of proper framework from the Government regarding local PV manufacturers and imported PV components, Lack of proper trained technicians at a district level, etc. Nonetheless, Uganda has an immense potential for the PV industry and a proper cooperation between Makerere University and FSEC, backed by the World Bank fund Energy for Rural Transformation, can put Uganda in a short future in an excellent position in terms of Africa.

8. AUTHORS

Principal Author: **Izael Pereira Da Silva** Holds a PhD in Power Systems by the University of Sao Paulo Brazil. Has been lecturing Energy Utilization and Electricity and Magnetism for four years at Makerere Faculty of Technology. Has been engaged in research regarding renewable sources of energy and Electricity policies for the last three years, in cooperation with the Ministry of Energy.
His address is: Makerere University
P O Box 7062, Kampala – Uganda
Telephone 256 41 543594

Co-Author: **Edward Kyalimpa** obtained a B.Sc. Degree in Chemistry in Makerere University, 1992. Did a post-graduate Diploma in environmental science and technology in the International Institute for Hydraulic Infrastructure and Environmental Engineering, Delft, The Netherlands. Trained as solar PV technician at KARADEA Regional Solar Training Facility in Karagwe Tanzania. Appropriate Technology Officer for Uganda Rural Development and Training Programme since 1993 to 1998. Was the responsible for the implementation of a solar-based rural electrification project. Over 200 SHS have been installed under this project. Currently is working for Uganda Photovoltaic Pilot Project for Rural Electrification as a solar PV technology specialist .