

---

## CHAPTER EIGHT

# WATER AND ENERGY

---

### 8.1 Introduction

Uganda is endowed with abundant renewable energy resources. These include plentiful biomass supplies, extensive hydrological resources, favorable solar conditions and large quantities of biomass residues from agricultural production, among others. With the exception of biomass, Uganda utilizes only a small fraction of its renewable energy resource potential.

Biomass, principally fuel wood and charcoal, is in quantity terms the most important energy source in Uganda. Wood fuel (firewood and charcoal) on both non-commercial and commercial basis constitutes about 93% of energy consumed in the country. Sources of these dry materials are mainly trees and bushes, which occur in all types of land cover use e.g. forests, woodlands, bushlands, agricultural farms etc.

Uganda's Modern Fuel supply and consumption is composed of Petroleum products about 6% and electricity about 1%.

#### 8.1.1 Current Hydropower Planning Status

Almost all of Uganda's current Hydropower (300MW) is generated at Kiira and Nalubaale stations located at the outlet of Lake Victoria, which is part of the Nile system. There are also a few existing small-scale Hydropower schemes contributing a total of 20 MW.

Currently domestic power demand exceeds the available supply by as much as 80 MW during peak periods, and is growing at the rate of 8% per year. Load shedding is common and the shortfall in generation capacity is limiting growth in many sectors of the Ugandan economy.

The Government formulated a Hydropower Development Master Plan (Kennedy and Donkin, 1997), to guide the hydropower planning and development process in Uganda. The Master Plan includes a comprehensive study of all the potential large-scale and small-scale hydropower schemes that are possible both on the White Nile and on all non-Nile rivers in the country. It also outlines a well-documented energy development strategy based on power demand forecasts, historical Lake Victoria hydrology, project generation potential, environmental effects, and cost criteria.

## 8.2 Hydropower Development

Hydropower is the major source of electrical power in Uganda. It is the most abundant and cheapest electrical power source in the country.

Uganda has a comparative advantage in hydropower resources in the region. Most of Uganda's hydropower potential is concentrated along the White Nile with a total estimated potential of 2,000 MW. In addition, there are also several small rivers in different parts of the country, with a potential for mini and micro hydropower development.

### 8.2.1 Large Scale Hydropower Development

To-date, only a small fraction of Uganda's hydro resources are exploited. Almost all of Uganda's current Hydropower (300MW) is generated at Kiira and Nalubaale stations located at the outlet of Lake Victoria.

The process for the development of Bujagali Hydropower scheme is already underway and that for Karuma Hydropower scheme will commence shortly. Completion of these two schemes will add another 400 MW to Uganda's power supply, which will go a long way in reducing the power deficit. **Table 8.1** shows the major potential hydropower schemes.

**Table 8.1- Major existing and potential hydropower schemes in Uganda**

<i>Site</i>	<i>Current Installed Capacity (MW)</i>	<i>Max. Potential (MW)</i>	<i>Proposed Installed Capacity (MW)</i>	<i>Status</i>	<i>Comm Date</i>
<i>Owen Falls</i>	180	-	-	In Operation	1954
<i>Owen Falls Extension</i>	-	-	200	Partly Commissioned. (120MW from 3 units). The other 2 units are to be commissioned by June 2005.	2000
<i>Bujagali</i>	-	320	250	Negotiations in progress	2005
<i>Kalagala</i>	-	450	350	Feasibility study completed	N/A
<i>Karuma</i>	-	180	150	Feasibility studies completed, negotiations in progress	N/A
<i>Ayago South</i>	-	234	N/A	Preliminary studies available	N/A
<i>Ayago North</i>	-	304	N/A	Preliminary studies available	N/A
<i>Murchison</i>	-	642	N/A	Preliminary studies available (has adverse environmental effects)	N/A

N/A= Not Applicable

All the above potential hydropower projects are solely for hydropower generation purposes. To-date none of the projects has been conceived as a multi-purpose project. In line with the current policy on private sector driven service delivery, the government strategy is to encourage and attract the private sector to invest in most of these hydropower projects. The response has so far been good with already two projects (Bujagali and Karuma) having attracted private sector investment. With the increased private sector involvement in the power sector, Government has hitherto established the Electricity Regulatory Agency (ERA) to regulate the sector and ensure “fair play” by all potential players in the business of power generation, transmission and distribution and to protect the consumers from exploitation by “profit hungry” private companies. Besides ERA, government has also strengthened the National Environmental Management Authority (NEMA) to enforce strict compliance of all power projects to the existing environmental management laws and regulations. This includes among other things the requirement for comprehensive environmental impact assessments (EIA) and audits for new and existing hydropower projects respectively.

### 8.2.2 Small Scale Hydropower Development

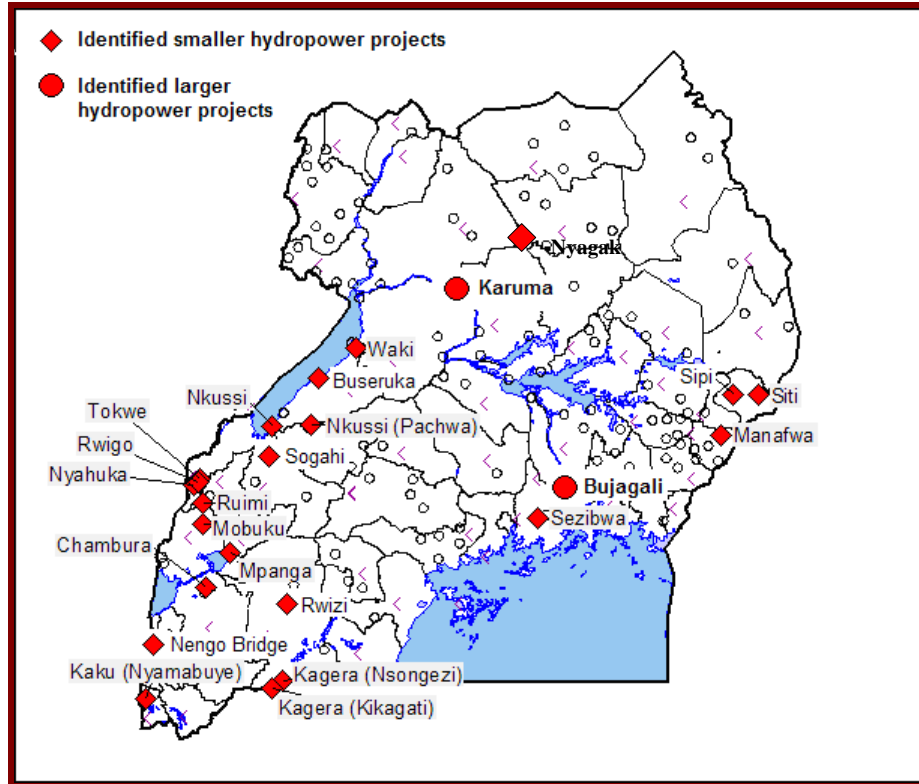
Besides the large-scale hydropower sites, Uganda also possesses a number of small sites with potential for mini- and micro hydropower development. The current contribution of the small-scale hydropower schemes is about 20 MW. **Table 8.2** below shows the existing and potential small-scale hydropower schemes in Uganda.

*Table 8.2- Existing and potential small-scale hydropower schemes*

<i>Site</i>	<i>District</i>	<i>Installed Capacity (MW)</i>	<i>Estimated Potential (MW)</i>	<i>Status</i>
<i>Maziba</i>	Kabale	1.0	-	In operation
<i>Kuluva</i>	Moyo	0.12	-	In operation
<i>Kagando</i>	Kasese	0.06	-	In operation
<i>Kisizi</i>	Rukungiri	0.06	-	In operation
<i>Mobuku 1</i>	Kasese	5.0	-	In operation
<i>Mobuku 2</i>	Kasese	-	11.1	Pre-feasibility Studies complete
<i>Mobuku 3</i>	Kasese	10.0	-	In operation
<i>Muzizi</i>	Kibale	-	4.0 – 10.0	Estimate
<i>Paidha</i>	Nebbi	-	6.0 (with dam) 3.3 (run of river)	Ready for development
<i>Rwizi</i>	Mbarara	-	0.5	Pre-investment studies completed
<i>Kakaka</i>	Kabarole	-	3.0	Estimate
<i>Nsongezi</i>	Mbarara	-	2.0	Estimate
<i>Nyamabuye</i>	Kisoro	-	2.2	Pre-investment studies completed
<i>Siti</i>	Kapchorwa	-	1.0	Feasibility study planned
<i>Sipi</i>	Kapchorwa	-	5.4	Pre-investment studies completed
<i>Anyau</i>	Arua	-	1.5	Feasibility study completed
<i>Haisesero</i>	Kabale	-	1.0	Estimate

<i>Site</i>	<i>District</i>	<i>Installed Capacity (MW)</i>	<i>Estimated Potential (MW)</i>	<i>Status</i>
<i>Kitumba</i>	Kabale	-	0.2	Estimate
<i>Mpanga</i>	Kabarole	-	0.4	Estimate
<i>Nyakibale</i>	Rukungiri	-	0.1	Estimate
<i>Leya</i>	Moyo	-	0.12	Estimate
<i>Amua</i>	Moyo	-	0.18	Estimate
<i>Nyarwodo</i>	Nebbi	-	0.4	Estimate
<i>Mvepi</i>	Arua	-	2.4	Estimate
<i>Esia</i>	Moyo	-	0.24	Estimate
<i>Ala</i>	Arua	-	1.5	Estimate
<i>Agoi</i>	Arua	-	0.35	Estimate
<i>Nkussi</i>	Kibale	-	0.9	Estimate
<i>Mitano</i>	Kabale	-	2.0	Estimate
<i>Kikagati</i>	Mbarara	-	-	Abandoned
<i>Sezibwa</i>	Mukono	-	0.5	Estimate
<i>Tokwe</i>	Bundibugyo	-	0.2	Estimate
<i>Mgiita</i>	Bundibugyo	-	0.15	Estimate
<i>Miria Adua</i>	Arua	-	0.1	Estimate
<i>Sogahi</i>	Kabarole	-	2.0	Estimate
<i>Ishasha</i>	Rukungiri	-	4.0	Feasibility study and plant design completed
<i>Buseruka</i>	Hoima	-	15.3	Pre-feasibility studies completed
<i>Nengo Bridge</i>	Rukungiri	-	7.7	Pre-feasibility studies completed

Figure 8.1 shows the location of some identified hydropower projects that are being considered for development by the energy sector.



*Figure 8.1 - Some Identified Hydropower Projects*

### 8.3 Hydropower Consumption

#### 8.3.1 Electricity Coverage

Only 9% of Uganda's population is supplied with grid electricity, and 70% of these customers reside in the three major towns of Kampala, Entebbe and Jinja. Approximately 20% of the country's urban population is connected to the national grid, while only 3% of the rural population is connected to the grid. Official records show that there are about 230,000 grid electricity users. The national average annual per capita electricity consumption is about 44 kWh, compared with an average of 170 kWh and 10 kWh for the major urban areas and rural areas respectively.

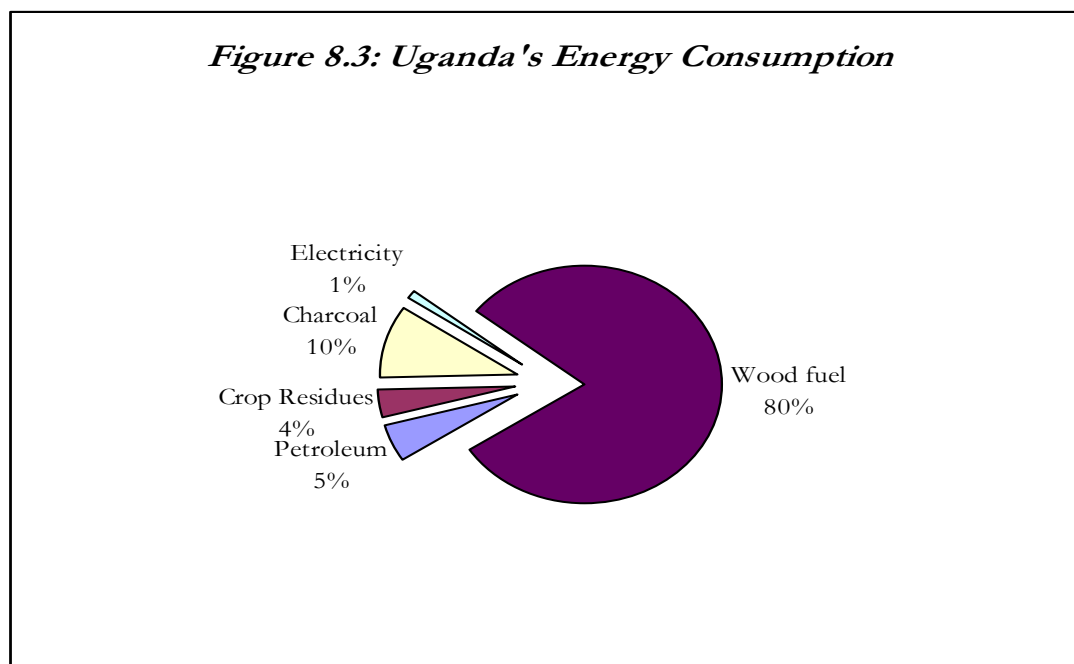
**Figure 8.2** shows the existing national electricity grid and the planned future extensions.

PRESENT AND FUTURE UEB NETWORK



Figure 8.2 - Existing Electricity Grid and the Planned Extensions

Uganda's per capita energy consumption of 0.3 TOE or 12.72 GJ, is among the lowest in the world. Few people have access to modern energy supplies such as electricity and petroleum products. The energy consumption is about 5 million TOE/year of which approximately 94% is biomass (wood, charcoal and agricultural residue). Wood fuel is the dominant energy source accounting for 80 per cent of the total energy consumed in the country. Wood fuel is consumed either as charcoal (largely consumed in urban areas) or firewood (mostly used in rural areas). **Figure 8.3** shows the dominant position of wood fuel in the energy sector of Uganda.



### 8.3.2 Electricity Pricing

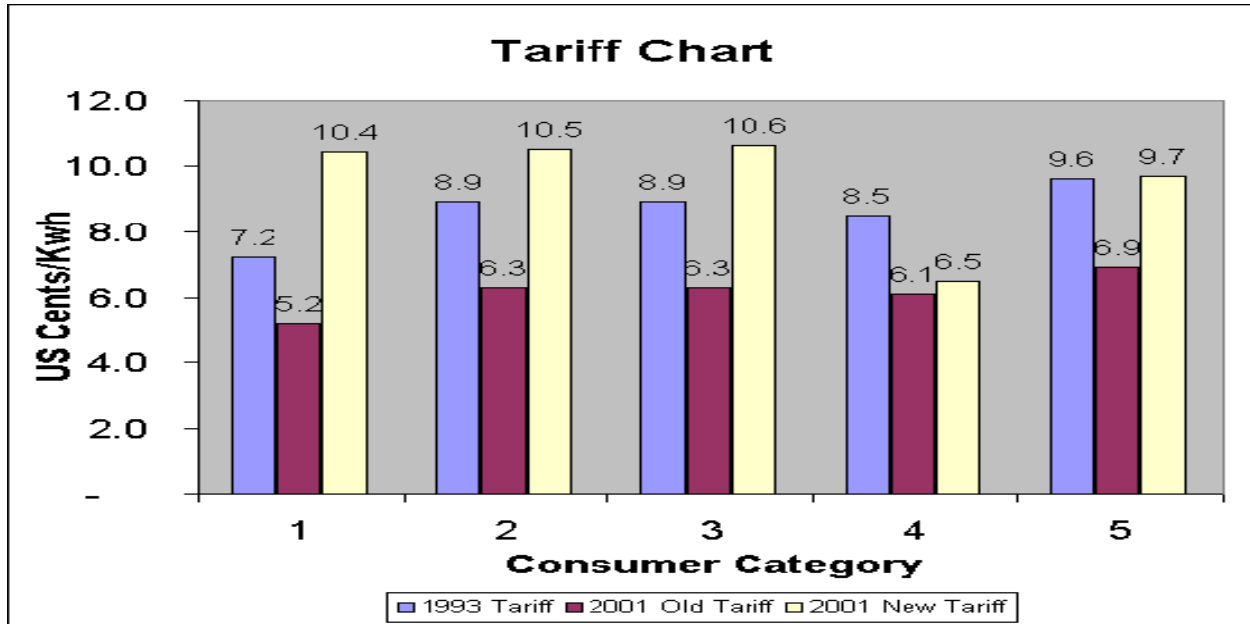
The Electricity Regulatory Authority (ERA) conducts annual electricity tariff reviews to ensure that the revenue requirements of the utility companies are met in a sustainable manner and the consumers are not overcharged. The annual tariff reviews are carried out in order to:

- ✓ Correct for inflation and currency exchange;
- ✓ Support new capital investments in the sector;
- ✓ Attract private sector investment in the sector;
- ✓ Remove cross subsidies to reflect the cost of supply for each customer category; and
- ✓ Cover operation and maintenance costs.

The current tariff structure provides for subsidies to the poor customers. However, the subsidy is within the same class of consumers and not across different classes. For example, during the 2001 tariff review, the domestic tariff for the first 30 kWh per month was set far below the long run marginal cost (LRMC) rate at Ushs. 20/= per kWh. Consumption

between 31 and 200 units per month was set near the LRMC at Ushs. 70/= per kWh; whilst consumption above 200 units was set above LRMC at Ushs. 100/= per kWh to subsidise poor customers. **Figure 8.4** shows the tariff trend for the past 10 years.

*Figure 8.4 – Electricity Tariff Trend*



## **8.4 Rural Electrification Program**

Rural electrification forms an integral part of the Government's wider rural transformation and poverty eradication agenda. The Ministry of Energy and Mineral Development in consultation with the Ministry of Finance, Planning and Economic Development, the Ministry of Local Government and other stakeholders in the private and public sector prepared a Rural Electrification (RE) Strategy and Plan covering the period 2001 to 2010, which was approved by Cabinet. As part of this plan, Government in collaboration with the private sector has initiated a number of rural electrification programs, the most noticeable ones of which include the Energy for Rural Transformation (ERT) program and the Uganda Photovoltaic Pilot Project for Rural Electrification (UPPPRE). These two programs are complementing the traditional approach of grid extension.

The primary objective of the RE Strategy is to reduce inequalities in access to electricity and the associated opportunities for increased social welfare, education, health and income generating opportunities.

### **8.4.1 Energy for Rural Transformation (ERT)**

Under the ERT program, Government, in collaboration with the private sector and our development partners, is planning to undertake a massive rural electrification initiative covering all regions of Uganda.

Under the ERT program, Government aims to achieve a rural electrification rate of 10% by the year 2010. This implies that 480,000 rural consumers (a net increase of 400,000 over the year 2000 figure) are to be serviced. It is estimated that 15% of the increase in serviced households will come from higher connections to the existing grid outside the urban triangle, 40% from extension of the interconnected grid, 25% from isolated grids and 20% from photovoltaic solar systems.

### **8.4.2 Uganda Photovoltaic Pilot Project for Rural Electrification (UPPPRE)**

UPPPRE is one of the programs implemented by government to increase rural access to electricity as part of the Rural Electrification Strategy.

The aim of UPPPRE is to create the necessary conditions for accelerating access to electricity using solar technology by isolated and dispersed rural areas projected not to have access to grid-based electricity in the near future and which have both ability and willingness to pay the unsubsidized cost of the systems. On a macro level, the impacts of the program include:

- ✓ Prices of solar equipment have gone down by 30% due to an increase in the number of suppliers and buyers. There has been a recorded growth in sales of 20% per year.
- ✓ An increase in the number of people accessing solar systems with support of village banks and Micro-finance credit schemes. As a result more people in the rural areas are switching from Kerosene to solar lighting.

## References

---

**Acres International Ltd., 1990.** “Proposed extension to Owen Falls Generating Station: feasibility study report. World Bank, Uganda Electricity Board”.

**African Energy Policy Research Network (AFREPEN) (2001):** Power Sector Reform in Uganda. Proceedings of a National Policy Seminar, 5th-6th October 2000. Windsor Lake Victoria Hotel, Uganda. Sponsored by Sida/SAREC and AFREPEN/FWD. Available at: [http://www.afrepen.org/Pubs/Occasional\\_Papers/pdfs/op8.pdf](http://www.afrepen.org/Pubs/Occasional_Papers/pdfs/op8.pdf)

**Cassidy, J.A. 1991.** “Review of Hydrology for Lake Victoria: Implications with regard to extension of the Owen Falls Hydroelectric Project. Report to the World Bank”.

**Energy Sector Management Assistance Program (ESMAP) (1996):** Uganda: Energy Assessment (193/96). UNDP/World Bank.

**Government of Uganda (1999a):** The Electricity Act, 1999. Act No. 6 of 1999. Acts Supplement No.6. Acts Supplement to the Uganda Gazette, No. 56 Volume XCII. Dated 1 November, 1999. Entebbe: UPPC (by Order of the Government).

**Kennedy & Donkin Power Ltd., 1996.** “Hydropower Development Master Plan - Part 1. Uganda Electricity Board, Uganda”.

**Lock, R. (1995):** ‘Financing of Private Power Development and Power Sector Reform in Emerging Nations: An Essential Nexus?’, Energy Policy, 23(11): 955-65.

**Ministry of Energy and Mineral development, 2003:** “The Uganda Alternative Energy Resource Assessment and Utilization Study – Identification and Ranking of Small Hydropower Projects for Feasibility Studies – Technical Report”.

**Ministry of Energy and Mineral development, 1996:** Joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP).

**Uganda Investment Authority (2001):** Investing in Uganda: Energy, No. 18.

**Utility Reform Unit, 2002:** Uganda Electricity Distribution Company and Uganda Electricity Generation Company Privatization – Briefing Note.