

Small hydropower situation and needs in Uganda; Potential and development opportunities

Dan Marlone Nabutsabi

Hydro Power Association of Uganda Ltd (HPAU)
EAGEN Insurance House
Plot 14 Kampala Road
P. O. Box 28190
Kampala, Uganda

Introduction

Uganda is located south of the Sahara in the central-eastern Africa, the most southern part crossed by the equator line. The total area is 241,551 sq km (93,263 sq ml). The greater part consists of a plateau, though the Rwenzori Mountains lie along the western border while Mount Elgon lies on the eastern border. Water occupies 41,028 sq km (15,841 sq ml), with Lake Victoria and the Nile taking the bigger portion of this.

In Uganda, small hydropower (SHP) is generally defined as hydropower plants with installed capacity of up to 20 mega watt (MW). While large-scale hydropower is located along the Nile, over 50 small- and medium-hydro sites are located mainly in the western and the eastern regions of the country which are hilly and mountainous and with potential resources yet to be exploited.

Uganda is a country with abundant potential for small hydropower development. There are many identified sites suitable for small hydropower facilities. Small schemes are generally privately owned and operated by independent power producers (IPPs). Some of them supply electricity to isolated grids. To date there are 20 SHP under operation, with an average investment costs of US\$3 to 4 million per MW installed.

1. Hydropower Situation and Needs in Uganda

Uganda is well-endowed with energy resources distributed throughout the country including hydropower, biomass, solar, geothermal, peat and fossil fuels. According to the Uganda Bureau of Statistics (2019), about 50 per cent of the population has access to electricity. Consumption of electricity is among the lowest in the world at 215 kWh per capita per year, less than half that of the Sub-Saharan African average of 552 kWh. The electricity supply system in Uganda was developed during the 1950s and 1960s with the construction of the Owen Falls Hydropower Station with 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.

In 2017, electricity generation in Uganda totalled 3,874 GWh with a clear dominance of hydropower share. The current contribution of hydropower in Uganda's electricity generation mix is 87 per cent and is expected to go up to 92 per cent once Karuma HPP (600 MW) is commissioned. According to the Second National Development Plan, the Uganda Government expects to increase generating capacity to 41,738 MW by the year 2040.

The gross theoretical hydropower potential of the country has not been fully assessed. The technically feasible potential of Uganda is 20,833 GWh/year and the economically feasible one - 12,500 GWh/year. About 15 per cent of the technically feasible potential has been developed so far.

In 2018, hydro plants generated 3,638 GWh, which was 89 per cent of the total generation; with hydro contributing to more than 80 per cent each.

A recent study indicates that Uganda has a hydro resource potential of 4,137 MW. As of 2019, 32 hydropower plants that were in operation, with a total installed capacity of 1,667 MW. This comprises some 20 micro and small hydropower plants (up to 10 MW). The current contribution of hydropower in Uganda's electricity generation mix is 87 per cent.

2. Potential and Development Opportunities

2.1 Small Hydro Potential in Uganda

A total of 59 mini hydropower sites with a potential of about 210 MW have been identified through different studies. This gives a fair picture of the small and mini hydro potential in the country. Some of the sites can be developed for isolated grids and others as energy supply to the grid.

Regarding small hydropower projects, the current policy is that their development is undertaken by the private sector. The Renewable Energy Feed-in Tariffs (REFiT) are in place to promote investment in small hydropower and other renewable power projects.

There are many unexploited potential SHP sites in Uganda, which could potentially supply electricity to areas not covered by the national grid.

2.2 Development Opportunities

Uganda's SHP policy is integrated within the whole energy and hydropower sector. This provides the legal framework for developers and operators.

REFiTs were introduced under the Renewable Energy Policy (2007) to promote a greater private sector engagement in power generation from renewable energy sources. The REFIT applies to systems of prescribed priority technologies, including SHP, of installed capacity in the range of 0.5 to 20 MW. To qualify for the REFIT, the projects must be connected to the national grid.

The government has worked in tandem with IPPs, development partners and public-private partnerships to bridge the financing gap for the development of SHP projects. Other key sources of funding among these are the Global Energy Transfer Feed-in-Tariff (GET FIT) Programme and the support from Power Africa, whose main objective is "to assist East African nations in pursuing a climate resilient low-carbon development path resulting in growth, poverty reduction and climate change mitigation."

In terms of educational framework, Makerere University in Kampala has about 95 per cent of the total student population in Uganda's universities. More than 20 private universities and a smaller number of non-university institutions are providing education. Vocational and Technical Education is a necessary aspect of the education system in Uganda. Some programs provide graduate engineering level education to students seeking education at the tertiary or post-secondary level. There is, however, no hydropower engineering study program in the country education system.

There is therefore a huge opportunity for investment in the country geared towards leveraging the knowledge, understanding, capacity and skills in hydropower design, development, operation and maintenance.

Since hydropower development is starting to progress in this country the basic hydropower knowledge would be advantageous. There is a need to transfer European-top-level experience, knowledge, available state-of-the-art hydro technology to Ugandan researchers.

High upfront costs and limited access to early-stage support and equity investment present another limitation, as interest rates from commercial lenders are quite high due to the perceived high risks of the investment. There is a perception of high risk of default on payment by the single off-taker. This is a great investment opportunity for companies and organisations that are ready to plough in long term venture capital.

There is a need for capacity building within the government institutions, particularly as relates to planning, design and construction of hydropower plants.

Uganda Vision 2040 identifies electricity generation as one of the key strategic interventions for social-economic transformation of the country. This includes increasing access to 30 per cent in 2020 and 80 per cent in 2040 (a 6 per cent annual increase), with off-grid electricity playing only a minor role. While this is expected to be mainly low-carbon due to large hydropower resources, there is a potential to achieve 100 per cent access cost-effectively by 2040 with a greater emphasis on small-scale off-grid renewable solutions.

The key challenges for hydropower development in Uganda, and most countries in Africa, include the need for substantial up-front investment capital which cannot easily be raised by the sector, as well as environmental and social concerns such as the resettlement and compensations of persons affected mainly by the large hydro projects, and inadequate local implementation experience and technical capacity.

Even with over 40 stakeholders active in the SHP sector, there are no hydraulic machinery equipment producers in the country. With the current political stability over the 30 years of the National Resistance Movement government, there is a very conducive investment climate, with several planned heavy industrial parks, which will increase the demand for clean energy over the next 5 to 10 years substantially.

The Author

Dan Marlone Nabutsabi retired last February from the Electricity Regulatory Authority (ERA) of Uganda where he had served as an active member of the electrical Installation Permits Committee for over 12 years; as a representative of consumer advocacy organisations. He has also served as the Alternate Chair, deputising Eng. Ken Adams, on the Operators and Developers Chamber of the Hydropower Sustainability Protocol Governing Council (HSGC), International Hydropower Association, from 2017 to 2019. In 2014 he co-founded the Hydro Power Association of Uganda Ltd (HPAU), where he is the current Executive Vice Chairman and also the Team Leader for the HYPOSO project in Uganda. He is passionate about institutional capacity building, development and sustainability especially for start-ups, especially those dealing in renewable energy technologies. He has spoken at various local and international meetings, including Future Energy Uganda Conference, International Water Stewardship Program (IWaSP)/GIZ Regional Conference on Water Stewardship for Sustainable Hydropower in Nairobi, Kenya, and recently at the RENEXPO Interhydro at Salzburg.

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