Journal of Energy Technologies and Policy
ISSN 2224-3232 (Paper) ISSN 2225-0573 (Online)
Vol.6, No.9, 2016

Examining the status of the energy sector in Uganda with focus on electricity

Bbuye Martin
School of Science, Nkumba University, P.O. Box 237, Entebbe Uganda

Introduction

Energy is one of the key sectors in Uganda's economy. The present peak demand is about 40 MW and growing at an annual rate of 8%. Therefore, in order to meet this growth demand, about 20 MW of new generating capacity needs to be added each year (Ministry of Energy and Mineral Development (MEMD), 2009). Observation was made on the major method used for collecting data for the status of energy sector. This chapter was derived from objective entitled examining the status of the energy sector in Uganda with focus on electricity of the study.

According to the National Development Plan (NDP- 2010/11-2014), energy is one of the complementary sectors. The NDP highlights the limited access and use of energy as a factor that significantly slows down economic and social transformation. The low energy consumption per capita in Uganda is identified as a major contributing factor to the slow economic transformation by limiting industrialization as well as value addition. Energy exploitation and consumption patterns indicate that Uganda is still in infancy stage of energy application in production. The current exploitation pattern of energy in Uganda comprises Biomass (92%), Fossil Fuels (7%) and Electricity (1%). Most of the residential/domestic energy consumption is biomass used in form of wood as charcoal and firewood, a situation that is not sustainable as this form of energy is nonrenewable, costly and has significant negative impacts on the environment (MEMD, 2002). The NDP identifies low level of access, high tariff and low generation as the main reasons for a lot of reliance on biomass energy. This pattern also explains the low levels of industrialization and commercial production in the country.

Study Objective:

The objectives of the study were to examine the status of the energy sector in Uganda with focus on electricity, and to share knowledge with the other researchers and consumers who need environmental conservation related information

Methods used to collect data:

Primary data was collected through Questionnaire, Observation, Focused group discussion and Photography. Secondary data was gathered by reading Journals, Newspapers, electricity production agency books and relevant write-ups

Results

The results were generated from four areas of power/electricity production. These were cogeneration, small hydro power projects/mini/pico, hydro power and other energy production technologies (thermal, wind and solar projects).

1) Cogeneration

Cogeneration is the production of electricity by processing heat from a single thermo dynamic machine. Through this process, biomass such as Bagasse is used to fuel the thermo dynamic machine that heats up steam, which then drives a turbine(s) to produce electricity (Karekezi and Ranja, 1997), as the simultaneous production of electricity and heat energy (AFREPREN, 2004). Cogeneration strictly refers to an energy recovery system, which sequentially generates electrical power and thermal energy

2) Kakira Sugar Works

Kakira Sugar Works is the Madhvani Groups' economic flagship. The sugar complex at Kakira and has grown from the original factory with a capacity of 150 tons of cane per day in the 1930s, to over 3500 tons of cane per

day in the 1990s. It has now expanded to 6000 tons of cane per day by 2009 Total Cane Demand (TCD).The Kakira sugar works has a saying that; "From cane to sugar and electricity".

A sugar factory is usually very efficient in utilizing all resources optimally. These resources include: Sugar cane, Water, Steam, and Power. The basic resource of sugarcane can itself be used to co-generate steam and power.

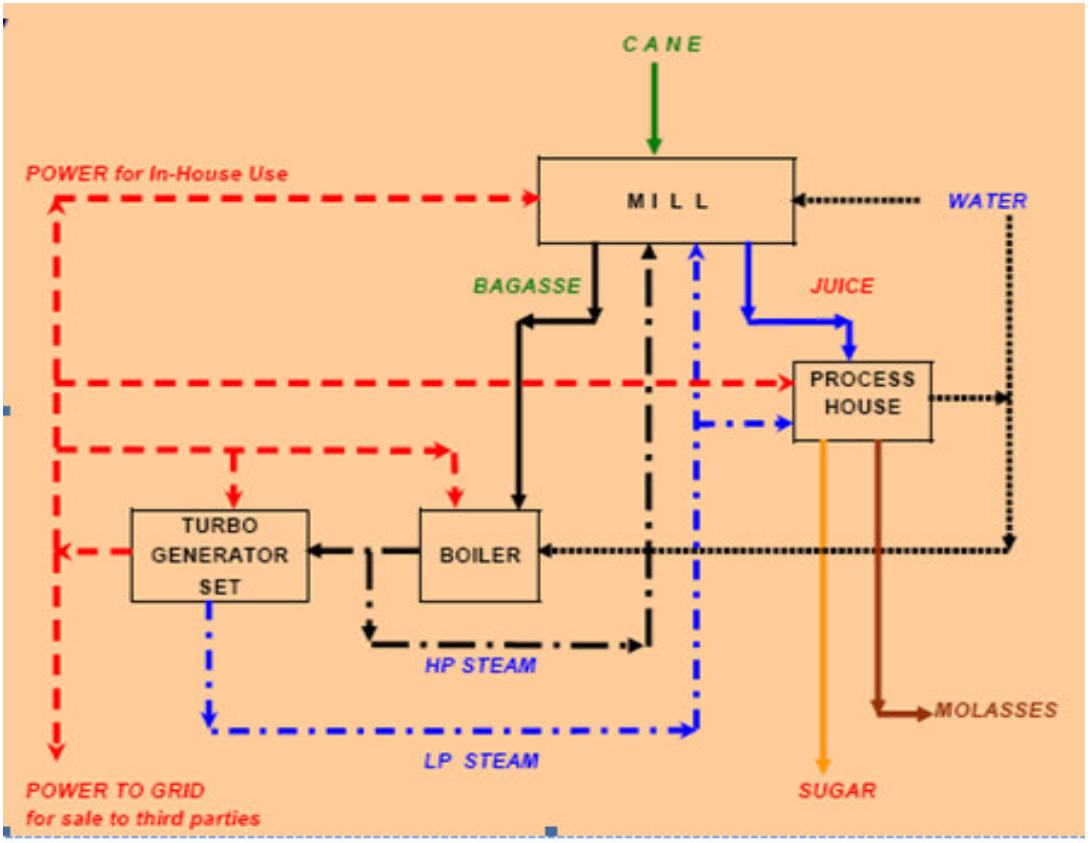

Figure 1: Cogeneration

3) Kinyara Sugar Works

Kinyara Sugar Works has been in existence since 1972. It's 51% of the shares owned by the Retailers Association of India (RAI) of Kenya. The factory has increased sugar production from 25,000 tons in 1995 to 65,000 tons in 2005. The factory has a cane crushing capacity of over 3,500 Total Cane Demand (TCD) by 2012. There were 8 camps that accommodated all workers of Kinyara Sugar Works. The research targeted four camps. Five respondents were captured from each camp and a stratified sampling method was adopted. This was done on counting every five houses and picked the sixth for interviewing following the selected internal camp roads. Data were coded to show how the responses were following one another to avoid repetition.

4) Small Hydro Power Projects

Energy sources are renewable because they are naturally replenished, or their supply is so vast that human consumption can never meaningfully deplete them, except for bio-gas, the total renewable energy consumed by Ugandans is estimated at 1% in the light of boosting up electricity supply. Research has been done in small/Micro/Pico hydropower systems and their viability to rural electrification scheme (Bw'Obuya, 2002). While the definition of the terms "Micro", "Pico" vary significantly, Ministry of Energy and Mineral Development defines capacity below 5 KW as Pico. The need for electricity is irrefutably immense and also couple up with various sites in the country; it makes Pico hydropower systems the most viable scheme for power production in Uganda.

i. Buseruka Mini Hydro Power Plant

Hydromax Ltd plans to initiate the Buseruka hydropower project, which is a 9 MW run-off river project with an annual production of 53.68 MWh (design value). The project is located on River Wambabya in Buseruka sub-County in Hoima district, western Uganda at the flanks of the Western Rift valley overlooking Lake Albert. The purpose of the project is to utilize the water resources for generating electricity in an environmentally sustainable manner to meet electricity demands. This would help improve the quality of life and support economic growth in the local area and in the country in general as well as replace electricity generated from the Uganda source mix which includes diesel generators.

ii. Bugoye Hydro Power Project (Mobuku II)

According to the information given by the manager, Mobuku I sells its power to Uganda Electricity Transmission Company Limited (UETCL) at 13 US cents per KWhr and Kilembe investment Ltd and UMEME distributes it to the consumers. The transmission is done by UETCL. All the power generated at Mobuku II amounting to 14 MW is sold to UETCL at 13 US cents per KWhr and its connected to the National grid. All the 9.5 MW generated at Mobuku III is used by Kasese Cobalt Company Ltd (KCCL) on its activities, meaning that nothing is sold to the national grid. KCCL uses more power than what Mobuku III generates, and this means energy from the national grid is used to boost up the Mobuku III output.

iii. Status of other Mini Hydro Power Stations in Uganda

a) Sezibwa Falls

Sezibwa Falls are located in Nagojje sub-County approximately 5 km off Kampala Jinja Highway at Kayanja Trading centre approaching Namagunga schools in Mukono County, Mukono District. At the Falls, there is Sezibwa Falls Resort. The site occupies approximately 15 ha of partly mailo and public land.

b) Kalagala Falls

Kalagala Falls is located along river Nile in Kayunga District. The Falls are approximately 6 km from Kangulumira trading centre along Kayunga – Jinja road. Next to the Falls is a Buganda cultural centre used as a tourist stopover.

c) Ririma Falls

The River Ririma originates in Manafwa district along Mt. Elgon ranges. The Falls are approximately 15 km away from Lwakhakha border point (Lwakhakha Town Council). It is a rural remote area where the inhabitants are purely practicing subsistence agriculture and little commercial farming.

d) Sipi Falls

Sipi Falls on Sipi River 1, 2 and 3 are located along Soronk Kapchorwan road within the Mt. Elgon ranges. There are a number of touristic centres near Sipi Falls. The Falls are within Kapchorwa District in North Eastern part of Uganda. Sipi River flows from Mt. Elgon to Lake Kyoga.

e) Muyembe Seremityo Power Production Centre

River Muyembe is located in Kapchorwa District immediately after Soronko Trading Centre and almost at the junction of Soronko – Moroto – Kapchorwa roads. It carries large volumes of dirty water.

f) Manafwa River

This river stretches from Mt Elgon hills and traverses all the way to Lake Kyoga. However, the point where the researcher reached was where the river crosses Mbale – Tirinyi road. NWSC gets water at this point for Mbale Municipality. That particular point is in Manafa District just less than 15 km from Mbale Township.

g) Nkusi River Bridge at Pachwa

The bridge is located along Kagadi – Hoima Road at Pachwa. At present, the river has no active power production dam except just before the bridge is Falls a few metres away.

h) Weki Hydro Power Project

River Weki borders Hoima and Masindi districts near Butiaba on Lake Albert. It has some reasonable amount of water flow. If a dam is constructed, 5 MW of energy is expected to be generated.

i) Mutiti Hydro Power Project

The river on which the hydro power is proposed is known as River Mutiti. It is located in Kabarole district along Hoima / Fort Portal Road.

j) River Tokwe

It is located along Fort Portal – Bundibugyo Road in Bugombwa village, Bundibugyo district, Busalu sub-County.

River Nyahuka

Located in Nyahuka Town Council, Balihukunga village in Budibugyo district along Bundibugyo to the border with Congo. At Nyahuka Bridge immediately after Nyahuka Town Council, two streams join to form the major Nyahuka river (Nyahuka and Rwabatawa river). The river is expected to produce 0.70 MW. It flows from Mt. Rwenzori Ranges.

k) Rivers Ishasha and Rwimi Project

Located in Mukikongo LCI, Rugendabe sub-County, Kanungu District. The bridge is on the Fort Portal - Kasese Road. Water volume is big enough to support electricity production with added technology. Expected power output at commissioning is 5 MW.

l) River Kamuyora Seselo

This is River originates from Lake Bunyonyi and crosses Kabale-Kisoro Road near Muko trading centre. This river has the potential to generate hydro - electricity as it flows from Rwenzori highlands into the valleys. It is found in Kiriba village, Busanza sub-County in Kisoro district.

m) Nyaagak Power Project

It is located in West Nile district along Nyangak River. Can generate 3.5 MW and supply residents of Zombo, Nebbi, Maracha, Terego, Arua, Yumbe, among others. Started construction in 1998 and it was open in November 2010. Project cost is Ug. Shs. 7 billion.

5) Hydro Power Projects

a) Bujagali Hydro Power Project

In mid 1990 the American company AES, through AES Nile Power Ltd (AESNP) was awarded the project contract by Uganda government to build Bujagali dam and power house, which the World Bank supported financially and at present the project was commissioned and under operation.

b) Kiira Hydro Power Station

In 1993 work started on the Owen Falls Extension project. The new project is a second powerhouse located about 1 kilometre (0.62 miles) northeast of the Nalubaale Power Station, which was built in 1954. A new canal was cut to bring water from Lake Victoria to the new powerhouse. Major construction was completed in 1999. The first power from two units out of the installed five units, came online in 2000.

c) Nalubaale Power Station

Nalubaale Power Station, often known by its old name, Owen Falls Dam, is a hydroelectric power station across the White Nile near to its source at Lake Victoria in Uganda. Nalubaale is the Luganda name for Lake Victoria.

d) Other Energy Technologies

The stability of hydrology on Lake Victoria and the commissioning of the 50 MW Aggreko-Mutundwe thermal plant played a significant role in the reduction of the continuous black outs. The diesel fired generation plant was decommissioned at the end of August 2008 (GoU, 2009).

i) Thermal

There were five Thermal Power Stations visited for the purpose of this study which included Namanve Thermal Power Station, Tororo Thermal Power Station, Bugala Thermal Power Station, Electro-Maxx Thermal Power Plant, Invespro (U) Ltd Thermal Power Plant

ii) Wind

iii) Solar Energy

Discussion

a) Cogeneration Projects

Uganda has two major electricity production points by cogeneration and these include Kakira Sugar Works located in the Eastern part of the county and Kinyara Sugar Works located in the Western part of the country (Masindi District).

Under cogeneration, the crushed cane sugar is used to generate heat to burn the boilers. The steam from broilers turns the turbines which generate electricity.

Under the agreement between the Government and the power plants, the generated electricity is supplied to the National Grid and some little is retained at the factories to run the different factory activities like lighting, heating and running the factory machines. Cogeneration clearly shows the process in which the cane passes until sugar and electricity are produced. The process under which the cane is processed in the mill produces two items: juice and bagasse. Bagasse is taken back to the gardens and used as fertilizer or used for heating the boilers to generate steam for running the turbines which finally generate electricity. The best examples in Uganda where cogeneration is applicable are Kakira and Kinyara Sugar Works.

During the electricity production process, water discharged from the boilers is allowed to join the natural steam at a distance of approximately 1 km away. The results indicated that from the factory to the first point of water testing (100 m) away to point two before joining the natural stream several parameters were tested. These included among others: pH, electrical conductivity, colour, turbidity, total dissolved solids, suspended solids, alkalinity, water hardness, calcium, magnesium, bicarbonate, chloride, fluoride, iron, sulphate, nitrate at faecal coliforms. All these were tested at the Government Central Laboratory (National and Sewerage Corporation Laboratory – Bugolobi).

b) Small Hydro Projects

Uganda is gifted with a number of small hydro production potential centres or points. Those that were identified included: Bogoye I, II and III, Nyagaka, River Wambabya, among others. This involves further the estimated capacity in mega water per station as per the Ministry of Energy and Mineral Development data.

c) Hydro Power Projects

The three main dams supply electricity to Uganda with a total of 820 MW from Nalubaale Dam (180 MW), Kiira Dam (40 MW) and Bujagali Dam (600 MW). The management of electricity in Uganda has been distributed into three parts: Generation (UEGCL), Transportation (UETCL) and Distribution (UEDCL). The distribution of electricity to the different consumers by UMEME is the most important part for this study.
All the electricity generated at the three dams is transported and distributed by UMEME as one product.

d) Other Energy Technologies

The different energy technologies are categorized as thermal, wind and solar. Though they are not very reliable but they have to a reasonable extent substitute power supply to those places where there is little or no hydro power electricity supply. Thermal power plants have been located in different parts of the country. For instance Namanve, Lugogo, Mutundwe within Kampala Urban area and Tororo in the Eastern Region of the country to boost up the low energy supplies that traversed in the period between the years 2000 and 2008. Solar energies have contributed a lot to rural areas where there is no electricity at all. It is also used as a substitute where electricity is not reliable and it is highly needed for the execution of the operations of particular institutions, for instance hospitals.

Wind energy though not very common in Uganda also assists or substitutes in those areas where it is too costly to transport the electric cables from the power dams to those areas. For instance: wind vanes or wind mills have been sighted in North Eastern part of the country (Karamoja) where the wind flow is to a certain extent stable. Though wind energy is not very reliable but it fills up the gap where there would be no electricity at all.

Conclusions

The study examined the status into four generation categories which all lead to the generation of electricity. Cogeneration resulting from heating of water using bagasse has no serious adverse effect on the environment. Small hydro power projects are boosters of electricity supply in Uganda. More than 20 sites have been identified as potential sites that can contribute to the general power demand countrywide.

The three major hydro power stations of Nalubaale, Kiira and Bujagali along River Nile are the biggest generators of electricity in Uganda. They are assisted by the Mini Hydro Power Generation centres mentioned above. The high demand for electricity due to the increased rate of development countrywide led to the construction of the two centres (Kiira and Bujagali) on top of the Nalubaale which was constructed in the 1950s.

Other energy technologies such as thermal, wind and solar also contribute positively to the high energy demand countrywide. More than five thermal power plants were constructed in the 1990_s to boost up the situation which was alarming. The energy demand was far above the energy supply and thermal power plants complemented the gap for the economy to remain functioning. Wind energy is not very common in Uganda due to insufficient heavy moving winds to run the fans that would turn the turbines to generate electricity. Even in Karamoja where it was tried, it did not succeed effectively because the wind was not strong enough to turn the wind vanes to generate electricity. Solar energy technology is progressing steadily in Uganda since sunlight is consistent anyway. Out of twelve hours in a day, only an hour of sunshine would adequately charge the solar batteries for effective supply of electricity to the consumers. The rest of the eleven hours solar power can serve a large percentage of the households in Uganda.

4.5 Recommendations

a. Sensitization of Communities

The community should appreciate the value of using electricity unlike the continuing with traditional culture of depending on biomass for both cooking and lighting. The community should as well appreciate the different technologies used during electricity production/ generation, distribution and consumption patterns at the consumer level. The Central Government, Non-Governmental Organizations, Community Based Organizations and many others should allocate their biggest budgets to sensitization so that their environment conservation programmes succeed. UMEME, the Agency Monopolizing the distribution of electricity in Uganda should have a fully-fledged department / programme to sensitize the consumers about their environmentally friendly product for most of their needs for power.

b. Policy formulation and implementation (Central and Local Governments)

Formulation of polices by the Central Government should be emphasized to run and manage the day affairs of their beneficiaries. Environmental concerns should be given high priority especially for primary schools under their jurisdiction. In primary schools countrywide, a topic on environmental conservation should be introduced in science subjects that can be taught from primary one to primary seven.

c. Prioritization at budgeting stage

Environmental concerns at budgeting stages both at Central and Local Government levels should be given first class priority. This should be done in order to take care of the environment. Mitigation measures should be addressed seriously during all stages of power generation and distribution. The Central and Local Governments should avoid the tendency of capitalizing on high capital investments at the expense of the environment.

REFERENCES

AFREPREN. (2004). Renewables and energy for rural development in Sub-Saharan Africa.London ; New York : Zed Books ; Nairobi : African Energy Policy Research Network (AFREPREN), 2004

African Development Bank. (1998). African Development Report (1997) Tunis: African Development Report

Barnes, D.F. and Floor, W.M. (1996). Rural energy in developing countries: a challenge for economic development. *Annual Review of Energy and the Environment,* 21: 497-530.

Beaver, B. and Bernsten, R. (2009). Data Preparation and Analysis. *http://www.aec.msu.ed/fs2/survey/Bernsten and Beaver rev Data Preparation and analaysis/pdf/[Acessed 02/04/2012.*

Duffey, R.B. and Miller, A.I. (2002). From option to solution: the nuclear contribution to global sustainability using the newest innovations. World Nuclear Association Annual Association proceedings, Vienna.

Ecotrust, (2003/2004), Annual Report, Building Partnership to Conserve Uganda's National Heritage Kampala – Uganda.

Electric Power Research Institute (1990). Efficient electricity use: estimates of maximum energy savings. Palo Alto, Calif.: The Electricity Power Research institute.

Handa, T.; Oda, A.; Tachikawa, T.; Watanabe, Y.; Ichimura, J.; Nishi, H. (2008). Table-based scheduling method for distributed demand side management, Industrial Electronics. IECON 34th Annual Conference of IEEE 10-13 Nov. Page(s): 2748 - 2753.

Karekezi and Kithyoma,W. (eds) (2005). Sustainable Energy in Africa: Congenertion and Geothermal in the East and Horn of Africa – Status and Prospects, Nairobi, AFRPREN/FWD and Heinrich Boll Foundation (HBF)

Willemse, J., Ludgren, A.B. and Singer, C.E. (2000). ISES Seminar on Rural Electrification in Africa. Pretoria : E&Co.