THE GHG EMISSION REDUCTION IN THE ENERGY SECTOR – UGANDA'S EXPERIENCE

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ABSTRACT

Uganda is a signatory to several international conventions and agreements on climate change. Provision of energy is also a national priority. This paper looks at how Uganda is attempting to increase accessibility of modern energy in the rural areas within the context of international climate change agreements. A case study of the West Nile Hydropower Power project, in which the high and unattractive investments in a 3.5 MW hydropower plant to replace inefficient gensets is reformulated as a CDM project with a projected emission reduction of two million tons of CO_2. This reduced investment costs and leveraged its profitability.

1. INTRODUCTION

Uganda is one of the few developing countries that has experienced relatively high economic growth rates over the last decade, but it is one of the countries with lowest electrification in the world. The electrification is very low in Uganda; amounting to only 4.3% for the whole country with less than 1% in the rural areas [1]. To address this issue, the Uganda Government has put in place favourable policies that will allow the private sector to get involved in electricity generation and distribution in Uganda [2]. However, in most cases investment in small-scale hydropower is not attractive in remote parts of Uganda. In order to make investment in such areas attractive alternative flexible financing mechanisms like the Clean Development Mechanism is considered a viable option for facilitation of power generation by a private investor in remote areas.

There are many programmes which are being implemented by the Government to increase availability of modern energy. Energy for Rural Transformation is one of the ongoing energy programmes to increase access to electricity in rural areas from the present less than 1% to 10% in the next ten years [3]. The programme is assisted by the World Bank.

1.1 Economy

Uganda has experienced relatively high economic growth rates over the last decade. The Government has implemented pro-business policies and relative stability has been achieved over the last decade. In the years 1990 – 2001, the Gross Domestic Product (GDP) growth rate was 6.8 per cent per annum [4].

1.2 Population

Uganda has a population of 24.6 million, of which about 13 percent live; in the urban areas and 87 percent live in the rural areas. The national population growth rate has been about 3.4 percent per annum over the last decade. It is one of the highest in the world. The population growth rate is currently about 5.0 percent per annum in the urban areas, while in the rural areas it is about 3.1 percent. The overall population density is about 126 persons per square kilometre. [5]

1.3 The State of Energy Consumption

One of the main indicators of economic progress and the results of development of a country is the per capita energy consumption. The total energy consumption of Uganda in 2002 was estimated to be 301.6 Peta Joules [6]. Uganda's energy mix comprises of biomass, petroleum and electricity. Biomass is the main source of energy contributing about 92.3%, petroleum 6.4% and electricity 1.3% [7]. Biomass is mostly used by households. Uganda faces significant constraints to continued rapid economic development due to lack of sufficient electric power. The problem is even worse in the regions, which are not connected to the national grid like the West Nile Region.

1.4 Small Scale Hydropower Plants

Uganda has a potential of small hydropower totalling to about 70 MW.(7) Most of the sites are located in the mountainous regions in the eastern and western parts of Uganda. Most of the existing micro hydropower plants were developed for missionary hospitals like Kagando (120 kW), Kiluva (120kW) and Kissizi (60 kW). In most cases it is not economically attractive to invest in small power plants in Uganda. These were basically funded by charities. But with emergence of CDM and other international arrangements, there is a growing interest in the development of small-scale hydropower plants using private power producers. While some institutions like Kissizi hospital are planning to expand their installed capacity to 300 kW, there are new players like Uganda Rural Electrification Company and Hydromax who are planning to develop hydropower sites with installed capacity of over 5MW [8].

1.5 Energy Policy

Uganda has a comprehensive and detailed policy on energy [9]. The main legal instrument influencing development in the sector is the Electricity Act 1999. The Act is focused on electricity [10] and its objective is to liberalise and introduce competition and active participation of the private sector in the Uganda power sector. Under the Electricity Act, Electricity Regulator Authority (ERA) was established to regulate generation, transmission, distribution, sale, export and distribution of electrical energy in Uganda. It is an autonomous institution whose Board Members are nominated by the Ministry of Energy and Mineral Development. In addition, a rural electrification policy is to be formulated with the main aim of increasing access to electricity by the rural community.

1.6 Energy and Development

Energy is a crucial ingredient for regional development. The government has created a conducive environment and policies to allow private investors to play an active role in the energy sector. Energy input in the rural areas will facilitate agro-processing industry thus adding value to the agriculture produce as well as creating jobs.

2. THE HYDROPOWER PROJECT

2.1 Background

West Nile lies in the north – Western part of Uganda. It comprises districts of Nebbi, Moyo, Arua, Adjuman and Yumbe. It is one of the poorest regions in Uganda. The economic activities in this region are agriculture in the rural areas and commerce in the urban areas. The region has a great potential for agricultural production. With a newly constructed trunk road joining the major towns in the area, agriculture production and commerce within the region is expected to increase. There are hardly any major industrial activities going in West Nile apart from coffee processing and cotton ginning, which are seasonal.

The supply of electricity from diesel generator sets is limited to Arua, Nebbi and Piadha. These are urban centers that have a total population of over 50,000. There are five diesel generator sets with operating capacity of 776 kW, supplying electricity to about 800 customers. Electricity is available only four hours a day. It is estimated that the installed capacity of private generators is 2.86 MW, generating over 7.65 GWh per annum [11]. The users of such assets spend about US $0.65 per kWh. The current price for diesel is US $0.95 per litre. The current prices for grid connected domestic sector is 0.08 $ per kWh [12].

During the 90's, West Nile was perceived as a high-risk area due to civil unrest in neighbouring countries like Democratic Republic of Congo and Southern Sudan. There are at times insecurity incidents along Kampala – West Nile main road. The high level of poverty in the region exacerbates the situation.

The investment by a private developer in energy sector could not materialize under these circumstances if there is no incentive to reduce transaction costs and leverage its profitability. Yet such a project would bring reliable electric energy to a region of Uganda that is experiencing strong economic growth. This coupled with liberalization of the sector encouraged the establishment of the West Nile Rural Electrification Company, with the objective of building, owning and operating an electricity power system for the area.

The core of the West Nile Rural Electrification Company's West Nile Hydropower project is the construction of a hydropower plant, with a capacity of 3.5MW that is estimated to generate approximately 2 million tons of CO_2 reduction during its 30-year lifetime. The US $20.8 million project involves the construction of two small hydropower stations, efficient diesel backup facilities, and the rehabilitation of the mini-grid in the region. The initiative will replace emissions from highly inefficient diesel and petrol-fuelled generators. The project is part of the Government of Uganda's Energy for Rural Transformation (ERT) scheme, which is supported by the World Bank and various bilateral partners. The World Bank Prototype Carbon Fund (PCF) and Energy for Sustainable Development provided instrumental support in project planning and assistance.

2.2 The Status of the Project

The project was endorsed on May 2, 2000 by the Ugandan National Focal Point for the UNFCCC based at the Ministry of Water, Lands and Environment. Uganda is a Non-Annex I signatory of the United Nation Convention on Climate Change (UNFCCC) and acceded to the Kyoto Protocol in March 2002. Meanwhile, a 33 kV transmission line between Arua and Nebbi is under construction. The transmission line will be leased to the investor. The project developer West Nile rural Electrification Company is still negotiating with banks to secure financing for the project.

Installation of an efficient 1.5MW diesel generator is on going at Arua and 1 MW will be installed in Nebbi. It is expected that by the end of March 2005, the West Nile districts of Arua and Nebbi will receive electricity for 18 hours a day after the installation of 1.5 MW high efficiency diesel generator. The cost of the project is US $1.2 million [13]. These units will provide base load during the construction phase of hydropower plant and peaking load after the construction.

2.3 The Project Baseline

Currently the base line for rural Uganda is diesel. A demand survey was carried out to establish the historic baseline trend data and emission reduction potential. The survey provided basic information such as petroleum products consumption for power generation for business,

households and road transport of petroleum fuel. The development of a baseline scenario; was made by World Bank PCF Experts. When the project is implemented, it is be monitored by the Monitoring and Verification Protocol.

Although the West Nile Hydropower Project was designed as a regular size CDM project, there are now new rules for small-scale hydropower plants in place so as to make small projects competitive with regular large projects. The Marrakech Accords established a fast track for such small-scale projects with simpler eligibility rules. Thus renewable energy projects with installed capacity up to 15 MW will be among the fast track projects. Since West Nile Hydropower Project falls within this range, it implies that the project may have to be redesigned as a small-scale project to make it more attractive. In addition it is informative to critically analyse the assumptions made in developing the baseline.

3. DISCUSSION ON THE BASELINE

In any CDM project, emission reduction is important because it is an important ingredient in determining the tariff. The emission reduction has to be real, measurable and quantifiable. The fund that will be accrued from the sale of carbon will offset the tariff. Thus the variations in the baseline over time will certainly affect the future tariff structure.

In the West Nile Hydropower Project (WNHP), emission reduction in the base year is then project to the accredited period of the project. Some of the assumptions made were:

- The means of transporting fuel from Mombasa to the project area will be by road
- West Nile will not be connected to the national grid for the next twenty years
- No commercial hydropower development will take place within the project period
- Should demand exceed installed capacity, further additional efficient generators will be installed to meet the growing demand.

A review of these assumptions is presented below.

Most of the people in the project areas use diesel and petrol generators of different capacities and efficiencies. Currently, fuel transportation is indeed by road from Mombasa. The transportation of fuel by road contributes significantly to the GHG emission. This situation can happen if there is failure on the pipeline that carries fuel from Mombasa to Eldoret via Nairobi. Furthermore, there is a plan to extend the oil pipeline from Eldoret to Kampala. If this extension materialises, it means that projected emission reduction will vary at the time of implementation. That implies that there will be a shift in the baseline. This in turn means that there should have been more that one scenario when projecting emission reduction over many years. But in the WNHP, the projected emission reduction was given for only one scenario. Since the emission will vary depending on the time and situation, there is a need to monitor the baseline during the project life cycle. This capacity does not exist at national level at present and needs to be developed.

The Government has given a go-ahead to the development of Karuma hydropower station to be added to the national grid. It will have an installed capacity of 100MW by the year 2008 at estimated cost of US$200 million. Further installed capacity of 100 MW will be added in the future. This site is less than 150 kilometres away from the main load centres in the WNHP. Yet in the WNHP, it was assumed that additional energy demand would be met by increasing installed capacity of efficient diesel generators. If the energy demand outstrips supply, addition of efficient diesel generators may not be viable. Since the tariff will be high, the Government could decide to extend the national to West Nile. That could alter the projected emission reduction significantly.

4. OTHER PERTINENT FACTORS

There are other factors that warrant consideration in this project. Some of these are discussed in the proceeding sections.

4.1 Carbon Financing

There is a lot of uncertainty about the future prices of CER. There are many factors that will influence the market. The sellers have to make a good judgement on how much CER they can sell now and how much they can retain for the future market. There are also several buyers; for example:

- World Bank PCF Finance who are offering US$ 3.5-5 per tonne.
- ERUPT who are offering Euro 5-9 per tonne
- The Dutch CERUP who are offering Euro 3.30-5.50 per tonne.

In the WNHP, the PCF will purchase 1.3 million tonnes of CO_2 under an Emission Reduction Agreement. If the WNHP project produces more ERs than PCF can buy, the excess amount will be shared between the project entity and the PCF. The sharing formula will be a function of the market price at the time of sharing. The project entity is then free to sell their shares, as they like.

4.2 Validation

WNHP will be validated as a CDM project by SGS (Societé Général de Surveillance) an international inspection, verification; and testing company. SGS is one of the international firms that have applied for accreditation as an Operating Entity. The SGS is waiting for a decision from the Executive Board. The PCF is to register the project officially as a CDM project with the CDM executive board as soon as the necessary provisions to be decided by the UNFCC are in place.

4.3 The Approval Process

The project was a government initiative to provide power in the West Nile region. The whole process before and during approval was carried out by the Government. The private sector came in when the project became attractive. The upcoming issues like establishment of National Designated Authority was not among the requirements at the time. At national level, there is no legal status regarding CDM projects in Uganda. The legal issues are yet to be addressed. This has implications for any other future projects.

5. LESSONS LEARNT

A number of lessons can be drawn from this project:

- Being the fist CDM project in Africa, it is important to note that the potential investor was not willing to invest unless the project was profitable. It seems that there are many investors who are waiting to see the success of one project before they can venture into CDM related projects.
- The transaction costs could have been higher if the PCF redesigned the project to make it more attractive to the investor.
- The rules and procedures of the CDM process keep changing; investors should always be kept informed of the changing rules and other developments.
- There are still many uncertainties regarding the future carbon market. Investors will have to make decisions on when to sell the ERs. There is therefore a need to increase investors' confidence in CDM projects and show that the flexible mechanism will have practical application in developing countries. That will require Governments to put in place legal and financial mechanisms to promote CDM.

6. REFERENCES

[1] Uganda national energy balance 2002, Ministry of Energy and Mineral Development April 2003

[2] The Electricity Act 1999, Ministry of Energy and Mineral Development, November 1999.

[3] Uganda Energy for Rural Transformation Project, Appraisal Document 2001

[4] World Bank Wold Development Indicators, 2003 pp 187-188

[5] Uganda Bureau of Statistics, 2002 Population and Housing Senses, Preliminary Report November 2002. p5

[6] Uganda National Energy Balance 2002, Ministry of Energy and Mineral Development, April 2003

[7] Uganda National Energy Balance 2002, Ministry of Energy and Mineral Development, April 2003

[8] Development in small-scale hydro power in Uganda, Ministry of Energy and Mineral Development.

[9] Energy Policy for Uganda, Ministry of Energy and Mineral Development, September 2002.

[10] The Electricity Act 1999, Ministry of Energy and Mineral Development, November 1999.

[11] Energy Demand and Electricity Load distribution Profile for West Nile Methodology and Synthesis Report.

[12] New Electricity Tariff, Uganda Electricity Distribution Company, January 2004.

[13] Prototype Carbon Fund, Uganda West Nile Hydropower, Project Design Document, August 2002.

[14] PCF and Energy for Sustainable Development Ltd ESD, UK, The Prototype Carbon Fund , Baseline study , Uganda West Nile Hydropower Project. August 2001.

[15] Construction Review Journal for Construction Industry November 2003.

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