Uganda: Energy Consumption

Energy Situation

Uganda has a total primary energy consumption of 0.0593 quadrillion Btu which is an equivalent of 14.94 Mio tons of oil. Biomass is still the most important source of energy for the majority of the Ugandan population. About 90% of the total primary energy consumption is generated through biomass, which can be separated into firewood (78.6%), charcoal (5.6%) and crop residues (4.7%). Electricity is contributing only 1.4% to the national energy balance while oil products, which are mainly used for vehicles and thermal power plants, account for the remaining 9.7%.

Concerning electricity generation, Uganda has an installed capacity of 822 MW, mostly consisting of hydropower (692 MW; 84%). Access to electricity at national level in Uganda is still very low with 19% (1991: 5.6%; 2006: 9%; 2010: 10%; 2013: 15%) but only 7% in rural areas. Uganda currently has one of the lowest per capita electricity consumption in the world with 215 kWh per capita per year (Sub-Saharan Africa's average: 552 kWh per capita).

The energy sector is one of the key sectors of the Ugandan economy. The sector provides a major contribution to the treasury resources from fuel taxes, VAT on electricity, levy on transmission bulk purchases of electricity, license fees and royalties and foreign exchange earnings from power exports. Significant public investment has injected into the sector, particularly in the area of electricity supply. Following liberalization, the power sub-sector is now attracting the largest private sector investments in the country. The sector is not only a vital input into other sectors, but also major source of employment.

Problem Situation

Wood fuels are largely used for cooking in rural areas while charcoal mostly provides for the cooking needs of the urban population. High demand for wood fuels used inefficiently results in overuse and depletion of forests.

In 2012, 14.1% of Uganda's land area was covered with forest. The land available is becoming scarce and households prefer to use the land for food crops rather than planting trees. Since 1990, the forested area decreased from 49,240 km² down to 29,880 km². This means that from 1990 until 2012 more than 19,360 km², equaling 39 % of the existing forest disappeared. Currently about 90,000 hectares (equals 900 km²) of forest cover are lost annually, which leads to fuel wood scarcity in rural areas and increasing price levels of charcoal and fuel wood.

Between 2005 and 2008 the charcoal price rose at an enormous nominal rate of 14% per year. In addition, illegal cutting of trees increased. The production of charcoal is carried out under primitive conditions with an extremely low efficiency at 10 to 12% on weight-out to weigh-in basis and an efficiency rate on calorific value basis at 22%. At the same time, households use biomass in a very inefficient way as the three-stone fire is still widely spread. Urban and rural households are facing increasing energy costs or spend more time collecting firewood.

Furthermore, the traditional use of firewood is responsible for high indoor air pollution levels, thus causing respiratory diseases that affect women and children in particular. Moreover, the latter spend many hours and travel long distances to collect fuel wood. This deprives women of valuable time to engage in income generating activities and children to go to school and study.

A total of 93% of rural households without access to electricity are currently using traditional lighting technologies such as candles or kerosene lamps that give poor quality lighting, emit noxious fumes and present hazards in terms of fires or burns (in particular for small children). More so, the majority of social institutions like schools and health centres in rural areas, do not have access to electricity, which leads to inferior health and education services in comparison to electrified institutions. Lack of access to electricity also severely constrains the economic development of rural areas of Uganda, preventing the establishment of businesses that require electric power or forcing companies to buy diesel or petrol generators that are costly to operate and negatively impact the environment.

Energy Resources

Uganda is richly endowed with abundant energy resources, which are fairly distributed throughout the country. These include hydropower, biomass, solar, geothermal, peat and fossil fuels. The energy resource potential of the country includes an estimated 2,000 MW of hydro power, 450 MW of geothermal, 1,650 MW of biomass cogeneration, 460 million tons of biomass standing stock with a sustainable annual yield of 50 million tons, an average of 5.1 kWh/m2 of solar energy, and about 250 Mtoe of peat (800 MW). In addition, petroleum in an estimated amount of 6.5 billion barrels, of which 1.4 billion barrels are recoverable, was discovered in the western part of the country and exploitation is underway. The overall renewable energy power generation potential is estimated to be 5,300 MW with an expected rise.

Biomass

Biomass is the predominant type of energy used in Uganda, accounting for 94% of the total energy consumption in the country. Charcoal is mainly used in the urban areas while firewood, agro-residues and wood wastes are widely used in the rural areas. Firewood is used mainly on three-stone fires in rural households and in food preparation by commercial vendors in urban areas.

Only about 10% of all households use efficient stoves. The same applies to the burning of farm residues. Firewood in some institutions like schools and hospitals is however used on improved stoves. Charcoal is mainly used on a metallic stove traditionally known as a ‘sigiri’ though the use of the clay sigiri is picking up.

For the conversion of firewood into charcoal, earth mounds and pits are used as charcoal kilns. These have a wood conversion efficiency of 10 to 12% on weight-out to weight-in basis. This implies that about 9kg of wood are needed to produce 1kg of charcoal, which translates into 22% efficiency on an energy-output to energy-input basis. Introducing improved technologies may increase efficiency to achieve 3 to 4kg of wood per kg of charcoal, which corresponds to 50% to 60% efficiency respectively on an energy basis.

Efforts to train charcoal burners have mainly been unsuccessful as most of them do it on an individual basis. Like in most African countries, research, development and dissemination of efficient and modern biomass technologies are not yet at the desired level.

Biomass stoves: Best practice case study

Against the background of high deforestation rates and firewood scarcity in Uganda, the Ministry of Energy and Mineral Development, with the support of the German Agency for International Cooperation (GIZ) through the Energy Advisory Project (EAP), partnered with NGOs and the private sector to promote the improved *Rocket Lorena Stoves* for households and institutions. The rocket stoves for households have been modified to fit the socio-economic setting of the poor by using locally available materials that can be obtained cheaply or at no cost. More information on the strategy, has been successfully used to disseminate over 175,000 *Rocket Lorena stoves* in Bushenyi and Rakai districts in Uganda since 2005.

Hydropower

The electricity supply system in Uganda was developed during the 1950s and 1960s with the construction of the Owen Falls Hydropower Station (later renamed Nalubale Power Station) with 10 generators and a total installed capacity of 150 MW. Later the power station was refurbished and upgraded to 180 MW and a new power station, Kiira, was constructed with a capacity of 200 MW.

The private companies Kilembe Mines Ltd, Tronder Power and Kasese Cobalt Co. Ltd have their own smaller hydropower plants Mubuku I with 5.4 MW, Mobuku II with 14 MW and Mobuku III with 10.5 MW. The stations were initially built to supply their own industrial activity, but due to the interruption in the copper and cobalt production activities, the companies entered into a contract with the UETCL in 2003 to sell power to the grid.

Other power stations are the Kanungu Power Station of Eco Power with 6.4 MW, and Mpanga Power Station of Africa Energy Management Systems with 18 MW. Three other small hydro power stations Kuluva (120 kW), Kagando (60 kW) and Kisiizi (300 kW) supply electricity to

isolated hospital grids. The German Agency for International Cooperation (GIZ) set up small hydro power plants in Bwindi (64 kW) and Suam (40 kW).

Uganda's total installed capacity is 822MW, generated primarily from Owen Falls Hydropower Station at Jinja in the South-Eastern part of Uganda. However, during droughts (like in 2009), only around half of the installed capacity could be used as a result of the low water level of Lake Victoria. Contributing to electricity supply problems is the fact that growth in demand for electricity has not been matched with new generation capacity. To alleviate this problem, the government has procured emergency thermal generators. A new hydro facility was developed at Bujagali, and has been operational since February 2012. The installation capacity is 250 MW. Before Bujagali became operational, 150 MW thermal capacities had been added in order to bridge the gap until the beginning of 2012.

Solar energy

The level of solar energy utilization in Uganda is still very low. The use of solar PV began in the early 1980s mainly driven by donor-funded programmes for lighting and vaccine refrigeration in health centers. Later the Uganda Railways Cooperation, a government parastatal, installed 35kW at 29 locations for communications and signaling. The Uganda Post and Telecommunications Cooperation also installed 30kW at 35 remote telecommunication sites throughout the country.

In 2001, the Government launched the Rural Electrification Strategy and Plan (RESP) for the years of 2001 to 2010. It expired in 2012 due to delayed implementation. Among others, the RESP was supposed to increase the use of solar PV in rural areas. Unfortunately the RESP for 2001-2010 did not meet expectations. The plan anticipated rural electricity access to grow from the then-estimated 1% percent in rural population access to 10%. However the actual result was an increase of rural access by less than 5% percent. The RESP also had a target of 80,000 PV systems by 2012 but in the end only 7,000 systems were installed. Following this, the Electrification Strategy and Plan 2013-2022 was published.

As part of the rural electrification program, Energy for Rural Transformation (ERT I), supported by the World Bank, is implementing PVTMA, a sales-based performance subsidy scheme that also provides business development support to private PV dealers, which is expected to

increase PV sales. Under the same programme, the Ministries of Health, Education, Water and the Uganda Communications Commission have procured PV systems to meet their sectors' electricity needs.

The Ministry of Health planned for 568 PV systems for health centers under ERT Phase I. Finally 79 Solar DC vaccine fridges were supplied to Health Centers (HC); 261 staff houses received stand-alone solar PV energy packages for lighting and operation of radio and TV/VCR; and 220 medical buildings received 17 stand-alone solar PV energy packages. The Ministry of Education planned for 458 solar systems for 129 post-primary institutions in 10 districts. By the end of the ERT I, 94 of the 129 institutions had been electrified.

After ERT I, the second phase of Energy for Rural Transformation (ERT II) project was initiated. Its focus is to increase access to energy, Information and Communication Technology (ICTs) in rural Uganda. There are three components to the project, which are: rural energy infrastructure, the ICT and energy development in terms of cross sectoral links and impact monitoring. The project has been running from 6th of April 2009 and set to end by 30th June 2016 and will cost about 105 million USD.

Geothermal energy

The exploration for geothermal resources in Uganda is still at the reconnaissance and exploration stage. Reconnaissance surveys on Ugandan hot springs started in 1921 by the geological survey of Uganda and the first results were published by Wayland (1935). In 1973, as a result of the oil crisis, an attempt was made to initiate a geothermal project with United Nations support, but this did not materialize due to the political turmoil in the country at the time.

Geothermal energy resources in Uganda are estimated at 450 MW. Exploration for geothermal energy has been in progress since 1993. So far, three potential areas all situated in western Uganda, in the western branch of the East African Rift Valley were identified for detailed exploration. The three potential areas are Katwe-Kikorongo, Buranga and Kibiro. Based on recent assessments, they have all been ranked as potential targets for geothermal development. The current study results indicate that the temperature level varies between 150°C and 200°C which is sufficient for electricity generation and for direct use in industry and agriculture. The rest of the geothermal areas of Uganda are at a preliminary level of

investigation and results will soon be available as basis for their prioritization for detailed surface exploration.

Cogeneration

Currently there is a capacity of 29.7 MW in two cogeneration plants installed, which both run with bagasse as fuel. There is a considerable potential of cogeneration in the sugar processing industry as well as textile manufactures, beer industry, cement industries and foods and beverages industry. The potential in the sugar industry alone is currently estimated to be over 100 MW while for other industries it could be over 50 MW. Cogeneration contributes to power generation as well as to the goal of energy efficiency.

Fossil fuels

The annual consumption of petroleum products was 1.4 billion litres in 2012, which has since been steadily increasing. The average annual growth of petroleum consumption is about 7%. The composition is as follows: Petrol (41.1%), Kerosene (6.1%), and diesel products (52.8%). Uganda imports all its petroleum products from overseas since there is no local production yet. However, oil was detected in six sedimentary basins in Uganda, the most prospective being the Albertine Graben covering 23,000 km2 in the Western Rift Valley along Uganda's Border with the Democratic Republic of Congo.

Currently the amount of oil discovered is about 6.5 billion barrels of which 1.4 billion barrels are recoverable. But it has to be noted that the numbers change every now and then, suiting to the political situation or new research projects. This discovery is placing Uganda among the foremost African oil producers. So far over 1.5 billion US$ has been invested in seismic and drilling of wells. By international standards, the cost of finding a barrel of oil has been very low in Uganda.

What's the way forward?

Uganda has a long way to go if it has to key into the "sustainable Energy for all" Initiative of the United Nations (SE4ALL) and to also achieve the millennium development goals (MDG) by 2030. Developing and harnessing of the country's renewable energy potential is still demanding if the country's energy needs are to be met. It has to set its objectives in the Energy and Renewable energy policies so as to meet the energy needs of Uganda's population for socio and economic development in an environmentally sustainable manner and to increase the use of modern renewable energy sources from the current 4% to 61%. This is an ambitious target that should be backed up with capacity building activities in modern energy technologies and adequate financing.

It is clear, that the provision of sustainable energy solutions in Uganda is crucial for alleviating poverty, strengthening the country's economy and protecting the environment. Indeed, the Government of Uganda is committed to securing a stable energy supply for long-term social and economic development of the country. This is emphasized in the Constitution of Uganda (1995) and the Energy Policy (2002), whose goal is "To meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner."

While this is an on-going process (provision of sustainable energy solutions), a study commissioned by WWF Uganda Country Office (WWF UCO) has shown that it is possible to meet 100% of Uganda's energy needs from renewable energy sources by 2050.