REPUBLIC OF THE GAMBIA

MINISTRY OF ENERGY

DRAFT FINAL

National Energy Policy - The Gambia 2015-2020

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ABBREVIATIONS AND ACRONYMNS

ADB	African Development Bank
AFD	Agence Francaise de Development
ASP	Agricultural Services Project
BADEA	Arab Bank for Economic Development
CAS	Country Assistance Strategy
CILSS	Organisation for the Control of Drought in the Sahel
CRR	Central River Region
DANIDA	Danish International Development Agency
DCD	Department of Community Development
DGIS	Director General for International Cooperation of the Netherlands
DOSTIE	Department of State for Trade, Industry and Employment
EDF	European Development Fund Electricite de France
ERP	Economic Recovery Programme
EU	European Union
FVA	Fuelwood Vendors Association
GAMTEL	Gambia Telecommunications Company
GBA	Greater Banjul Area
GDP	Gross Domestic Product
GEAP	Gambia Environmental Action Plan
GGFP	Gambia-German Forestry Programme
GMD	Gambian Dalasi
GOTG	Government of The Gambia
GREC	Gambia Renewable Energy Centre
GTZ	German Technical Assistance Agency
GWh	Giga watt-hour
HFO	Heavy Fuel Oil
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
IPP	Independent Power Producer
KPS	Kotu Power Station
KV	Kilo Volt
KW	Kilowatt
KWh	Kilowatt-hour
LI	Lahmeyer International
LPG	Liquefied Petroleum Gas
LRR	Lower River Region
MHC	Moukhtara Holding Company
MT	Metric Tonne
MWh	Megawatt- hour
NAWEC	National Water and Electricity Company
NBR	North Bank Region
NGO	Non-governmental Organisation
OECD	Organisation for Economic Cooperation and Development
OMVG	Organisation for the Development of the Gambia River Basin
PRSP	Poverty Reduction Strategy Paper
PSD	Programme for Sustainable Development
PV	Photovoltaic
RE	Renewable Energy
RPTES	Review of Policies in the Traditional Energy Sector
TCP	Technical Cooperation Package

TOE	Tonnes of Oil Equivalent
UNCCD	United Nations Convention to Combat Desertification
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
URR	Upper River Region
VHF	Very High Frequency
WARP	West African Replenishment Programme
WB	World Bank
WCR	West Coast Region
WGP	West African Gas Pipeline
WPP	West African Power Pool

1.0 INTRODUCTION

1.1 Energy Crisis and Major Challenges Facing the Energy Sector

Energy has long played a central role in the development and functioning of the world's economy. An essential input to agricultural production, transportation, industry, commerce and household , reliance on energy will continue to grow as world population continues to increase and standards of living improved. The Gambia is no exception. The trend towards increased mobility, urbanization and an integrated global economy will further accelerate our energy use and dependence. Increased energy use and mechanization comes with its own burdens with respect to cost, the environment, health, safety, lifestyle and community.

Recent analysis of international energy trends shows that under "conventional development strategies," global energy consumption is projected to be half again as large in 2015 as it was in the early 1990s, and may double again between 2015 and 2030 (please show reference). Most of the growth in energy use and its associated environmental impacts will occur in developing countries like Gambia. Future changes in population, technology, and economic growth are unknown; however, it is clear that a balance between energy, economics, and the environment will be needed for sustainable development to occur in The Gambia.

A growing dependence on energy carries significant costs of its own. The extraction, refinement, transportation, and storage of fuels carry an immense environmental burden, as does its ultimate consumption, and disposal of waste products. These burdens have both local and regional manifestations ranging from impacts on soil, groundwater and land-use, to those on atmosphere and ocean. Foremost, among many of our communities are the local and regional environmental impacts. While these are not new issues, the need to manage Gambia's energy use and reduce its negative impacts has grown more immediate as our economy grows.

The Gambia's long-term economic development strategy and long-term program, known as Vision 2020, recognizes that infrastructure and in particular a reliable power supply, is vital in sparking economic growth. Access to electricity is a precondition for the establishment of new industries or the expansion of existing ones in The Gambia.

To achieve these objectives, government has taken cognisance of the enormous tasks and challenges that it currently faces in attempting to address the energy "crisis." The major challenges include:

1.1.1. Limited access of funds for investment in new assets and inadequate maintenance of old and ageing electricity power facilities, which have led to a progressive decline in the reliability, cost effectiveness, and efficiency of service to the general public ;

1.1.2. Rapidly growing demand for all forms of energy;

1.1.3. Heavy reliance on imported petroleum products to meet the country's energy requirements, thus, placing a heavy burden on the foreign exchange reserves;

1.1.4. An institutional framework for the energy services characterised by fundamental weaknesses including a fragmented policy-making process;

1.1.5. The over-exploitation of forest resources for domestic fuel with negative consequences on the environment.

{Needs sub-heading or connected to the first sub-heading}

The level and intensity of commercial energy use in a country is a key indicator of the degree of economic growth and development. The challenges facing the Electricity sub-sector in The Gambia include weak transmission and distribution network , high cost of power, low per capita power consumption, and low countrywide electricity access. According to Doing Business 2014, The Gambia is ranked 120 out of 189 economies on the ease of access to electricity. The rankings for comparator economies and the regional average ranking provide another perspective in assessing how easy it is for an entrepreneur in The Gambia to connect a warehouse to electricity. Obtaining an electricity connection is essential to enable a business to conduct its most basic operations. The lack of reliable electricity supply in the country reduces the annual sale revenues of Gambian businesses and reduces Gambia's annual GDP growth. Electricity access in The Gambia is still extremely low in comparison to that of peer countries. Gambia's countrywide rate of household access to electricity was 35per cent in 2010, far below that of other West African countries with similar per capita income levels. Rates of electrification are much higher in the Greater Banjul (GBA) area than anywhere else in the country—with electrification rates estimated at over 80 per cent in that region in 2010 (indicate reference). The GBA contains three of the country's four largest cities namely Banjul, the capital (the largest in terms of population), Serrekunda, and Bakau. The West Coast Region has the second highest electrification rate in the country, at slightly under 20 per cent. Electricity access in the Upper River Region, Lower River Region, Central Region, and North Bank Region follow in that order.

Gambia's reliance upon thermal generation has translated into high electricity costs. In 2011, the cost for small-scale domestic users, i.e. those consuming less than 40 kWh, was $0.07. For mid-range users' consumers between 41-600 kWh, the price was $0.24/kWh. For those consuming between 601 and 1000 kWh, the price was $0.26/ kWh. Commercial users pay $0.29/kWh. These prices are comparable to many of the Gambia's neighbours, including Senegal (GRO Energy, Gambia Power Sector Study 2013).

Some other challenges facing the energy sector in The Gambia include quantity, quality and reliability of energy supply, high initial capital outlay, and long lead times from feasibility studies to development of energy infrastructure, mobilizing adequate financial resources to undertake investment in the power sector and high cost of energy, low per capita incomes and the low level of industrialization. Challenges of institutional arrangements, governance issues, lack of research institute, funding constraints and inadequate human resources capacity, overlap of mandate of various institutions are some of the policy bottlenecks inhibiting the coherent and systematic development of the sector.

2.0 Targets Set for Improvements in the Socio-economic Indicators and Relationship to Energy

Goal 1 – Eradicate extreme poverty and hunger

- Halve, between 1990 and 2015, the number of people living on less than US$1 a day
- Halve, between 1990 and 2015, the number of people suffering from hunger
- Importance of energy in achievement of these goals
- Access to energy services enable companies to develop
- Lighting extends trading hours beyond daylight
- Using machines improves productivity
- Energy may be provided by small local businesses, thereby creating jobs (maintenance, etc.)
- Privatising energy services can raise funds for governments who can then invest them in social services
- Clean and efficient fuels reduce the portion of income households spend on cooking, lighting and heating
- 95per cent of basic food must be cooked before being eaten and require water for cooking
- After-harvest losses are reduced thanks to preservation through drying, refrigeration and/or freezing
- Energy for irrigation boosts productivity and improves nutrition

Goal 2 – Achieve universal primary education

- Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
- Importance of energy in achieving this goal
- Energy provides access to water, hygiene, lighting and heated/air-conditioned rooms, all of which lower absenteeism
- and encourage children to stay in school by creating a better environment both for them and their teachers
- Electricity makes it possible for schools to access media outlets for communication and educational ends (distance learning)
- Having energy makes it possible to use all kinds of educational equipment such as projectors, computers, printers, photocopiers and scientific apparatus,
- Modern energy systems and efficiently-designed buildings cut costs and, therefore, reduce school enrolment fees, increasing access of poor families to education

Goal 3 – Promote gender equality and empower women

- Eliminate gender disparity in primary and secondary education, preferably by 2005 and in all levels of education by 2015 at the latest
- Importance of energy in achieving this goal
- The availability of modern energy services greatly reduces the amount of time women and girls have to spend on basic survival activities (gathering wood, drawing water, cooking, manual harvesting, etc.)
- Clean cooking equipment diminishes women's exposure to pollution and improves health
- Quality lighting makes it possible to study in the home and follow evening courses, public lighting makes women safer,

Goal 5 – Improve maternal health

- Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio
- Importance of energy in achieving this goal
- Energy services are needed to improve medical conditions for mothers – for refrigeration, sterilization, surgical operation equipment, etc.
- Excessive workloads or manual labour are harmful to the general health of pregnant women

Goal 6 – Combat AIDS/HIV, malaria and other diseases

- Halted, by 2015 and begin to reverse the spread of AIDS, malaria and other major diseases
- Importance of energy in the achievement of this goal
- Electricity in health centres makes it possible to open them at night-time, maintain qualified staff, use specialist
- equipment (for sterilization, refrigeration medicine, etc.) and storage of vaccines and medicine
- Energy is required to develop, manufacture and distribute medicines and vaccines

3.0 ROLE OF ENERGY IN THE GAMBIAN ECONOMY

3.1 Overview of the Sector

The availability of a reliable system of energy supply that is efficient, affordable and environmentally sound is crucial for progress in all three dimension of sustainable development and a condition for transition to a green economy. Energy powers industrial processes, commerce and agriculture and supports the provision of resources in the health, education and water and sanitation sectors. The Government of The Gambia therefore places high importance in the development of the energy sector and has created a Ministry of Energy in 2007 charged with this responsibility. The Gambia Government is committed to the ECOWAS White Paper on energy for all by 2030 and the UN Sustainable Energy For All (SE4ALL) initiative, both of which are crucial for the attainment of the MDGs and similar objectives.

The energy sector is a crucial support to economic development. Energy is an important input in all sectors of the economy. Access to energy can improve the socioeconomic capital of the population and the attainment of all the MDGs. In addition, access to adequate, affordable, and reliable energy supply is crucial to support the socioeconomic development of any country. This is why the Government places much importance on the energy sector for development. Thus, it will focus its support in this sector through improving: electricity supply use of renewable energy, use of petroleum and existing regulatory framework.

3.2 Energy Balance

According to UNDP RIO + 20 Report (2010), the energy balance of The Gambia indicates that the biggest consumers are the households and the transport sectors; the balance has consistently shown increase in petroleum products for energy generation and transport. Increase in wood fuel share of total energy consumption; increase in fuel wood consumption by households and increase in electricity demand. LPG consumption has also been gradually emerging as a substitute for fuel wood energy. Because fire wood is cheaper than LPG the demand for the latter has been restricted to high income people who prefer it because it is more convenient.

The Government of The Gambia is therefore committed in its energy policy to review the price structure of imported LPG and determine retail prices of LPG. The Gambia as member of ECOWAS is part of the West African Pipeline Initiative, which is an ECOWAS Regional Energy Project, which seeks to define the sub region's integrated energy resources to meet energy needs within the community and to develop a network to market the product.

The provision of electricity for both the urban and rural populations is a priority. The electricity supply has realized significant improvements since 2006. The Independent Power Producer (GEG), in 2006 inaugurated a 26 MW generator plant in Brikama, West Coast Region. The first phase of the Rural Electrification Project in 2006 also commissioned six isolated stand-alone power plants in six communities with a total installed capacity of 4 MW.

While the electricity sub-sector is fundamental to the socioeconomic wellbeing of the country and shows much potential, it faces several challenges including:

Low electrification rate (only about 40 per cent of the population has access to electricity)

- High electricity tariff, due to heavy dependency on fossil fuel for electricity generation and low operational efficiency of the national state owned utility.
- High electricity losses, mainly due to ageing transmission and distribution infrastructure

During the PAGE implementation period 2012-2015, the Government intends to improve the wellbeing of the population by improving access to electricity. This will be done through:

- Increasing the electrification rate by increasing electricity generation, more efficient use of electricity and attracting, through appropriate and reasonable incentive and facilitation processes, the private sector investment in the sector.
- Promoting the use of renewable energy resources such as wind and solar for electricity generation, particularly in the rural areas. This will promote fuel switching from fossil to renewable energy and thus reduce emissions of greenhouse gases from the activity.
- Increasing operational efficiency of the electricity utility companies through the use of more efficient technologies for electricity generation and ensure close monitoring and implementation of regulations governing electricity production and distribution.
- Upgrading and replacing the ageing transmission and distribution infrastructure to reduce the electricity losses.
- Rehabilitation and replacement programs for the ageing power generating equipment at the power plants to improve both availability and efficiency

3.3 Energy Demand and Consumption

The Gambia relies almost entirely on biomass (wood fuels) and imported petroleum products to meet its energy requirements. However, in the face of rapid depletion of forest reserves due to rapid urbanisation, bush fires, farming, etc. the energy options based on biomass are very limited [LAHMEYER 2006a]. Furthermore, due to high cost of imported petroleum products, the National Water and Electricity Company (NAWEC) is finding it extremely difficult to service the growing oil import bills particularly for electricity generation.

Over the period 1995 to 2006, installed generation capacity grew from nearly 14 MW to 46 MW. Six isolated power stations located at Farafenni, Kerewan, Barra, Kaur, Bansang, and Basse supply electricity to provincial areas. All these provincial power stations run on diesel generators and provide electricity for about six hours in the mornings and six hours in the evenings. For details please see section 5.1.3 (b).

In addition, 33 kV transmission lines transfer energy from the power stations at, Kerewan, Farafenni, Bansang and Basse to more than 15 remote transformers from where low voltage lines help to supply nearby customers. Farafenni has now also been interconnected with Soma through an undersea cable, whilst Bansang supplies Jangjanbureh and other villages up to Wassu.

A multi-donor project called the Rural Electrification Project was the most important electricity infrastructure project for the provinces during this period. Electricity demand in the provincial towns has also increased sharply with the installed capacity doubling in less than a decade. Current load shedding and installation of mobile units indicate that the trend is set to continue. The table below gives an overview of the installed capacity of isolated power stations.

Table 2: Installed Capacity of Isolated Power Stations (the content of the table needs to be verified and confirmed by POD)

Location	Ref	Installed KW	Type	Total Installed KW	Fuel
Essau	G1 G2	200 200		400	LFO
Farafenni	GI G2 G3 G4	600 600 1800 1500	 CAT CAT	3,300	LFO
Kerewan	G1-5	60/100/400/500	IVECO VOLVO	1,000	LFO
Kaur	G1-4	60/60/60/300	PERKINS	480	LFO
Bansang	G1-4	3 X 200, 1X 500		1,100	LFO
Basse	G1- G5	2 x 600 1x 1600 1 x 800 1x 1120	PERKINS CUMMINS	4,720	LFO

Source: NAWEC (2014)

NAWEC has made significant improvement in addressing the high network and commercial losses. The high penetration rate of prepayment meters (>80%) has virtually eliminated arrears and non-payment within the residential class. The government itself has also shown leadership by changing most of the meters in Government Ministries and other government buildings from credit to CashPower. The challenges remain with municipalities who are responsible for streetlight. The annual electricity consumption per customer group is provided in Table 3 below. The so-called "maximum demand" in NAWEC's statistics are larger commercial and industrial clients (e.g. supermarkets, hotels and telecommunication companies).

Recently, NAWEC embarked on a major rehabilitation of the network in the GBA. This project was funded by Venezuela, and has resulted in significant reduction of technical losses of the network and access for many communities in the West Coast Region.

Table 3: Electricity Consumption Per Customer Group (table needs to be updated by Commercial Division)	**Consumption by Year in MWh**						
Customer Category	**2009**	**2010**	**2011**	**2012**	**2013**	**Est. 2014**	**Total**
Domestic	40,934	51,433	47,829	20,933	14,149		
Commercial	7,561	15,521	7,195	3,159	2, 470		
Hotel/Club/Industries	37,403	48,505	33,531	20,944	18,010		
Agriculture	18	27	55	6	5		
Local Authority	303	478	360	427	559		
Central Government	7,496	9701	6,372	3,040	2,814		

Sub Total (Credit Sales)	91,889	125,665	95,342	45,929	38,007
Prepayment (All Category)	10,124	62,535	69,492	131,593	190,641
Own Consumption	7,756	5,820	8,896	6,256	7,564
Total	109,769	194,020	173,730	186,150	236,212

Source: NAWEC

Nearly half of the annual electricity consumption in NAWEC's service area is related to the residential sector. The group of large (mainly industrial) customers comprises almost a third, and the commercial sector is responsible for some 11 per cent of the billed consumption. The institutional sector (including local authorities and central government) ranks in fourth place with some 8.5 per cent. Almost negligible is the requirement of the agricultural sector.

Based on customer numbers and annual electricity consumption figures the final electricity consumption is less than 101kWh per capita per year. The Gambia belongs to those countries with the lowest per-capita-electricity consumption. The electricity average consumption in Germany in the same year is around 7,081 kWh per capita (World Bank, 2013).

With rapid population growth driven by a declining mortality rate and influx of migrants from the sub-region, the population of The Gambia increased from 200,000, in 1950, to 1.361 million (2003 census). The National population growth rate is estimated at 2.8 percent per annum. Large-scale population shifts from both internal and cross-border immigration have further increased population density in the GBA. The effects of the two generations of rapid population growth are reflected in the age pyramid. As girls reach maturity, the number of women of child-bearing age will increase dramatically. Despite the anticipated decline in fertility rates, resulting from the population programmes (current and future programs), rapid future population growth is likely to surpass the two million mark, by the year 2020 which has significant implications for the country's energy sector.

The Gambia relies almost entirely on biomass (wood fuels) and imported petroleum products to meet its energy requirements. The energy options are very limited in the face of the rapid depletion of our forest resources through (bush fires, farming, grazing activities and exploitation). Because of the high cost of imported petroleum products which constitute an increasing burden on the country's foreign exchange reserves, the Government / NAWEC is finding it increasingly difficult to service the growing oil import bills particularly for electricity generation. The problem has worsened in recent years due to the declining groundnut production, and the very high international price of oil which consequently has put pressure on the cost of foreign exchange.

4.0 SECTOR OBJECTIVES

4.1 Electricity

To improve the energy supply system by ensuring:

- Addition of generating capacity of heavy fuel oil (HFO) fired generators of higher unit capacity (15 to 25MW) in the short term
- Promote the development of alternative thermal generation (gas, steam, etc.) as a long term strategy;
- Private sector participation in electricity generation through a regionally competitive set of policies;
- That NAWEC and all Independent Power Producers (IPPs) perform their functions efficiently under the effective oversight of PURA;
- That NAWEC is a viable business entity able to meet shareholder obligations;
- Enforce the renewable energy law, and achieve 20% at least per cent renewable energy generation capacity by 2018.

Improve access and provide an affordable energy service through:

- Ensuring the rehabilitation of the transmission and distribution system;
- Embarking on the rural electrification project to cover all viable towns and villages identified;
- Encouraging the use of energy efficient generators optimise electricity production costs;
- Sensitisation program for efficient use of energy
- Exploitation of sub-regional and regional initiatives directed at augmenting local capacity to develop energy resources.

4.2 Domestic Fuels

Reduce the heavy dependence on wood and charcoal as a source of energy by:

- Encouraging and popularising the use of energy-saving cooking methods;
- Encouraging and popularising the use of briquettes and biogas
- Implement the forest management control programme;
- Transferring management responsibilities for forests to local communities.

4.3 Renewable Energy

Enhance the renewable energy potential base by:

- Encouraging the introduction of wind pumps for water lifting, for energy conservation purposes;
- Introducing solar water heaters in institutional facilities, hotels and private households;
- Popularising the use of Solar PV systems in the provinces to provide power for health and veterinary clinics and telecommunication facilities.

4.4 Petroleum Products

Secure future energy supplies by:

- Encouraging oil exploration activities through the creation of a policy environment that is friendly to investors;
- Encouraging the private sector to build new port terminals for petroleum and LPG as appropriate;
- Regulating and monitoring the pricing structure of petroleum products;
- Popularising the introduction of kerosene burners for cooking in the rural areas.

4.5 Liquefied Petroleum Gas (LPG)

- Adopt a regional approach for the popularisation of LPG as cooking fuel in the urban areas;
- Encourage research and development of innovative appropriate technologies for household application in the use of LPG in both rural and urban areas
- Regulate and monitor the pricing structure for LPG;
- Encourage private sector participation in the provision of infrastructure to improve storage capacity and popularise the use of butane gas as an environmentally- friendly source of fuel.

5.0 ELECTRICITY

5.1.1 Overview

The power supply sector has been experiencing several problems in meeting the nation's energy demand. The major issues in the current power crisis include inadequate capacity in all segments of the value chain to meet the demand, the high technical and non-technical losses in the power system and the high electricity tariffs (some of the highest in the World) for all categories of consumers. Although the availability of generating plants is satisfactory, inadequacy of capacity, low network accessibility and reliability rates and limited distribution network capacity have resulted in high frequency of power outages. Low total power system losses and tariff optimisation are key to attaining sub-regional competitiveness in electric energy supply.

The National Water and Electricity Company (NAWEC), currently under the purview of the Ministry of Energy (reflecting the importance attached to this area by Government) should, ideally, meet the needs of up to the 350,000 House Holds but, due to the limitations highlighted, NAWEC currently serves only 130,000 electricity customers (House Holds). Also, on account of the numerous constraints faced in the provision of power supply, the Company is unable to meet the desired 100 per cent coverage especially in the Greater Banjul Area.

For the Sub-sector to play its rightful role, in terms of competitiveness, it is imperative that private sector investment complements public sector efforts, and the prerequisites for this type of intervention include a review of the existing institutional framework, legal and regulatory provisions and participation in sub-regional and regional energy-related initiatives.

NAWEC is currently served by thermal power stations that mainly run on heavy fuel oil in the GBA and diesel power stations in the provincial towns and clusters they serve.

The electricity sub-sector saw Africa's first IPP, Gampower exit with the decommissioning of its 8.5MW power plant. GEC entered the sector with a power plant of Deutz generators (HFO), capacity 25.6MW installed. A renewable energy actor, GamWind recently entered the sector as an IPP with about 1.0MW installed wind turbine capacity.

There are two other power stations in service in the GBA:- Brikama Power Station (I) IPP and Brikama Power Station (II). Thereof the total installed capacity (including provinces) is about 100MW compound losses nothing of sales from production to about 24%

a. Generation

The current power supply situation can be considered as precarious with some improvements envisaged at the end of this year. The current installed capacity at Kotu and Brikama 1 & 2 Power Stations are 30.7, 37.6 and 8.9 MW respectively at about 54% availability against the current suppressed peak power demand of 46 to 50 MW. . Except for essential load centres, all other customers are impacted by daily planned and unplanned power outage.

The two 6.4MW Deutz generators recently acquired 2nd hand by GOTG were successfully commissioned in later part of 2013 and been operational since then. Increasing the total installed generating capacity at Brikama 1Power Station to 37.6 MW .

b. Transmission and Distribution

An integrated power Transmission and Distribution (T&D) network is operated and maintained by NAWEC.

The power grid has made significant expansion in recent years:-

1) Two 33KV transmission lines have been installed in the GBA/Brikama area of total length 115km.
2) The 33KV network serves several 33/11KV sub-stations (KPS, Brikama, Mile 2, Mile 5, Bijilo etc) that feed in 181KW of 11KV sub-transmission lines distribution transformers (11/04KV)
3) Two 33KV transmission lines have been added in the Western Division (Brikama-Kalagi and Brikama-Kartong).
4) The provincial power networks operate similar radial networks, employed to serve clusters of towns and villages.

The T&D network in the GBA/Western Region is significantly constrained with low voltage levels (29.5KV) at its primary sub-stations and poor receiving and voltages.

Venezuela Project
The Government of Venezuela through the GOG has granted NAWEC a facility of US$25million, towards the rehabilitation and expansion of the T&D infrastructure.

Project Executed
Together with the Venezuela project, NAWEC executed the West Coast Electrification Project, Kabadu project. Network extensions are a continuous part of NAWEC reaching un-served areas and loss reduction.

OMVG Project
OMVG has come a long way since 1966 towards realising its dreams. Hydro-electric power plant projects (Sambagalou: 128MW and Kaleta: 228 MW) are well underway. The hydropower plants should be complemented with an interconnection network of 225KV 1,709KM power transmission line linking the hydro sites and the electrical networks of the four countries of the OMVG.

Power Network Challenges
- Rehabilitate low and medium networks and reduce losses to industry standards.
- Improved network stability.
- Upgrade transmission network and improve load flow.

c) Power System Losses

NAWEC carries a level of technical and non-technical losses amounting to several times the industry norm. Various analyses conducted on the transmission and distribution system have placed the compounded losses at 35-45 per cent (e.g. 39.3 per cent EDF MV Network Study: 2012). The Company launched a pre-payment metering system – Cash Power 2000 in 1998 in an effort to arrest non-payment of bills and also address the issue of non-technical losses. To date over 100,000

Customers are served through prepayment meters, significantly improving NAWEC's revenue position.

5.1.2 Electricity Supply and Demand, and Electrification Rate

NAWEC's current (2014) effective capacity of 42.7 MW against a suppressed peak demand of 46 to 50 MW leaves it with zero reserve capacity thus exacerbating the daily load shedding currently in practice. . It is projected that with 20.0MW of generating capacity scheduled for NAWEC Brikama 2nd Phase, a significant capacity deficit would still remain if the recommended scheduled maintenances of power generating equipment are to be carried out on time without being noticed by the consumers. The issue of ageing generators to be retired i.e. G1, G2 and the growing incidence of unplanned outages warrant immediate planning and action. In addition, the suppressed demand within the existing networks' coverage, embargoed Sub-stations and overloaded feeders is undefined. However, it is projected that where the transport capacity is increased, and coverage extended to un-served communities, electricity demand within the GBA would far exceed 100MW.

5.1.3 Sources of Generation

The NAWEC operates several thermal power stations that run on either diesel and/or heavy fuel oil. The hydropower potential of the Gambia River is currently being planned to be harnessed through the OMVG projects; OMVG has among its priority projects the construction of several hydro-electric power plants and a power inter-connection/transmission line linking them to the power system networks of the four countries.

The Gambia has recently realised a new independent renewable power producer in the form of GAMWIND. GAMWIND has successfully installed a wind farm of capacity 1.0MW in Tanji with a tie line to the NAWEC grid. The GOG/NAWEC in partnership with UNIDO is currently implementing a pilot 200KW Solar/diesel hybrid project for Kaur Town.

a. Kotu Power Station

The heart of NAWEC's generation system is Kotu Power Station equipped with eight (8) generators that rated a maximum power output of 41.4 MW. Tables 4 to 6 present the composition of generators at Kotu Power Station, NAWEC Brikama and GEG.

Table 4: Generation Kotu Power Station

No.	Description	Type	Installed Capacity (MW)	Available capacity (MW)	Fuel	Commission
1	KPS – G1	Mirrlees	3.0	2.6	LFO	1981
2	KPS – G2	Mirrlees	3.0	0	LFO	1981
3	KPS – G3	Mirrlees	3.4	2.6	HFO	1997
4	KPS – G4	DEUTZ	6.4	5.5	HFO	2001
5	KPS – G6	Man B&W	6.4	5.5	HFO	1990
6	KPS – G7	DEUTZ	6.4	5.5	HFO	2002
7	KPS – G8	DEUTZ	6.4	0	HFO	2002
8	KPS – G9	DEUTZ	6.4	5.5	HFO	2009
			41.4	27.2		

Table 5: Generation IPP Brikama Power Station

No.	Description	Type	Installed Capacity (MW)	Available Capacity (MW)	Fuel	Year Installed
1	BRK – G1	DEUTZ	6.4	0	HFO	2006
2	BRK – G2	DEUTZ	6.4	5.5	HFO	2006
3	BRK – G3	DEUTZ	6.4	5.5	HFO	2007
4	BRK – G4	DEUTZ	6.4	5.5	HFO	2007
5	BRK – G5	DEUTZ	6.4	5.5	HFO	2013
6	BRK – G6	DEUTZ	6.4	5.5	HFO	2013
			38.4	27.5		

Table 6: Generation Brikama Power Station – NAWEC

No.	Description	Type	Installed Capacity (MW)	Available Capacity (MW)	Fuel	Year
1	BRK – G1	WARTZILA	8.9	8.3	HFO	2011

Generator Data, NAWEC, Power Generation 2012

b. <u>Provincial Electricity Services</u>

As mentioned in section 3 above, NAWEC operates six (6) small scale power systems in the provincial centres of Basse, Bansang , Jangjanbureh, Mansakonko, Farafenni, Kerewan; (NAWEC: December 2013). Juffureh and Kamuna are smaller stations that serve NAWEC's water reticulation systems in their respective areas. These power stations operate diesel fired generators (see Table 2) that feed into isolated medium and low voltage networks which when available, supply electricity for 12 to 15 hours per day. Besides serving a small customer base of about 6,500 customers, the provincial power stations provide the vital electricity supply for the water reticulation systems in Basse, Bansang, Jangjanbureh, Mansakonko, Farafenni, Barra and Kerewan respectively.

<u>5.1.4 Demand</u>

The analysis of energy demand has been fairly elaborated in the Energy Master Plan (EDF 1993) and NAWEC's Corporate Plan (1999 – 2003) projecting an annual growth in demand of 6 – 8.5per cent.

The key factors shaping electric energy supply and its use in the future are: -

- Population growth;
- Economic and social development;
- Financial and institutional conditions;
- Local/regional and global environmental concerns;
- Efficiency of energy supply and use;
- Technological innovation and deployment; and

The current electricity customer base in the GBA and provinces is 120,000 customers (Source: NAWEC). The electrification rate of the GBA and provinces average below 40 per cent, except for Banjul where the rate stands at 80 per cent (NAWEC: 2013). The number of households for the GBA now stands at 115,000 households and is rising.

a. Peak Power Demand

The current production (capacity) power transport and network are insufficient to serve customers at peak demand periods, thus the continuous load shedding in the GBA. The EDF network study in 2013 pegs the maximum power demanded at 85 mw (recorded peak load) + 20MW load shed plus 10mw of standby generators = 100 mw. Given that the suppressed peak measured now stands at 24MW and the transport capacity constraints, a revised maximum power demand as at today is over 100MW (Source: NAWEC: 2013).

b. Technical and Non-technical Losses

Although several figures have been presented as the integrated electricity losses of NAWEC (e.g. the EDF MV network study – 39.3 per cent), NAWEC's 2012 Annual Report states that the technical and commercial losses are estimated to be 24 per cent. A comprehensive study on system losses and detailed accounting for its discrete components is yet to be carried out. However, Table 7 presents the annual generation data (less own consumption at production) and electricity sales data for the GBA and provinces (Basse, Bansang, Mansakonko, Farafenni, Jangjanbureh, Kerewan) respectively.

Table 7: NAWEC Electricity Production/Sales Data in kWh (GBA) and Provinces

Year	KPS	B-IPP	B-NAWEC	Provinces	Electricity sales (approx)
2007		157,020			140000
2008	80,848	130,087			147000
2009	79,032	146,513			150000
2010	101,102	134,022			190000
2011	99,824	119,834	19,912		160000
2012	102,009	84,533	50,391	8,584	175000
2013	101,191		28,738		

Source: Data NAWEC: 2013

5.1.5 Accessibility/Availability/Acceptability

a. Accessibility is the provision of reliable and affordable modern energy services for which payments are made. Commercially viable electricity is unaffordable to many people, yet at the same time a socially-affordable price would not attract sufficient investment. The current cost of connection to the NAWEC electricity grid (minimum D6, 500) and the average weighted tariff of D9.7/KWH are high. The current policy of full cost recovery plus margin on service connections should be reviewed to enhance accessibility of electricity.

Table 8: Electricity Tariff (GMD/KWh)

Description	Category		Tariff (D)
Domestic	1	Component Range 0-300kWh 301 – 600 kWh 601 – 1000 kWh Above	June 2012 9.10 9.45 9.70 10.40
Commercial	2		9.70
Maximum demand Hotel/ club/ Industry	3		10.40
Agriculture	4		9.10
Area Councils	5		9.70
Central Government	6		9.70

Source: NAWEC 2014

b. Availability covers both quality and reliability of delivered electricity. Unexpected power cuts bear a high cost for society that cannot be ignored. The world's growing reliance on information technologies makes reliability even more critical. The electricity sector has been plagued with capacity availability problems since September 1977. However, the recently commissioned 8.9 MW generator and the additional two of 12.8MW funded by Social Security and Housing Finance have helped to replace the capacity gap of some decommissioned plant.

c. Acceptability addresses environmental goals and public attitudes. NAWEC has abandoned the incineration of HFO sludge, a practice replaced with the recycling of the sludge. The degradation of the Kotu Power Station (KPS) grounds and environment has been significantly reduced. Prepayment metering has improved NAWEC's cash flow. Consumers do not only purchase electricity in advance but manage their consumption as well ~~its utility~~ (demand side management).

5.1.6 Use Locations and Customer Base

The use locations of electricity can be best described as countrywide. NAWEC's concentration of service is determined by default areas of use. However, the need for electricity supply is countrywide, stations like Sapu, health centres, tourist resorts to name a few are located around the country and auto produce.

The dominant users of electricity with respect to NAWEC's customer base are domestic consumers followed by commercial users, as shown in Table 9 below. The realisation of the rural electrification project Phase I resulted in increase in users. Phase II implementation has begun with 44 towns and villages targeted.

Table 9: NAWEC's Customer Base by Category

	Category	No. of Customers
1	Domestic	86 840
2	Commercial	18 536
3	Central Government	140
4	Agricultural	68
5	Local Government Authority	1 245
6	Maximum Demand	936
	Total	105 584

Source: NAWEC Commercial: 2013

5.1.7 Energy Resources and Technology Options

With a 100 per cent oil-based thermal generation of electric power, NAWEC has been hard hit by a crippling increase in the price of fuel. The soaring price of diesel and heavy fuel oil in the World market and the slide of the Dalasi have seen the cost of fuel surge to record levels. Should the current price level of fuel not subside sufficiently, NAWEC will not be in a position to finance its inputs and meet other financial obligations satisfactorily, given that 80 per cent of NAWEC's operating expenses are on items procured from abroad. In 2012, NAWEC reported an operating loss for the year of D887, 587,000.00.

The country has limited number of energy resources consisting of wood, sunlight (solar) and wind. According to studies carried out nearly 43 per cent of the land area of the country is classified as indigenous forest, which provides firewood. The country receives 2500 hours of sunshine yearly and the daily solar energy potential is an average 2.5 kJ per square centimetre area ($2.5KJ/cm^2$). Average wind speed countrywide is 2.5 metres per second, which is low for productive electricity generation.

5.1.8 Impacts of Programmes/Projects

a. Prepayment Metering – Cash Power 2000

A project was launched in 1998 with 1000 Cash power 2000 electricity meters. The number of customers has now grown to over 100,000, resulting in total prepaid sales on average of D681, 556,771.00 annually including arrears recovery. NAWEC carries a total of D571.7 million in arrears, equivalent to seven months sales. The cash power customers have accrued zero debt and for indebted customers on Cash power, recovery is as per a percentage of every purchase. Therefore certainty in the recovery of debt is assured. With Cash power there is**: no reading of meters, no billing or distribution, and no disconnection.** (NAWEC: Commercial 2013).

b. Generation Capacity

By adding 50MW of generating capacity, NAWEC will double its heavy fuel-generating stock and meet the demand with some reserve in the short term. The network capacity and its transfer efficiency, limit the power-reaching customers. The injection of 50MW significantly alters the supply-demand equation, solving the chronic capacity shortfall, thus affording NAWEC some respite for planned capacity additions.

Through additions of several generators, NAWEC's installed power generating capacity is 100MW but available capacity range from 45 to 55 per cent, the most recent being an IPP power plant owned by SSHFC consisting of 2 x 6.4MW Deutz generators. The transmission network grew through the addition of several 33/11KV sub-stations distribution.

5.1.9 Current Initiatives and Expectations

a. Capacity Expansion on the Local Transmission and Distribution Network

On the GBA electricity system, actions are being taken to reduce the technical and non-technical losses and solve the power shortage problem. A study to rehabilitate the medium voltage networks has been recently completed by the Electricite de France (EDF) financed by Agence Francaise de Development (AFD).

The EDF study has defined the following elements geared towards the optimisation of the power system network: -

- Treatment of reactive energy transported over the network;
- Re-absorption of electrical overload constraints;
- Reduction of losses on the 11 kV network;
- Capacity expansion of the medium voltage network with three feeders;
- Re-absorption of electrical overloads constraints on the 33 kV network and saving of losses;
- Rehabilitation and upgrading of the main system BUS BAR substation.

The West African Power Pool (WAPP) has since been fully operationalised and currently serves as an important and functioning tool spearheading the integration and development of the regional power network. As part of the initiative, WAPP has stepped in to partner the OMVG and implement part of the 225KV interconnection. (Senegal, Gambia, Guinea Bissau, Guinea).

b. Energy Development Under the Sub-regional Project of the Organisation for the Development of the Gambia River Basin (OMVG)

The African Development Bank (ADB) extended a Technical Assistance Grant to the Organisation, for the development of the River Gambia (OMVG), for conducting a feasibility study on the development of hydropower plants (128 + 225MW) and the transmission (interconnection) of the power networks of the member countries – Guinea, Guinea-Bissau, Senegal and The Gambia. Construction of the Kaleta site is currently underway funded by the Chinese. It is intended that Guinea will sell energy to the OMVG under an MOU between the country and the OMVG.

A regional perspective to energy markets and sector development offers significant benefits. Interconnection of national power markets will help encourage private investment through expanding market size, thereby helping investors to manage commercial and political risks. Interconnection also encourages global-scale projects, which lowers supply costs through a reduction in supply reserves, and decrease strategic risk by increasing countries' supply options.

A sub-regional transmission power grid and generation power pool will harness the above benefits and complement the West African gas pipeline project, which stretches from Nigeria to Ivory Coast. Given the vast gas reserves of Nigeria, the potential for large-scale power generation projects for the region is feasible in medium to long-term goal.

c. The West African Power Pool (WAPP)

As is the case with most other developing countries, the majority of countries in West Africa are cash-short and credit-poor and, consequently, cannot self-finance their expansion of their power generation systems to meet felt needs. Other constraints include their inability to raise significant amounts of investment capital, their small size and investor perceptions of the Region's high risk. The Energy Ministers of ECOWAS States seek to mitigate these constraints through the creation of the WAPP which, it is hoped, will be more appealing to international lenders and investors. The initiative seeks to assess and harness the energy generation potential of member-states, and ensure rational use through a common grid linking the different states.

The next steps in furthering the initiative include development of WAPP's legal provisions, institutional and technical designs, and operating rules and procedures.

d. The West Africa Gas Pipeline (WAGP)

The WAGP Concept, which was also initiated by the ECOWAS Energy Ministers, under the umbrella of the West Africa Regional Energy Project, seeks to define the Sub-region's integrated energy resources to meet the energy needs of the countries within. One of the aims of the Project is to develop a network to market the product.

5.1.10 Support Anticipated from Donors/Development Partners

The development of a policy framework for the electricity supply industry and the definition of stakeholder roles are encapsulated in the Electricity Law and the multi-sectoral regulatory legislation. Most recent is the enactment Renewable Energy law which complements the electricity law, and provides a mechanism for producers of renewable electricity to auto-produce and sell their surplus energy to the Grid.

ECOWAS Energy Support

In partnership ECOWAS and Government of The Gambia have developed an emergency power supply project for NAWEC to the tune of US$31.9million. The project shall be implemented over twelve months with specific interventions in (i) fuel, (ii) spare parts and (iii) capacity building.

5.1.11 Constraints

The development of the electricity sub-sector is handicapped by two major constraints. The shortage of finance, resulting in limited investments in new generators, transmission and distribution networks required to improve the capacity that is necessary to satisfy the demand. It has also prevented adequate maintenance of the existing transmission and distribution networks leading to irregular and inefficient electricity supply. The lack of maintenance has resulted in highly lossy lines (losses being more than twice the industry norm).

Another constraint is the present institutional set up of the sub-sector. The country presently lacks the institutional capacity to articulate the strategic framework and regulation to guide investors and independent power producers in the sector.

The total electricity demand in the country cannot be satisfied because of the mismatch between peak demand and capacity and in the provinces, the deficiency is aggravated by the unreliability of the generators. The output of the power stations in the provinces is much less than the estimated annual demand of 10,000MWH.

a. Existing Institutional and Regulatory Framework

NAWEC was incorporated as a company limited by shares under the Companies Act in May 1995. The share capital of the company is D100,000,000.00 (One hundred million Dalasis only), shares valued at D10 each.

The Social Security and Housing Finance Corporation, Gambia Ports Authority and Gambia Telecommunications Company each hold one (1) percent of shares and the remaining 97% held by the GOTG according to the NAWEC statute. However, the current Board of Directors does not include corporate representation from any of the three firms holding a one- percent stake.

The principal functions of the Ministry of Energy as regards the electricity sub-sector, as contained in the NAWEC Act, are as follows;

- Establish Policy that promote an environment conducive to attracting investments in the construction and rehabilitation of the electric sector in the short, medium, and long term;
- Promote the restructuring and privatisation of state enterprises in the electric sector and the establishment of a competitive electricity market;
- Support scientific research and education in electricity sector matters, promote efficiency in the production, transmission, distribution, and marketing of electricity, and create a comprehensive electricity conservation program for the Gambia;
- Monitor and recommend policies regarding the effect on the environment of all electricity activities, and incorporate national environmental protection goals in formulation and implementation of energy programs;
- Establish policies to promote the establishment of relationships between Licensees and electric sector entities in foreign countries, and promote the establishment of transit and import/export relationships in the electric sector;
- Establish policies regarding direct subsidies for electric supplies to specific customer classes and policies regarding priority consumers of electricity;
- Establish a strategy for electric sector emergency situations; and
- Establish policies to enhance The Gambia's energy security.

5.1.12 Electricity Law

The Electricity Law has been enacted and its objectives and purposes as stipulated are:

- Effect a transition to a private investor controlled and operated sector in which, through competition, where feasible, and regulation in non-competitive markets, prices accurately reflect production, transmission, dispatch, distribution and commercial costs;
- Establish cost effective and reliable electric supplies for all classes of consumers; and
- Encourage private sector investments in electricity sub-sector activities.

The Electricity Law further elaborates its purposes as follows;

- Assign responsibility for overall policy development in the electricity sector to the Ministry responsible for electricity matters, and relieve it from regulatory, ownership, and operational responsibilities in the sector;
- Establish a framework to regulate the electric sector and establish an autonomous regulatory body (the "Regulatory Commission") for these purposes;
- Promote energy efficiency (Demand Side Management);
- Assure sufficient and reliable electric supplies for the population and the economy at just and competitive rates;
- Encourage domestic and foreign private capital participation in the electric sector; and
- Promote competition in The Gambia's electricity markets.

5.1.13 Donor Assistance

Over the years a number of donor interventions have been received primarily to improve the reliability of the supply and the efficiently of its distribution system. The source and nature of this assistance are varied and limited. Assistance received so far was:

- African Development Fund
- IDB & BADEA } Rural Electrification, NAWEC Brikama power plant, 20 MW Brikama II Plant, Gunjur Water Supply Project and the Kotu Ring Water Project

- Agency Development de France – Study on Rehabilitation of Transmission and Distribution Network.
- Indian Government – Study and Project finance for Phase II Rural Electrification, Water and Electricity Expansion Project
- Venezuela Government: Rehabilitation and Expansion GBA Network
- OFID: Energy Access and Expansion Project
- GEF/UNIDO: Solar Hybrid in Kaur

5.2 Rural Electrification

5.2.1 Overview

During the last decade, many countries in sub-Saharan Africa have been engaged in implementing sound macroeconomic policies and structural reforms geared to raise per capita incomes, reduce inflation, and narrow the financial imbalances. Despite these reforms, poverty remains widespread and the development process sidelines many people. The development process should be inclusive if it is going to be sustainable. One key aspect of the inclusiveness is the engagement of the rural areas, where the majority of the populace reside, into the mainstream of development.

Improving the access to health services and education is important. It is also important to raise employment and productivity in the rural areas by increasing access to energy. Traditional forms of delivery have not been effective at this task and access to electricity has been mostly limited to the urban areas. Along with other rural development actions, rural electricity can bring economic prosperity to rural areas and help lay the foundations of a stable, inclusive and brighter future for the Gambia.

Hybrid power solutions such as the solar/diesel power project is a positive initiative that has the potential of making provincial power supply services viable and sustainable in the medium to long term.

5.2.2 Rural Electrification (RE) Project

In 1993, Electricite de France (EDF) prepared an electrification master plan for the GBA and the rural provinces, which basically envisaged the electrification of towns within 80-km radius from two proposed central power stations in the rural centres of Mansakonko and Bansang.

Lahmeyer International (LI) was contracted by NAWEC in 1997 to prepare an "Engineering Study" for economically feasible rural electrification projects based on the EDF conclusions and recommendations of the 1993 master plan.

The LI study presented recommendations with respect to the location and size of the power plans and the associated transmission network to electrify the fifty settlements that met the selection criteria.

Following the realisation of Phase I of the RE Master Plan, a study funded by the Indian Government culminated in the tender and award of a US $20 million contract for the realisation of Phase II. The project has been mobilised and effectiveness reached.

a. **Project Description**

The project consists of:

- Construction of six power stations
- Supply, installation and rehabilitation of six transmission and distribution networks;
- Compensation;
- Supply and installation of environment monitoring equipment;
- Consultancy service for supervision and Audit.
- 30km transmission lines (388 km)
- 222km of distribution lines in four regions
- 8MW (4x2MW) Heavy Fuel Oil (HF0) Generators

b. Project Objectives

The primary objective of the project is to encourage economic growth in the country by providing continuous power supply to 44 towns and villages thereby contributing to the reduction of poverty in the project area. The project aims to develop the initial stage of a national power grid, which will eventually be connected to the Greater Banjul system.

c. Project Cost and Sources of Finance

The total cost of the project net of taxes is estimated at GMD 800 million of which GMD 760 million will be externally funded EBID, ECOWAS, Bank for Investment and Development though the Indian Line of Credit. The remaining amount is to be funded locally by NAWEC in local currency.

The ADF funds will be utilised to finance part of the networks, the Environmental Marketing Equipment and the consultancy services. BADEA will finance the foreign exchange cost of the power stations component while, the IDB will provide all the foreign exchange funds for part of the networks. NAWEC will finance the entire local cost of the project amounting to D33 million.

The proposed project is a major element of government's economic policy, which is aimed at the stimulation of growth and the improvement of the social conditions of the population by bringing basic services to the rural areas. When it becomes fully operational in 2016, 289,000 rural inhabitants will have access to regular power supply. Due to a funding gap of US $10Million, the Project shall be implemented in two phases. GOG/NAWEC is working to secure the additional funds for the second phase.

Its implementation will enhance the economic opportunities of the populace in these areas and improve their social well being thereby assisting in the reduction of poverty. Consequently, rural migration to the GBA will be reduced.

5.3 Petroleum Products

5.3.1 Overview - Petroleum Products Consumption and Supply in The Gambia

The petroleum sub sector is segmented into Upstream, Midstream and Downstream involving activities from the exploration and production stage to transportation and storage and marketing. The Gambia has off shore sites that are considered to have prospects for oil. Given the significant potential economic development to be offered in the expected discovery of oil, government is preoccupied in ensuring the judicious exploitation for the maximum benefit of Gambians. The Gambia imports all of its petroleum requirements which are mainly refined products like gasoline, diesel, heavy fuel Oil, Kerosene/Jet A-1 and liquefied petroleum gas as shown in Table 10 due to

the absence of a local refinery. Petroleum product imports are mainly used for electricity power generation and in the transport sector.

The Gambia imports all its petroleum product requirements under a contract arrangement with Euro African Gambia Ltd (EAGLE) the only license holder that has the authority to import bulk petroleum products. Euro African Gambia Ltd has erected a modern fuel depot at Mandinary that has a storage capacity of 51,000 metric tons.

5.3.2 Supply and Demand Situation and Access Rate by Beneficiaries

The petroleum requirements of the country consist of diesel oil (gas oil), kerosene/aviation (jet) fuel and Liquefied Petroleum Gas (LPG). The consumption of liquid products grew from 107.6 million metric tons in 2005 to 146.5 million metric tons in 2012. There was a fluctuating trend in the demand for HFO but demand for diesel oil gradually increased from 39.4 million metric tons in 2005 to 63.2 million .metric tons in 2012 whiles the supply for gasoline or petrol has remained constant from 2005 up to 2010 when it steadily increased from 18.3 million metric tons to 22.3 million metric tons in 2011 and 18.4 million metric tons in 2012. The supply of kerosene/jet fuel has remained constant over the years. The main petroleum consuming sectors are transport, construction and electricity generation.

The supply of petroleum products to the Gambia (the main source of supply is the Ivory Coast) is through contract arrangement entered into between EAGLE and Total Oil International. Subsidiary international oil marketing companies such as GALP, Elton, Gambia National Petroleum Company (GNPC) and Total and other local operators lift the products from the depot at Mandinary to meet their individual market demands. The system is functioning efficiently as these operators all have their own logistical support arrangements. The new support facilities for handling petroleum supplies and distribution are:

a) A submarine pipeline for discharging tankers at Mandinary;
b) A 51 thousand metric ton storage depot located at Mandinary;
c) About 55 retailing stations countrywide.

5.3.3 Quantities Used

The use of petroleum products for the past years has increased tremendously due to growth in the overall economy of the country. Table 10 below shows quantities imported from 2005 to 2012.

Table 10: Imports of Petroleum Products (Metric Tons (,000)

YEAR	Petrol (Gasoline)	Kerosene (Jet fuel)	Diesel	HFO	TOTAL
2005	16,713.00	14,361.00	39,356.00	37,178.00	**107,608.00**
2006	15,028.00	18,554.00	42,526.00	36,407.98	**112,515.98**
2007	17,979.00	21,751.00	42,152.00	44,874.00	**126,756.00**
2008	15,435.16	14,959.98	44,107.40	42,387.71	**116,889.25**
2009	17,895.57	14,975.26	50,571.13	54,916.40	**138,358.36**
2010	18,251.23	15,952.96	67,001.56	51,361.30	**152,567.05**
2011	22,331.45	18,526.43	67,153.55	47,745.17	**155,756.60**
2012	18,406.23	16,177.72	63,175.04	48,742.41	**146,501.40**

Source: Euro African Group Ltd

5.3.4 Marketing

The marketing of petroleum products is carried out by subsidiaries of international oil companies and local operators through their respective retail stations. As part of their marketing strategies Petroleum companies are engaged in the following:

- Issuing of pre-paid fuel coupons
- Food item incentives for purchase above a given threshold targeting commercial vehicle drives
- Media advertisements by way of sponsoring Radio {programmes

5.3.5 Accessibility and Access Modalities

Distribution of petroleum products is carried out as follows:

- Through oil tankers for quantity imports from overseas;
- In-country distribution to retail outlets by Lorries (10 tons and above).

The accessibility and access modalities are of great concern to the oil companies in terms of security and environmental concerns. A pool of tanker-trucks operated by individual oil companies' service the supply chain from the depot at Mandinary.

5.3.6 Use Locations

Pumping stations for petroleum products are located in identified areas all over the country providing a 24–hour retail service in the GBA to customers. Also a fuel dump is provided at the Banjul Airport for storage and supply of jet fuel to aircraft. Access to petroleum products need to be improved as the population grows by encouraging the establishment of filling stations in rural communities where in the absence of Service Stations, road side sale of petroleum products is a common feature.

5.3.7 Existing Institutional and Regulatory Framework

The Ministry of Petroleum is responsible for all petroleum matters including the promotion and coordination of hydrocarbon exploration.

The Office of the Commissioner for Petroleum is headed by a Commissioner for Petroleum assisted by a highly trained support staff. The mandate of the Ministry includes the promotion of the country's hydrocarbon potentials, negotiating the award of exploration and production licences, negotiating bilateral and multilateral cooperation agreements and developing policies and strategies to enhance the development of the industry.

The petroleum sector is effectively unregulated in the Gambia, except for the price formula for market stabilisation. The sector is largely self-regulated by the four major companies, Total, Galp, GNPC and Elton oil, with regulatory oversight relying principally on the goodwill of these companies to conduct their activities according to high ethical and international professional standards.

However, given the limited size of the market and the increasing number of players, some regulation is needed to avoid the potential for abuse. With retail prices fixed, most of these concerns can be addressed through regulation in the form of a licence for each discrete activity (i.e. imports, wholesale and retail sales, storage, transportation and distribution).

The Government has responsibility for ensuring public safety and protecting the nation's environment. Consequently, all petroleum storage facilities, the Mandinary Depot, the aviation tanks and product tankers should have licences that define the standards under which they should operate.
It is also the case that government should have rules and regulations relating to the off-loading of fuel at the service stations, its transportation and conditions of storage.

5.3.8 Existing Constraints

The key constraints affecting the use of petroleum products are as follows:

- The small size of imports mainly due to the size of the market
- The low levels of import/export trade activities
- Overall narrowness of economic activities
- There is only one primary depot owned and managed by (Euro Africa Gambian Limited)
- There is a lack of regulation/laws governing the sector
- EAGLE determines the rate of through-put
- Dead-weight cost of shipping, given the limited size of consignments
- Ownership of storage depot

5.3.9 Future Outlook

The future outlook for the sector is to anticipate significant contribution to GDP. The emergence of new players in the downstream sector like GNPC, Jah Oil, Speed, to name a few, and the prospect of a more competitive market complemented by adequate regulation would create a stable environment and maximise customer value.

Strategic Reserves: The Gambia is totally dependent on imported oil and gas and the maintenance and sustainability of a strategic stock reserve (3 months' duration) would be an expensive venture. The GOTG in partnership with the Oil companies should review the Legal Stock and Insurance Stock levels required to build a strategic reserve.

Storage Depot: EAGLE has erected an ultra-modern depot of international standard at Mandinary that has a storage capacity of 51 thousand metric tons. The depot is connected by a submarine pipeline link to the bunkering site out stream. Safe guards for health, safety and environmental issues relating to the operations at the Depot need to be considered.

In order to maintain a stable supply, the GOTG needs to further review the petroleum standards specification to ensure that high quality petroleum products are being imported into the country. There is the need to create a level playing field to ensure fair competition in the domestic petroleum products market. To monitor the process of product marketing and to stop the proliferation of service stations in unsafe residential areas, government should work with stakeholders particularly the NEA to establish minimum criteria for establishing service stations.

Currently, the issues facing the Gambia's Petroleum Products Sub-sector can be broadly defined as follows:

a) The demand for a reliable and stable supply of high quality petroleum products at competitive prices;

b) Activities within the value chain of the Sub-sector should be performed within a well regulated framework in conformity with health, safety and environmental standards;

c) The need to be prepared for emergency response to oil spills, and also mitigate the risks of fire/explosions.

d) The need to maintain strategic reserves of petroleum products which, sometimes can manifest itself in stock-outs of products.

5.4 Liquefied Petroleum Gas

5.4.1 Liquefied Petroleum Gas (LPG)

Like all petroleum products, LPG is imported and is sold in different sized cylinders. It is used by affluent urban households and in the tourism industry. Access to LPG use continues to be hindered by high capital cost to obtain cylinders and also high refill costs which currently is about D62/kg. Foreign exchange fluctuations have also impacted on gas pricing and market contraction.

Table 11: LPG imported in The Gambia (1996 – 2012)

Year	Tonnage of LPG	Import Value (D'000)	Import Price (D/kg)
1996	1,450	6,827,000	4.71
1997	1,124	5,300,000	3.40
1998	1,430	4,733,000	4.72
1999	1,380	6,130,000	4.71
2000	1,500	-	4.91
2009*	2,500	US $ 1.6m	
2010*	2,250	US $2.146	28.14
2011*	2,235	US $ 2.416	31.68
2012*	2,288	US $ 2.433	31.90

Source: The World Bank (2010); EuroAfrica Group, 2012
**Values available in US $ only.*

From the data above it can be seen that there has not been any major growth in the tonnage of LPG imported, although the figures have increased by only 50per cent over the last 15 years. The price per kg, which gives an indication of the local retail price (excluding operational and distribution cost) has increased sharply to about D32/kg (2012 CIF at D30/US $) values. This shows the sensitivity of LPG to the exchange rate and how this limits its popularity by Gambian households.

In 2014, a ''12kg'' LPG bottle is retailing D725 giving a retail price of about D60/kg of LPG. Another major issue not currently addressed by any policy is the quality of the LPG bottles. This is a major safety concern and has resulted in a series of accidents. Most of the current companies do not have trademark cylinders and are simply involved in refilling cylinders introduced in the market more since the 1990s. Only GALP Energia is marketing LPG through new and safe LPG cylinders.

Another key issue that highlights the weak regulatory regime is the lack of standards on the exact weight of the products. Consumers should be properly sensitised to know what they are buying and the product should be sold with the exact amount of gas clearly specified. Lack of awareness would only erode public confidence in LPG products.

5.4.2 Supply Sources and Demand Situation and Access Rate

All the LPG is imported in The Gambia. In the past the importation was both by tanker truck from Senegal and also by sea freight. Recently, all of the LPG is being imported by sea freight.

The table below shows the current players in the LPG retail market. The oldest of these companies is GamGas which was established in the early 1980s.

Table 12: Evolution of LPG Retailing in Gambia (2005-2013)

2005	2013	Operating Status
GAMGAS	GAMGAS	In Operation
Elf		Divested from sector. Merged with Total
Shell		Withdrawn from market. Bought by GALP
M&C		Ceased operations
Touba Gas		Withdrawn from market
	GALP	New entrant
	Sanyangba Gas	New entrant

Source: Sahel Group, 2014

According to Table 12 above it is clear that the LPG market has undergone significant consolidation, and changed a lot in that it is now less competitive. From five companies at the beginning of the millennium, there are now three companies involved in the LPG supply.

5.5.3 Marketing

Of all the household energy fuels, LPG is has the most formal marketing structure. The Portuguese multinational, GALP Energia has pursued the most comprehensive marketing strategy in order to gain market share. This has focused on safety of its cylinders and incentives like free gas when new consumers make deposits for a cylinder. GALP cylinders can be bought in all their petrol stations whilst other companies distribute their gas from other filing stations or through corner shops and selected outlets. Most other gas companies conduct little or no advertising, perhaps because they are well established.

The LPG market is not regulated by any legislation and at the moment it is not very clear under which Ministry it falls under. There is a Ministry of Petroleum and also a Ministry of Energy however LPG companies are not licensed by any Ministry at the moment.

5.5 Domestic Fuels (Wood/Charcoal, etc.)

5.5.1 Supply and Demand Situation and Access Rate

Over the last three decades there have been several studies and surveys to determine fuel wood consumption in The Gambia. The timing between these surveys has not been systematic and consistent and only a few of them have been national exercises. A lot of the data available has been based on estimates of per capita use but the results have been somehow close and consistent.

According to the 2005 DCMI study, the most recent comprehensive study on fuel wood consumption was the National Household Energy survey; charcoal and firewood represent about 97 per cent DCMI] of final energy consumption in households, its market value still dwarfs other energy forms notably electricity and liquid petroleum products.

Various estimates have been made for the total fuel wood consumed in The Gambia. Table 13 below gives some of the estimates from historical data.

Table 13: Fuel Wood Consumed in The Gambia

Survey Title	Year	Est. kg/capita/day				Total
		Rural	Urban	Rural	Urban	
OPENSHAW	1972/73	2.96	2.72	122	378	500
ORGATEC	1981	1.6	1.80	64	366	430
VON BULOW	1982/83	0.73	1.00	-	-	
COWI CONSULT	1983	1.00	0.62	-	-	
STEINER	1993	0.54	1.04	5	-	
DMCI Nat. Survey	2005	1.56*	1.67*			
Jarju, NARI	2008	1.05				

Sources: see bibliography(latest available data)

The last Energy Policy document made an estimation of 485,000 tons of fuel wood (RPTES, 1994) being consumed annually. However it can be seen from the table above different studies over different period have given different results. A report by NARI in 2008 estimates that about 477,476 tons of fuelwood are consumed annually. The most comprehensive recent data can be derived from the DMCI study, which gives total firewood consumed in The Gambia for 2005 to be 796,252.7 tons with a market value of about D226 million (2005 prices). An additional 13,000 tons of charcoal are estimated to have been consumed. This represents a significant discrepancy in the data.

However, it is clear that imported fuel wood, which accounts for a major part of the national energy balance and consumption (>80per cent is biomass) is not captured properly in trade statistics.

Figure 1 – Main Imports from ECOWAS 2012

In 2012, wood and related products represented only 1.33 per cent of all imported goods from the ECOWAS region. This value is far lower than the market value reported by DMCI in 2005. It can be seen that fuel wood is not properly captured. Rather timber and other products are captured. It is clear that systematic record of all fuel wood consumed should be gathered. This is important to know as a national statistic to ensure that there is proper and coherent energy planning since it is and will remain the most widespread and most used form of energy for the foreseeable future.

5.5.2 Supply and Demand Situation and Access Rate

Household energy consumption in The Gambia represents the biggest demand for energy accounting for more than 80 percent of the final energy demand. This high percentage contribution has remained consistent for more than three decades and remains to this day.

The sources of charcoal and firewood in the urban areas are mostly from retailers. Firewood is normally bought split into small sticks whilst charcoal is sold in bags of between (15 -20 kg) or in small nylon bags of about a kilo (1 -1.5kg) each.

The importation of charcoal and firewood is mostly from the southern Senegal region and Guinea and it involves middlemen who buy it from other producers at the sources. In some instances the charcoal markets are different from the timber merchants.

Although charcoal, a major urban fuel is imported, significant amounts of it are produced in the West Coast region, despite the legal implications. The main driver has been the relative ease of transportation following the development of the major highways such as the coastal road and the Brikama- Soma highways. Urban expansion is also leading to large areas of virgin land being cleared into ad hoc charcoal production areas.

The fact remains, however, that since the bulk of it is imported, The Gambia's natural vegetation and or forest cannot support current demand. The closest estimate has been suggested to exceed domestic resources by 100,000m^3 annually [Jarju, NARI 2008]. It is clear that unless alternative sources of energy are promoted, increasing reliance on foreign importation of a major fuel source like fuel wood could raise key energy security issues. Further, most wood comes from casamance forest, which forms an ecosystem around the Gambian border with Senegal. Therefore, exploiting such ecosystem will as well negatively affect the biodiversity of resources in The Gambia..

5.5.3 Technology Options

There are a variety of technologies and fuels being used for household energy in The Gambia; however, the majority is derived from wood. The most important activity in Gambian household is cooking, which accounts for also the largest consumption of energy derived from fuel wood.

Fuel Wood

This represents the major fuels in almost all Gambian households used either for cooking or other domestic use. Fuel wood may be used as dry firewood, processed as charcoal or derived from semi-industrial processes such as lumbering and saw milling activities.

a) **Firewood:** firewood is used with almost all cooking stoves available including the improved cooking stoves. In the urban areas firewood is available as a commercial product and is often imported. The tree species often used for firewood is of very valuable timber known locally as 'wien', and in the rural setting people often gather firewood from nearby bushes and used it with three stone stoves.

   Within the artisanal fisheries industries where a lot of fish preservation through smoking takes place, significant amount of firewood is used. This is often gathered locally from within The Gambia and is mainly from shrubs etc. Significant amounts of logs are also used in the baking industries for local bread production and also for take-away meat roasting called *'Afras'*.

b) **Charcoal:** charcoal use is very widespread and it is used mainly for cooking in urban households. It is preferred by women due to its easy use, and also for its smokeless combustion after ignition.

c) **Saw dust and waste wood products:** off cuts and saw dusts are also used but in significantly small quantities. These are often used by households where the fuel is processed, and it is often obtained free. A number of NGOs have tried to promote improved stoves but this is not very widespread.

d) **Agricultural wastes:** the most reliable evidence of use of agricultural waste for energy is the use of groundnut shells. These have been used since the early 1980s but recently their

emergence as a sustainable fuel wood alternative has been promoted by the private sector through a number of initiatives. It is currently being made into briquettes, and sold with a special stove as well.

5.5.4 Institutional and Legal Framework

Despite being such a significant contribution to the energy makeup in The Gambia, the household energy sector is the least regulated and there are several institutions and ministries involved in regulating different parts of the value chain.

The Ministry of Energy and the Ministry of Forestry are directly involved in the fuel wood regulation with the latter having a more regulatory role both in primary exploitation and regulating transport etc. Historically, there has been restriction on the production of charcoal in the Gambia.

The Forest Act is administered by the Minister responsible for Forestry. However, it is unclear if there is established coordination between the Forestry and Energy Ministries in terms of charcoal monitoring and regulation. Indeed, in the past the Department of Community Development, under the Ministry of Local Government, had implemented a long running programme on efficient cooking stove making, promotion, etc.

The sector needs better coordination and governance to ensure coherence in the policy objectives of the different Ministries.

5.5.5 Constraints

The Government of The Gambia has attempted to protect the environment by prohibiting the production of charcoal in the Gambia and by making the cutting of green trees for use as fuel wood illegal. However, it is still not evident that most fuel supply as such has really played a major role in the degradation of the natural forest cover.

The more significant factors appear to be population pressure growth and slash and burn agriculture and bush fires. Need for firewood increases due to increasing population,

To address these challenges, the following main recommendations must be considered.

- While leaving the ban on domestic production of charcoal in place the legalisation of the import and trade of charcoal should be re-examined, in conjunction with the means needed to monitor the product flows effectively.
- Government should legalise the transfer of management responsibility of forest to local population thus permitting the multiplication of the existing forestry project to all regions. (i.e. Forestry Management Concept). This could lead to a more efficient way enforcing the existing laws, regulations and guidelines
- Making sure that harvesting of green trees for fuel wood is only permitted in zones that have been brought under community management, under provision of agreed management plans between the communities and Forestry Department.
- Making periodic biomass inventory which will permit the analysis of change in land use, and the establishment of permanent sample plots to measure productivity on a regular basis.
- To maintaining a broad spectrum of consumer choices of fuels, should be made by the private sector to reduce the cost of hydro-carbon fuels as substitutes, in particular by attempting to lower the cost of importing, storing, and bottling of LPG. Also the prospect of kerosene as a substitute fuel for cooking should be further examined.
- In view of the Gambia's natural resources, the promotion of planned agro-forestry must be given high priority.

5.5.6 Future Outlook

The considerable headway in the formulation of effective household energy policies and strategies during the last decade, and to which all stakeholders added new elements has had a very positive effect, notably by accelerating the implementation of the household energy sector.

Future government donor support for traditional energy are being incorporated within the broader framework of natural resources management which is a logical step, given Gambia's scarce endowment of forestry resources. The need to clearly define traditional energy associated problems within the framework of land use and deforestation issues are finally being tackled. It is envisaged that along with the establishment of a better database on the tradition energy sector for the Gambia, better sustainable management of our natural forest resources (wood fuel) will take place nationwide

A land use plan is imperative to sustainably manage natural resources.

5.6 Renewable Energy

5.6.1 Overview

The Gambia lies within latitude 13.28N and 14.0N and enjoys a favourable tropical weather and lies within the Sahel region of West Africa. Thus for most of the year solar irradiation is very high and wind speeds are however moderate.

Renewable energy has a long history in The Gambia. Solar PV was first used for rural lighting and telecommunications facilities since the early 1980s. However, it is for rural water pumping that solar PV has had a major impact. Indeed, more than 2MW of PV has been installed through various government and donor funded projects to provide water to rural and isolated communities. The results are indeed very impressive with more than 90 per cent of these populations having access to clean drinking water.

5.6.2 Supply and Demand Situation

Table 14 indicates the evolution of demand and supply in the RE sector especially in relation to wind power and solar PV. Currently the contribution of RE to grid connected electricity production is less than 1 per cent. There is no data on off-grid solar PV except the stand alone projects installed by Senegambia Beach Hotel, Luigi's Complex and Lemon Creek Hotel.

The number of foreign assistance projects using renewable energy technologies in The Gambia has increased rapidly in the last 10 years. Unfortunately, there is very little structured information gathering to obtain useful data derived from these projects (supply and demand, forecast). This is especially true for small units like solar PV whose use is widespread especially for water pumping. The government maintains the largest and longest ongoing programme using solar PV for rural water supply.

Table 14: Supply and Demand Situation for Renewable Energy

Technology	2012	2013	2014
Solar PV		30 Kw	
Wind Power	200Kw	1MW	1MW
Solar thermal			
Biofuels (biogas)			

Reliable data is necessary to gauge system performance and the economic cost of the installed systems vis-a-vis operating costs as well as social acceptance. Without adequate data, planning will be difficult and there will be serious risk of repeating the mistakes of failed projects again and again, as is the case with biogas.

5.6.3 Supply Sources

Suppliers of Solar PV systems in The Gambia have increased significantly but the market remains almost unregulated. There are now several companies and small business selling solar PV or solar related appliances. In some instances companies from Germany, the UK or Spain come to carry out installations. In addition, many hardware stores in The Gambia now sell some component of a renewable appliances, mainly solar device, equipment or appliance including batteries, panels or pre-installed packages.

For solar PV the main suppliers are:

a) Essien Solar
b) Regional Solar Engineering
c) MP Trading
d) Gambia Electrical Company;
e) SWEGAM;
f) Gam-Solar; and

For Solar Thermal:

a) LC Solar
b) Gambia Electrical
c) Gamsolar
d) Regional Solar Engineering

For Biomass briquettes:

a) Greentech Ltd.

5.6.4 Infrastructure and Impacts of Pact Programmes/ Projects on the Energy Situation

The impact of past programmes (for both public and private sector) has been very positive. By far the longest running renewable energy adoption programme has been the rural Water Supply Projects implemented by the Ministry of Water Resources. The result has positioned The Gambia amongst the countries in Africa with the highest access rate to clean drinking water. Currently it is estimated that The Gambia has attained more than 93 per cent access to clean water. However it must be noted that proper inventory of these projects needs to be conducted as some were installed since the early 1990s.

Declining energy production from these systems, as well as high operations and maintenance costs are urgent issues that need to be addressed. This calls for more long term review of the sustainability of solar water systems even though they still remain the best option for rural water supply.

On the renewable electricity side, the government together with UNIDO implemented the GEF-funded project in which two significant projects were installed; the GAMWIND Tanji wind farm installed two turbines of 450kVA each.

The main challenges for the project has been land related issues and also payment from the off taker NAWEC. Timely payment by NAWEC to all IPPs is critical if future investment is envisaged in the sector.

The UNIDO/GEF project also installed an 8.3kW modern solar PV system for productive uses in Tujereng for women empowerment activities at a local training centre. Such projects should be promoted as they incorporate RE in gender based development activities. The potential for scalability is very high especially in agriculture where women are heavily involved in horticultural activities.

The joint Gambia government GEF UNIDO project represents a model that can be replicated. It is a US $ 2m grant project that implements RE projects through co-financing. With the co-financing, there is greater private sector participation and also assurance of long term sustainability. The project also aims to avoid greenhouse gas emission, but also through funding of concrete projects, create a critical mass of a viable RE sector with the associate support services.

The key components of the project are:

Table…….

Project Component	Status 2014
Demonstrating Viability of RE projects a. Women's Education Center b. GAMWIND c. NAWEC hybrid d. QCELL Wind powered Basse stations e. 8.4KW solar power gardening project f. Tanji Fisheries Project	Implementation is as follows: a. Fully implemented and operational b. Turbines erected and operated during 2013 c. Procurement on going d. Installation phase e. Re-advertised f. Stalled
Strengthening legal and Regulatory Framework	Completed and RE law has been enacted.
Capacity Building and Training	Training has also been incorporated in some of the projects. Staff of various institutions including GTTI took part in hands-on training during the implementation of one of the projects.
Project Management Unit	Currently housed at GREC giving GREC some visibility. MOE staff have also been actively participating in the project.

Within the hotel industry, many of the hotels have begun implementing solar PV and solar thermal technologies. By far two of the biggest solar water heating systems within the hotel industry are at the Senegambia and at the Kombo Beach Hotels. The Kombo Beach Hotel made an investment of about $60,000 and the savings were such that the payback time was calculated to be less than 4 years.

Senegambia Hotel also installed a solar water heating system as a pilot with two tanks of about 3,000L. Other hotels like Palma Rima have numerous vacuum type solar water heaters on the roofs of their bungalows.

5.6.5 Institutional and Legal Framework

The absence of laws and regulations and state institutions governing the renewable energy sector has deterred its progress in The Gambia in the past decades. However, this is changing rapidly with new institutions such as a dedicated Ministry of Energy, PURA, etc which has made integrated interventions much easier and guarantees investor confidence in The Gambia. The year 2013 witnessed significant policy initiatives being launched to address this gap. In December 2013 the government passed the Renewable Energy (RE) Act.

The main objectives of the Act are;

a) Promote RE development

b) Incentives and support for grid connected RE systems

c) Registration of installers and promotion of standards on RE equipment and appliances

d) Establishment of an RE Fund

5.6.6 Current Initiatives by Government of The Gambia

The development of the RE sector also depends on various institutions including Ministries, and further streamlining of the approval and permitting process would be key in promoting investment in RE in The Gambia. NAWEC has begun to show more interest in RE projects and has in 2013 begun the procurement of a grid tied RE system for one of its provincial stations.

The Government has also recently formulated an electricity master plan into 2030 investing in demand growth and which technology options to take to produce power. Renewable Energy plays a major part in all scenarios. This integrated plan puts emphasis on promoting fuel diversification policies and developing domestic energy resource supply options including increased exploitation of renewable energy technologies such as solar.

In 2005, the Gambia government with funding from the African Development Bank, conducted a 14 month RE Study and Master plan. The study made a thorough assessment of RE resources in The Gambia, conducted resource measurement along the length and breadth of the country as well as presenting a feasibility study of key economically viable projects in both solar and wind.

The first project was a wind energy project in Batakunku, a village along the West Coast. The project was community based with a wind turbine of 150kVA supplying the village with electricity. A unique feature of the system was that being grid-tied it would sell surplus electricity to the grid. This is very important considering the intermittent nature of wind energy but also considering its usefulness during off peak hours.

The Batakunku project demonstrated the viability of wind energy as a competitive energy source and also as a rural electrification model. A 900kVA wind farm was also later constructed nearby with a target to produce about 800,000MWhs per year.

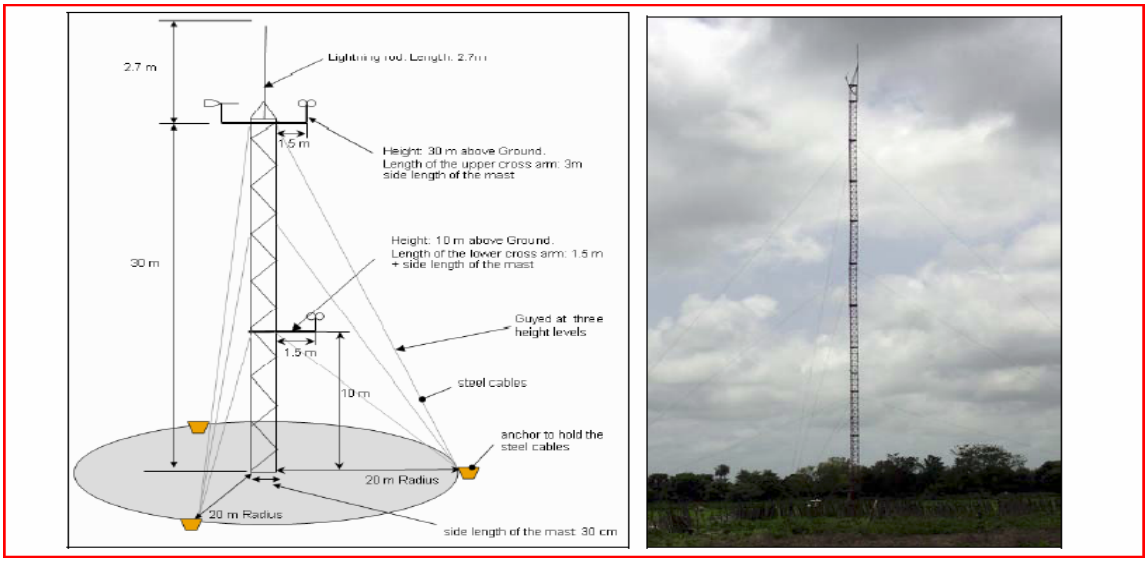
Solar PV has also enjoyed a major boost following a sharp drop in prices due to competitive manufacturing from East Asia.

A Renewable Energy Association has also been formed which comprises mainly all the leading RE companies and practitioners in the country. The Association has also been involved in promotional activities. However, it is still a young institution and needs to be more active.

5.6.7 Technology Options

Wind

The assessment of the wind energy resource for The Gambia has been characterised as being modest and most promising along the coast both on the north and south banks. The RE Study of 2004 erected eight (8) wind energy measuring stations in The Gambia and showed average wind speed of only around 5m/s. The measurement was taken at only 30m and projections made for speeds above that.



Figure…….

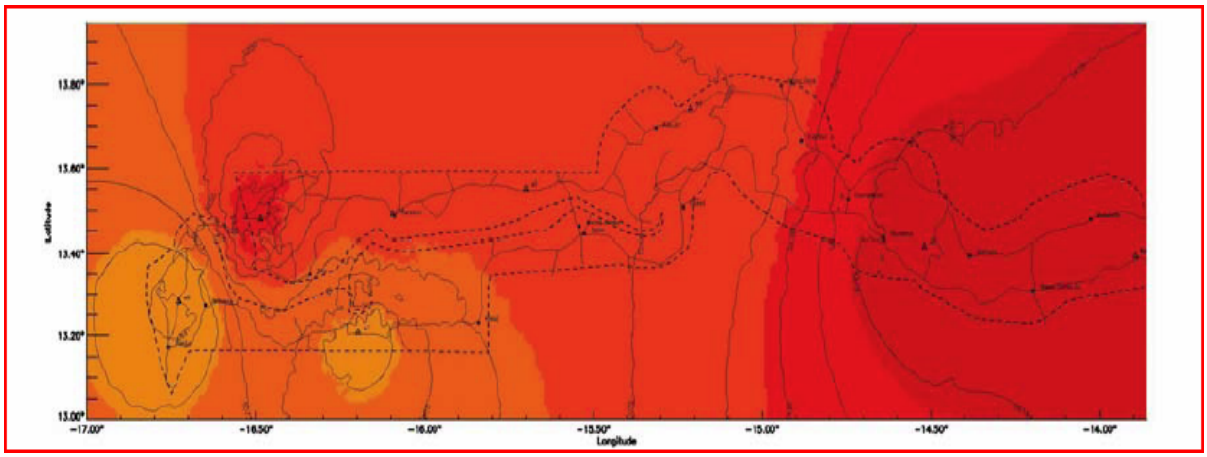
The potential for wind energy has been exploited in two distinct projects, and it has proved to be financially sustainable albeit with grant funding and using re-power turbines. The commercial implementations of these projects have illustrated that wind energy can be a significant contributor to the Gambian energy mix. However, infrastructure constraints such as cranes to lift bigger nacelles continue to be a limitation. The extent to how much an intermittent energy source such as wind can be integrated with the NAWEC grid would also have to be studied. There is no doubt that more detailed and specific wind energy measurements would have to be undertaken as the old study might be outdated. Perhaps a more focused study on wind measurement at height of 60m would give more reliable information. Another major limitation of wind energy is the competition with land for urban or tourism development.

Wind energy for mechanical power to lift water for gardening also has a huge potential only in terms of increasing agricultural productivity but also for local employment opportunities. The technology is very matured and with a little capacity building and training of local technicians to manufacture them.

Solar PV

Solar is without doubt the most abundant energy source. Indeed the solar resources have been measured to be as high as 6500Wh/m^{2}d especially around May. The use of solar PV in The Gambia

is well established although more incentives need to be initiated by government to speed up its uptake.



Figure……Solar Map of The Gambia Feb 06

Solar Thermal

Solar thermal technologies involve using the heat from the sun as an energy source. This could be exploited for water heating, for food preparation and preservation. Due to the increased rise in electricity tariffs over the last few years, more and more people have been switching to solar water heaters especially as costs have also dropped dramatically.

Solar water heaters come in different forms either as pressurised or non-pressurised systems. The collector surface can also be of a flat plate or as an evacuated glass tubes. Recently, the most popular have been the evacuated glass tubes as they tend to be cheaper.

A national solar water heating programme could save the country significant amounts of foreign exchange especially within the hotel industry. The rise of eco-tourism has also seen solar water heating being embraced by the tourism industry.

Biogas

Biogas projects have been tried several times in The Gambia but all the projects have failed. The reasons are not very clear but cultural and lack of adequate and continuous supply of feedstock is the main one. However, it still has a potential if used in abattoirs or landfill sites. Unfortunately, the linkages between energy and waste in terms of landfill gas exploitation have not been properly studied nor incorporated in the design of new dumping sites. There is however an opportunity for private sector participation in waste management and energy exploitation.

Hydro

The Gambia has a very flat terrain and in fact no part of the country rises above 75m above sea level. The River Gambia does not experience any serious gradient within the boundaries of the Republic of the Gambia but it does have a hydro potential further upstream. The OMVG project has an energy component aims to build a dam of about 250MW at Sambagalou in eastern Senegal. However it is unlikely that such a project would be classified as renewable due to its size.

Modern Biomass

By far biomass is the most used source of energy in The Gambia. Traditional biomass exploitation is unsustainable and is not considered renewable. However, The Gambia has a long history with developing energy products from agricultural waste especially from groundnut shells.

Currently, there is a company, GreenTech Ltd, making briquettes from groundnut shells and marketing them, sold for cooking as a substitute fuel. Similar smaller projects were initiated before with grants from GEF. However, the GreenTech approach would prove successful as it is been marketed with a special stove. The success of this effort would rely a lot on the affordability of the stove and how well people take it culturally as a good and well developed distribution network is also critical if briquettes are to be used widely. It is also important to ensure that there is a level playing field since the un-regulated firewood and charcoal trade would always make briquettes uncompetitive commercially.
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5.6.8 Existing Constraints

Renewable energy particularly solar is still not economically viable in The Gambian context and is the most expensive renewable energy resource. RE/Solar technologies would become competitive only when the associated environmental externalities of fossil fuel-base generation are taken into account. The high cost of production reflects the high capital of RE devices.

Furthermore, due to the fact that some RE technologies i.e. solar are not financially viable at the moment, it may require additional support from the government by way of providing several incentives geared towards bringing cost of RE products in parity with grid cost. Until such measures are taken, renewable energy popularisation widespread utilisation would remain a challenge for Gambians.

The development of renewable energy in The Gambia has always been limited by the availability of skilled technicians and professionals. This is crucial for RE deployment. Despite a long history with RE, most of the training programmes have been ad hoc and have not been specialised long term continuous training. It is important that higher training institutions like the University of the Gambia and GTTI are involved not only in providing professionals but also involved in research and development. Vocational training institutions are indeed the most important as they have to produce the installers and technicians. This is necessary not only to ensure that installations are done to specified standards, but also local knowledge and employment are promoted.

A major challenge that the public have been complaining is that often installations are done by un-qualified technicians due to poor design. Thus as more and more RE technologies are being installed very often skilled labour is imported from abroad.

The quality of the components as well has been a worry. There needs to be a better coordination between the newly established Gambia Standards Bureau, the Ministry and other relevant regulatory agencies.

Thus existing institutions like GREC, GTTI and the University of The Gambia, need to be strengthened to introduce RE programmes. GREC, especially, needs to begin to take part in short-term training on RE and also RE awareness not only for the public but also for policy makers.

Currently GREC, which is under the Ministry of Energy is not staff by any technician. The Center has a huge potential considering that RE is receiving worldwide attention. The main mandate of GREC is:

i). Assist and advice government on the preparation and implementation of RE projects
ii). To provide training on RE technologies
iii). Perform maintenance on RE equipment
iv). Co-operation with other West African Centres
v). Carry out adaptive research and promotion of RE technologies

It is clear that GREC has suffered from lack of funding and staffing and it would need to have its mandate streamlined to ensure that it can survive.

Although energy is high amongst the priority areas within the general investment climate, competing policies such as fiscal and trade policies have also introduced significant barriers and did not offer clear and/or enough incentives over equipment importation of RE devices. The new RE law hopefully will address some of these challenges.

5.6.9 Future Outlook

There is an increase in investment from both public and development banks in The Gambia in renewable energy with a view to facilitate the availability, accessibility and affordability of RE technology nationwide.

In addition to the recent move by the utilities provider, government has re-orientated energy policies to ensure that investment in renewable energy technology makes sound businesses, economic sense. Also, in view of the fact that the cost of solar power devices are expected to improve significantly over the next decades…….. The future outlook in the utilisation of renewable technologies in the Gambia suddenly has a very bright future and must become an integrated component of future energy policy.

Renewable Energy would definitely play a major role within The Gambia's energy mix. The biggest potential impact would be in large scale renewable energy projects such as a solar park or wind farm. They would definitely reduce price volatility and save the country millions of dollars in foreign exchange.

The enactment of the RE law in 2013 would play a major role in achieving this goal. The law makes provisions for a Feed in Tariff (FiT) to be administered by PURA. A FiT regime would be a welcome incentive by investors. However, it is unclear what the tariff would be.

More emphasis should also be made to promote net-metering initiates in the country. This allows a faster RE technology uptake.

The Gambia Renewable Energy Centre, established by government since 1984 should also be upgraded into a Centre for RE training and demonstration. It should take a leading role in response to the RE policy development and work with international and regional institutions such as ECREEE.

6.0 ENERGY AND THE ENVIRONMENT

6.1 Situational Analysis - Introduction and Context

Energy is central to the Gambia's many economic, social and environmental concerns. Access to sustainable sources has a profound impact on multiple aspects of the Gambians such as poverty, problems of health, gender inequity and environmental degradation; it relates not only to physical infrastructure (e.g. electricity grids), but also has to be clean, reliable, affordable and commercially viability. In practical terms, this means delivering energy services to households and businesses that are in line with consumers' ability to pay. Thus investment in energy is indispensable for a prosperous and sustainable future of the country.

Since environmental impacts are an inherent part of energy production (including electricity production) and energy use, this chapter reviews and compares the environmental impacts of the various fossil-fuel (imported petroleum products) and renewable sources of energy on which the country depends to meet its energy requirements. It discusses the impacts that occur typically at the localized, national, regional or larger scales, on media (such as soil, air, water) global warming and pollution. This is particularly relevant in view of the fact that Gambia is Party to important regional and international treaties and conventions as listed in Table 15 .

Given that the country's energy options are very limited in the face of the rapid depletion of the forest resources through (bush fires, farming, grazing, and land development), the potential negative impact of uncontrolled exploitation of the forest cover to satisfy national household energy needs is a concern.

Although renewable energy sources have a smaller environmental footprint than power from fossil-fuel sources, environmental impacts created through electricity generated from them are equally a concern.

Table 15: Relevant International Agreements and Conventions Ratified by The Gambia

Agreement	**Focal Point**	**Focus Area**
UN Convention on Law of the Sea **(UNCLOS**)	Fisheries Department	Fisheries and the continental shelf
Convention on Wetlands of International Importance (**RAMSAR Convention)**	DPWM	Wetlands
UN Convention to Combat Desertification **(UNCCD)**	Forest Department	Desertification
UN Framework Convention on Climate Change (**UNFCC)**	DWR	Climate change
Bamako Convention on the ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa **(BAMAKO Convention)**	NEA	Trans-boundary Movement and Management of Hazardous Wastes within Africa
Convention for Cooperation of the Protection of the Marine and Coastal Environment of West and Central Africa Region **(ABIDJAN Convention)**	NEA	Marine and Coastal Zone Management
Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal **(BASEL Convention)**	NEA	Trans-boundary Movement of Hazardous Wastes
Convention on the Prior Informed Consent procedure for Certain Hazardous Chemicals and Pesticides in International	NEA	Hazardous Chemicals and Pesticides

trade **(Rotterdam (PIC) Convention)**		
Convention on Persistent Organic Pollutants (POPs) **(Stockholm Convention)**	NEA	Persistent Organic Pollutants
Convention on the Protection of the Stratospheric Ozone Layer (**Vienna Convention)**	NEA	Protection of Ozone Layer
Montreal Protocol on Substances that Deplete the Ozone Layer **(MONTREAL Protocol)**	NEA	Protection of Ozone Layer
Convention on the Prevention of Pollution from Ships **(MARPOL Convention)**	GPA	Marine pollution
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter from Ships. **(LONDON Dumping Convention)**	GPA	Marine waste dumping

6.2 Energy Sources in Gambia and their Potential Environmental Impacts

Fossil fuel-based

Fossil fuels used in the country are petroleum products (including heavy fuel oil and diesel) and natural gas which are finite and non-renewable resources, and remain the primary source for the production of electricity, powering the transportation and manufacturing sectors, and for domestic use. The combustion of these fuels releases their chemical energy, which produces heat to power turbines to generate electricity and the other forms of energy. Fossil fuels constitute a significant repository of carbon deep underground, and burning them results in the conversion of this carbon to carbon dioxide, which is then released into the atmosphere. This results in an increase in the earth's levels of atmospheric carbon dioxide, which enhances the greenhouse effect and contributes to global warming.

Depending on the particular fossil fuel and the method of burning, other emissions may be produced as well. Urban air pollution (sulphur dioxide, nitrous oxide, carbon monoxide, ozone) from vehicle emissions as well as atmospheric particulate matter is an environmental concern. Although not yet experienced in the Gambia, oxides of sulfur and nitrogen contribute to smog and acid rains resulting to the acidification of ecosystems.

6.3 Heavy Fuel Oil (HFO) and Diesel for Production of Electricity

NAWEC operates several thermal power stations in the country that run on either diesel and/or heavy fuel oil both of which are heavy pollutants by virtue of their constitution, particularly HFO. Use of HFO over the years may well have reduced the overall cost of electricity generation nationally, but waste generated in the process (particularly the sludge at the Kotu Power Station) has been a major source of environmental pollution; the sludge used to be stored in barrels, or left in open pits and drains within the perimeter fence of the station, and during heavy rains the sludge would overflow the drains, and escape into the adjacent rice fields and the Kotu Stream, polluting the entire area. This has both social as well as environmental implications.

Currently, the sludge is being processed at Mandinary for conversion into some form of diesel fuel for use by ships and heavy-duty trucks; the potential environmental and social impacts (especially if the process is not carried out efficiently) by way of air pollution, and on the people around the facility is inherent.

The gigantic electric generating facilities at Kotu occupy a large land area just for the power plant components alone. With on-site fuel storage facilities as well as structures for connecting to the

transmission grid, *on-site land impacts* have been evident at Kotu and indeed wherever electricity generators have been built, they leave their sites irrevocably scarred or polluted.

Off-site-land impacts are also evident because the generating facilities produce solid waste by-products of combustion that can be toxic. Some of these can be found at waste dumps. Another way in which a generating facility impacts land is by extending its environmental footprint beyond the boundaries of the power plant site.

Collecting and storing the fuel necessary to generate electricity can also impact land in much the same way by precluding other uses and leaving permanent scars.

Transporting fuel and other petrochemical products by road, sea or pipeline could create negative impacts by way of, for example spilling where it involves high seas, coastal areas, wetlands and water bodies. Typically, once at the Yellitenda ferry crossing, a relatively massive oil spill occurred, and such incidence could have devastating environmental consequences. Equally, the submarine pipe line carrying petroleum products to the storage depot at Mandinary poses a potential environmental hazard should there be a spill.

6.4 Petroleum Products

The petroleum products in the country consist of gasoline, diesel oil (gas oil), kerosene, and aviation (jet) fuel, and the main petroleum consuming sectors are transport, construction and electricity generation. Currently, petroleum products are supplied nationally are handled and distributed througha submarine pipeline and stored at the depot at Mandinary. Retailing is carried country wide at fuel stations with varying levels of environmental and safety standards.

The depot is connected by a submarine pipeline to the bunkering site out stream. Clearly, environmental and health safeguards issues relating to the operations at the depot (including the potential spilling of products into the aquatic environment) need to be considered.

Distribution of petroleum products is done:

i. Through oil tankers for quantity imports from overseas
ii. In-country distribution to retailers by lorries (10 tons and above)

Decanted into 20 liter containers, uncontrolled and unauthorized locations also retail the products along the roadside in some parts of the provinces.. Storage sites of these products are usually in the compounds of the vendors, exposing themselves and their families to fire hazards.

6.5 Liquefied Petroleum Gas (LPG)

Liquefied petroleum gas is a clean burning fuel which emits no smoke or residual particulate matter and has relatively low pollutant emissions. As it is a gas, it does not pose ground or water pollution, but it can cause air pollution.

However, it can be easily stored, transported and used virtually anywhere from urban areas to remote rural areas. These properties have made it an appealing fuel option which both meets household energy needs and causes very low levels of pollution. It has a number of advantages over traditional wood fuels including:

i. Instantly controllable flame temperature

ii. Environmentally friendly fuel with minimal sulphur content and sulphur- free emissions
iii. Can be used for a variety of applications
iv. No soot, burners have a longer life and therefore maintenance is low
v. No spillage as it vaporizes at atmospheric temperature and pressure
vi. Avoids scaling and decarburizing of parts

It however has potential downsides – it is highly inflammable at very low concentrations, and the gas is odourless (so the addition of a pungent odorant to enable rapid detection of leakages) - its use is considered significantly safer for household purposes.

In the country, the transportation methods used for LPG is by ship and off loaded to the depot in Mandinary. LPG is distributed by tanker trucks to the various filling plants.

6.6 Renewable Energy Sources (Solar, Wind and Hydro)

Using renewable sources of energy does not avoid impacts entirely, although the types and magnitude of environmental impacts differ substantially from fossil-fuel sources, and from one renewable source to another. Therefore, an understanding of the relative environmental impacts (mainly on the land, water, the types of material used in its manufacture, and its life-cycle global warming emissions**),** of the various electric power sources is essential to the development of a sound national energy policy.

Currently, the Government is implementing the study report on how to develop and promote the use of renewable sources of energy in the country with particular emphasis on rural areas. Specifically, projects will provide sufficient energy (particularly solar energy) to the population and improve their access to social services, such as education, health services and water supply.

A small scale wind park has already been connected to the NAWEC grid near the western Atlantic coast. This will contribute to poverty reduction through the improvement of economic and social conditions of the population particularly in the rural areas. In addition, it is hoped that this will help stop the ongoing environmental degradation and lopsided dependency on imported fossil fuels.

6.6.1 Solar Energy

The Gambia has a substantial solar energy potential - one of the most promising renewable energy sources of the country. Although the types of impacts vary greatly depending on the scale of the system and the technology used (Photovoltaic (PV) solar cells or Concentrating Solar thermal Plants (CSP), the environmental impacts associated with solar power can include land use and habitat loss, water use, and the use of hazardous materials in manufacturing.

The scale of the system - ranging from small, distributed rooftop PV arrays to large utility-scale PV and CSP projects - also plays a significant role in the level of environmental impact.

6.6.2 Land Use

Depending on their location, larger utility-scale solar facilities can raise concerns about land degradation and habitat loss. A total land area requirement varies, depending on the technology, the topography of the site, and the intensity of the solar resource. Estimates for utility-scale PV systems range from 1.4 ha to 4 ha per megawatt, while estimates for CSP facilities are between 1.6 ha and 6.7 ha per megawatt.

Unlike wind facilities, there is less opportunity for solar projects to share land with agricultural activities . However, land impacts from utility-scale solar systems can be minimized by sitting them

at lower-quality locations such as abandoned mining sites or existing transportation and transmission corridors. Smaller scale solar PV arrays, which can be built on homes or commercial buildings, also have minimal land use impact.

6.6.3 Water Use

Solar PV cells do not use water for generating electricity. However, solar thermal plants (CSP), like all thermal electric plants, require water for cooling. Water use depends on the plant design, plant location, and the type of cooling system. CSP plants that use wet-recirculating technology with cooling towers withdraw between 2,300 and 2,500 liters of water per megawatt-hour of electricity produced. CSP plants with once-through cooling technology have higher levels of water withdrawal, but lower total water consumption (because water is not lost as steam). Dry-cooling technology can reduce water use at CSP plants by approximately 90 percent. However, the tradeoffs to these water savings are higher costs and lower efficiencies. In addition, dry-cooling technology is significantly less effective at temperatures above 38ºC.

6.6.4 Hazardous Materials

The PV cell manufacturing process includes a number of hazardous materials, most of which are used to clean and purify the semiconductor surface. These chemicals, similar to those used in the general semiconductor industry, include hydrochloric acid, sulfuric acid, nitric acid, hydrogen fluoride, and acetone. The amount and type of chemicals used depends on the type of cell, the amount of cleaning that is needed, and the size of silicon wafer. Workers also face risks associated with inhaling silicon dust.

Thin-film PV cells contain a number of more toxic materials than those used in traditional silicon photovoltaic cells, including gallium arsenide, copper-indium-gallium-diselenide, and cadmium-telluride. If not handled and disposed properly, these materials could pose serious environmental or public health threats.

6.6.5 Life-Cycle Global Warming Emissions

While there are no greenhouse gas emissions associated with generating electricity from solar energy, there are emissions associated with other stages of the solar life-cycle, including manufacturing, materials transportation, installation, maintenance, and decommissioning and dismantlement.

Most estimates of life-cycle emissions for PV systems are between 32 grams and 82 grams of carbon dioxide equivalent per kilowatt-hour whilst those for CSP range from 36 grams to 90 grams of carbon dioxide equivalent per kilowatt-hour.

6.7 Wind Energy

Harnessing power from the wind is one of the cleanest and most sustainable ways to generate electricity as it produces no toxic pollution or greenhouse gas emissions. Wind is also abundant, inexhaustible, and affordable, which makes it a viable and large-scale alternative to fossil fuels. Despite its vast potential, there are a variety of environmental impacts associated with wind power generation that should be recognized and mitigated.

6.7.1 Land Use

The land use impact of wind power facilities varies substantially depending on the site: wind turbines placed in flat areas typically use more land than those located in hilly areas. However, wind turbines do not occupy all of this land especially where they are spaced appropriately; they must be spaced approximately 5 to 10 rotor diameters apart (a rotor diameter is the diameter of the wind turbine blades). Thus, the turbines themselves and the surrounding infrastructure (including roads and transmission lines) occupy a small portion of the total area of a wind facility.

In the Gambia, current practice is sitting wind facilities close to the beach occupying relatively small areas. Large wind facilities however have been found to use between 12 ha and 57 ha per megawatt of power output capacity. However, less than 0.4 ha per megawatt is disturbed permanently and less than 1.4 ha per megawatt are disturbed temporarily during construction of the wind facility.

The remainder of the land can be used for a variety of other productive purposes, including livestock grazing, agriculture, or highways. Alternatively, wind facilities can be sited on abandoned or underused land or other commercial and industrial locations, which significantly reduces concerns about land use.

In the event that offshore wind facilities will be constructed in the future in the diversification of the country's energy sources, offshore installations may compete with a variety of other ocean activities such as fishing, recreational activities, oil and gas extraction, and navigation.

Recommendation: Employing best practices in planning and sitting can help minimize potential land use impacts of offshore and land-based wind projects.

Wildlife and Habitat

The impact of wind turbines on wildlife, most notably on birds is cause for concern; evidence of bird deaths from collisions with wind turbines and due to changes in air pressure caused by the spinning turbines, as well as from habitat disruption has been established. These impacts are however relatively low, and do not usually pose a threat to species populations.

Offshore wind turbines can have similar impacts on marine birds, but as with onshore wind turbines, the bird deaths associated with offshore wind are minimal. Wind farms located offshore will also impact fish and other marine wildlife, and may actually increase fish populations by acting as artificial reefs.

Recommendations: Whilst the impacts will vary from site to site, generally wildlife impacts can be mitigated through better sitting of wind turbines; in addition, proper research and monitoring systems are needed for each offshore wind facility.

Public Health and Community

Sound and visual impact are the two main public health and community concerns associated with operating wind turbines. Most of the sound generated by wind turbines is aerodynamic, caused by the movement of turbine blades through the air. There is also mechanical sound generated by the turbine itself. Overall, sound levels depend on turbine design and wind speed. Some people living close to wind facilities might complain about sound and vibration issues, although these issues do not adversely impact public health.

Recommendation: It is important however, for wind turbine developers to take these community concerns seriously by following "good neighbor" best practices for siting turbines and initiating open dialogue with affected community members. Additionally, technological advances, such as minimizing blade surface imperfections and using sound-absorbent materials can reduce wind turbine noise.

Water Use

There is no water impact associated with the operation of wind turbines. As in all manufacturing processes, some water is used to manufacture steel and cement for wind turbines.

Life-Cycle Global Warming Emissions

While there are no greenhouse gas emissions associated with operating wind turbines, there are emissions associated with other stages of a wind turbine's life-cycle, including materials production, materials transportation, on-site construction and assembly, operation and maintenance, and decommissioning and dismantlement.

6.8 Hydroelectric Power

The Gambia's experience in hydroelectric power is the impending OMVG energy program which is planned to produce cheap accessible, reliable and carbon free hydro electric energy through an interconnection of the four member states.

Hydropower systems are clean, causing no emissions as they operate, but the environmental concerns center around disruption to the river flow, its natural surroundings, and especially to the fish living in the river and the animals and people that rely on the natural river habitats.

A critical assessment of its potential at various sites within the Gambia River Basin in 1999 concluded that the optimum scenario for meeting the various water demands (including irrigated agriculture, hydroelectricity production, navigation, control of saline intrusion, and conservation of ecosystems) could be achieved through:

- a high management of the turbine threshold at Sambangalou, (one of the dam sites located in Senegal) giving an output of 40 MW
- flow regulation allowing the development of 21,900 ha (18,000 of which lies in the Gambia) of irrigated crop
- augmentation of low flows to keep the saline front at about 170km downstream of river through intermittent release of freshwater from the dam to flush back the salt water

The OMVG energy program will be achieved through the construction of two hydro-electric dams at Sambangalou, with a capacity of 128mw, 400gwh per annum, and Kaleta (in Guinea) on the Konkoure River with a capacity of 240mw, 950gwh per annum. The two dams will be able to transmit through a 225kv interconnected transmission network of 1677 km that runs through the four member states. There will be a total of 15 transformer sub-stations (225/30kv) in the interconnection line which is a complete loop, the Gambian interconnection component beginning from Soma to Brikama passing through the horizontal axis of the West Coast Region

The already concluded feasibility studies have shown that the dam site at Sambangalou the interconnection would bear no major environmental impacts although the potential environmental impacts will be on the following:

6.8.1 Impact on Land Use

Flooding land for the hydroelectric reservoir has potential to destroy forest, wildlife habitat, agricultural land, and scenic lands. In many instances, entire communities can also be relocated to make way for reservoirs.

Impact on Wildlife

Since the dammed reservoir will be used for multiple purposes, such as agricultural irrigation, flood control, and recreation, so not all wildlife impacts associated with dams will be directly attributed to the two dams. However, hydroelectric facilities can still have a major impact on aquatic ecosystems. For example, though there are a variety of methods to minimize the impact (including fish ladders and in-take screens), fish and other organisms can be injured and killed by turbine blades.

Apart from direct contact, there can also be wildlife impacts both within the dammed reservoirs and downstream from the facility. Reservoir water is usually more stagnant than normal river water. As a result, the reservoir will have higher than normal amounts of sediments and nutrients, which can cultivate an excess of algae and other aquatic weeds. These weeds can crowd out other river animal and plant-life, and they must be controlled through manual harvesting or by introducing fish that eat these plants. In addition, water is lost through evaporation in dammed reservoirs at a much higher rate than in flowing rivers.

Furthermore, if too much water is stored behind the reservoir, segments of the river downstream from the reservoir can dry out. Thus, most hydroelectric operators are required to release a minimum amount of water at certain times of year. If not released appropriately, water levels downstream will drop and animal and plant life can be harmed.

Life-cycle Global Warming Emissions

Greenhouse gas emissions are produced during the installation and dismantling of hydroelectric power plants; after the area is flooded, the vegetation and soil in these areas decomposes and releases both carbon dioxide and methane. The exact amount of emissions depends on site-specific characteristics. However, current estimates suggest that life-cycle emissions can be over 220 grams of carbon dioxide equivalent per kilowatt-hour.

6.9 Domestic Fuels

Fuel wood represents the major source of domestic energy in the country. Based on household activities alone, it has been estimated that, on the average, per capita consumption of fuel wood equals around 0.17 cubic meters of wood per annum. This translates to the equation that each person consumes the sustainable harvest of between 1-2 hectares of forest (Steiner, 1994).

Around 70 per cent of the population lives in the rural areas, and it obtains its fuel wood locality from farmland, fallow land, bush, or the collection of deadwood from nearby forest. The production and consumption of fuel wood for energy have environmental impacts; harvesting of fuel-wood, in particular, contribute to deforestation, soil erosion, and desertification and social conflicts (see Table 16). Use of fuel-wood as an energy source can also contribute to the accumulation of CO_2, the main greenhouse gas, both because burning fuel wood produces CO_2, and because deforestation destroys an important carbon sink.

Table 16: Risks Associated with Forest Loss and Degradation

Function	Process	Implication
Climatic amelioration	Rainfall diminishes over deforested land, but not greatly	Prejudicial to agricultural and pastoral production
Soil	Unprotected soil loses fertility and/or rapidly erodes to a near-worthless condition	Highly prejudicial to agricultural production
Water catchment	Deforested slopes release water rapidly	Water loss during rains; water shortages during dry season
Habitat conservation	Heavy off-take of wood converts closed forest to open forests, and open forest to scrubland – leading to desertification	With less woodland, country would lose much of its wildlife and many rare species of plants
Culture values	Traditional culture depends heavily of forest products	Medicinal herbs and wood for carving become harder to find
Subsistence	Most rural dwellers augment their food supply with forest products	Wild fruits and other non-wood products such as honey become harder to find
Civil disorder and conflict	Competition for scarce resources	Diversion of government funds to settle disputes and conflicts instead of development

6.10 Potential Environmental Impacts of Oil and Gas Exploration and Development

The Gambia discovered commercial oil and gas in 2000, and subsequently the government began looking for partners for its exploration and development. However, oil exploration and production involve several activities that can have detrimental impacts on the ecosystem during the various stages including seismic surveys, exploration, development and production, and decommissioning. Thus the potential sources of pollution in the upstream sector of an imminent Gambian oil and gas industry, and their effects on the environment could arise as a result of the activities indicated below:

- Seismic Surveys could lead to acoustic emissions and accidental spills of chemicals into the marine environment

- Exploration requires drilling, and this could result in drilling discharges, atmospheric emissions and spills resulting in marine and air pollution. Fishing operations could be the victim of this type of pollution

- Development and production causes operational discharges, atmospheric emissions, waste disposal and noise leading to ground and marine pollution

- Decommissioning involves the physical closure or removal of structures, waste disposal and dumping at sea which could endanger fishing operations and navigation

Consequently the potential environmental impact of drilling for petroleum has implications for both the country and beyond, as marine pollutions (in off–shore drilling, for example) do not respect national boundaries. This is particularly important because the Gambia is party to some international and regional conventions (listed in Table 1.1) which are directly related to oil and gas exploration and development.

7.0 CONCLUSION AND RECOMMENDATIONS

In view of the potential negative impacts of this energy policy it is recommended that an Environmental and Social Impact Assessment (ESIA) of all the types of investments be carried out by NEA before they are implemented. The rationale for such studies is to evaluate the potential environmental and social risks and impacts in the areas and sites selected for the implementation of the investments. The process will examine ways of improving site selection, planning, design, and implementation; it also attempts to prevent, minimize, mitigate, or compensate for adverse environmental impacts, and to enhance positive impacts throughout the implementation of the proposed interventions and projects.

Specifically the following recommendations need to be considered:

1. NAWEC operates several thermal power stations in the country that run on either diesel and/or heavy fuel oil both of which are heavy pollutants by virtue of their constitution, particularly HFO.

   The current practice of recycling or converting the sludge and other wastes generated at the Kotu Power Station is not environmentally sustainable. It is important that other alternative and more environmentally friendly technologies be developed to manage the wastes generated from the use of these fuels.

   Therefore it is crucial that the relevant policies and national laws are developed to regulate the industry in line with the country's international obligations.

   In addition, NAWEC needs to develop its internal environmental policy whose implementation will be the responsibility of an Environmental Specialist on its payroll.

2. Even though LPG has an appeal as a fuel option which both meets household energy needs and causes very low levels of pollution, it however has potential downsides – it is highly inflammable at very low concentrations, and the gas is odourless (so the addition of a pungent odorant to enable rapid detection of leakages) - its use is considered significantly safer for household purposes.

   In view of the various levels and methods of management and handling of petroleum products, (some of which are grossly inadequate) stringent safety standards and guidelines need to be developed and enforced to ensure the safe distribution, storage and sale of the product.

3. Using renewable sources of energy does not avoid impacts entirely, although the types and magnitude of environmental impacts differ from fossil-fuel sources, and from one renewable energy source to another.

   Given the above, investors must conduct relevant environmental screenings of the technologies in order to mitigate any potential impacts on the environment and adjacent population.

   Fuel wood represents the major source of domestic energy in the country based on household activities alone accounting for more than 80 per cent of total energy consumed annually in the country. Harvesting of fuel-wood contributes to deforestation, soil erosion, and desertification. In view of this therefore, it is recommended that:

- The current government policy of transferring management responsibility of forest resources to the local communities be intensified for it augurs well for sustainability, and will be the only way to sustain fuel wood production and supply to both rural and the urban centers;

- The government should continue to promote and encourage popular use of affordable alternatives for energy in urban areas to bridge the gap between the demand and what the forest can sustainably supply;

- In the medium and long terms, the country's demand for fuel wood must be augmented by using alternative energy resources (e.g. briquettes, LPG, solar and wind energy, etc.), or establishing fuel wood plantations, including community fuel wood lots.

4. Strategies to curtail the effects of oil and gas development on the ecosystem should be developed. These include the need for government to:

    - Formulate petroleum industry-specific environmental protection guidelines and appropriate regulatory frameworks;

    - Employ an integrated approach involving (i) prescription of environmental codes and setting of standards to be met by operators, and (ii) the need for oil companies to develop environmental management system (EMS) to ensure that they operate within the environmental standards for the industry.

    - Carry out administrative and institutional structural reforms, as well as provide the necessary financial and human resources for the various stakeholder institutions to ensure effective implementation, enforcement and monitoring of environmental laws and regulations.

8.0 KEY RECOMMENDATIONS

In a deliberate attempt to realise the government's Vision 2020 for the Energy sector which is '***To ensure 100 percent access to modern energy services at affordable rates throughout Gambia by 2020'.*** The following key recommendations are pivotal:

a) Building a Sustainable Energy Platform for Growth

A current electricity capacity at 2014 is put at 75MW and additional demand is projected at 135MW by the Vision year of 2020. The estimated capital cost required for this investment is conservatively estimated at between 113 – 182 million dollars.

i. Accelerate the progressive implementation of the recommendations agreed by stakeholders Retreat held in 2011 foremost amongst which is policy decision to unbundle NAWEC.

ii. Pursue alternative energy sources such as hydro under the OMVG programme and large scale solar and wind energy options with development partners.

b) Building Renewable Energy Capacity

It is recognised that Renewable Energy has the latent potential to ameliorate the energy needs of The Gambia in an ecologically and environmentally sustainable manner. Green energy should be seriously considered as a viable energy alternative having regard to its manifold advantages such as independence from fossil fuels, and zero carbon emissions (GHG). The Gambia has abundant sunlight which is currently not harnessed to favourably impact our energy needs. On the road to the actualisation of our Renewable Energy potential, the following salient policy aspects require priority action:

i) Encourage the establishment of centralised solar power plants and wind farms as opposed to stand alone solar panels on roof tops and individual wind turbines in order to benefit from economies ofscale and to feed into the National Grid.
ii) Develop the regulatory framework for a feed in tariff mechanism to stimulate in a transparent and predictable manner investments in renewable energy.
iii) Facilitate and aggressively explore development partner investment opportunity into the Renewable Energy sector from multilateral, bilateral and foreign direct investment sources within PPP and IPP Framework Agreements.
iv) The socio-economic spin-offs from Renewable Energy will have the resultant effect of enhancing energy independence, fulfil the 'Green' power agenda, increase energy security, increase employment and serve as an impetus for domestic manufacturing and foreign direct investment.

c) **Oil and Gas**

The oil and gas industry constitute a driving force and a veritable catalyst for a modern economy if properly explored, developed and managed in a sustainable and value chain progressive manner. In this regard, government through the Gambia National Petroleum Company should systematically strengthen the value creating activities within the oil and gas value chain land ensure that we develop an efficient, diversified and sustainable energy mix to propel the Gambia's development aspiration under Vision 2020.

The various segments at the oil and gas industry generally divided into upstream, midstream and downstream activities. The upstream activities consisting of exploration, development and production of oil and gas resources while midstream and downstream activities ranging from the transportation of oil and gas, to refining and processing through the marketing and trading of end products should be intensified and systematically integrated.

To systematically impact on the energy situation in The Gambia regard with positive forward and backward linkages for energy security and economic and ecological sustainability.

With regard to the country's projected economic growth target of 6 percent over the next few years, there will be the urgent need to meet the exponential demand for energy going forward to 2020 and beyond in order to provide energy for businesses and the expanding population. Therefore, it is imperative to continue and intensity oil exploration activities both onshore and offshore for oil and gas.

i) Facilitate its drive to attract multinational oil companies to the sector.
ii) Continue to expand its strategic location advantage as a sub-regional hub for oil and gas storage and distribution entrepot at Mandinary.

The successful and timely implementation of the Energy policy to derive the maximum impact for socio-economic development and transformation is premised on ensuring the following salient parameters.

- Align policies coherently
- Development clear value propositions and measurable benchmarks
- Insightful
- Provide leadership focus
- Ensure high quality monitoring (SMART) and feedback for maximum impact.