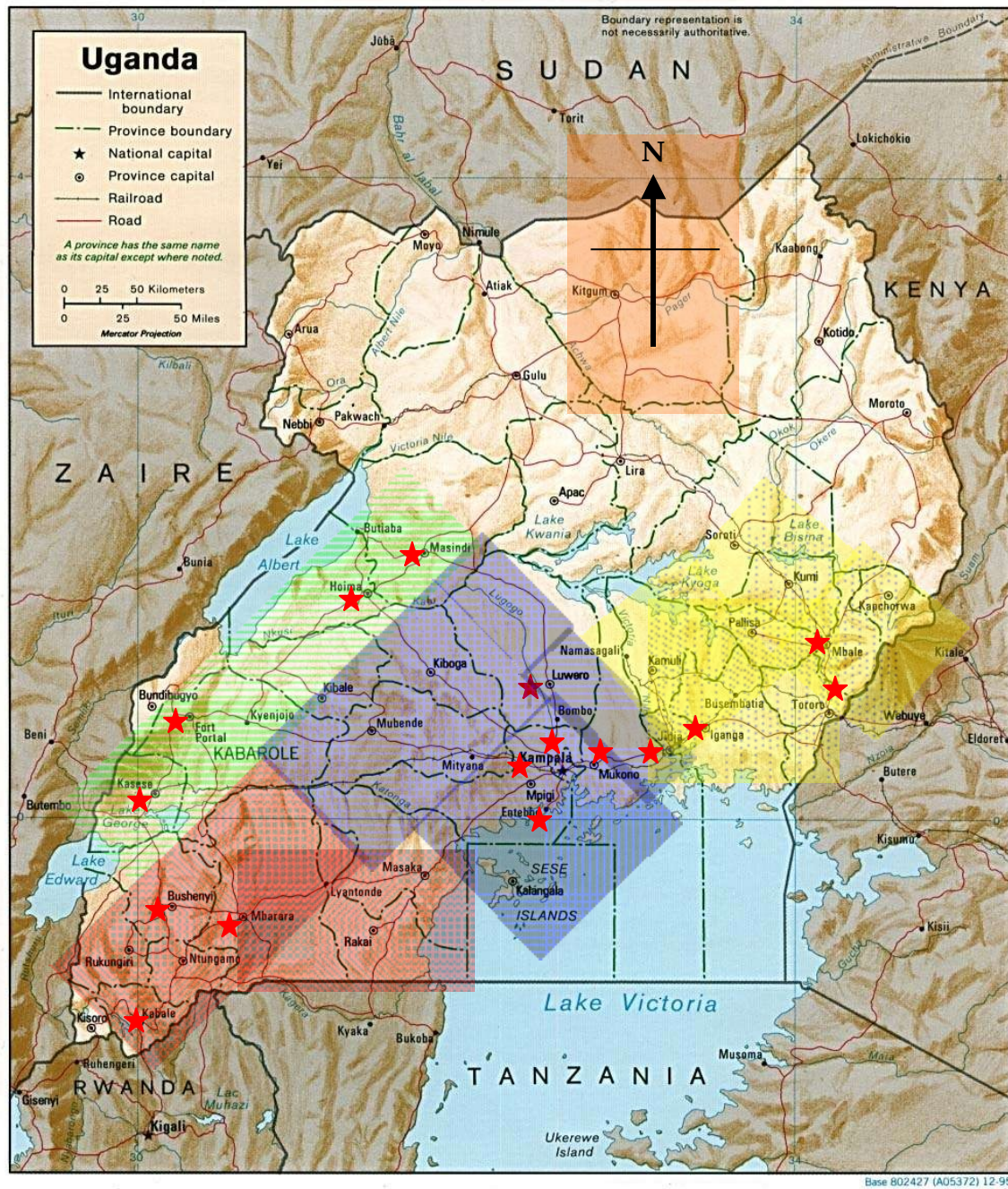







### Map of Uganda showing the study regions and districts



## Key

-  South-western region  
 Central region  
 Eastern region  
 Western region  
 Districts Surveyed

## PART ONE:

### BACKGROUND

Uganda's population is estimated to be 30 million people and is growing at an average rate of 3.6% per year (CIA, 2006)<sup>1</sup>. The growing population is obviously exerting pressure on the existing natural resources in quest for food, habitation, social, economic and environmental well being. Although the country's economy is reported to be impressive with an average real rate of GDP growth of 6.4% since 1991 that has led to an annual 3.3% increase in real GDP per capita, the majority of the population is poor experiencing hampered social and human development. The poverty levels in Uganda are reflected in the consumption pattern of modern energy that includes fossil fuels, hydropower and wind, solar and geothermal energy. The per capita consumption of these energy sources in Uganda is very small ranging from 5% to zero (*Annex I*). The supply and availability of energy is critical to the social and economic transformation and development of the country.

The main energy sources in Uganda are hydropower, fossil fuels and biomass (firewood & charcoal). The use of solar as a source of energy for lighting, heating and operating machines was not well known in Uganda, until recently in the 1980s when its use began to increase in the country. Solar is increasingly becoming an important electricity source, because of the scarcity of electricity and escalating tariffs from the conventional hydro- and thermal- power sources in the country. This is due to the failure by government to provide additional hydropower sources, the high operational costs of the existing and planned thermal power plants and the failure to develop other alternative electricity sources such as co-generation, wind and geothermal potential sources in the country. This is further aggravated by the recent unbundling and privatisation of the energy sector into many entities, namely; Electricity Regulatory Authority (ERA), Uganda Electricity Generation Company Limited (UEGCL), Uganda Electricity Distribution Company Limited (UEDCL), Uganda Electricity Transmission Company Limited (UETCL) and concessionaires ESKOM and UMEME all dependent on a single tariff for their operations and maintenance, resulting into the exorbitant and unaffordable tariffs that are currently being charged on the electricity consumers.

Consequently, some Ugandans have resorted to obtaining own (individual) electricity options to meet their domestic needs, which include installation of solar equipment and privately operated thermal generators. This, of-course, means that most of the people unable to purchase private-owned electricity sources are doomed to the erratic and unreliable national electricity grid that is characterised by frequent and rampant load-shedding and power-cuts, which is undermining peoples' operations (businesses) and the country's economy. The remaining people who have no access to any of these electricity sources are compelled to rely on fire-wood and charcoal for cooking and candle wax and kerosene for lighting. Use of gas for cooking and lighting is very rare in the country.

It is against this background that the National Association of Professional Environmentalists (NAPE), with financial support from SIEMEMPUU Foundation, decided to conduct a study in Uganda to assess the use and viability of solar energy in the country based on the following objectives

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1 . CIA World Fact Book, 2006

- To assess the use and viability of solar energy in Uganda;
- To identify the limiting factors for solar energy installation and use in Uganda; and
- To suggest interventional strategies for the promotion of solar energy use in Uganda

This report contains the results of the study that was conducted in 4 regions of the country, namely; eastern, central, southern and western part of the country. The north of the country was not covered by this study, because of the insecurity that has plagued the region.

## PART TWO

### APPROACH AND METHODOLOGY

The study was conducted in 4 geographic regions of the country, namely East, Central West and South-west. The North was omitted from the study because of the uncertainty of the prevailing security situation. The following districts were therefore covered:-

- Jinja, Iganga, Busia and Mbale in the Eastern region;
- Kampala, Wakiso, Mukono, Luwero and Entebbe Municipality in the Central region;
- Masindi, Hoima, Kasese and Kabarole-Fort Portal in the western region; and
- Mbarara, Bushenyi and Kabale in the South-western region.

The study was based on purposive sampling and was supported by guided questionnaires (*Annex II, III & IV*) and literature review. It was conducted through field visits, face-to-face interviews and focus group discussions. The selection of the sample for the individual interviews was based on the users and dealers of solar energy technologies. The research team was helped by district authorities to identify the solar technology users and dealers in each visited district. Focus group discussions were organised and held in each of the local communities visited in which opinions of people concerning solar energy use were obtained. The focus groups varied between 5-15 participants from village to village. A total of 635 respondents were interviewed and consulted in the study. These comprised of district authorities, policy makers, officials in the Ministry of Energy and Mineral Development, solar technology users and dealers. Other important parameters considered in the study were whether respondents used single or a combination of energy sources for their lighting and cooking needs.

A research team was dispatched to each of the regions to collect information. The team visited each selected respondent and conducted face-to-face interviews. After the interviews, focus group discussions were held within the local communities.

The quantitative and qualitative data obtained was pooled and analysed statistically. This data has been packaged and correlated with other information to prepare this report. The study lasted a period of 5 months.

## PART THREE:

### OVERVIEW OF ENERGY SOURCES IN UGANDA

The country's Energy Policy 2002 is *"to meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner"*. The need for an energy policy is also enshrined in the Constitution of Uganda (1995) which states that *"the State shall promote and implement energy policies that will ensure that people's basic needs and those of environmental preservation are met"*. In order to achieve this constitutional and policy provisions, there is need for the population to have access to adequate, affordable, reliable, quality, safe and environmentally benign energy services to support economic and human development. The lack of this access is the cause of the current prevalent energy poverty in the country. This energy poverty is also linked to other poverty dimensions of health, education, monetary and non-monetary (Mueller, 2003)<sup>2</sup>, agriculture, forestry, industry, transport, water and sanitation. The energy sector has the greatest environmental impacts in contrast to other sectors and therefore often undergoes greater scrutiny. The following are the main sources of energy in Uganda.

#### Hydropower

Uganda has an enormous hydropower potential (2200MW)<sup>3</sup> that is not being effectively and efficiently developed and utilised. Uganda has an installed capacity of 380MW of hydropower and is planning to install additional hydropower capacity at the proposed Bujagali (250MW) and Karuma (200MW) hydropower stations on River Nile. Despite these hydropower developments, the country is currently producing only 140MW. This is because of the declining amount of water available in the River for power generation and also due to problems associated with the planning and development of the existing hydropower potential. Although hydropower is environmentally benign, it is currently expensive and still remains unaffordable to the majority of the people. Only few people can afford it. There is a need to make hydropower affordable to the majority of Ugandans, if it is going to be the engine of socio-economic transformation of the country.

#### Geothermal

Uganda has a geothermal potential of 450MW<sup>3&4</sup>, but this potential has stagnated at the stage of exploration for the last 30 or more years. No concrete intervention has been put in place for its exploitation. Kenya is the only African country that has exploited its geothermal potential with an installed capacity of 128 MW (NAPE, 2005)<sup>5</sup>. Geothermal power is cheaper and has lesser negative environmental impacts than hydropower (BEL, 2007)<sup>6</sup> and therefore demands greater commitment and determination on the part of government to develop it as an additional energy source for the country.

#### Wind Energy

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- 2 . Mueller, A.M. (2003). Baseline Study: Energy Poverty in Bushenyi District, Uganda. Ministry of Energy and Mineral Development (MEMD). Summary Report. 62pp.
  - 3 . Energy Master Plan (1994). Ministry of Energy and Mineral Development, Uganda
  - 4 . Energy Policy (2002). Ministry of Energy and Mineral Development (MEMD).
  - 5 . NAPE (2005). Promoting Sustainable Energy Development: A guide to geothermal development in Uganda
  - 6 . Bujagali Energy Limited (BEL). (2007). Bujagali II-Economic and Financial Evaluation Study

Wind energy is promising in Uganda, especially along lake shores, hills and the northern flatter parts of Uganda that experience wind speeds of more than  $6 \text{ m s}^{-1}$  that can operate wind turbines. However, the contribution of wind energy to national energy needs is often downplayed by government technocrats on the basis that the lower wind speed are the ones most prevalent in the country and therefore make wind energy less efficient. Yet, no studies have deliberately been done to assess the contribution of wind energy in Uganda. The reported wind speeds have been recorded during the determination of weather at heights lower than those recommended for wind turbines. Additional studies are still required to assess the contribution and viability of wind to the energy needs of the country.

### Solar Energy

Uganda is endowed with sunshine that well distributed and high throughout the year. The country experiences  $5\text{-}6 \text{ kWh M}^{-2}$  radiation<sup>7</sup> per day on flat surfaces (MEMD, 2004)<sup>8</sup>. This insolation is highest at the Equator, but varies up to a maximum of 20% from place to place away from the Equator. It is highest in the dryer areas (north-east) and lowest in the mountainous areas (south-west) of the country. Solar radiation is also influenced by cloudy weather. Apart from its traditional direct use for drying foodstuff and clothes, solar energy is being used with appropriate technology for cooking food, water heating, refrigeration, lighting, telecommunications, and etc. in households, offices, hotels, schools and other organisations in Uganda. However, the scale at which solar energy is being used for purposes other than drying clothes and foods in Uganda is still very small. The use of the sun's radiation to generate electricity and heat energy for lighting and cooking is increasing greatly. It also has the potential of reducing the current demand exerted on the existing national grid-based power and consequently eradicating the negative impacts caused by over harvesting of the biomass resources by the masses.

### Fossil Oil

Uganda currently imports all its fossil oil needs through Kenya and Tanzania. The country has been consuming over  $550,000 \text{ m}^3$  of fossil oil annually in the form of petrol, diesel, kerosene, aviation fuel and lubricant oils (MEMD, 2004). The national annual consumption of these oils will definitely escalate in the coming years with the continued reliance on thermal power to supplement hydropower needs. These will obviously hike national expenditure and deplete national treasury reserves on the importation of these oils. There is need therefore to develop alternative and cheaper oil and other energy sources. In an effort to address this need, Uganda started in 2004 exploration exercises for oil in the western Rift Valley of the country that have proved promising ever-since. These oil finds are predicted to meet all the county's fossil fuel needs in the near future. Despite this development, use of fossil oil will essentially remain in the domain of the rich (high income) households and the energy-intensive commercial and industrial sectors, with the exception of kerosene which is used by the poor for lighting and limited cooking.

### Biomass (firewood, charcoal, crop residues & bagasse)

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7 . Energy Policy, (2002). Africa: improving modern energy services for the poor. Ed. S. Karekezi, M. Mapako & M. Teferra. Elsevier 1142p

8 . MEMD. 2004. Uganda Energy Balance. Ministry of Energy and Mineral Development (MEMD).



Biomass (i.e. firewood, charcoal & crop residues) is the commonest source of energy in Uganda. It accounts for 93% of the total energy consumption in the country (MEMD, 2001)<sup>9</sup>. Despite its importance, there is no comprehensive biomass energy demand strategy for the country. Of these biomass sources, firewood is the most predominant energy source in homesteads, institutions and some industries consuming up to 30% of commercial firewood. Charcoal constitutes 15-20% of the wood supply in the country (MEMD, 2001). Reliance on biomass energy also has several drawbacks related to the resultant environmental and health problems. The environmental problems are related with the depletion of forest cover and resultant change in macro- and micro-climates of the affected areas. The health problems are attributed to the resultant air-pollution due to burning and injuries during collection of the biomass material. Despite the associated problems, biomass offers attractive opportunities, if used in bagasse-based co-generation of electricity. Also, a number of innovative low-cost renewable energy technologies (e.g. energy saving stoves, etc) have been developed that reduce emissions and the demand for wood. These low-cost renewable technologies are suitable for the rural and urban poor and are increasingly becoming successful and effective, especially now when there is an increasing scarcity of firewood and trees for charcoal.

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9 . MEMD. 2001. National Biomass Energy Demand strategy 2001-2010. Ministry of Energy and Mineral Development (MEMD). 44pp.

## **PART FOUR:**

### **USE OF SOLAR ENERGY IN UGANDA**

Despite the abundance of solar energy in Uganda, its use as an electricity and heat source is still limited. The study found out that there were more solar energy users in the south-west and central regions than in the other regions. This could have been due to the government's programme to promote solar energy called the Uganda Photovoltaic Pilot Project on Renewable Energy (UPPPRE) that was conducted in these regions and also due to the presence of Non-Governmental Organisations (NGOs) and churches in the regions that offered soft loans and credits to people interested in using solar technologies. While there are credit schemes offered by banks and micro-finance institutions in the west and east for purchase of solar equipment, response towards these schemes has been minimal, because they are not well known by the public and also because of the high and disadvantageous interests charged on the loans provided by these financial institutions.

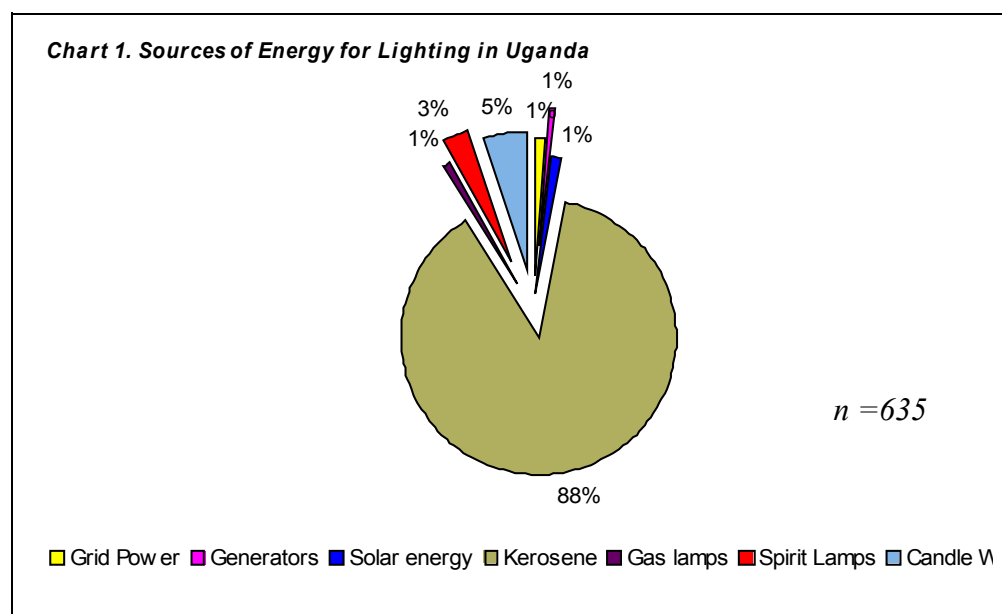
Of those interviewed and consulted, the majority were households. A few institutions such as health centres, clinics, hotels, restaurants, lodges, schools and hospitals use solar energy mainly for lighting and water heating. A total of 45 solar energy dealers were identified during the study. These dealers were mainly based in Kampala, although some had upcountry distribution points in the studied districts. Information obtained from the Ministry of Energy and Mineral development is that Government plans to install a 50MW capacity solar power station along Entebbe road as additional source of electricity.

Solar energy equipment are used to overcome the frequent load-shedding and high costs incurred using national grid electricity that has turned out to be unaffordable in the recent past and also to cater for electricity needs in areas not served by the national grid.

#### **Sources of Energy for Lighting in Uganda**

The study confirmed that the main sources of lighting energy in the country are national grid electricity, thermal generators, solar equipment, rechargeable touches, candles wax and kerosene, gas and spirit lamps. According to the people interviewed and consulted, the commonest source of lighting energy is Kerosene that is used in modern lamps and locally made Paraffin candles ("*Tadoba*") (Chart 1). This was followed by the use of candle wax and spirit lamps. Grid electricity, gas, solar energy and generators were the least used sources of lighting energy. While a combination of different light sources was used, they were not common.





**Table 1. Comparison of Energy Sources for Lighting**

The different sources of energy for lighting in Uganda were compared to relate the advantages, disadvantages and associated costs (expenditures) as a means of determining the most appropriate option. The comparison was based on a house with 3 bedrooms, a sitting-room, bathroom, 2 security lights and a kitchen and store using the light source over a period of 5 years. This includes the costs of purchase, installation and use for lighting, water heating, radios, television and fridges (where applicable) for a period of five years.

Energy Source	Advantage	Disadvantage	Annual costs for a 10 bulb household over 5 years (Ug.shs)
Solar	<ul style="list-style-type: none"> <li>➤ No monthly bills;</li> <li>➤ Readily available;</li> <li>➤ Can be used directly;</li> <li>➤ Simple and cheap technologies can be used;</li> <li>➤ It is safe to use;</li> <li>➤ Environmentally friendly.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Limited application;</li> <li>➤ It may not be viable for industrial purposes;</li> <li>➤ Requires expensive technology to convert solar energy into electricity</li> <li>➤ High propensity for theft</li> </ul>	<ul style="list-style-type: none"> <li>➤ Purchase 2,500,000;</li> <li>➤ Installation 500,000;</li> <li>➤ Annual Servicing costs 10,000 (50,000 in five years).</li> <li>➤ <b>Total = 3,050,000</b></li> </ul>
Hydropower	<ul style="list-style-type: none"> <li>➤ Relatively cheap to generate by international standards;</li> <li>➤ Has wide application;</li> <li>➤ Limited emissions;</li> </ul>	<ul style="list-style-type: none"> <li>➤ Monthly bills;</li> <li>➤ High costs of installation and connectivity;</li> <li>➤ Can cause shocks and death.</li> <li>➤ Requires large volumes of fast running waters to be effective;</li> <li>➤ Not easy to connect to some rural areas</li> <li>➤ Has major social and environmental impacts</li> </ul>	<ul style="list-style-type: none"> <li>➤ Purchase 300,000;</li> <li>➤ Installation 300,000;</li> <li>➤ Monthly bills 80,000 (4,800,000 in five years)</li> <li>➤ Annual 120,000 (600,000 in five years);</li> <li>➤ <b>Total = 6,000,000</b></li> </ul>
Thermal (diesel or Petrol)	<ul style="list-style-type: none"> <li>➤ Has wide application;</li> <li>➤ Easy to install;</li> </ul>	<ul style="list-style-type: none"> <li>➤ Expense to operate and maintain;</li> <li>➤ Significant emissions and</li> </ul>	Costs are very variable from individual to individual, but are

	<ul style="list-style-type: none"> <li>➤ Moveable;</li> <li>➤ Can be used in the absence of other energy sources</li> </ul>	<ul style="list-style-type: none"> <li>pollution;</li> <li>➤ Significant environmental and health impacts;</li> <li>➤ Is noisy</li> <li>➤ Has bad odour;</li> <li>➤ Has a lot of energy wastage in form of heat;</li> <li>➤ Based on a resource that is easily depleted</li> </ul>	obviously higher than those for hydropower, if used daily <ul style="list-style-type: none"> <li>➤ Purchase 2,000,000</li> <li>➤ Installation nil</li> </ul> Operation at 10 litres per day working 20 hours with 4 of rest (3,650 Lt per year). At a price of shs 2,200 per litre = 8,030,000 annually (40,150,000 in five years); <ul style="list-style-type: none"> <li>➤ Servicing costs at shs 10,000 per month (600,000 in five years)</li> <li>➤ <b>Total = 42,750,000</b></li> </ul>
Kerosene (Paraffin)	<ul style="list-style-type: none"> <li>➤ Can be used for lighting and cooking as an open flame;</li> <li>➤ Can be bought in small quantities according to need;</li> </ul>	<ul style="list-style-type: none"> <li>➤ Open-air combustion of Fossil oils (fuels)</li> <li>➤ Source of fires that cause loss of life and property damage;</li> <li>➤ Based on a source that is easy to deplete;</li> <li>➤ Significant emissions and pollution;</li> <li>➤ Significant negative environmental and health impacts;</li> <li>➤ Produces a lot of soot</li> <li>➤ Unpleasant odour;</li> <li>➤ Expensive to use;</li> <li>➤ Has limited application</li> </ul>	At a price of shs 1,700 per litre and consumption of 8 litres per week, annual cost would be shs 709,142 (3,545,710 in five years) <p><b>Total = 3,545,710</b></p>

Based on Table 1, use of solar technology as a lighting, radio, television, refrigeration and water heating energy source is 14, 1.97 and 1.2 times cheaper than using thermal, hydropower and Paraffin (Kerosene) in five years, respectively. It is therefore prudent to install solar energy technologies, if people are to make economic gains.

### Sources of Cooking Energy

The study also confirmed that the commonest source of cooking energy was biomass (firewood in the rural areas & charcoal in the urban centres). These were followed by Kerosene (Chart 2). Grid electricity, solar energy and gas are rarely used for cooking. Grid electricity and gas are used for cooking by mainly the rich (high income earners) in urban centres. Other ordinary people in the urban centres use grid power to cook using simple electric coils. There have been reports of power thefts from the grid by people who have unregistered (illegal) grid connections (BEL, 2007)<sup>10</sup>. This is because of the very high grid electricity tariffs that are unaffordable to the majority of the people. Photo 1 below shows solar equipment used for water heating in buildings.

10 . Bujagali Energy Limited (2007) Bujagali II-Economic and Financial Evaluation Study.



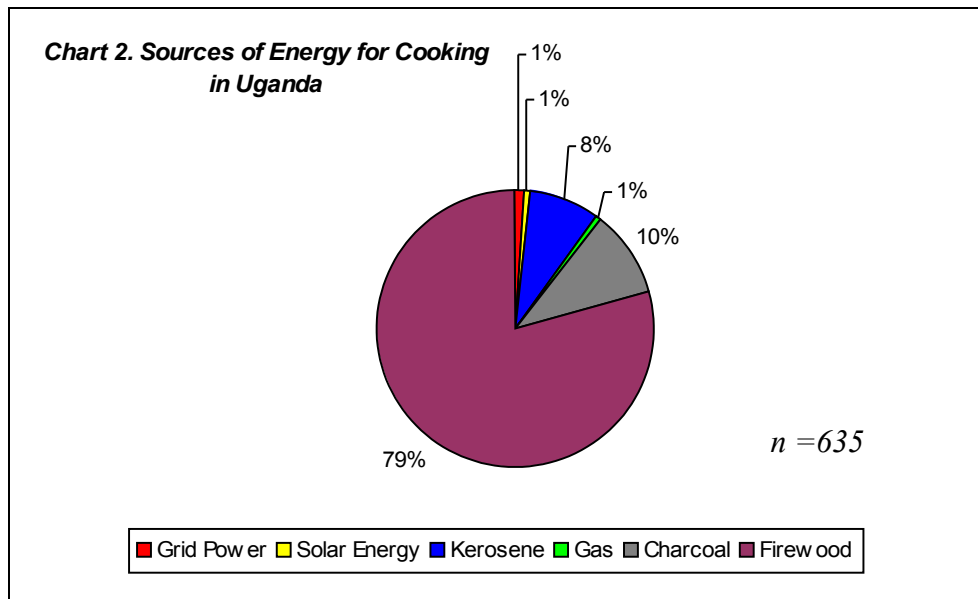
*Photo 1*

Source: NAPE File Photo

*Photo 1. Solar panels used for water heating on a building in Kampala city*

The use of solar energy technology in cooking is based on the thermal-electric systems and is still a new practice that has not yet become common in Uganda. Solar thermal-electric systems convert the sun's radiation in either heat or electric current used to cook food or heat water. Examples of solar thermal systems are the parabolic trough systems (Photo 3), parabolic dish system (Photo 4). The parabolic system consists of a parabolic reflector that reflects the sun's heat onto a cooking pot at the foci. Although there are efforts (also enshrined in the national energy policy) to promote solar energy technologies in Uganda, their use and application are not yet widely known and spread in the country.

The people interviewed and consulted do not use generators to cook food, because of the high operational costs. Gas is mainly used for cooking food by the rich people (high income earners) and some hotels in the urban centres. People who use gas for cooking are very few. The use of gas is also limited by the underlying fear of the risks of fires, especially in homes with children or people not conversant with using gas systems. Although use of a combination of energy sources for cooking was reported in the country (UBOS, 2005/6), this study revealed that the majority of the people interviewed relied on a single energy source for their entire cooking.



### Reasons for the Choices of lighting and Cooking Energy

People choose their lighting and cooking energy sources based on its affordability, availability and convenience.

Although, Kerosene, Charcoal and firewood are obviously cheaper energy sources for cooking, they are a cause of enormous environmental degradation, whose true monetary value may not be accurately computed, but whose negative impacts are real and severe. Further research is necessary to determine the actual environmental costs in monetary terms, so as to be able to determine the actual impact of using Kerosene, Charcoal and firewood in relation to other energy sources in order to determine the best option.



*Photo 2. Solar Panels used to Generate Electricity*



## PART FIVE:

### VIABILITY OF SOLAR ENERGY TECHNOLOGIES (EQUIPMENT) IN UGANDA

#### Knowledge (Awareness) on Solar Energy Use and Equipment in Uganda

Apart from the general knowledge that the sun's radiation is used for drying clothes and food stuffs, the majority of Ugandans are not aware about the use of solar technologies to generate electricity, heat water and cook food. This is due to little or lack of education or sensitisation in this regard.

As for those who have some knowledge on solar energy technology use, they said that:-

- The equipment is expensive to purchase and install initially, although in the long-run, it is cheaper than grid electricity;
- It has limited application and use domestically and commercially;
- It is convenient, safe and has no monthly bills compared to conventional electricity and heat sources;
- It is good for rural communities not served by the national electricity grid and where biomass resources are extremely depleted and scarce;
- It is environmentally benign;
- With the right technology, It is used for cooking and drying foods and fruits;
- Direct sunshine is also used to dry clothes and foods (Photos 5 & 6);



Photo 3



Photo 4

*Parabolic Solar Energy Panels Cooking Food (Photos 3 & 4)*



Photo 5



Photo 6

*Photos 5 & 6. Fruit Solar Driers that use the Sun's direct radiation*

Photographs 5 and 6 shows new fruit solar drying technologies that are highly effective ([www.sfsu.edu](http://www.sfsu.edu). & [www.nextbillion.net](http://www.nextbillion.net)). The technology in Photo 5 was developed in Uganda by Industrial Research Organisation with support from German Technical Cooperation and the Ministry of Energy and Mineral Development. Farmers in Uganda are optimistic that these technologies will reduce the massive post-harvest losses that are prevalent in the fruit, vegetable, cereal, legume, beverage, oil seed and other foods production sector. Unlike other drying processes, these technologies take less time and consume less energy. The dryers are easy and cheap to make. They can be made using locally available materials.

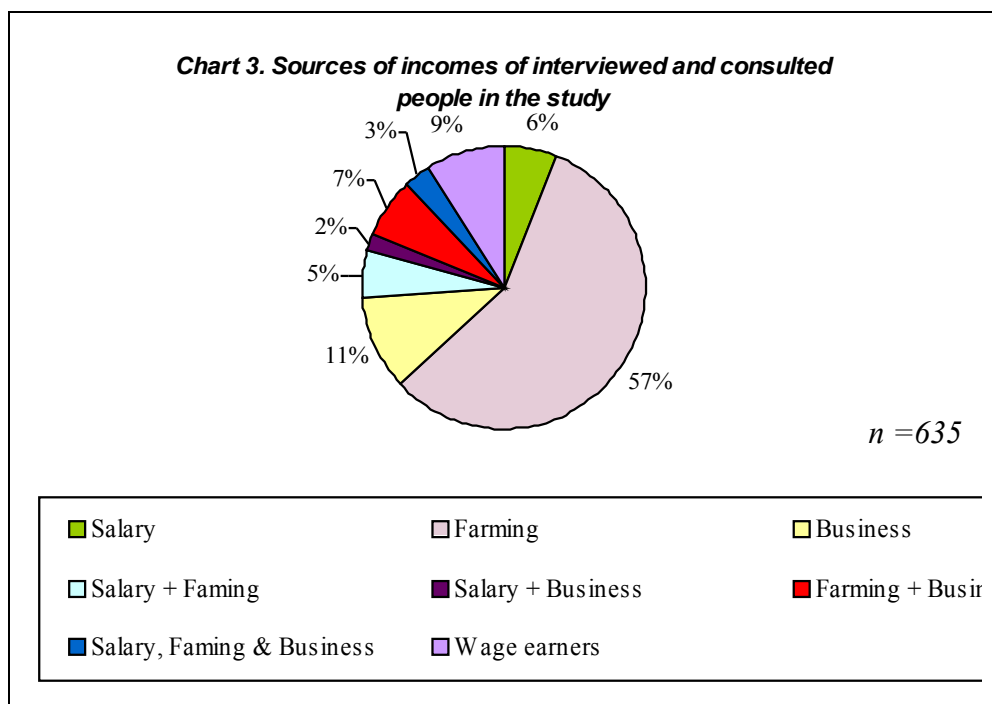
### **Awareness (Knowledge) on Costs and Availability of Credit, Educational and Maintenance Schemes for Solar Equipment in Uganda**

According to the people consulted, the majority of Ugandans do not know the costs of the solar technologies or whether there are credit, educational and maintenance services available. This also calls for raising more public awareness regarding the costs and availability of credit, educational and maintenance schemes in the country and where to find them, if promotion of solar technology use is to be successful in the country.

### **Sources of Income**

Household incomes in Uganda are mainly derived from farming, businesses, salaries and wages (Chart 3). Sometimes, people carry-out a combination of farming, business and employment activities to supplement their incomes. Eighty three percent of the people interviewed earn their incomes from a single source i.e. salary (6%), business (11%), farming (57%) and 9% wage earners (labourers).

Incomes of farmers, business people and labourers are uncertain and unpredictable due to seasonal variations in weather, farm yields, buying habits and labour hiring sequences and frequencies throughout the year. These categories of people often suffer frequent income shortages and stresses, making their financial planning throughout the year difficult in contrast to salaried workers. They are more likely to have difficult in making decisions as whether to purchase solar energy equipment or not. Whereas the country's Energy Policy is "to meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner", the greatest question and challenge is how the energy needs of all Ugandans, taking into account all social and income classes, can be met in an environmentally sustainable manner.



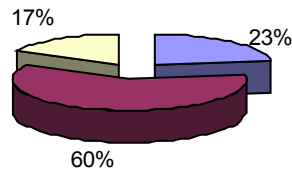
### Affordability of Solar Energy Equipment in Uganda

At the current price regimes, advanced solar energy technologies are still unaffordable to the majority of Ugandans. Even those who could afford to purchase a solar unit could not buy the desired solar energy capacities, because of the high purchase costs of the equipments. Instead, they resorted to sizes they could only afford, implying therefore that the cost of the solar technologies is still a major limiting factor.

Of the people consulted during the focus group discussions, 60% were not sure whether they could afford solar technologies or not (Chart 4). Seventeen were sure they could afford the technologies, while 23 were undecided. With increased awareness and the provision of credit schemes it is likely that those who were undecided or not sure about their ability to afford the solar technologies could change their minds. Therefore, there is need to increase awareness and understanding of the solar technologies among the masses as a means of promoting use of the technologies.



**Chart 4. People's views on their ability to afford solar energy equipment in Uganda**



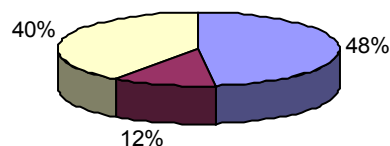
$n = 635$

Can not Afford ■ Not Sure ■ Can Afford

### Willingness to Buy and use Solar Energy Technologies

Approximately half of the people interviewed and consulted in the focus group discussions said they were willing to purchase and use solar equipments (Chart 5). Forty percent were undecided, while only 12% were not willing to purchase the equipment. All respondents reported that they were constrained by the shortage of money to purchase the equipment.

**Chart 5. People's willingness to purchase solar equipment in Uganda**



$n = 635$

Willing ■ Not Willing ■ Undecided

Since there are people who are willing to buy solar equipment, but are constrained by limited resources, there is need to facilitate them to purchase the solar technologies by providing them with low interest loans, interest free loans, subsidies or hire purchase schemes. Although Government put in place tax waivers on solar panels in a bid of making them affordable, the panels are still very expensive, because the waivers did not cover all the associated accessories (e.g. batteries, solar bulbs, etc.) that continue to make the equipment expensive.



***A Fishing Community in Kiziru, Mukono District on the shores of Lake Victoria in one of the Focus Group Discussion on Energy Sources in Uganda***

The fishing communities said that they used paraffin and spirit lanterns to attract and catch Mukene (*Rastrineobola argentea*) fish. They said these lanterns are laborious to use, produce smoke and sometimes are sources of water pollution through paraffin (spirit) spills into the Lake. With exception of spirit lamps, paraffin lanterns produce a relatively dim light that flickers a lot and therefore is not reliable bait. The spirit lamps are rather noisy and scare away the fish. Therefore, in their opinion, the fishing communities would prefer to use solar lamps that give-off bright and relatively steady light that would be good bait for Mukene.

The women and youth said they preferred solar lamps, because they do not need continuous purchase of dry cells, paraffin or spirit, are charged using the readily available sun and do not produce smelly fumes as do the paraffin or spirit lamps. In their opinion, strategies should be put in place to make solar lamps and other solar technologies affordable and readily available.

Schools, clinics, health centres, restaurants, lodges, inns and some hotels were of the opinion that solar technologies were a better energy source for lighting, water heating, refrigeration and operating radios and Televisions, because they were not noisy and provide relatively bright light and help reduce on energy costs of other energy sources. However, they reported that the use of solar technology was constrained by its high costs of purchase, high propensity to theft and the limited availability of qualified technicians for their maintenance and repair in the country.

Based on the opinions and willingness of the respondents in this study to use solar energy technologies, the high electricity tariffs, increasing scarcity of biomass energy sources, the rampant load-shedding and power-cuts in the country and escalating fossil oil prices on the world market, solar energy technology is increasingly becoming viable both as a business and as an alternative source of electricity and heat energy, especially in the rural areas.

### Gender Relations and Energy Needs

On average, each rural household consists of 7 family members 5 of which are often children. In the urban areas, the situation is not essentially different from that in the rural areas, except for a few minor variations. While the children contribute to work in the homes, they are often out of the home. This leaves the responsibility for the productive and non-productive, monetary and non-monetary workloads on the parents, but especially on the women (mothers) who do most of the cooking, fetching of water, washing and gathering firewood in rural areas and ensuring that food is on the table in urban areas. The dependence on firewood increases the burden on women's time.

Men are often the ones that control the monetary incomes of the households and therefore are the ones that determine energy sources and other consumable goods of the household. Whereas it is the men who determine the sources of energy in a home, it is the women who often know the energy needs of a home and struggle every day to ensure that food is on the table, despite the hardships they experience using the energy sources at their disposal. This situation obviously affects the well-being of the whole household. It is on rare occasions that the women are involved in determining the energy sources of a home i.e. whether to use ordinary or improved energy sources. Yet, it is clear that improved energy technologies are important catalysts to moving households up the energy ladder and out of poverty. Therefore in a bid to improve the energy welfare of households, both men and women should be targeted for sensitization and capacity building regarding the use of improved energy technologies, particularly solar technologies.

### Limiting Factors to the Promotion of Solar Technologies in Uganda

Solar equipment has:-

- A high propensity to theft;
- Limited or few service providers;
- Its limited application domestically and commercially;
- Initial high costs of purchase and installation;
- Lack of credit facilities in some places; and
- Lack of knowledge and awareness concerning solar energy use;
- There are several counterfeit solar goods on the market. These negate public's confidence in the quality of solar goods on the market and consequently retard sales and marketing of solar equipments.

These shortcomings on solar equipment are limiting its promotion and marketing in the country. There is need therefore for strategies that will enhance the marketing and promotion of this equipment in the country.

**Key Findings**

- Solar energy is currently being used for lighting, water heating, cooking and drying food stuffs in Uganda;
- Men still determine the energy sources of a home. They determine whether to rely on advanced or traditional energy sources, since they are the main income earners in a home. Therefore, in order to promote solar energy men should especially be targeted;
- Despite the tax waivers put in place by government, solar panels are still very expensive;
- The greatest limiting factor to the use of solar energy in Uganda is still its initial high cost of purchase and installation. There is therefore need to make the cost bearable by spreading it over time through soft-loans or credit schemes or putting in place a comprehensive tax waiver including all solar accessories;
- There is plenty of counterfeit solar equipment on the Ugandan market. There is need to put in place an effective mechanism to check the entry of counterfeits, because they affect the marketing of genuine solar products and negate public confidence in the solar products available on the market;
- Island residents and those in places far from the national grid have a keen interest and demand for solar equipment;
- The solar pilot projects carried out by government, churches, NGOs and the private sector have been successful, which is evidence that solar energy is viable in Uganda. Therefore, there is need for further support the use and promotion of solar energy technologies in the country.
- While solar PV units for electricity generation required advanced technologies to make and are expensive, the thermal based solar technologies for cooking and drying foodstuffs can be adapted using cheaper and readily available materials (Photo 5 & 6).

## **PART SIX**

### **PEOPLE'S COMMENTS ON THE SOURCES OF ENERGY IN UGANDA**

#### **Ministry of Energy and Mineral Development (MEMD)**

Comments from officials in the Ministry of Energy and Mineral Development:-

- Solar is not viable for industrial purposes, but is useful for other purposes;
- Solar energy equipment are expensive and may not be readily affordable to the majority of the rural poor;
- Taxes on solar equipment were eliminated by government, despite this; the equipment has remained expensive, because the solar equipment traders have not factored this into the prices of the equipment;
- Government proposed a subsidy on solar equipment and a mechanism for making it operational is still being developed by MEMD and Uganda Rural Electrification Agency (REA);
- If the shortcomings related to solar are overcome, it would be most suitable for rural communities not readily served by the national grid;
- Efforts are in place to establish assembling plants for solar equipment in Uganda, but these will still require importation of the solar units from abroad;
- Government is supporting a number of solar initiatives in the country using the Rural Electrification Fund;
- MEMD and REA are working with some micro-finance institutions to develop a credit (loan) scheme that would benefit interested parties;
- MEMD conducted and completed a pilot project on solar energy called the Uganda Photovoltaic Pilot Project on Renewable Energy (UPPRE) which was successful. It achieved increased dissemination of knowledge on solar energy in Uganda and offered a credit scheme to the communities for purchase of solar equipment” Officials in the Ministry of Energy and Mineral Development.

#### **Solar Energy Technology Dealers**

Comments from solar energy technology dealers:-

- The cost of solar panels is being directly influenced by the rate of turnover, which is very low causing the panels to stay long in stores and shops. Therefore, the costs of demurrage are eventually incorporated in the panels;
- While taxes on solar panels were scrapped, taxes are still being charged on other associated accessories;
- There is need to open up country outlets for solar equipment is influenced by demand.

#### **Other Respondents**

Comments from other respondents:-

- “If the current hydropower supply is regular and affordable, people would continue using it, because it is convenient and can be used in many applications” District Medical Officer Jinja
- Power should be considered a necessity and not a luxury and therefore deliberate efforts

should be taken to make it affordable and cheap.

- It should not be a customers' (consumers') responsibility (expense) to draw (pull) electricity service cables and associated equipment (poles, meters, etc.) to their premises, but the responsibility of the service provider" A businessman in Kampala
- "The irregularities in the energy sector of many allegedly illegal companies operating in the sector needs to be addressed. There is also need to eliminate the monopoly in the electricity sector" Spokesperson for Kampala city Traders Association (KACITA).
- "Use of charcoal has disadvantages, because it causes deforestation. It is also tedious and dirty to use". Production Officer, Masindi, District
- "Government is not addressing the deforestation problem adequately" solar Energy Technology dealer, Ishaka, Bushenyi district.
- "Government needs to subsidise hydropower to make it affordable, so that all people can afford it and abandon dependence on charcoal and thus preserve the forests". Respondent in Mbarara District.
- "The other sources of lighting energy used include candles, rechargeable lamps, inverters and dry cell torches"
- There are several counterfeit solar energy equipments that come onto the Ugandan market. These jeopardise the marketing of genuine solar equipment;
- Solar energy is good for boarding schools, hospitals and clinics, especially those up-country.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **Conclusions**

The use of advanced solar technologies as an alternative energy sources in Uganda is still at a very limited scale. Yet the country is endowed with plenty of sunshine sufficient to operate such technologies.

Whereas there are people who have knowledge on solar equipment use and application in Uganda, majority of the population is not aware of its use and application, because they lack the necessary information. It is therefore important that information concerning solar energy use is readily disseminated to the masses.

People decide on their sources of lighting and cooking energy based on its affordability, accessibility, convenience and interest. Therefore, any strategies for promotion of solar energy use should consider making the technologies available, accessible and convenient.

With the escalating national grid electricity tariffs and high operational costs of using generators, solar energy technologies are increasingly becoming popular in Uganda. This has therefore made solar equipment viable both as a business and an alternative source of energy. It is more viable now when the country is experiencing an inadequate supply of electricity from its major hydropower electricity sources.

Although government has initiatives to support solar energy development in the country, there is need for the individuals, the private sector, civil society organisations and local communities to increase their engagement in promoting solar technologies, so as to enable people shift from relying on destructive means (deforestation) for their energy sources.

The prevalent poverty in the country is among the factors limiting the purchase and use of solar technologies. There is need for a mechanism of credit or hire purchase schemes to make solar equipment affordable by spreading the cost over a period of time. There is need to establish linkages with micro-finance institutions to provide soft loans (credit) to clients interested in purchasing solar equipment.

There is need for technical institutes and universities in the country to train technicians in the manufacture, installation and maintenance of solar equipment.

There is also need for mechanisms or strategies to curb the rampant theft of solar equipment after they have been installed at premises, for example, the serialisation, insurance or security of the solar panels and accessories.

Although there is a provision in the country's Energy Policy to meet the energy needs of all Ugandans, it still remains a challenge to achieve. There is need for development of all available energy alternatives, if the country is to achieve its policy objectives.

Despite the tax waivers on solar panels put by government, the cost of solar units has remained very high and unaffordable to the majority. Also, the waivers do not cover certain key items in the solar system such as batteries and other accessories, because of the difficult to distinguish them from other ordinary electrical gadgets by the revenue systems. This is



probably the reason why solar units have remained expensive, because a bigger portion of the unit is still taxable.

### **Recommendations**

There is need to develop strategies for country-wide dissemination of information on solar energy as a means of promoting wider sales and use.

Government be directly involved in the promotion of use of solar energy equipment in the country, especially now at a time when government is promoting rural electrification. Government provides subsidies to purchase solar equipment

There is need for protection against theft through insurance, serialisation, certification or registration of solar equipment

There is need to put in place stringent measures to prevent the entry into the country of counterfeit solar equipments. For example, there is need for certification of solar energy goods entering the country.

There is need to establish up-country solar energy equipment distribution, marketing and maintenance centres.

There is need to build additional technical and professional capacity in the country in the fabrication, installation and maintenance of solar equipment in the country.

It should be a housing policy that all buildings install solar technologies for water heating and lighting

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# ANNEX I. Uganda's Energy Balance Based on Total Oil Equivalent (TOE), 2004.

Uganda Energy Balance for 2004											
Unit: TOE	Fuel wood	Charcoal	Residues	Gasoline	AV Fuel (=JetA1+AV Gas)	Kerosene (=Paraffin)	Diesel	Fuel Oil	LPG	Electricity	TOTAL
National Production	12,672,483	0	451,680	0	0	0	0	0	0	163,022	13,287,185
Imports	0	0	0	151,394	65,058	38,606	231,004	50,493	2,832	189	539,575
Exports	0	0	0	0	0	0	0	0	0	16,908	16,908
Primary Energy Supply	12,672,483	0	451,680	151,394	65,058	38,606	231,004	50,493	2,831	180,118	13,843,667
<b>% All primary Energy</b>	<b>91.50%</b>	<b>0.0%</b>	<b>3.3%</b>	<b>1.1%</b>	<b>0.5%</b>	<b>0.3%</b>	<b>1.7%</b>	<b>0.4%</b>	<b>0.0%</b>	<b>1.3%</b>	<b>100%</b>
Charcoal production	-5,241,025	524,103	0	0	0	0	344	0	0	103	-4,716,476
Prod+Trans+Dist. Losses	-353,879	-24,957	21,509	-7,209	-3,098	-1,838	-11,000	-2,404	-135	-75,061	-501,091
Net Supply Available	7,077,579	499,145	430,171	144,185	619,660	36,768	220,004	48,088	2,696	71,036	8,591,632
<b>%Net supply Available</b>	<b>82.40%</b>	<b>5.8%</b>	<b>5.0%</b>	<b>1.7%</b>	<b>0.7%</b>	<b>0.4%</b>	<b>2.6%</b>	<b>0.6%</b>	<b>0.0%</b>	<b>0.8%</b>	<b>100%</b>
Residential	5,257,983	367,431	430,171	0	0	33,091	0	0	2,157	29,618	6,120,451
Commercial	1,057,520	131,714	0	0	0	3,677	0	0	0	11,644	1,204,556
Industry	762,076	0	0	0	0	0	22,000	48,008	539	29,773	862,477
Transport	0	0	0	144,185	61,960	0	176,003	0	0	0	382,148
Agriculture	0	0	0	0	0	0	22,000	0	0	0	22,000
Other	0	0	0	0	0	0	0	0	0	0	0
<b>TOTAL CONSUMPTION</b>	<b>7,077,579</b>	<b>499,145</b>	<b>430,171</b>	<b>144,185</b>	<b>61,960</b>	<b>36,768</b>	<b>22,004</b>	<b>48,088</b>	<b>2,696</b>	<b>71,036</b>	<b>8,591,632</b>
<b>% All secondary Energy</b>	<b>82.40%</b>	<b>5.8%</b>	<b>5.0%</b>	<b>1.7%</b>	<b>0.7%</b>	<b>0.4%</b>	<b>2.6%</b>	<b>0.6%</b>	<b>0.0%</b>	<b>0.8%</b>	<b>100%</b>
<b>Supply Pattern</b>			Demand	Energy	Electricity		Energy Consumption per capita (kgOE)				326.7
Biogas	93.2%		Residential	71.2%	41.7%		Commercial Energy Cons. Per capita (kgOE)				22.2
Oil Products	6.0%		Commercial	14.0%	16.4%		Total number of households				5511735
Electricity	0.8%		Industrial	10.0%	41.9%		National Grid Electrification Rate (%)				4.0
<b>TOTAL</b>	<b>100.0%</b>		Transport	4.4%	0.0%						
N.B The Energy Balance does not include the energy produced by renewable energy technologies (Solar PV, Biogas) which is estimated to sum up to a minor amount.											
Source: Ministry of Energy and Mineral Development (MEMD)											

## ANNEX II. INDIVIDUAL QUESTIONNAIRE

### VIABILITY OF SOLAR ENERGY IN UGANDA

*The information presented in this questionnaire shall not be used for any other purpose than what it is intended for in the objectives below.*

#### OBJECTIVES OF THE STUDY

- Assess the use and viability of solar energy in Uganda
- Identify the limiting factors for solar energy installation and use in the country
- Conduct a study to compare solar energy use with other energy sources in the country

#### 1.0. SECTION A: Respondent Identification

1. Respondent No.....
2. District.....; County.....; Sub-county.....; Rural/Urban
3. Individual/ Household/business/Organisation/Institution (tick appropriately)

#### 2.0. SECTION B: General Information

1. What are your sources of energy for lighting (tick appropriately)
  - a) National Electricity Grid (UMEME)
  - b) Thermal/ Generator
  - c) Solar Energy
  - d) Combination of Grid and thermal energy
  - e) Combination of Grid and Solar energy
  - f) Kerosene (paraffin)
  - g) Gas
  - h) Pressure (spirit) lamps
  - i) Other (specify).....
2. Give reasons for your choice of energy for lighting in 1 (above)
  - a) It is affordable
  - b) It is only one available
  - c) It is convenient
  - d) Choice
3. What are your main sources of energy for cooking (tick appropriately)
  - a) National Electricity Grid (UMEME)
  - b) Thermal/ Generator
  - c) Solar Energy
  - d) Combination of Grid and thermal energy
  - e) Combination of Grid and Solar energy
  - f) Kerosene (paraffin)
  - g) Gas
  - h) Charcoal
  - i) Fire wood
  - j) Other (specify).....
4. Give reasons for the choice(s) of energy for cooking
  - a) It is affordable
  - b) It is the only one available
  - c) It is Convenient

d)Choice

5. Do you know anything about solar energy? **Yes.... No ....** If yes, skip to 8; if no go to 6

6. Would you like to know about solar energy? Yes ..... No ..... If yes, skip to 24; If no, go to 7

7. Why would you not want to know about solar energy? (give reasons)

.....  
.....  
..... skip to 25

8. What do you know about solar energy?

.....  
.....  
.....  
.....

9. What type of solar equipment (assets) do you know? If 9 is not filled, skip 11

i. ....  
ii. ....  
iii. ....  
iv. ....

10. Are any of the types of solar systems mentioned in 9 above easily accessible to you or in your community?

11. Do you know any institution or individual in your community that use solar energy **Yes... No...;** If yes, go to 12; if no, skip to 13

12. Where are they located?

Nearby (in the community).....  
Outside the community .....  
Far-away ..... (give distance or place)

13. Do you know the costs for solar energy equipment (lighting, cooking and water heating) **Yes... No...**  
If yes, go to 14; if no, skip to 15

14. What are the costs of solar equipment for:

a) Lighting .....  
b) Cooking .....  
c) Water heating .....

15. Are you aware of any credit, hire purchase or subsidy schemes for solar energy equipment and installation? **Yes .... No .....**; If yes, go to 16; If no, skip to 17

16. Where are they located?

Nearby (in the community).....  
Outside the community .....  
Far-away ..... (give distance or place)

17. Are you aware of any education (training or awareness) programmes on the use of solar energy? **Yes... No...** If yes, go to 18 & 19; if no, skip to 20

18. Where are the training programmes located

Nearby (in your community) .....  
Outside the Community .....  
Far-away ..... (give distance or place)

19. Who are offering education (training or awareness) on use of solar energy?

- a)Government ministry/department
- b)Solar Business Company(ies)
- c)Civil Society Organisations
- d)Other (specify) .....

20.What is the nearest source of solar energy equipment?

- a)By location .....
- b)By distance .....
- c)Do not know .....

21.Do you know of any solar maintenance centres? **Yes.... No...** If yes, go to 22; if no, skip to 23

22.Where are the solar energy maintenance centres located?

- Nearby (in the community) .....
- Outside the community .....
- Far-away .....

23.What are the advantages of solar energy compared to other energy sources e.g. hydropower, biomass, thermal (generators), kerosene (paraffin) etc.

.....

.....

.....

.....

24.What are the limiting factors (constraints) in promoting solar energy use in your area or community?

.....

.....

.....

.....

25.Are there any cultural or traditional factors that limit use of solar energy in your community? Yes .....  
No..... If yes, go to 26; if no here or no in 5 & 6 above, skip to **Section C**

- a)for Cooking .....
- b)for Water heating .....
- c)for Lighting .....

26.What are the cultural or traditional factors that limit solar energy use

.....

.....

.....

.....

### 3. SECTION C. Economic Status of Respondent (affordability)

1.What are your major sources of income?

- a).....
- b).....
- c).....
- d).....

2.On average, how much do you earn per month? Shs.....

3.Would you like to try (use) solar energy

In your home Yes ..... No ..... If yes, go to 4; If no go to 5)

4.What would you use for

- Lighting only
- Water heating only
- Cooking only
- Lighting and water heating
- Lighting and cooking
- Water heating and cooking

5. In your office (workplace) Yes.... No ..... If yes, go to 6; If no, go to 7

6. What would you use for

- Lighting only
- Water heating only
- Operating office equipment e.g. Computers, etc

7. At your present income, do you think you can afford to use solar energy? Yes ..... No ...

8. What should be done in order for you to use (afford) solar energy?

.....

.....

.....

.....

**4. SECTION F:** Do you have any other comments, suggestions, questions or recommendations?

.....

.....

.....

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.....



## ANNEX III. FOCUS GROUP DISCUSSION QUESTIONNAIRE

### VIABILITY OF SOLAR ENERGY IN UGANDA

*The information presented in this questionnaire shall not be used for any other purpose than what it is intended for in the objectives below.*

#### OBJECTIVES OF THE STUDY

- Assess the use and viability of solar energy in Uganda
- Identify the limiting factors for solar energy installation and use in the country
- Conduct a study to compare solar energy use with other energy sources in the country

#### 1.0. Section A: Respondent Identification

Respondent Designation .....

District.....; County.....; Sub-county.....; Rural/Urban

2.0. What are the common sources of lighting energy in your area?

- a) National Electricity Grid (UMEME)
- b) Thermal/ Generator
- c) Solar Energy
- d) Combination of Grid and thermal energy
- e) Combination of Grid and Solar energy
- f) Kerosene (paraffin)
- g) Gas
- h) Pressure (spirit) lamps
- i) Other (specify).....

3.0. Give reasons for the choice of energy for lighting in 2 (above)

- a) It is affordable
- b) It is only one available
- c) It is convenient
- d) Choice

4.0. What are the common sources of cooking energy in your area?

- a) National Electricity Grid (UMEME)
- b) Thermal/ Generator
- c) Solar Energy
- d) Combination of Grid and thermal energy
- e) Combination of Grid and Solar energy
- f) Kerosene (paraffin)
- g) Gas
- h) Charcoal
- i) Fire wood
- j) Other (specify).....

5.0. Give reasons for the choice of energy for cooking in 4 (above)

- a) It is affordable
- b) It is only one available
- c) It is convenient
- d) Choice

6.0. Do you know anything about solar energy? Yes... No .... If yes, skip to...; If no, go to 7.0.

7.0. Would you like to know about solar energy equipment? Yes ... No... If Yes, go to ... If no, go to 8

8.0. Why would you not want to know about solar? (give reasons)

.....  
.....  
.....  
.....

9.0. What do you know about solar energy?

.....  
.....  
.....  
.....

10. What type of solar energy equipment (assets) do you know? If 10 is not filled skip to 12.

.....  
.....  
.....

11. Are any of the types of solar systems mentioned in 10 above easily accessible in your area?

12. Do you know any individual or institution in your area that use solar energy? Yes ... No... If yes, go to 13; if no, skip to 16

13. Who are they?

.....  
.....

15. Where are they located?

Nearby (in the community) .....

Outside the community .....

Far-away ..... (give distance or place)

16. Do you know the cost of solar energy equipment (lighting, cooking and water heating)? Yes... No.... if yes, go to 17; if no, skip to 18

17. What are the costs for solar energy equipment for

a). Lighting .....

b). Cooking .....

c). Water heating .....

18. Are you aware of any credit, hire purchase or subsidy schemes for solar energy equipment and installation? Yes... No ..... If yes, go to 19; if no skip to 21

19. Which schemes do you know?

20. Where are they located?

Nearby (in the community or district) .....

Outside the community or district .....

Far away ..... (give distance or place)

21. Are you aware of any education (training or awareness) programmes on the use of solar energy? Yes... No ..... If yes, go to 22; If no, skip to 25.

22. Which are they?

.....  
.....  
.....

23. Where are they located?

Nearby (in the community or district) .....

Outside the community or district .....

Far-away ..... (give distance or place)

24. Who are offering education or training on use of solar energy in your area?

Government Ministry/department .....  
Solar Energy Business Company .....  
Civil Society Organisation .....  
Other (specify) .....

25. What is the nearest source of solar energy equipment?

By location .....  
By distance ..... km(miles)  
Do not know

26. Do you know of any solar maintenance centres? Yes ..... No ..... If yes, go to 27; if no skip to 28

27. Where are the solar maintenance centres located?

Nearby (in the community or district) .....  
Outside the community or district .....  
Far-away .....(give distance or place)

28. What are the advantages of solar energy compared to other sources of energy (e.g. hydropower, biomass, thermal (generators) kerosene (paraffin), etc.

.....  
.....  
.....  
.....  
.....

29. What are the limiting factors (constraints) in promoting solar energy use in your area?

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.....  
.....

30. What are the major sources of income for people in your community?

.....  
.....  
.....  
.....

31. Do you think that people in your community can afford solar energy equipment?

.....  
.....

32. What laws, taxation structures and institutional frameworks do you know that govern use of solar energy equipment in your area?

.....  
.....  
.....  
.....

33. Does the district have its own local energy policies or plans to guide energy use and development? Yes....  
No ..... If yes, go to 34; If no, skip to 35

34. Which are they?

.....  
.....  
.....  
.....

35. On what policies or plans does the district base its energy use and development?

.....  
.....  
.....  
.....

36. Is energy supply in the district sufficient? Yes ..... No..... If yes, skip to 38 If no, go to 37

37 What plans do you have to address the problems of energy supply in the district?

.....  
.....  
.....  
.....

38. What suggestions, questions, or recommendations would you give?

.....  
.....  
.....  
.....

39. Do you have any other comments, suggestions, questions or recommendations to make?

.....  
.....  
.....  
.....  
.....

## ANNEX IV. QUESTIONNAIRE FOR SOLAR ENERGY BUSINESSES

### VIABILITY OF SOLAR ENERGY IN UGANDA

*The information presented in this questionnaire shall not be used for any other purpose than what it is intended for in the objectives below.*

#### OBJECTIVES OF THE STUDY

- Assess the use and viability of solar energy in Uganda
- Identify the limiting factors for solar energy installation and use in the country
- Conduct a study to compare solar energy use with other energy sources in the country

#### 1.0. Section A: Respondent Identification

Name of Company.....

District.....; County.....; Sub-county.....; Rural/Urban

2.0. What are the common sources of lighting energy in your area?

- a) National Electricity Grid (UMEME)
- b) Thermal/ Generator
- c) Solar Energy
- d) Combination of Grid and thermal energy
- e) Combination of Grid and Solar energy
- f) Kerosene (paraffin)
- g) Gas
- h) Pressure (spirit) lamps
- i) Other (specify).....

3.0. Give reasons for the choice of energy for lighting in 2 (above)

- a) It is affordable
- b) It is only one available
- c) It is convenient
- d) Choice

4.0. What are the common sources of cooking energy in your area?

- a) National Electricity Grid (UMEME)
- b) Thermal/ Generator
- c) Solar Energy
- d) Combination of Grid and thermal energy
- e) Combination of Grid and Solar energy
- f) Kerosene (paraffin)
- g) Gas
- h) Charcoal
- i) Fire wood
- j) Other (specify).....

5.0. Give reasons for the choice of energy for cooking in 4 (above)

- a) It is affordable
- b) It is only one available
- c) It is convenient
- d) Choice

6.0. What type of solar energy equipment (assets) do you sale.

.....

.....  
.....  
7.0. Where do you buy (purchase) these solar systems mentioned in 6 above?

.....  
.....  
.....  
.....  
8.0. Do you know any individual or institution in your area that uses solar energy? Yes ... No... If yes, go to 9.0; if no, skip to 11

9.0. Who are they?

.....  
.....  
10. Where are they located?

Nearby (in the community) .....

Outside the community .....

Far-away ..... (give distance or place)

11. What are the costs of solar energy equipment for

a) Lighting .....

b) Cooking .....

c) Water heating .....

12. Are you aware of any credit, hire purchase or subsidy schemes for solar energy equipment and installation? Yes... No ..... If yes, go to 13; if no skip to 15

13. Which schemes do you know?

14. Where are they located?

Nearby (in the community or district) .....

Outside the community or district .....

Far-away ..... (give distance or place)

15. Are you aware of any education (training or awareness) programmes on the use of solar energy? Yes... No ..... If yes, go to 16; If no, skip to 19.

16. Which are they?

.....  
.....  
.....  
17. Where are they located?

Nearby (in the community or district) .....

Outside the community or district .....

Far-away ..... (give distance or place)

18. Who are offering education or training on use of solar energy in your area?

Government Ministry/department .....

Solar Energy Business Company .....

Civil Society Organisation .....

Other (specify) .....

19. Do you know of any solar maintenance centres? Yes ..... No ..... If yes, go to 20; if no skip to 22

20. Which are they?

.....  
.....

21. Where are they located?

Nearby (in the community or district) .....

Outside the community or district .....

Far-away .....(give distance or place)

22. What are the advantages of solar energy compared to other sources of energy (e.g. hydropower, biomass, thermal (generators) kerosene (paraffin), etc.

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.....  
.....

23. What are the limiting factors (constraints) in promoting solar energy use in your area?

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.....  
.....  
.....

24. What are the major sources of income for people in your community?

.....  
.....  
.....  
.....

25. Do you think that people in your area can afford solar energy equipment?

.....  
.....

26. How many individuals or institutions have you sold solar equipment?.....

27. What laws, taxation structures and institutional frameworks do you know that govern selling solar energy equipment in your area?

.....  
.....  
.....  
.....

28. Is energy supply in the district sufficient? Yes ..... No..... If yes, skip to 38 If no, go to 29

29. What plans do you have in promoting solar energy sales in your area?

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.....  
.....  
.....

30. What suggestions, questions, or recommendations would you give?

.....  
.....  
.....  
.....

31. Do you have any other comments, suggestions, questions or recommendations to make?

.....  
.....  
.....



## **ANNEX V. NAPE'S GUIDING TOOL**

### **1.0. Market Survey of Solar Equipment and dealers/Companies**

1. Identify dealers/companies of solar equipment on the Ugandan market
2. Determine prices of solar equipment and installation costs
3. Identify cost of a fully fledged solar system that could support all domestic functions requiring electricity
4. General affordability among the communities of solar equipment (affordability)
5. Quality of solar equipment and its impact on solar dissemination
6. Availability of solar parts for maintenance of solar equipment
7. Tax related issues and how they affect the cost and dissemination of solar
8. Availability of policies and their impact on solar dissemination
9. The relationship between the solar energy suppliers and policy makers and how it affects solar dissemination

### **2.0. Legal and Institutional frameworks Influencing Importation, Sale and Use of Solar equipment in Uganda**

1. Laws governing importation, sale and use of solar equipment
2. Taxation structure and levels of subsidy
3. Institutions involved in the importation, sale and use of solar equipment
4. Has the district developed its own local energy policies to guide energy use and development in the district
5. Which of these policies specifically target increasing solar use in the district
6. Is the energy supply in the district sufficient
7. What are some of the local solutions to the energy problems
8. Are there any specific renewable energy awareness programmes
9. Which of these programmes target increased solar dissemination in the district/country
10. What suggestions/recommendations can the respondent give