

Exploring and Enhancing the Recent Trends and Applications in the Energy Sector of Uganda: a Legal Perspective

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Submitted: 27 July 2018; Accepted: 02 Aug 2018; Published: 11 Sep 2018

Abstract

This paper reviews the energy sector of Uganda, which is characterized by excessive use of Biomass to provide for over 90% of the energy needs, Uganda being one of the least developed countries in the East African Region. Hydropower provides over 90% of the electricity generated in Uganda while solar, geothermal and other energy sources are underdeveloped. The legal regime and the energy policies are geared towards the use of modern, and clean energy efficient technologies. Various institutions are important in ensuring sustainability in the energy sector of Uganda. This is in form of stimulating Public Private Partnership, attracting multilateral and bilateral agencies to provide funding, grants, and technical assistance in renewable energy projects. The Clean Development Mechanisms of the United Nations avail project developers the opportunity to obtain carbon finance. Several opportunities in Uganda's energy sector have been highlighted. Equally, several challenges hindering the development of the energy sector and utilization of renewable energy resources have been identified. Finally, conclusion and recommendations for proper management of Uganda's energy sector have been suggested.

Introduction

Generally, Energy is ability to do work [1]. It is also a way of measuring output and quality of goods and services generated with a given set of inputs [2]. Energy is used in this modern civilization to do work since [3] many people have learnt how to change energy from one to another. In Africa, energy is seen as the engine for economic growth and development for any society or country [4]. With a projected population of about 40 million people today, Uganda is richly endowed with abundant energy resources that are relatively distributed throughout the country. These include biomass, hydro, solar, petroleum, geothermal, cogeneration, peat and fossil fuels among others. Uganda's energy matrix is dominated by biomass energy sources contributing about 95% to the total energy consumption. Biomass can be separated in firewood to constitute 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% [5].

Concerning electricity, Uganda got hydroelectric power station in 1911 and in 1915, thermal electricity was introduced at Owen Falls where as in 1954 the first hydro-electricity power was produced at Owen falls dam in Jinja [6]. Uganda has an energy resource potential estimated at 2500MW of hydropower, Uganda's energy sector boasts of more than 21 electricity generating plants [7] with a total installed capacity of 927.4MW by the end of 2017, yet it only consumes 600MW.

Energy Consumption in Uganda

Uganda's total energy consumption is estimated at 5 Million tons of oil, of which 93% is derived from biomass [8]. Electricity and oil products contribute 7%. Residential related activities consume an estimated 70.3%, commercial use is estimated at 13.6%, industrial use at 10.7%, transport use at 5% and other uses is 0.4% [9]. The most energy consumed in residential activities is woody biomass energy, which cannot be used in industries. This is because there is low-level access to electricity energy, high tariffs and low generation capacity [10].

Uganda has an estimated energy resource potential, which includes hydropower potential of (over 2000MW), 450MW of geothermal, 460 million tons of Biomass standing stock with a sustainable annual yield of 50 million tones, cogeneration (1,650mk), peat power (800mk), high solar power energy of 5.1kWh/m²/day and fossil fuel thermal potential as well as a high nuclear potential, although the consumption of electricity per capital is low [11]. Oil has been discovered from Western part of the country although all fossil and fuels used in Uganda presently are imported with petroleum import bill [12].

Sources of Energy

Uganda's energy mix comprises biomass, petroleum, peat, solar and electricity, but reliance is mainly on biomass [13]. The most recent source of energy is solar power.

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 [14]. 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 [15]. 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 weigh-in basis. This implies that about 9kg of wood are needed to produce 1 kg 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 4 kg of wood per kg of charcoal, which corresponds to 60% to 50% efficiency respectively on an energy basis [16]. 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.

Petroleum

Petroleum is also used to generate energy [17]. Petroleum products include premium motor spirit (PMS), automotive Gasoil (AGO), Bulk illuminating kerosene (BIK), Aviation fuel oil (FO) and liquefied petroleum gas (LPG). All these products are imported.

The consumption of petroleum in Uganda currently stands USD at 550,000m3 per annum [18]. The petroleum import bill is now at 160 million per year. Government licensed 20 oil marketing companies out of which only 15 are in operation. The government maintains oil fuel in the reserves at Jinja for strategic purposes.

Uganda's petroleum industry dates way back to the 1920s when EJ Wayland, a government geologist reported hydrocarbon seeps in the Albertine Graben [20]. Both shallow and deep wells were dug including Waki-B-1 in 1938, but there was halt in activities due to world war and the political instabilities that rocked Uganda then [19].

Activity resumed in the 1980 with aeromagnetic survey undertaken in 1983/4, and in the same year the petroleum unit was created under the Department of Geological Survey and Mines plus the first Petroleum Exploration and Production Act was passed in 1985 [21].

Further geological and geophysical data was collected in the 1990s, which was used to promote oil exploration in Uganda in International Fora [22]. This attracted international oil companies to join exploration in Uganda including Petro Fina in 1991, Uganda General Works Engineering Company in 1993, Heritage Oil and Gas Limited (Heritage) dug deep wells (Turaco- 1, 2, 3) in the Semliki Basin but later relinquished them, due to poor prospects. In 2004, it was convinced to acquire a license in Exploration Area 3A and Exploration Area 1, along with a partner, Energy Africa [23]. Hardman Petroleum and Energy Africa were also licensed between 1997 and 2004 [24].

Following a successful drill of Mputa 1 well in 2005, commerciality of Uganda's oil was declared by government and several other wells were explored such as Waraga, Kajubilirizi (Kingfisher),

Nzizi, Ngassa, Taitai, Karuka, Ngege, Kasamene, Kigogole, Ngiri, Jobi- Rii, Nsoga, Wahrindi, Ngara, Nsoga, Mpyo, Jobi-East, Gunya, and Lyeo [25].

Currently the Ugandan oil and gas development is conducted by Tullow Oil a British's oil independent, Total a French oil major and China National Offshore Oil Corporation (CNOOC) a Chinese State Oil giant.

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 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. With the liberalization of the economy and the unbundling of the electricity utility, both Nalubale and Kiira hydro power stations were leased to Eskom (U) Ltd under a 20-year concession agreement. The hydropower stations form the backbone of the electricity supply network in the country. 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, Mubuku II with 14 MW and Mubuku 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 are 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). The country is facing occasional electricity supply shortages. Uganda's total installed capacity is 822 MW, generated primarily from Owen Falls Hydropower Station at Jinja in the South-Eastern part of Uganda (see Wikipedia "List of power stations in 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 has been developed at Bujagali, and is 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. All big power generation plants belong to the Ugandan Electricity Generation Company Limited (UEGCL) but are operated and managed by ESKOM, Aggreko and other companies. (Two dams in Uganda are equipped with sluice gates and have proper plans for the management of upstream water and land use issues. However, there are no national plans for optimized operation of power plants under variable flow regimes).

The national generation capacity stood at 862 megawatts. Uganda expects to have generating capacity of at least 1,681 megawatts by the end of 2020 [26]. Hydro power contributes 1% of Uganda's energy supply [27]. Uganda installed hydropower capacity of 683mw with current peak demand of 400mk growing at annual rate of 18% and 20MW of new generating capacity needs to be added each year [28].

There is a growing gap in Uganda between electricity supply and demand and large-scale hydro electric developments are the most economical way for the country [29]. The hydropower facility only supplies 135mk during the generation output, which reduces depending on the weather situation. And the demand for electricity changes, during day 26mk and during night 350mw. Uganda has 17 completed hydro power stations and 6 stations under construction.

Completed Hydropower Stations

	Electricity power station	Capacity(megawatts)	Year completed	River	District
1	Adekokwok hydropower station	8	2014	River Adekokwok	Lira
2	Bugoye power station	13	2009	River Mubuku	Kasese
3	Bujagali power station	250	2012	River Nile	Buikwe
4	Kabalega Power station	9.0	2013	River wambambya	Hoima
5	Kanungu hydro power station	6.6	2011	River Ishasha	Kanungu
6	Kiira power station	200	2000	River Nile	Jinja
7	Mpanga power station	18	2011	River Mpanga	Kamwenge
8	Mubuku 1 power station	5	1950s	River Mubuku	Kasese
9	Mubuku 111 power station	10	2009	River Mubuku	Kasese
10	Nalubale power station	180	1954	River Nile	Buikwe
11	Nyagak power station	3.5	2012	River Nyagak	Zombo
12	Kisiizi power station	0.3	2008	River Kisiizi	Rukungiri
13	Gwere-luzira power station	0.5kilowatts	2009	River Amon	Moyo
14	Siti Hydroelectric power	5.0	2017	River Siti	Bukwo
15	Muvumbe power station	6.5	2017	River Maziba	Kabala

16	Rwimi power station	5.6	2017	River Rwimi	Bunyangabu
17	Siti 11 power station	16.5	2017	River Siti	Bukwo

Under Construction

1	Isimba power station	183.2	to be completed in 2018	River Nile	Kamuli
2	Karuma power station	600	2020	River Nile	Kiryandongo
3	Nkusi hydroelectric power station	9.6	2018	River Nkusi	Hoima
4	Achwa 11 hydroelectric power station	42	2020	River Achwa	Gulu
5	Nyamwamba power station	14	2018	River Mobuku	Kasese

Solar Power

Uganda has plenty of sunshine throughout the year giving solar radiation of 5.1kwh per square meter per day [30]. The insolation is favorable for all solar technology application [31]. Some of the solar applications include solar photovoltaic (PV) water heating, cooling and crop drying [32]. It provides power for lightening, telecom indications, vaccine and blood refrigeration, radios and televisions in some areas [33]. Solar power provides a good alternative source of renewable energy in areas where national power cannot reach like mountainous areas and islands [34]. In any case, electricity distribution in rural areas is still limited [35]. Therefore, solar energy comes in handy as the best alternative.

Geothermal

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 in 1935 by Wayland. 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 then. Geothermal energy resources in Uganda are estimated at 450MW. Exploration for geothermal energy has been in progress since 1993 [37]. So far three potential areas all situated in western Uganda, in the western branch of the East African Rift Valley have been identified for detailed exploration [38]. 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 [39].

Peat

Peat is not technically a renewable energy source, as it takes a long time to develop, and is infinite. However, a theoretical peat

volume of about 250 million oil-equivalent tones exists in Uganda. Considering the varying quality of peat, the rather strict wetland policy in Uganda, and the impossibility of using conventional peat production methods, some 10% could be used for power generation. This peat resource volume would be adequate for generation of about 800MW of electricity for the next 50 years [40].

How is The energy Sector Regulated

Legal Framework

The Uganda Constitution 1995

The Constitution is the mother law in Uganda. All laws derive their validity from it. Under Objective XXVII (iii) the State shall promote and implement energy policies that will ensure people's basic needs and those of environmental conservation are met [41]. Provisions on equitable development [42]. The stimulation of agricultural and industrial growth [43] and promotion of energy policies for meeting people's energy needs in an environmentally friendly manner [44] provides the necessary mandate.

The National Environment Act Cap 153

The Act obligates all energy projects to undergo an Environmental Impact Assessment (EIA) as a condition for licensing or implementation [45]. Uganda ratified Kyoto Protocol, with the view of providing incentives for investors in renewable energy technologies for the abatement of carbon emissions [46]. EIA guidelines for the energy sector have been developed. Accordingly, all energy projects are subjected to EIAs and public hearings before construction. A committee of stake holders was set up to monitor compliance and to mitigate actions agreed upon [47].

Electricity Act cap 145

This Act sets the legal basis for the industry's restructuring, including the establishment of the Electricity Regulatory Authority (ERA). The Act also partly established a standardized feed-in-tariff based on the principle of avoided cost pricing, in accordance with the Electricity Act. The tariff should be able to translate into cash revenue that will not require the investor to resort a capital subsidy [48]. Furthermore, the Act established the Electricity Disputes Tribunal responsible to hear and determine all the matters referred to it relating to electricity sector (ss.109 and 93). The tribunal has all the powers of the High Court and it can review its Judgment and orders upon an Application by an aggrieved party (s.110). The following regulations have been enacted to enforce the Electricity Act: The Electricity (Licensing Fees) Regulations-2003, The Electricity (Installation Permits) Regulations-2003, The Electricity (Primary Grid Code) Regulations-2003, The Electricity (Quality of Service Code) Regulations-2003, The Electricity (Safety Code) Regulations-2003, and The Electricity (Tariff Code) Regulations-2003.

Petroleum Supply Act 2003

The main objective of the Act is ensuring petroleum supply in Uganda. This has to be adequate, reliable, efficient and economical for the consumers (s.3). The Act also aims at ensuring improved petroleum governance by charging different stakeholders with different roles like institutional and consumers suppliers.

The Act applies to the export, import, re-export, transport, processing supply, storage, distribution, wholesale and retail sale to industrial consumers of petroleum products and installations (s.4). It further applies to petroleum products like natural gas. The Acts restricts any person from carrying out any activity like construction or major

modification of installation without a license (s.17). It emphasizes the renewal of permits in cases of expiry. The Act also makes it possible for all persons whether Ugandan or foreigner to participate in all activities of supply chain, subject to this Act and any other applicable laws (s.29). It emphasizes a fair competition by participants in the supply chain by putting a prohibition on anyone attempting to control prices thereby avoiding free market for petroleum products in Uganda (s.30). This Act prohibits discrimination by means of quality, quantity or prices.

Petroleum, Exploration, Development & Production Act No.3 of 2013

The Petroleum (Exploration, Development and Production) Act, No. 3 of 2013 seeks to give effect to Article 244 of the Constitution, to regulate petroleum exploration, development and production; to establish the Petroleum Authority of Uganda; to regulate the licensing and participation of commercial entities in petroleum activities; to provide for an open, transparent and competitive process of licensing; to provide for efficient and safe petroleum activities; to provide for the conditions for the restoration of derelict lands and to repeal the Petroleum (Exploration and Production) Act, Cap. 150 and other related matters [49].

The Act's significance laid the formulation of regulations such as the Petroleum (Exploration, Development and Production) Regulations 2015, the Petroleum (Exploration, Development and Production) (Health, Safety and Environment) Regulations 2016, the Petroleum (Exploration, Development and Production) (National Content) Regulations 2016 and the Petroleum (Exploration, Development and Production) (Metering) Regulations 2016.

The Public Private Partnership Act 2015

This is the law that provides a framework for the public private partnerships in the development of the economy whereby government joins hands with the private investors in the implementation and funding of selected projects. The energy sector is one of the sectors targeted for such partnerships [50]. Bujagali and Karuma power projects are being developed on the basis of Public Private Partnership to generate electricity in the medium term [51]. The Act lays down an elaborate procedure for negotiating, design, implementation and monitoring a public private project.

Mining Act 2003

The mining Act governs the allocation, and sharing, of revenue benefits from the energy sector. For instance, according to the Act, 80% of the oil revenue goes to the Central Government, 17% goes to Local Governments and 3% goes to landlords. The Act defines the respective roles played by central and local governments as well as traditional institutions [52].

Policy Framework

Energy policy for Uganda 2002

This policy spells out the government commitment to the development and use of renewable energy resources for both small- and large-scale applications. The overall policy goal was to increase the use of modern renewable energy to at-least 61% of the total energy consumption by the year 2017. The policy also had a target to meet the energy needs of Ugandans for social and economic development in an environmentally sustainable manner. One of the objectives of this policy was to establish the availability, potential and demand of various energy resources in the country and increase

modern access, affordable and reliable and administration including managing energy related environmental impacts.

In realization of the above objectives, the policy came up with strategies. Renewable power investment increases accessibility of electrical power to middle income households and economic development. The policy also put in place solar energy technologies. However, its upfront costs were high, and there was no regulation that obligated urban developers to invest in solar energy technologies. The policy also recommended appropriate legislation to operationalize some of the new policy measures which include; the feed in tariffs, biofuels production and blending, adoption of alternative technologies, regulation of charcoal, production and transportation, fiscal and financial investment.

The responsibility for the policy lies with the Ministry of Energy and Mineral development and Renewable Energy Department is to be developed with the Ministry. A credit support facility known as Uganda Energy Capitalization Trust is instituted to help realize the policy.

Renewable Energy policy 2007

This is a comprehensive policy document, setting out government's policy, vision, goals, principles and objectives for promoting sustainable utilization of renewable energy in Uganda. The policy document includes much detailed information on the potential for renewable energy development. It also includes a standardized Power Purchase Agreements and feed in tariffs for electricity generators below 20MW [53]. The policy further aims to provide a framework to increase in significant proportions the contribution of renewable energy in the energy mix [54]. The overall objective is to increase use of modern renewable energy technologies. The policy aims at maintaining and improving the legal and institutional framework to promote renewable energy investments [55]. To achieve this, the Policy put in place legislation and regulations to promote appropriate use of Renewable Technologies in other sectors (RETs) and develop appropriate regulations for grid connections and wheeling of electricity generated from renewable energy [56].

Whereas the PPA has been put in place, regulations for grid connections and wheeling electricity from renewable energy and RETs are not yet in place [57].

National Oil and Gas Policy for Uganda (NOGP), 2008

In February 2008, Uganda's Ministry of Energy published the NOGP, which explicitly recognizes many of the challenges, including the need to mitigate the potential for negative economic and fiscal impacts that often stem from a sudden influx of oil wealth. The policy aimed at enacting petroleum legislation for management of petroleum revenues and monitoring performance in the petroleum sector through policy statements and annual budgets [58].

The NOGP outlines internationally recognized mechanisms for managing such impacts and turning the finite resource into sustainable development outcomes. The policy also highlights the need for a long-term national strategy to ensure optimal impacts from oil and gas exploitation by maximizing value along the value chain. The overarching goal of the policy is that oil and gas development in Uganda will 'contribute to early achievement of poverty eradication and create lasting value to society'. In particular, the NOGP concurs with the emerging global consensus on the critical importance of transparency in handling all aspects of natural resource management,

with transparency and accountability towards stakeholders enshrined as a guiding principle in Uganda's future governance framework.

Institutional framework

Ministry Energy and Mineral Development (MEMD)

The Ministry is mandated to manage and safeguard the rational and sustainable exploitation and utilization of energy and mineral resources for social economic development; it is responsible for coming up with policies that guide in the development and exploitation of energy, minerals, oil and gas resources and regulates and evaluates activities of private companies [59].

The Ministry sets up goals in ensuring effective energy supply for social economic development in an environmentally sustainable manner. To be able to achieve all these goals, the Ministry and legislation that will regulate the activities of the ministry and other activities involved.

Electricity Regulatory Authority (ERA)

This is a statutory body established under the Electricity Act of 1999 [60]. The Authority is responsible in regulating the generation, transmission, distribution, sale, export and import of electrical Energy in Uganda (ERA) [61]. It is responsible for licensing competent operators and owners of electricity companies in Uganda's electricity supply industry [62]. It reviews and sets electricity traffics, prices, and charges and other terms of supplying electricity in order to ensure a fair play, i.e. it sets tariffs to allow for a fair return on capital while at the same time protecting electricity consumers [63]. The Authority is also responsible for monitoring compliance by licensed companies: it is also responsible for advising the Minister responsible for energy on the necessity for electricity power supply to the users.

Electricity Dispute Tribunal (EDT)

The Electricity Disputes Tribunal was established under the electricity Act and it's mandated to hear and determine all matters relating to electricity sector in a business-like manner instead of relying on lengthy Court processes [64]. The Tribunal handles all disputes relating to transmission, Distribution, and regulation of electricity. Any person aggrieved with the supply of electricity or related cases may apply to the tribunal for a redress. In ensuring better services to people, the Tribunal made strategies like, campaigns on television and radios in sensitizing people about the services redder by the people [65].

Rural Electrification Agency (REA)

Uganda's economy is transforming from the use of traditional energy sources like firewood and other forms of biomass. The transformation involved careful determination of which technology is appropriate. Rural Electrification Agency's objectives are to provide electricity to rural communities. REA came up with Electrification master plan to guide on how this master plan prioritizes projects on the basis of their value in financing the economy [66]. REA implements governments' priority of rural electrification projects for public funding as determinedly the board.

Uganda National Bureau of standards UNBS

UNBS was established under section 2 of the Uganda National Bureau of Standards Act [67]. Its mandate is to develop and promote standardization, quality assurance, laboratory testing, and metrology to enhance the competitiveness of local industry, to strengthen

Uganda's economy and promote quality, safety and fair trade [68]. It is also responsible for ensuring compliance in the energy sector, including electricity and oil and gas production in Uganda and also provides quality assurance in the importation of petroleum products into the country. UNBS ensures standards in the petroleum sector. This helps in meeting the local and international markets. UNBS provides detailed characteristics of processes, products and services, which may not be included in the law or regulations [69]. The major role of UNBS is formulation and protection of the environment against dangerous, counterfeit and substandard products [70].

Uganda Investment Authority (UIA)

It aims at ensuring sustainable energy by pushing ahead with local initiatives and projects in order to transition to a more efficient and secure energy outlook. It operates in partnership with the private and government sectors in ensuring economic growth and development. UIA is a stop center offering free services and, relevant licenses related to the businesses one is operating.

Directorate of water Resources management (DWRM)

This is under Ministry of Water and Environment, responsible for managing water resources in Uganda, in an integrated sustainable manner in order to secure and provide water of adequate quality, and quantity for social economic needs. This is a body responsible for issuing licenses for surface water abstraction and construction to project developers developing hydropower projects. It is also having mandate of issuing permits for water discharge and underground water extraction.

National Environment Management Authority (NEMA)

This is an institution established under National Environment Act cap 153 as a principal Agency charged with the responsibility of co-ordinating, monitoring, regulating and supervising environment management in Uganda. NEMA is charged with the duty for regulating the impact of renewable energy investments on the environment. It awards certificates of environmental decrease, impact Assessment, reports and Resettlement Action plan [71].

Uganda Electricity Transmission Company limited (UETCL)

This is the system operator and owns transmission systems. It is a bulk suppliers and single buyer of power for the national grid. It is the purchasers of all generated power in the country. Generators of electricity are expected to sign a standardized power purchase agreement with the UETCL.

Uganda Electricity Distribution Company Limited (UEDCL)

UEDCL owns the distribution infrastructure operating at 33kV and below. It is responsible for the retail of electricity including metering and billing of consumers. UEDCL buys bulk power from UETCL in accordance with the terms set in the Power Purchase Agreement. UEDCL granted a concession (2005-2042) to Umeme (a venture by Eskom and Globeleq) to manage and operate the national distribution grid.

Uganda Energy Capitalization Trust (UECT)

This is a public trust entity, mandated to facilitate rural electrification and renewable energy investments. A number of commercial banks, development banks and micro-finance institutions participate in the Credit Support Facility (CSF)

Available opportunities in Uganda's Energy Sector

1. Opportunities are bound in the manufacture and marketing of charcoal briquettes. The briquettes are best for the institutional markets because they can directly substitute wood without modifications to the stores.
2. Investors have unique opportunity to participate in the Ugandan incentives and broad participation by the private sector.
3. Investment opportunities exist for biomass, solar and mini hydropower generation to provide electricity. For renewable energy, schools, restaurants, hospitals- both in rural and urban areas, among other institutions are potential markets and future opportunities will be available especially if the government and local authorities decide to further enforce the restrictions on cutting down trees.
4. Private sector participation is quite significant in both rural and urban electrification. This is regulated by public-private partnership Act.
5. Export opportunities exist in the great lakes region and the COMESA-Africa's single regional economic group.
6. The Ugandan government liberalized energy sector to the extent that electricity generated by a private producer can be sold fractional wide.
7. The government has promised solar energy development as a way of speeding up rural electrification. This is user friendly to everyone including low and high income earners.
8. In the energy sector, the experts can be employed from national and international levels in evaluating application for permits. This helps in maintaining the quality and standards required by the law (S.19 Petroleum supply Act 2003.)

Challenges

The major challenges in the energy sector revolve around lack of a mix of energy sources in power generation, low level of access to modern energy, inadequate infrastructure for generation, transmission and distribution and low-level energy efficiency.

Other challenges include the following among others,

1. There is inadequate co-ordination and information sharing among the various project, government institutions and private sector.
2. Lack of strong legislative framework, practical policy, legal and regulatory environment for private sector to be attracted to investing in renewable energy development.
3. The main aspect here is tariff management. All consumers would like to have a very low tariff. However, there is need to invest in the sector for it to expand and provide reliable services. On the other hand, utilities may be tempted to charge higher rates in order to cover other aspects of mismanagement.
4. The high upfront costs of investing in renewable energy technologies make them uncompetitive in the energy market.
5. The private sector is reluctant to invest in large infrastructure energy projects [72]. This is because infrastructural projects require heavy investments and as such there has been excessive hedging by the private sector in view of the perceived market risks [73]. The transactions have in general, been characterized by very protracted negotiations, demand for guarantees.
6. Appropriate mechanisms are lacking to enable modern and efficient services to be accessed by rural population.
7. Government institutions lack capacity to plan for and monitor the sector and carry out appropriate research and development because of understaffing in key areas, budgetary constraints and lack of curricula in energy studies at institutions of higher

- learning.
8. Lack of regulation of construction of renewable energy technologies other than power production is a big challenge within Uganda's energy sector [74].
 9. Experience has shown that substantial financial resources for grants will be required once development of Rural Electrification (RE) projects is scaled up. This therefore, necessitates more support towards the Rural Electrification Fund.
 10. The local banks do not have an appetite, yet for long term lending. This has been one of the main constraints in implementation of private sector project.

Conclusions and Recommendations

Conclusion

Uganda has a long way to achieve the sustainable energy for all Initiative of the United Nations and also to achieve the millennium development goals (MDGs) by 2030. Developing and harnessing of the country's renewable energy potential is still demanding if the country's needs are to be met. Uganda's energy regulations and policies should be in line with the objectives in energy and renewable energy to meet the needs of Uganda's population for socio and economic development in an environmentally sustainable manner and to increase the uses of modern renewable energy sources.

Recommendation

There is need for continuous and deliberate measures/laws to provide economic instruments to regulate biomass production and use, to achieve sustainability of supply and protect the environment following Kyoto protocol and Copenhagen resolutions among other environmental protection conventions.

Since fuel wood has been the main fuel in the rural areas, there is need to encourage and enforce adoption of wood saving cookers, outside the traditional three stones. This should continually be done, by passing Acts, regulations; ordinances by both at central government and local government as the medium term protect the environment.

There is need to encourage Ugandans to shift to modern energy sources by encouraging marketers as well as providing incentives to increase production and use and creating an enabling environment to achieve low and affordable prices for fuels, appliances and equipment, gadgets and apparatus among the majority of the citizens.

There is need to encourage and enhance energy saving and efficiency methods in charcoal production and use in areas in which they have not permeated to protect the environment from degradation. Under electricity sub sector, costs should be reduced and electricity tariff setting harmonized to minimize costs transfer to low income households with regard to fuel and exchange rate adjustment costs which have remained high due to over reliance of thermal electricity generation. Note that increasing funding and resources in the electricity sector to increase clean electricity generation from wind energy will not only put more electricity to the national grid, but also ensure improved access and reduction in cost of power as well as protect the environment from carbon dioxide emissions.

There is need to ensure that universal access to electricity in the rural areas for majority of citizens is adhered to so as to increase access. This would reduce on the use of biomass with its associated effects on the environment due to health problems associated with smoke from use of Kerosene, there is need for the government to

increase the penetration of other alternative fuels such as biogas and solar energy by making them available and cheaper to the users. There is need to enhance policy implementation with regard to petroleum products price by ensuring friendly regulations to ensure that prices reflect consumer satisfactions. Renewable energy There is need to put in place deliberate measures to improve penetration of renewable technologies by providing fiscal incentives as well as credit facilities for both consumers and providers of energy in this sub sector. The renewable technologies (solar, wind, biogas) are the fuels for rural Uganda since they are stand alone. Moreover, self-regulations in the renewable energy sub sector e.g. in solar and other forms of energy to ensure quality supply of products, should be promoted.

Lessons on best practices, from developed countries indicate a need for a proper legal, contractual and institutional framework to regulate access to natural resources by investors. Ideally this should be separate commercial activities from the state regulatory function such that any national oil company involved in exploration, production and marketing of oil products should be distinct from those bodies performing regulatory functions, such as the energy ministry and the petroleum agency [75].

Government should continue to involve all stakeholders in energy issues. The capacity and independency of government agencies critical to successful management and improved transparency in the energy sector should be strengthened. These agencies include the National Environmental Management Agency, the Petroleum, Exploration and Production Department and the Ministry of Energy and Mineral Development (including through creation of a functioning information officer and a petroleum data base), and local government officials [76].

Government agencies should develop a strategy to work with other stakeholders such as civil society organizations, international development partners, local government structures, the media and local people. The capacity of parliamentarians, civil society and the media should also be strengthened. Government should implement initiatives and companies to ensure wide public consultation on specific issues that arise, such as the current oil production feasibility studies, any new licenses, and upcoming Environmental Impact Assessments. Oil companies should pay particular attention to working relations and interactions in their local areas of operation [77].

Energy agencies and other related bodies like National bureau of standards should actively enforce the legal regime, in order to ensure that the objectives of the energy sector are realized

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