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Electricity and Renewable Energy Sector Analysis and Recommendations

ANNEX G

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ABBREVIATIONS

ACDB	Community Development Association of Bambadinca
ADPP	Ajuda para o Desenvolvimento do Povo para o Povo
BAD	Banque africaine de développement - African Development Bank (AfDB)
BADEA	Arab Bank for Economic Development in Africa
BEI	Banco Europeu de Investimento (European Investment Bank)
BOAD	Banque Ouest Africaine de Développement (West African Development Bank)
BT	Low Voltage
CFAF	Communauté Financière Africaine Franc (African Financial Community Franc; currency)
CIFAP	Professional Centre of Guinea-Bissau
CPER	Centros de Produção e Electrificação Rural
DDO	Distillate Diesel Oil
DEPE	Direção dos Estudos, Projetos e Estatística (Directorate for Studies, Projects and Statistic)
DG	Direção Geral (Directorate General)
DGE	Directorate General of Energy
EAGB	Company of Electricity and Water of Guinea-Bissau (Empresa Publica de Electricidade e Aguas da Guine Bissau)
ECOWAS	Economic Community Of West African States
FAC	French Development Agency (Agence Française de la Cooperation)
FED	European Fund for Development
GDP	Gross Domestic Product
HFO	Heavy Fuel Oil
IBSA	India, Brasil and South Africa Fund Project (Projecto do Fundo da India , Brasil e Africa do Sul)
KfW	Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute)
LV	Low Voltage
MEI	Ministry of Energy and Industry
MV	Medium Voltage
NGO	Non-Governmental Organisation
OMVG	Organization for the Gambia River Development
PPE	Programme for Energy Production
PPP	Public-Private Partnership
PRS	Poverty Reduction Strategy
SE4ALL	Sustainable Energy for All
SIE-GB	Sistema de Informação Energética da Guine-Bissau
TOSTAM	ONG Internacional Norte Americana sedeada em Dakar
UEMOA	Union Économique et Monétaire Ouest-Africaine (West African Economic and Monetary Union)
WAPP	West Africa Power Pool

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1 SUMMARY

Guinea Bissau currently faces the challenge of increasing the energy access and energy security for its population, as well as trying to simultaneously mitigate climate change. The unstable political and economic environment in Guinea Bissau has affected the development of several sectors of the economy, including the energy sector, and the country is trying to recover from the long period of instability. Guinea Bissau is currently preparing for democratic elections which will be undertaken under the oversight of UN and will take place during March-April 2014.

The resulting scenario after those years of civil and political unrest have left Guinea Bissau with a poor electricity system and service. Due to the low availability of funding, external aid reduction, political instability and weak institutional and human capacities, it is still hard to achieve the targets for the eradication of poverty and minimize socio-economic inequalities in Guinea Bissau.

Currently, biomass (wood, charcoal, agricultural and forestry residues) is the only physically available and economically accessible fuel for most of the population. Although extremely rare, the available power in Guinea Bissau has dropped more than 80% in the past years (from 12.7 MW in 2003 to 2 MW in 2013 for the public sector and from 15 MW to 2.5 MW for self-producers over the same period). Since 2000, electricity generation has completely collapsed in this country; at the moment, the available power production is only 2 MW to face a demand constantly increasing, estimated at 30 MW.

There is no regional interconnection now with other countries but there is a projects that will improve the situation of Guinea Bissau: the OMVG (Regional Organization for the Valuation of the Gambia River) with a HV line coming from neighbouring Guinea-Conakry, passing through Guinea-Bissau, Gambia and ending in Senegal later. According to the map presented in the WAPP (West Africa Power Pool) website, the project proposes to connect Guinea Bissau with Senegal and with Guinea through a 225 kV line.

The Government of Guinea-Bissau, through the Ministry of Energy, Industry and Natural Resources (MEINR) remains committed to the process of sectoral reorganization, and at the same time, the implementation of the Energy Sector Policy, with major focus in the electricity subsector. One of the constraints that hinders the development of the energy sector is the difficult national/international financial situation marked by scarcity of resources, thus imposing the need for adopting new strategies in the energy subsector.

For instance, one of the biggest challenges that the sector has, is the adjustment of the commercial rate so that it corresponds to the inherent cost of production. The tariffs set in 1989 are still in effect and do not take into account the cost of production. Currently a tariff study is to be carried out.

With regards to the regulatory, policy and institutional framework, Guinea Bissau has some strategies, policies and regulations in force that make reference to the use of renewable energy sources. The most relevant one is the *Energy Master Plan for Infrastructure Development for the Production and Distribution of electricity in Guinea Bissau*, which is still under development and the *Poverty Reduction Strategy Paper* that understands the promotion and development of Renewable Energies as an important factor for the development of the country.

There are four renewable energy sources available in Guinea Bissau: solar photovoltaic, biomass, wind and water energy (both in terms of applying traditional hydroelectric plants or ocean (tidal) energy plants). Amongst RE sources, solar photovoltaic (PV) is by far the most exploited source for electricity generation in the country because it is the most sustainable one for rural areas to power schools, health centres, houses and offices and photovoltaic water pumping systems for potable water. Given the delicate situation of the grid supply, roof-top PV applications could also be attractive for urban households or industries.

Biomass is used mostly for cooking purposes in domestic applications. In reference to the costs of renewable energy technologies, the collected information and studies show that biomass energy from cashew shells would be the most attractive option as the resource is quite abundant in the country. In fact, there have been initiatives focusing on this renewable energy, particularly on the use of cashew shells, which is generated as a waste of cashew nuts production that has been growing in the past years.

Hydropower energy is a well-developed technology that could be harnessed in Guinea Bissau, and within this context, the Saltinho hydropower project (19 MW) becomes very relevant for the country.

With regards to wind energy, Guinea Bissau has low wind speeds, but there is some potential to study on the coast of the country. Geothermal energy studies were not conducted in the country and due to the geographical location of Guinea Bissau, geothermal resources are not likely to be attractive. Tidal energy potential is very low in Guinea Bissau for large applications but hope remains with the development of tidal power plants with small capacity (2 MW), which is outstanding in Portugal.

Although capital costs for renewable energy are high whereas commonly used diesel options need a lower investment, diesel generation systems rely on diesel fuel to operate, which significantly increases their operational costs throughout their lifetime, thus making RE more attractive. In fact, an IRENA Report on renewable power generation costs, states that with current prices for fossil fuels and conventional technologies, renewable technologies are now the most economical solution for off-grid electrification and for centralised grid supply in locations with good resources (IRENA, 2013).

As it can be concluded, there is potential in Guinea Bissau to promote renewable energy applications and projects, but there are some barriers that hamper their development and should be addressed. These are:

- Financial barriers, which are associated to the availability of financing instruments and financing institutions in the country, as well as the high initial capital costs of renewable energy solutions ("affordability").
- Institutional and regulatory barriers, which are related to the unstable political and economic environment in the country, the lack of a clear tariff structure, the insufficient policy and regulatory support for RE development, and the insufficient institutional capacity.
- Technological barrier are derived from insufficient renewable energy baseline data, the current poor energy transmission and distribution grid, and the insufficient technical capacity in the local market to identify, develop and implement renewable energy projects.
- Information and awareness barriers are linked to the limited available information on renewable energy technologies and opportunities, the lack of access to information for the general public and the limited information for Independent Power Producers (IPPs) on how to develop renewable energy projects.

Based on the described scenario, a set of activities is suggested in order to be executed under a GEF-UNIDO project that would help improve the local environment and capabilities to promote investments in renewable energy in Guinea Bissau. The set of activities is mainly focused on:

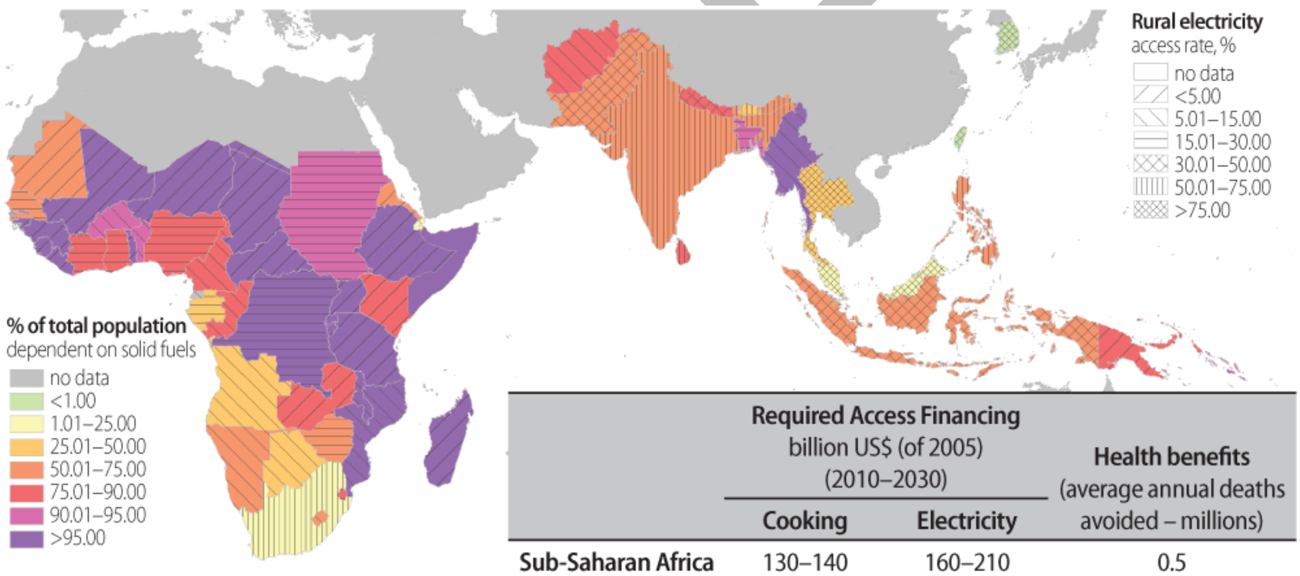
- Aid investment projects with potential for replication and scale-up
- Strengthening the legal and regulatory framework and the institutional capacity

2 INTRODUCTION

The General Assembly of the United Nations Organization has declared 2012 the International Year of Sustainable Energy for All (SE4ALL). It urged the Secretary General to organize and coordinate activities to increase awareness of the importance of addressing energy issues. In response, the Secretary-General launched a global initiative on sustainable energy for all. The initiative aims at mobilizing actions by governments, private sector and civil society around three objectives: to ensure universal access to modern energy services, double the overall rate of improvement in energy efficiency and doubling the share of renewable energy in the global energy mix, all to be achieved by 2030.

The unstable political and economic environment in Guinea Bissau has affected the development of several sectors of the economy, including the energy sector. After several years of economic downturn and political instability, in 1997, Guinea-Bissau entered the CFA franc monetary system, bringing about some internal monetary stability. The civil war that took place in 1998 and 1999 and a military coup in September 2003 again disrupted economic activity, leaving a substantial part of the economic and social infrastructure in ruins and intensifying the already widespread poverty. Following the parliamentary elections in March 2004 and presidential elections in July 2005, the country is trying to recover from the long period of instability despite a still-fragile political situation. Unfortunately in 2010, the military took over the government and that generated a decrease in external aid (e.g. EU and Spanish cooperation) but Guinea Bissau is currently preparing for democratic elections which will be undertaken under the oversight of UN and will take place during March-April 2014.

The resulting scenario after those years of civil and political unrest have left Guinea Bissau with a poor electricity system and service. The chronic crisis in the electricity sector represents a high cost for the entire economy of Guinea-Bissau, adversely impacting production costs and the population's standard of living. The need for modern energy services (electricity, motive power, modern fuels) are huge at all levels (productive sectors, social sectors, residential). Moreover there is an urgency for the implementation of actions to address the country's overall economic development delay as well as for the eradication of mass poverty.



	Required Access Financing billion US$ (of 2005) (2010–2030)		Health benefits (average annual deaths avoided – millions)
	Cooking	Electricity	
Sub-Saharan Africa	130–140	160–210	0.5
South Asia	160–180	55–60	0.8
Pacific Asia	~ 20	10–60	0.3

Figure 1: Illustrative figure for populations lacking access to clean cooking fuel and electricity in major problem regions of sub-Saharan Africa and South and Southeast Asia. Colours denote lack of access to clean cooking fuel and hatched areas denote a lack of access to electricity. The table gives the regional costs and related health benefits that will result from attaining universal access in these regions by 2030. Note that these regions account for over 85% of the total global population without access to electricity and over 70% of the global population that still depends on solid fuels. (Source: An energy vision for a planet under pressure, 2012[1])

Figure 1 shows that Guinea Bissau as well as most of the Sub-Saharan Africa countries face a low energy access rate and are mostly dependent on solid fuels (traditional biomass (including charcoal and, to a lesser extent, coal)). It shows the hot spots where

1 http://www.igbp.net/publications/policybriefsforrio20summit/policybriefsforrio20summit/anenergyvisionforaplanetunderpressure.5.7edb9cae136f47276108000494.html

populations are most severely affected by a lack of access to energy as well as by premature deaths caused by household air pollution.

With regards to on-grid electricity generation, the situation is characterized by a structurally faulty service, both in quantity and quality due to the obsolescence of production, the disparity of production tools and the high dependence on imported oil in a context of scarce financial resources. There is a rapidly growing gap between electricity demand (estimated at 30 MW) and the available national generation capacity (estimated at ~2 MW for public sector and 2.5 MW for self-producers in 2013). Guinea Bissau is mostly dependent on diesel-based generation and many people opt to have their own diesel generators (especially in embassies, hotels, international organisations, etc.). The strong dependence of Guinea Bissau (non-oil producing country) on energy imports (mainly petroleum products) is an important factor that has negative impacts on the economy, because of the weak positive correlation between domestic energy consumption and the creation of wealth. Moreover, the oil bill of the country continues to grow, tendency that has been registered over the last fifteen years, from less than 10% of export earnings in 2000 to more than 50% since 2008.

3 REVIEW OF THE ELECTRICITY SECTOR IN GUINEA BISSAU

3.1 Summary and Overview

For reasons related to the availability of funding, political instability and weak institutional and human capacities, the efforts made in economic and social development are still far from achieving the targets for the eradication of poverty and socio-economic inequalities in Guinea Bissau. The need for modern energy services (electricity, motive power, modern fuels) are huge at all levels (productive sectors, social sectors, residential). Moreover there is an urgency for the implementation of actions to address the country's overall economic development delay as well as for the eradication of mass poverty.

The positive correlation between population growth and growth in energy consumption is sharp and can be explained by the preponderance of biomass in final energy consumption, due to the level of poverty of the majority of the population and the fact that fuelwood is the only fuel physically available and economically accessible. In contrast, there is no strong positive relationship between the evolution of economic growth (GDP) and the energy consumption, because many industries that do not directly contribute to the production of wealth (GDP) are major energy consumers (Administration, Army, public lighting, etc.).

The strong dependence of Guinea Bissau (non-oil producing country) on energy imports (mainly petroleum products) is an important factor that has negative impacts on the economy, because of the weak positive correlation between domestic energy consumption and the creation of wealth. Moreover, the oil bill of the country continues to grow, tendency that has been registered over the last fifteen years, from less than 10% of export earnings in 2000 to more than 50% since 2008.

3.1.1 Main characteristics of the energy sector

A - Energy Balance

Biomass (wood, charcoal, agricultural and forestry residues) alone accounts for almost 100% of assets in primary energy of Guinea Bissau. The national final energy consumption is also characterized by the predominance of biomass up to 87.8%, followed by 11.7% for petroleum products and electricity for only 0.5%.

In 2010, households accounted for 89% of final energy consumption (all categories), followed by the transport sector (8%), industry (2%) and other sectors (services, agriculture) for 1%. These ratios reflect the very low industrial, agricultural and economic development of the country, and refer to the magnitude of the economic and energy challenges to the achievement of SE4ALL.

B - In the electricity sector

The situation in the electricity sector is characterized by a structurally faulty service, both in quantity and quality due to the obsolescence of production, the disparity of production tools and the high dependence on imported oil in a context of scarce financial resources. Only a small proportion of the population has access to electricity: the national electrification rate was estimated at 11.5% in 2010. This average masks huge disparities between the capital city of Bissau (with 29.1% rate of electrification), the other major cities of the country (with an average of only 4.3% electrification rate), and the rural areas with less than 1% electrification rate.

The hydroelectric potential of Guinea Bissau is high, however only an estimated 33.84 MW hydropower capacity has been identified so far (Saltinho (14MW) and Cussilinta (13MW)) in studies carried out in the 1980's. The production of electricity is mostly thermal and marginally based on new and renewable energy (solar PV and biofuels).

Although extremely rare, the available power in Guinea Bissau has dropped more than 80% in the past years (from 12.7MW in 2003 to 2MW in 2013 for the public sector and from 15 MW to 2.5MW for self- producers over the same period). Since 2000, electricity generation has completely collapsed in this country; at the moment, the available power production is only 2 MW to face a demand constantly increasing, estimated at 30 MW.

Households and household fuels: Final consumption of households is composed of approximately 93% of firewood, against about 7% of charcoal, 0.1% for electricity and 0.2% for kerosene and butane gas (including less than 0.05% for the latter). Less than 0.25% of Guinea-Bissau households (mainly consisting of urban households in the social block called "easy" and located in Bissau city) have access to butane gas for domestic use.

D - New and Renewable Energies

The country has important fields of new and renewable energy (hydro, solar, wind, bioenergy, and ocean energy) undeveloped because of inadequate financial, regulatory and technical capacities.

E - Energy Efficiency

In the energy balance sheet of 2008, the portion of the cumulative energy loss (inevitable and avoidable losses) between the gross supply (983 ktoe) and the energy delivered to the door of the end users (final consumption of 841 ktoe) was estimated at 14.5%.

The efficiency of the use of traditional fuels through the "three stone fireplaces" and "metal braziers" is very low, between 5 and 7% and between 12 and 15%, respectively. Furthermore, traditional methods of charcoal production (through the millstones ground) have very low weight yields (20%) and energy (33%). Thus, the biomass energy sector in Guinea Bissau could significantly improve in terms of the overall efficiency through extension of practices and equipment to improve efficiency in the production and consumption of traditional fuels (dissemination of "Casamance wheels carbonization" of semi-industrial production of charcoal stoves, improved stoves, etc.). As it can be seen in Figure 2 the thermal electric potential amounts to 47.79 GWh, with 12.42 MW installed. EAGB energy production remains the largest, being responsible for 79% of the total country's production and that is concentrated in Bissau. The Production and Rural Electrification Centres (CPER, from the acronym in Portuguese *Centros de Produção e Electrificação Rural*) are responsible for 14% of the total electricity in the country, while auto producers are responsible for 3.34%. These last ones are located both in Bissau and other parts of the country.

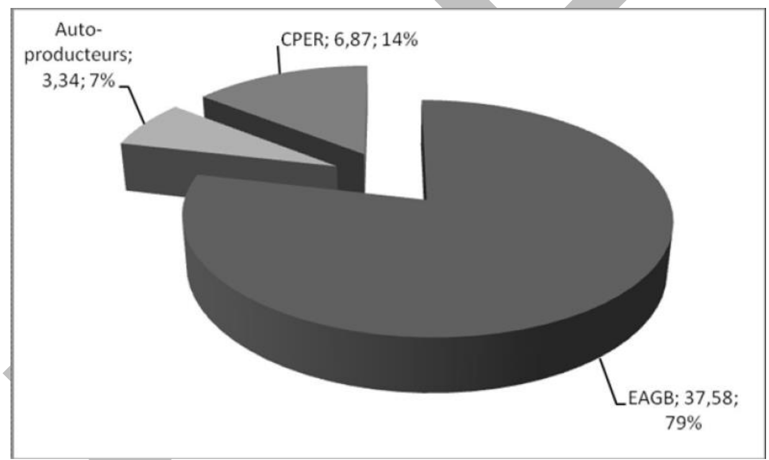


Figure 2: Guinea Bissau Thermal Energy Production (CABIRA-BCP, 2012)

Both the low wage level and the availability of coal at a reduced price, limit the penetration of butane gas in Guinea Bissau, in addition to the psychosis of "gas that kills" and strips traditional flavours of the kitchen fire. As proof, the 2011 socio-economic survey on energies of households revealed that in relation to energy cooking, only 1% of households use gas stove. The same survey indicates that the ability to pay the butane gas would be around 3,815 CFAF per household at the national level, which would be within the prices of a little more than 4 kg of butane per month per household in Guinea Bissau.

3.2 Sector Objectives

The energy sector is an economic and social vocation, a provider of products, services and welfare. It is a transversal sector as it is indispensable for all sectors of socio-economic development. Energy cannot be disassociated from the needs of the population and the national economy, it contributes significantly to human activities, contributing to the improvement of living conditions, particularly in the fields of education, health, access to drinking water and activities generating income.

Energy is present in nature in various ways and subject to further processing and use. It can be found in the form of water, solar radiation, wind movement, heat, oil and its derivatives, biomass, geothermal and electricity. It is vital to the national economy. The correlation between output growth and energy consumption is an important indicator of development. As would be expected, the economic development of Guinea Bissau is heavily dependent on the capacity of producing and delivering energy in sufficient quantity and quality for the socio-economic and productive sectors, including industry, agriculture, mining, livestock, fisheries, education, health and the domestic sector. The energy sector includes the energy raw materials and derivatives, energy sources, production or processing cycles, transport, distribution, marketing, use, energy saving measures, and institutional actors involved, etc. However, with population growth and the expansion of economic activity, the country faces the increasingly need to solve the problem of constrained supply (both in quantity and quality), and it is imperative that the country implements timely measures to ensure sustainable economic development.

The Government of Guinea-Bissau, through the Ministry of Energy, Industry and Natural Resources (MEINR) remains committed to the process of sectoral reorganization, and at the same time, the implementation of the Energy Sector Policy, with major focus in the electricity subsector. One of the constraints that hinders the development of the energy sector is the difficult national/international financial situation marked by scarcity of resources, thus imposing the adoption of new strategies in the energy subsector aimed at:

- Reformulation of the objectives and strategic directions of the government in the field of energy and water;
- Creation of a framework of reference for the intervention of the partners in the context of the reform of the energy sector which opens the possibility of the emergence of new actors, such as public private partnerships (PPPs) in the distribution segment and private sector production of electrical energy.
- Minimize: the inefficient use of energy resources, low people's access level to energy, imbalance between supply and demand, low rate of the country's energy coverage and existence of significant distortions between different areas of the country.
- Creation of conditions for the production and regular supply of the country with different forms of energy in order to ensure the development of activities related to domestic, services and industry sectors.
- Creation of necessary conditions for the rehabilitation of existing infrastructure as well as for their effective management, to ensure the quality of services and sustainable development of the sector.
- Modify the role of the State as it should have the function of defining sectoral and sub-sector policies, to ensure: the update of laws, the creation of relevant institutions, adequate tariff policy, mobilization and control, and further investments for environmental protection.
- Creation of the conditions for the participation of private capital in the development of the sector as well as in the management of public assets.
- Promote alternative energy sources in order to ensure efficiency and energy saving, especially those related to forests and mangroves.
- Promote the production of electricity from the existing water resources, including the Saltinho/Cussilinta hydropower plants and other water sources, provided that the economic costs are reasonable, in order to minimize the dependence of the country on imported energies; and
- Development of sub-regional cooperation, particularly in the context of OMVG (Organization for the Gambia River Development), in order to maximize the benefits of the integrated market and the interconnection with the transmission and distribution of electricity.

These conditions will be created in parallel with the adoption of a policy that reflects the actual costs of operating the infrastructure sector, in order to facilitate the activities that depend on it. On the other hand, the tariff policy should incorporate the factors that can drive and, at the same time, guide the companies or institutions to adopt programs aimed at energy efficiency and cost reduction. These actions should have an impact on penetration and greater accessibility of goods available to disadvantaged consumers as a way to fight poverty. The applicability and efficiency of these measures will be ensured by the implementation of the decisions taken by the Government decree on the liberalization and regulation of sub-fuels, the Electricity Act that determines priorities and regulates the action of the various actors. The energy consumption in Guinea-Bissau is characterized by the almost total dependence of imported petroleum fuels to meet the needs of the transport, industry and lighting. Energy consumption also depends fundamentally on the wood that is used as a domestic fuel to meet the energy needs of the kitchen, the traditional activities of the villages, commercial and craft activities.

The national energy sector has been severely affected in recent times by the difficult economic situation in the country and the energy consumption per capita in the country is about 0.25 toe/year; indicator of the low level of development of the sector.

The means of producing electricity are virtually nonexistent; the government was forced to resort to rental groups that concentrate in Bissau. In the remaining villages electricity production is very uneven, causing the current imbalances between urban and rural areas. Distribution networks and marketing system are scarce for most sectors and villages, a fact that causes great difficulty to farmers with regard to meeting their basic needs, especially in the so-called conventional energy sources (commercial). These difficulties are intensified by the continuous decline of firewood collection areas, mainly in the Northern and Eastern regions of the country.

The effects of drought and climate change, as well as pressure on the environment caused by the production of charcoal needed for domestic consumption and export, have created great difficulties to the people living in the northeast, which are constantly obliged to straddling increasing distances to face energy demand and production activities.

SUB - SECTOR OF ELECTRICITY

Over the last twenty years, only nine urban locations (Bissau, Bafatá, Gabu, Cacheu, Farim, Catió, Bolama, Bissorã and Bubaque) benefited from public investments in infrastructure to produce electricity. The investments made in the field of electrification, from the seventies, are in the order of fifty-five million ($55 million) U.S. dollars (including recent investments in Bissau) for the whole country, with about 30% allocated to Bissau. Concerning the impact of these investments, only 40% of the capital's population enjoys directly or indirectly from this government effort, while in other urban centres, the average is 36.5%. Nationally, the electrification rate is 20%

which means that only one in a group of five people has access to electricity in Guinea Bissau. With diesel power plants completely degraded (only 5.5 MW available), a network of medium voltage (MV) of 135 km and a low voltage (LV) network of approximately 300 km, the EAGB has failed to meet the needs of its 19,000 consumers. The irregular power cuts due to low productivity, inadequate tariff, inadequate methods for revenue collection and poor quality of the product supplied, have caused disruption of social, technical and financial assistance to users. Power cuts due to lack of available power have reached all neighbourhoods of Bissau. Inside the country, despite the relatively recent construction of MV and LV networks in seven urban centres (Project Gazelle, with about 60 km of cables and lines), there are still problems related to technical means of production. These problems are compounded by the difficulty in obtaining spare parts as a result of unavailability of money for their purchase. With low electrification rate and inadequate tariffs, most of the "islands of power" face financial difficulties and lack ability to auto financing, thereby resorting to frequent support from the Government to cover the costs. Despite its nationwide, EAGB created in 1983, has developed its activities only in Bissau for financial reasons. This requires the existence of three modes of administration for the subsector, with all the problems inherent to them, namely:

- Management of public service commercial (in Bissau): EAGB
- Management of public service with the participation of public funds: MERN/SEE
- Management of municipal services (subsidies): local administrations

The different activities planned for both Bissau and other interior centres being materialized in the form of projects shall aim not only to reinforce the capacity and efficiency of production, distribution and sale of electricity but also the improvement of technical and financial management of resources, training and development of human resources available to the subsector.

SECTOR DEVELOPMENT STRATEGY

The strategy that will be put forward for the development of the energy sector in urban and suburban areas will be based primarily on two main principles:

- Consolidation and development of the infrastructure sector, so as to facilitate people's access, the implementation of a policy to reduce energy costs, guarantee quality of service, and sustainable economic development;
- Reorganization / reform of the institutional framework in order to establish, consolidate and separate the role of the state as an entity responsible for the development of sectoral policy and environmental protection, being the other functions assigned to other regulators, management, control heritage and private operators.

The goals of electrification in general and rural electrification in particular require, on one hand, strengthening institutional and operational capacities of the Directorate General for Energy (DGE of the Ministry of Energy and Industry (MEI) of Guinea Bissau, and on the other hand, the creation of a structure (Rural Electrification Agency) for the coordination and development and implementation of strategies and initiatives for rural electrification. The creation of an autonomous body (real and functional structure) regulating, the electricity sector in particular and energy in general, is also necessary for better sectoral governance.

The magnitude of the gap to improve the energy efficiency of biomass energy (firewood, charcoal, agro-forestry residues, biogas, biofuels, etc.) requires the creation of a formal framework for interdepartmental cooperation and coordination as well as the creation and coordination of strategies and initiatives in energy efficiency.

To achieve the objectives of the initiative "Sustainable Energy for All", Guinea Bissau shall ensure the review and adaptation of the main tools of sectoral governance (in the energy and environment sectors, in particular) including laws and decrees related to Forest Code, the Framework Law on the Environment and Electrical Code (in development), so to promote accountability and participation of local communities and the private sector as well as the anchor governance of energy and environment sectors in the issue of poverty reduction and decentralization and empowerment of local and private actors.

To facilitate public-private partnerships and private sector participation (for the mobilization of adequate funding), adjustments will be needed in the investment code (for guarantees and facilities to be granted) and procurement procedures.

All this assumes that the recurring security order and political governance issues are finally resolved.

3.3 Generation Capacity

Since independence in 1973 (40 years) the country lacks a national network of transmission and distribution of electricity, despite the several efforts for its realization. Today it is still one of the biggest challenges this sector faces. However with the prospects of the construction of future dams Kaleta, Sambagalou, Saltinho and Cussilinta and other big plants such as the 15 MW thermal plant in Bôr and the 15 MW solar PV plant and the OMVG network, the country should have a national grid for the transmission and distribution of electricity for its population in the future.

3.3.1 Installed On-Grid Capacity

Currently, the installed capacity in the country that is injected in the distribution network of 6 kV, 10 kV and 220 V is approximately 13.7 MW of which 12.7 MW is from public production of EAGB and 1 MW comes from public plants within the interior of the country. However, the available power is 8.5 MW. Given the difficulties of the country both in the financial, economic, social and political context, the Government was unable to honour its commitments with the production and transport of the electricity to the entire population. Thus individual and collective initiatives have and are emerging in the sphere of production of electricity to meet their needs and the surplus production is distributed through the neighbourhoods through a 220 V network in terrible conditions of safety and sustainability. At present, the country self-producers[2] surpassed the public production and it is estimated that there is nearly 21 MW of installed power according to the investigations conducted recently by Directorate General (DG) where effective production needs are around 30 MW of electricity.

3.3.2 Installed Off-Grid Capacity in Urban Areas

The installed capacity of the electricity network in urban areas of Guinea-Bissau, beyond the installed capacity of the EAGB is in the order of 12.7MW connected to the medium voltage network of 6kV and 10KV. Small self-producers of electricity were identified, which create their own networks for the supply of surplus electricity to the neighbourhoods, being the capacity of these generators smaller than 3 MW.

3.3.3 Installed Off-Grid Capacity in Rural Areas

In rural areas we have to consider:

- The central electricity grid built with Project Gazelle, namely: Bafata, Gabu, Contuboel, XIMES, Bambadinca, BOLAM, Catia, and FARIMA Bissora,
- In the east area of the country a distribution network in 30 kV, with a 110 km length was built including its respective distribution networks in 6 kV and 220 V.

However, despite the effort of this projects, all of them were vandalized (stolen for the use and sale of copper) and are not operating at the moment and thus the installed capacity currently does not exceed 1.5 MW.

3.3.4 Capacity Development Projections

Since independence, Guinea-Bissau had a few major projects in the energy sector, particularly in the electricity sector, starting in the 80's. There were 3 famous projects: Elephant, Gazelle and Mosquito, funded by the Netherlands and the former Soviet Union who financed the construction of power stations. The Gazelle project, funded by BAD, worth USD 8 million dollars, and was used for the construction of electricity networks in 8 villages of the country.

Table 1: Project List

Project Name	Objective	Financing Entity	Amount (in million USD)	Year of execution
Gazelle Project	Construction of grids in 8 villages	BAD	8	1982
***Energia* Project**	Develop different studies: solar, electricity distribution, capacity building and studies related with the productive sector.	WB	2.8	1994
		WB	0.2	
		BEI	8.0	
Scorpion Project	Distribution	AfDB	5.0	
	Production	BADEA	4.4	
KfW	Reinforcement of EAGB electricity production Distribution / electricity grids	KfW	2.7	1993
		KfW	1.4	
		KfW	0.3	
New Plant	Productive Sector		4.2	
Rehabilitation	EAGB Management	FAC	2.2	
PRMI/BM	Institutional development and sectoral studies	WB	1.2	Jun 09-Jan 10
PRMI/BM	Rehabilitation and stabilization of the electricity systems	WB	55.2	2008-2013

[2] The self-producers in Guinea Bissau, produce the electricity for their own consumption and then sell the excess of the electricity to others. The self-producers in Guinea-Bissau are not Independent Power Producers (IPPs) that only produce power to be sold.

Project Name	Objective	Financing Entity	Amount (in million USD)	Year of execution
PRMI/BM	Rehabilitation and improvement of the commercial and financing management system of EAGB	WB	1.2	Feb.09-Jun.12
PRMI/BM	Institutional development and performance improvement	WB	0.02	2013-2013
Construction of the Bôr power plant (55 MW)	Construction of the Bôr thermal power plant: 1st phase 15 MW	BOAD	30	In preparation
Construction of the Solar Thermal Power plant Gardette e Mafanco	Photovoltaic solar plant of 10MW in Gardette, HELIUS – I solar project	Suntroughenergy	28	In preparation
	Photovoltaic solar plant of 10MW in Mafanco, HELIUS- II solar project AC		28	

3.4 Transmission and Distribution

3.4.1 National grid systems

Guinea-Bissau has no transmission lines of electricity, there are currently only electrical distribution networks or grids, starting with a unique and exclusive source: the thermal EAGB Plant and others in the interior of the country. The transmission and distribution of electricity in 30 kV is 110 km long, connecting the eastern part of the country, however it has been vandalized and the copper was stolen (wires) and today only vestiges remain of this ambitious project for Guinea-Bissau.

By not having a proper national grid, the country produces its power through the installed thermal power plants and is transported via underground cables at 6 kV and 10 kV for different arteries of cities or towns, and then distributed through substations placed in almost every neighbourhood and city. Currently, the actual voltage of the grid in Bissau is 6 kV and 10 kV (MV), and 220 V (LV) and the system has a radial configuration, from the source of production directly to the consumers. For the transmission grid, in Bissau, there is an ambitious project under consideration which will involve the development of a ring with three injection points: in the power station, in Bôr and in Antula. The ring will be developed in medium voltage (33.6 kV). The actual grid configuration and the projected ring are shown in Figure 3.

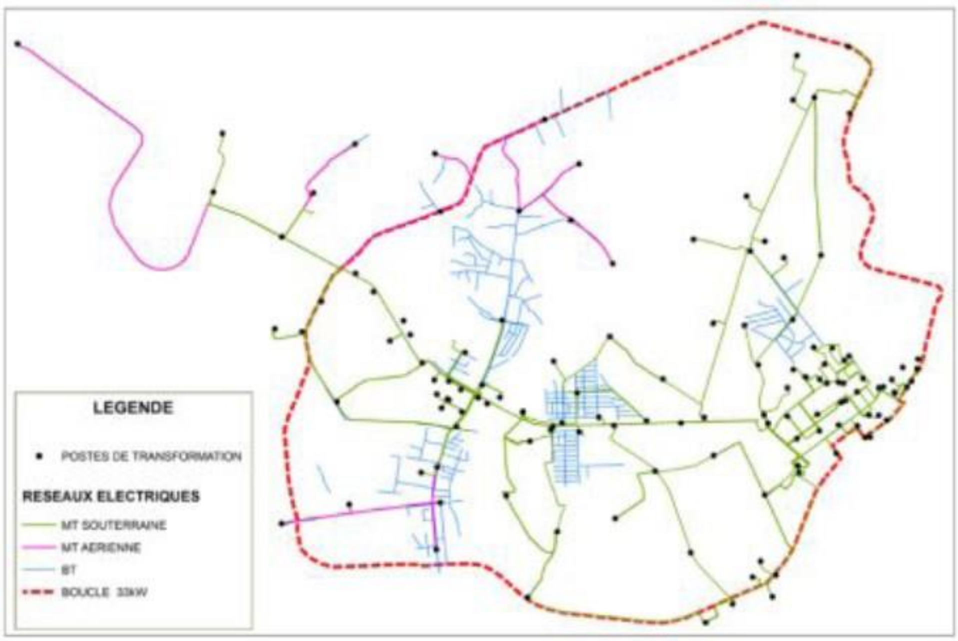


Figure 3: Guinea Bissau future medium voltage ring, 33.6 kV, for Bissau grid

Moreover, and in connection with the regional OMVG project, there is currently a project idea for the construction of the national network, which is illustrated in Figure 4.

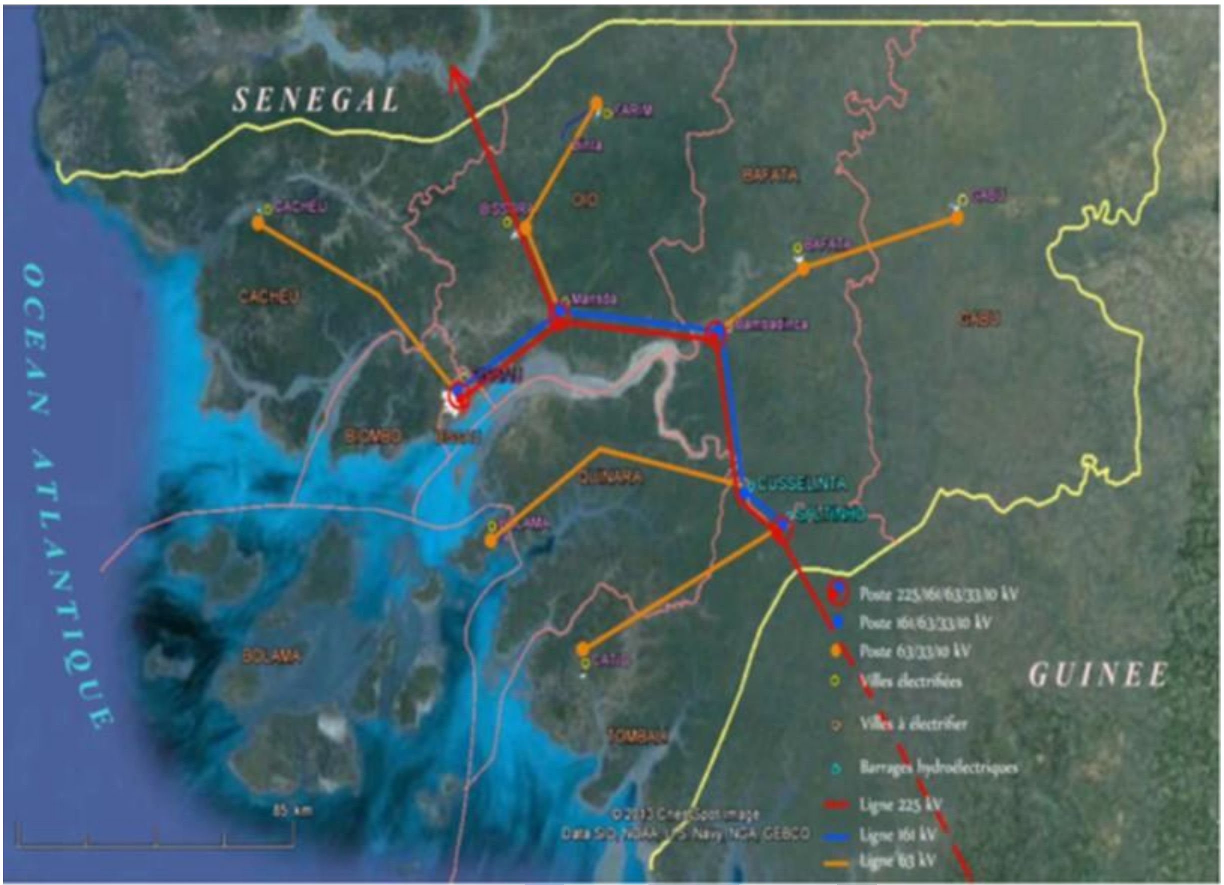


Figure 4: Project idea of the national future grid

3.4.2 Regional Interconnection

Currently there is no regional interconnection, despite the fact that the country is inserted in the sub-regional organizations of electricity interconnection, such as: OMVG (Organisation pour la Mise en Valeur du Fleuve Gambie - Regional Organization for the Valuation of the Gambia River) and the WAPP (West Africa Power Pool), coming from neighbouring Guinea-Conakry, passing through Guinea-Bissau, Gambia and Senegal later (Figure 4), which will be developed in the near future. The value of the OMVG interconnection project is estimated at €946 million, of which the share of infrastructure in the territory of Guinea-Bissau is:

- 1218 km of 225 kV line, conductors ASTER 570 mm² with optic fibre cable security.
- 4 transformation stations 225/63 kV, in Bissau, Saltinho, Bambadinca and Mansoa.

3.5 Energy Balance – Demand and Supply

3.5.1 Electricity Generation Trends

The productive sector of the country is predominantly of diesel based generators that do not exceed 2.5 MW each. Lately some heavy fuel oil based generation sets of 2.5 MW each were installed. Besides the diesel generators, Guinea Bissau has planned a solar photovoltaic power plant of 314 kW for the production of electricity (which will start operation in 2014), as well as some pilot projects for energy cogeneration with cashew shells, whose energy sources or resources are abundant in the country. There are still some projects to be developed in the context of hydroelectric plants, in particular, the OMVG dams and Saltinho/Cusselinta, just to name a few. **Erro! A origem da referência não foi encontrada.** shows the historical electricity production and consumption in Bissau city and **Erro! A origem da referência não foi encontrada.** the installed and available power in secondary centres in 2010.

Table 2: Historical production and consumption of electricity in Bissau

Year	Installed Capacity (MW)	Available maximum power (MW)	Max. power reached (MW)	Energy production (GWh)
2002	12.95	6.12	5.48	15.69
2003	17.51	7.80	4.80	12.09
2004	17.51	7.80	5.30	19.87
2005	17.51	7.80	4.25	16.24
2006	17.51	5.30	4.00	20.44
2007	14.67	2.80	2.60	4.71[3]
2008	14.95	4.35	4.25	12.48
2009	16.07	5.19	3.88	14.49
2010	7.36	4.10	3.89	12.40
2011	10.68	5.80	6.33	32.25
2012	10.68	8.95	6.95	27.49

Sources: DGE, DEPE statistics; EAGB

Table 3: Installed and available power in 2010 in secondary centres

Centre	Installed Capacity (kW)	Available Power (kW)	Year of installation
Bafatà	790+450	1240	1980 and 2010
Bissorã	200	200	2001
Bula	220	220	2001
Bubaque	400	0	2008
Cacheu	350	350	2009
Canchungo	200+530	730	2009
Catio	400	0	b)[4]
Farim	530+220	0	1999 and 2009
Mansoa	150	150	2003
Quinhamel	150	150	2001
Gabu	350 + 150	500	2010

3.5.2 Electricity Consumption Trends

The trends for the consumption of electricity in Guinea-Bissau are growing and are worrisome given that what is produced, despite the investments in the sector, is insufficient to meet the demand. Following the experience of thermal generation in Guinea Bissau, the supply of electrical energy is structurally and chronically insufficient or deficient. The national Programme for Energy Production (PPE) indicates the installation in Guinea Bissau of four units of 45 MW each, 11.25 MW each year to meet demand with a reserve of 12%. This strategy is true for the Optimistic Scenario, and therefore remains optimal. In this view, it is proposed two (2) production variants: (i) units operating with fuel and (ii) gas turbines. It is said that with gas turbines, there are still opportunities to apply combined cycles, which is an advantage for future developments. In the Pessimistic Scenario, the power requirement is less than 50 MW in 2025. In this view, BOAD projects (15 MW) and OMVG (35 MW) may be sufficient, which complement the existing sources of production (5 MW).

[3] Refers only to the first 3 months (January, February and March)

[4] b) this value is not available due to lack of DGE resources to perform statistics

For the electricity demand for both energy consumption and peak power requirements, it is considered two (2) scenarios already developed in the study on energy needs, namely the Realistic Scenario and the Optimistic Scenario. Thus, according to the Realistic Scenario:

- The rate of growth of electricity demand at the national level is 7%.
- The national power needs are 166 GWh in 2012 to 391 GWh in 2025.
- In the capital Bissau, the projected peak demand would increase from 31 MW in 2012 to 72 MW in 2025 and the power generation requirements increase from 101 GWh in 2012 to 138 GWh in 2017.
- The national peak would increase from 54 MW in 2012 to 125 MW in 2025.

In the Optimistic Scenario:

- The total energy consumption of Guinea -Bissau increases from 168 GWh in 2012 to 506 MWh in 2025.
- In Bissau, it is estimated that electricity consumption will increase from 101 GWh in 2012 to 153 GWh in 2017, amounting to 301 GWh in 2025.
- Peak demand in Bissau is estimated to increase from 32 MW in 2012 to 93 MW in 2025.
- The national peak demand is projected to increase from 55 MW in 2012 to 160 MW in 2025.

3.5.3 Electricity Imports/Export Trends

Guinea-Bissau does not import nor exports electricity. However in the future it is expected to start importing through regional agreements such as the OMVG, and if the country builds hydroelectric plants on the Corubal River or mini-hydropower plants it will be even able to start exporting electricity to the sub-region.

3.5.4 Peak Hours, Power Cuts and Load Shedding

Normally the peak hour starts at 6 PM; a fact that explains why the consumption of electricity is almost entirely domestic and the absence of industries. If there are small factories, hotels, trading companies or embassies their electricity needs are supplied by independent generation sets since the EAGB is not able to honour their commitments and provide a regular supply during the 24 hours. The company EAGB never reached a regular supply of electricity to their customers, and then obviously power cuts exist very frequently as there is insufficient capacity to meet the demand. Reasons for the power cuts are: financial situation of the company, the lack of liquidity, lack of maintenance and lack of fuel supply.

The shape of the load curve, shown in Figure 5, can be described as follows:

- 0 H - 5 H: a hollow is registered;
- From 5 H - 9 H: morning low load connected at dusk and morning freshness;
- From 9 am to 17 H: increase in expense related to the industrial, administrative and service (with air conditioning);
- From 17 H - 20 H: relative decrease in load due to the closure of administrative services;
- From 20 H - 0 H (midnight): highest load for lighting and air conditioning.

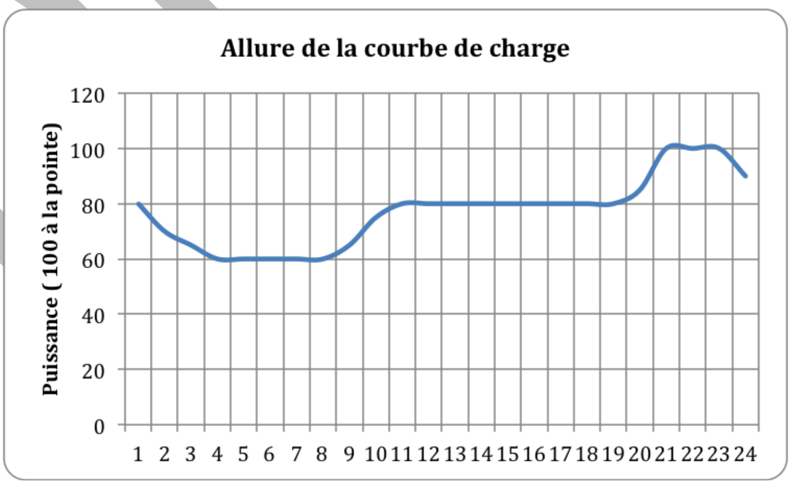


Figure 5: Daily load curve

3.5.5 Technical and Commercial Losses

In recent years there has been a considerable improvement with respect to losses due to improvements made to both the production system, transportation and commercial systems. In the past, losses were in the order of 45% and now they are around 25.5%. However, this is still something very important to be solved. The following table summarises the technical data of the production and commercialization of electricity of EAGB in 2012.

Table 4: Technical data of the production and commercialization of EAGB/2012

Technical Data	Unit	Value	Observation
Electrification rate	%	5.6	-
Installed production capacity	MW	11	-
Peak demand	MW	30	-
Production	MWh	26,579.73	-
Losses (total)	%	25.5	-
Transport losses	%	2.0	Distribution Medium Voltage (MV)
Distribution losses	%	5.0	Distribution Low Voltage (LV)
Technical losses	%	7.0	Distribution MV and LV
Non-technical losses	%	25.5	Commercial

3.6 Electricity Consumers

Over the years there has been a slight growth of consumers connected to electricity and water company of Bissau (EAGB), which experienced an improvement in 2010 due to the emergency program of Guinea-Bissau in relation to the energy sector, particularly in relation to the productive sector, funded by ECOWAS (Economic Community Of West African States) and UEMOA (Union Économique et Monétaire Ouest-Africaine) for 10 million euros for the acquisition of fuel and generator sets. It is relevant to point out that some costumers are supplied by independent generators. This is for example the case of the customers in the city of Gabu which over the years have been supplied by the Guinean ELECTROSOLAR company that provided electricity to 520 customers. Moreover other cities worked with self-producers and community managed systems.

Table 5: Client data - EAGB

Years	2008	2009	2010	2011	2012
Consumers	18 756	18 369	20 866	21 789	21 840
Client with meters	14 997	15 136	17 905	18 902	18 953
Retainer costumers	3 759	3 233	2 961	2 887	2 887

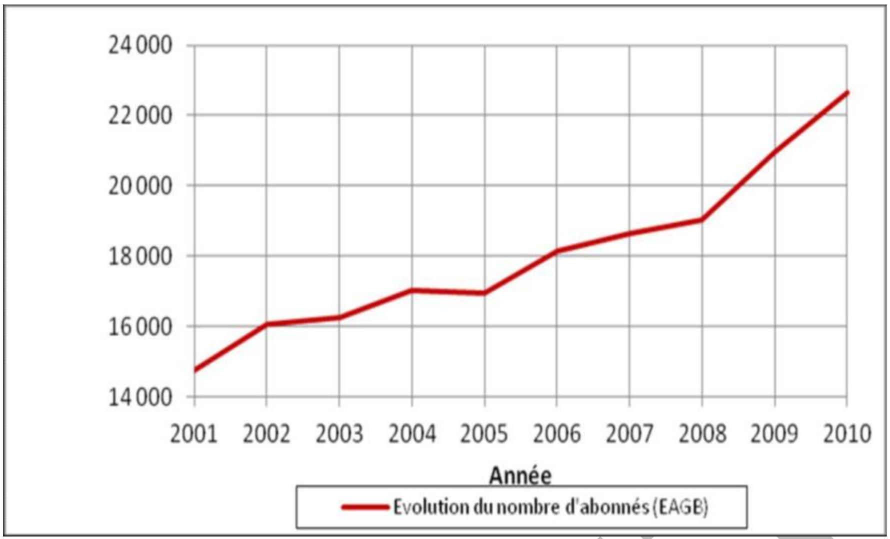


Figure 6: EAGB clients evolution - CABIRA/Plano Director

3.6.1 Electricity Access in Urban and Rural Areas

The rate of access to electricity in the country varies somewhat in view of the precarious situation of the electricity production in the country.

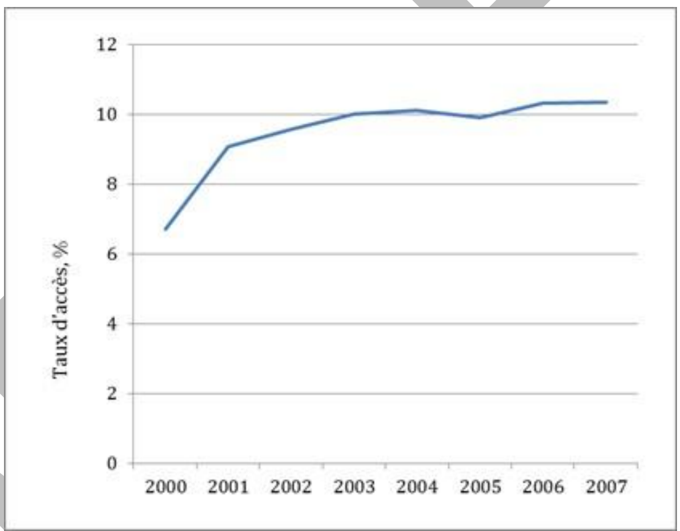


Figure 7: Electricity access rate. Reference year 2006. SIE-GB

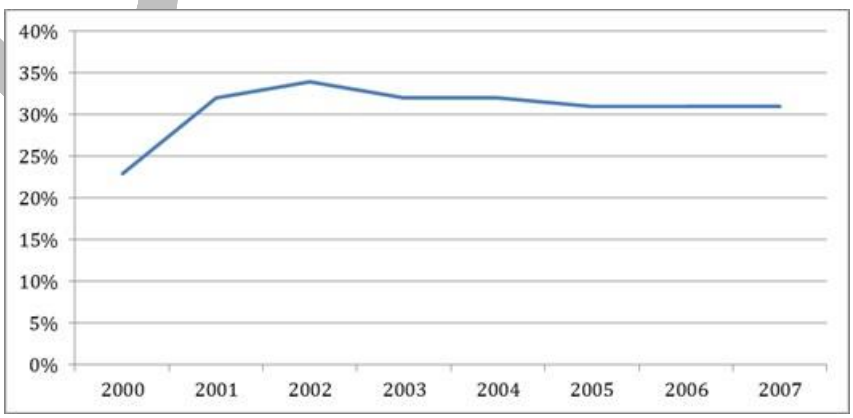


Figure 8: Bissau electrification rate. SIE-GB, reference year 2006

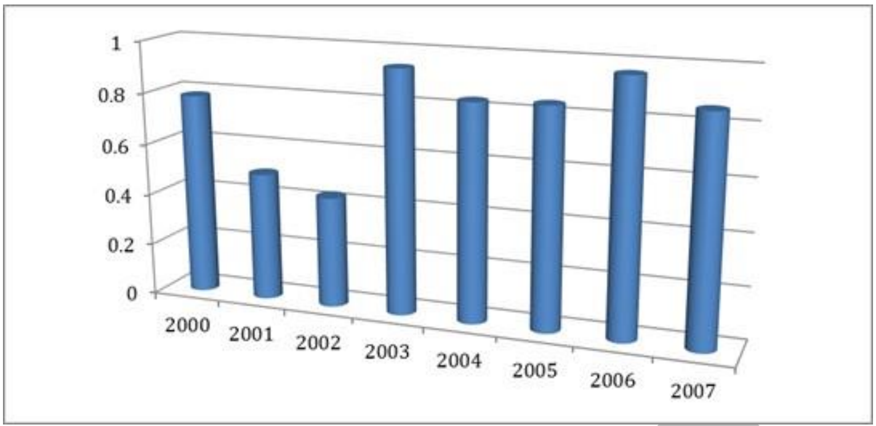


Figure 9: Rural areas electricity rate SIE-GB, Reference year 2006

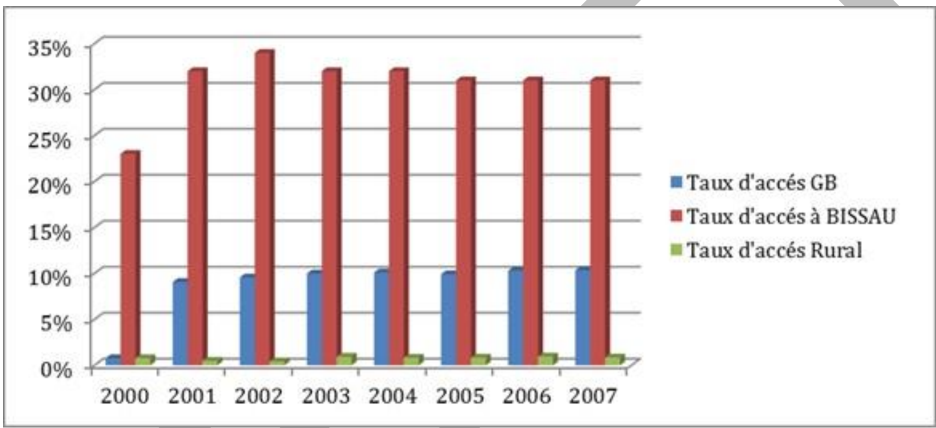


Figure 10: Comparison between different access rates, SIE-GB, reference year 2006

Note that the electrification is far from being resolved, then one of the ways to solve this issue is by including decentralized rural electrification projects with renewable energy systems. The country must embrace renewable energy projects through programs in order to revolutionize the subsector.

3.6.2 Willingness and Ability to Pay

Since its independence, the country has not experienced good times in production and consumption. There has always been demand for electricity where the balance that can be done between demand and supply, demand always outstripped supply. In Guinea Bissau much poverty is present, people live below the poverty line with less than 1 USD per day. Despite the poor population, Guineans always have in their minds the advantages of having electricity and there is always an interest in paying for electricity, provided it exists. Actually, the public company (EAGB) never provided electricity to 100% of their customers and thus there has been proliferation of self-producers that are selling electricity at more than 1 Euro/kWh (in certain locations customers are able to pay around 50,000 CFAF above the minimum wage). It is also relevant to highlight that these self-producers' customers are required to make/pay for their own connection that can sometimes cost more than 100,000 CFAF, depending on the distance. Furthermore, it is also significant that these self-producers don't have a permit for the sale of electricity and are not controlled in terms of the tariffs that they charge, as laws and supervision of that in the subsector do not exist.

3.7 Costs of Energy Provision

The costs of energy provision were estimated under the tariff study that is being carried out by IDEA. The study revealed that the status quo scenario is the situation of stable rates, which are in force since 1997. In this scenario, it is assumed that the average rates for the year for different categories of customers remain stable at their respective levels of 2010: 338 CFAF/kWh for residential customers, 232 CFAF/kWh for business customers and 137 CFAF/kWh for water pumping. In this case, and considering the continuation of the current situation, the average selling price of electricity would drop from 284 CFAF/kWh in 2014 to 247 CFAF/kWh in 2018, and then remain stable at 247 CFAF/kWh until 2020[5]. In this status quo scenario, EAGB would have positive results, in respect to the conditionality for the two financial criteria considered in this tariff study (the ratio of debt coverage and the rate of return on equity). Within this scenario, the study revealed that cash is always negative and would reach a low of around -5.5 billion FCFA in 2017 and, because the investment with a share of 20% is financed by equity effort, but especially the sharp increase in working capital requirements, following strong growth in activity. The study also revealed that EAGB may reduce its capital requirements using an advance on consumption and encouraging the prepayment. With a sound financial position, EAGB may also obtain short-term loans to finance stock. The resulting turnaround, compared to the situation observed in recent years, can be explained simply by the following assumptions:

- Fuel Consumption: it was detained a 50% allocation in DDO and 50 % in HFO in 2014, that will evolve gradually to 20% in DDO and 80% HFO in 2020, whereas in the past the consumed fuel was essentially the DDO. Note that fuel purchases account for nearly 56% of charges
- Annual operating and HFO costs 17 % less than the DDO.
- Retirement of 26 % of staff after payment of debts and reducing social personnel expenses in the same proportion.
- Strong growth in activity that would better absorb fixed costs (personnel costs, depreciation and amortization, foreign service, financial charges, etc.).

In conclusion, the current rates would prove high enough to ensure the financial autonomy of activity in the context of these assumptions. Nevertheless, the tariff structure should be revised based on the results of the analysis of the fee schedule (Part D of the tariff study) and marginal cost pricing study that follows (a study that will follow the tariff study that is being conducted).

3.8 Electricity Tariffs

One of the biggest challenges that the sector has is the adjustment of the commercial rate so that it corresponds to the inherent cost of production. The tariffs set in 1989 are still in effect, which does not take into account the cost of production. Currently a tariff study is to be carried out.

3.8.1 Current

The following figure shows the tariffs currently in place in Guinea-Bissau.

[5] This will be due to the fact that in 2018 the Kaleta hydropower Project developed under the regional OMVG project and the 15 MW with HFO will start operation; as well as due to the expected improvement in the transmission and distribution lines (improvement of the technical and commercial losses).

Table 6: Current electricity tariffs in Guinea Bissau

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Les tarifs en vigueur :

Tarif	Unité	Prix CFA
ELECTRICTE		
Tarif normal (usage général)		
BT Tarif Normal		
Prime fixe en monophasé/mois	Point de livraison	3 649
Prime fixe en tri phase /mois	Point de livraison	21 892
1ère Tranche < 200 kWh / mois	kWh	128
2ème Tranche > 200 kWh / mois	kWh	245
MT Tarif Moyenne Tension		
Prime fixe par KVA installé/mois	KVA	5 838
Active heures pleines	kWh	128
Option Active heures creuse (0 à 8)	kWh	102
Réactive < 0.75 Active	kVARh	38
Tarifs spéciaux		
BT Tarif Social		
Prime fixe / mois	Point de livraison	920
1ère tranche < 50 kWh	kWh	81
2ème tranche 50 à 200 kWh	kWh	161
3ème tranche > 200 kWh	kWh	322
BT Tarif Entreprise et Commerce		
Prime fixe en monophasé/mois	Point de livraison	41 388
Prime fixe en tri phase /mois	Point de livraison	197 042
Active heures pleines	kWh	161
Option Active heures creuse (0 à 8)	kWh	129
Réactive < 0.75 Active	kVARh	48
EAU		
Prime fixe / mois	Point de livraison	591
Tarif forfait < 30 m3 / mois	M3	131
Tarif forfait > 30 m3 / mois	M3	205
1ère Tranche < 30 m3 / mois	M3	131
2ème Tranche > 30 m3 / mois	M3	205
Bornes fontaines	M3	131

3.8.2 Projections

3.8.2.1 Analysis of the current tariff system and potential for tariffs modification

The analysis of the current pricing system has led to the formulation of proposals for its improvement and restructuring, which are the following:

1) Definition of a “slice”/category of consumption for low-income clients: this slice should correspond to "economic concern customers” subscribing to a maximum power of 1 kVA and consuming up to 50 kWh per month. If the customer exceeds in a given month the 50 kWh then he will be charged for that month the price of the higher slices/tariff categories. It goes without saying that the customers benefitting from the social tariff of that subscribe for more than 1 kVA lose the benefit of the first instalment.
2) Set a price for all the other low voltage customers regardless of their nature and consumption. This rate will be paired with a charge per kVA power subscribed and price of energy. The corollary for the definition of the charge unit and single output for low voltage (LV) customers is the abandonment of all existing fixed premiums.
3) Set a price for medium voltage hourly positions with:

    a. Two time positions tariff by reference to the load curve;

    b. A fee of power related to the contracted power.

4) Include a contractual clause in the sales contract and the MV Business and Commercial client specifying: the contracted power (LV customers under Normal and Social categories will be controlled by the limit of powers available to them by the circuit breaker or electronic counter) and the ways of charging power if demand exceeds the contracted one.
5) Follow the call of real power by the customer, with a counting system with a "maximum" indicator or recorder power for wholesale MT customers. Any excess of the contract power should lead to billing of a penalty.

6) Return the tangent (phi) to 0.6 instead of 0.75 (passage cos (phi) 0.8 to 0.85). This action will charge more reactive energy or encourage customers to equip themselves with compensation means. In this way, the price of kVARh is corrected as follows:
   - 31 FCFA/kVARh for LV customers;
   - 26 FCFA/kVARh for MV customers.

   Lower tariffs will be far outweighed by the amount of energy charged (or the gain performance of the electrical system in case clients equipped with compensation means).

Financial Analysis

A financial study was carried out to determine the magnitude of the financial needs of EAGB, given operating forecasts and necessary investment. To do this, beyond the necessary financial stability, which is the fundamental constraint to comply with any business; two major financial criteria were considered in this analysis: the ratio of debt coverage and the rate of return on equity. Other criteria considered in this study were: a service coverage ratio of at least 1.5 debts and a return on equity of 6%.

A financial projection model was developed for the purpose of financial analysis. The model allows for the projection of state results and projected balance sheets for the next seven years (2014 - 2020), therefore calculating the financial indicators above referred. The simulations made with the model showed that the current rates are generally high enough to ensure the financial autonomy of the activity under the assumption, i.e. EABG activities.

3.8.2.2 Proposed implementation schedule for the new tariff system

A) Preparation Phase

- Provide adequate and calibrated recording equipment for all clients to record the energy (installations of electronic meters);
- Installation of a metering system capable of recording consumption by item and time of the day for customers subscribing to tariffs with different schedules positions.

Once these conditions are met, it is proposed to move to a first transitional stage overhaul of the tariff system as follows:

B) First Phase:

1. Apply a social tariff for low-income population keeping the current rate of 81 FCFA/kWh with a charge related to the subscribed power of 1,500 FCFA/kVA/month, enclosing the following:
   - Calibrate the maximum power 1 kVA ;
   - Define a single block of 50 kWh per month.

   If the customer's usage exceeds 50 kWh per month for a given month will be charged according to Normal rate with the application of the levy power of the tariff for the month in question.
2. Merge the two rates LV Normal and Social LV in one tariff rate called LV Normal (or General) and discards the concept of Single and Three Phase. For this category the tariff will be the following:
   - Energy Price: 125 FCFA/kWh for consumption between 0-200 kWh and 245 FCFA/kWh for consumption higher than 200 kWh;
   - Power Charge: 1,500 FCFA/kVA/month
3. Create a category for LV Business and shops as follows (with reference of discarding of phase or single phasing):
   - Energy Price: 170 FCFA/kWh which is an intermediate level between the current rate (161 FCFA/kWh) and the marginal cost (180 FCFA/kWh);
   - Power Charge : 3,000 FCFA/kVA/month;
   - Reactive Energy: 31 FCFA/kVARh.
4. Fix the rate MV as follows:
   - Energy Price: 139 FCFA/kWh equal to the marginal cost at peak (noting that the average cost of fuel rises to 129 FCFA/kWh).
   - Power Charge: 6,000 FCFA/kVA/month
   - Reactive Energy: 26 FCFA/kVARh

Thus, the new fee schedule in the transitional stage will look like depicted in Table 7.

Table 7: Tariff for the 1ª Phase (Source: Tariff Study IDEA)

	Cost of Energy (FCFA/KWh)	Cost of Reactive Energy (FCFA/KVArh)	Power Charge (FCFA/month)
Low Voltage (LV) Social tariff			
Uniform Category, 0-50 kWh	81	-	1,500/kVA
Low Voltage (LV) Normal tariff			

1st Category: <200 kWh	125	-	1,500/kVA
2nd Category: >200 kWh	245		
Low Voltage (LV) Companies and Commerce			
Uniform tariff	170	31	3,000/kVA
Medium Voltage (MV) Tariff			
Uniform tariff	139	26	6,000/kVA

C) Second Phase

Carry out assessments on the tariff structure introduced and once the necessary data is made available determine the impact on society as well as the customers. After that introduce the proposed second changes to the tariff structure:

- Maintain the same Social Tariff with energy prices of 81 FCFA/kWh and a fixed fee of 1,500 FCFA/kVA/month for consumption of less than 50kWh and a maximum capacity of 1 kVA;
- For normal LV rates, economic logic suggests that marginal cost is charged uniformly at 182 FCFA/kWh with a fixed premium of 1,500 FCFA/kVA/month. Since this would result in a significant impact for small consumers (less than 200 kWh/month consumption) it is proposed to increase the tariff of the category 0-200 kWh, while reducing the rate of upper middle. As evolution must be gradual, the tariff can first start at 140 FCFA/kWh for the 1st Category and at 230 FCFA/kWh for the 2nd category under the LV Normal Tariff. This will be translated into an increase in energy prices by 12% for small customers (consumption less than 200 kWh/month).
- For LV customers (Companies and Commerce), the following pricing positions should be charged:
    - Energy price: 155 FCFA/kWh in plain hours and 304 FCFA/kWh in peak hours;
    - Power Charge: 3,000 FCFA/kVA/month;
    - Reactive Energy: 31 FCFA/kVARh.
- For MV customers apply the following tariff:
    - Energy price: 139 FCFA/kWh in plain hours and 255 FCFA/kWh in peak hours;
    - Power Charge: 6,000 FCFA/kVA/month;
    - Reactive Energy: 26 FCFA/kVARh.
- For possible future High Voltage (HV) customers, apply the following tariff structure:
    - Energy price: 130 FCFA/kWh in plain hours and 224 FCFA/kWh in peak hours;
    - Power Charge: 9,000 FCFA/kVA/month;
    - Reactive Energy: 26 FCFA/kVARh.

Thus, the new fee schedule for this second phase is the one shown on the following table.

Table 8: Tariff for the 2nd Phase (Source: Tariff Study IDEA)

	Cost of Energy (FCFA/KWh)	Cost of Reactive Energy (FCFA/KVArh)	Power Charge (FCFA/month)
Low Voltage (LV), Social tariff			
Uniform Category, 0-50 kWh	81	-	1,500/kVA
Low Voltage (LV) Normal tariff			
1st Category: <200 kWh	140	-	1,500/ kVA
2nd Category: >200 kWh	230		
Low Voltage (LV) Companies and Commerce			
Peak Hours	304	31	3,000/ kVA
Plain Hours	155		
Medium Voltage (MV) Tariff			
Peak Hours	255	26	6,000/kVA
Plain Hours	139		
High Voltage (HT) Tariff			

Peak Hours	224	26	9,000/kVA
Plain Hours	130		

It is important to refer that in the tariff study conducted by IDEA the cost of the energy produced in the solar photovoltaic project Helius I (being developed by Suntroughenergy) estimated at 0.29 USD/kWh was considered. However to integrate the cost of OMVG the tariff study needs to be updated. The following table summarises the scenarios considered in the tariff study. As it can be seen the former predicted tariff of 38.92 FCFC/kWh corresponds to the second scenario presented.

Table 9: Different scenarios considered in the tariff study

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Tariff in the injection point	Production (CFAF/kWh)	24.23	28.35	25.39	23.58	19.96
	Transport (CFAF/kWh)	9.84	10.57	8.60	7.21	5.79
	Total (CFAF/kWh)	34.06	38.92	33.99	30.79	25.75

3.9 Cross-cutting issues

3.9.1 Links to non-electricity sectors (e.g. cooking, water heating)

In other sectors, Guinea Bissau has the highest prevalence of consumption of firewood and charcoal for cooking, for making bread and cakes (pastries). Indeed biomass accounts for 87% of energy consumption in the country, and in the residential/domestic sector biomass represents 99.3% of total energy consumption (firewood and charcoal).

Despite hospitals and hotels, not much energy is used for heating the water, since it is tropical/warm country, and thus not so much hot water in used in Guinean's homes. To face hot water demands, some hospitals have installed solar collectors for heating water, e.g. Raoul Foulerou hospital where they have installed 6 x 200 litre solar thermal system.

3.9.2 Gender Analysis

The problem began to be seen as an important catalyst for development because gender issues normally lie on home service, mainly in the kitchen, in search of firewood and coal. However today in the country the primarily responsibility for the trade of firewood and coal is of the commercial sector, and with the women only lies the task of educating children.

In Guinea Bissau many girls and women have been trained in the installation and maintenance of solar systems through projects such as India, Brazil and South Africa (IBSA), TOSTAM where they take over the management of installed systems. They are managing as well the water points of PRS I and PRS II Project. Moreover women were trained in the art of confection of cookers and improved stoves, they are working with clay for the ADPP improved stoves, and they are chairing the Community Development Association of Bambadinca (ACDB), which will then manage the TESE PV Plant. Thus, the gender issue in the energy sector is gaining space and scale.

4 INSTITUTIONAL AND REGULATORY FRAMEWORK

4.1 Summary

Up to now, there are few regulations, incentives or legislative framework that support the use of renewable energy (RE) in Guinea-Bissau (see Table 10). It is planned to create regulations that allow private operators to get involved in rural electrification, thus offering opportunities for the utilization of RE. The most critical technical barrier is the lack of accurate data on available RE resources (REEGLE, 2012). There are however, plans, programmes and strategies tending to increase the utilisation of renewable energy, which make a very important "first step" in Guinea Bissau towards the achievement of a more sustainable development scenario in the future.

4.2 Existing Policy, Legal and Regulatory Framework

The following table briefly describes those policies and regulations that are currently in force and that have either a direct or indirect implication towards renewable energy development in Guinea Bissau.

Table 10: Policy, legal and regulatory framework

Strategies, Policies and Regulations in force	Description
Official Bulletin, nº18, May 19th 2004 – National Environmental Management Plan (TESE, 2010)	Within the Specific Objectives of the Plan that focus on "Preservation, Protection and Conservation", para. #9 states that it is necessary to develop actions that allow for a rational use of natural resources, and preserve the endangered biological resources.
Decree Law nº 2/2007, June 29th, 2007 – Determines the structure of the energy sector, its organization and the principles applicable to different forms of energy	This Decree-law foresees actions related with RE: the use of diversified sources and forms of energy in the country (Article 2c); the creation of a favourable environment for the utilization of traditional and RE sources (Chapter II, Article 4 e)); the encouragement of private development and exploration of sources of energy (Chapter III); that the development of forms of energy should preferably be through RE (Chapter III, Article 12.2); promote investments in RE and in clean energy (Articles 16 and 17). This decree-law also defines RE as the resources that exist naturally and are renewable by nature continuously (geothermal, biomass, solar, wind and hydro)
Decree Law nº 3/2007, June 29th, 2007 – Regulates the generation, transmission and distribution, import and export of electricity in the country. (TESE, 2010)	This document states that the electricity sub-sector is overseen by the government agency that is in charge of the Energy sub-sector, that is, the Ministry of Energy and Natural Resources, which is supported by the General Directorate of Energy and is responsible for: i) definition of the sub-sectoral policy; ii) management and development of domestic energy resources; iii) arbitration and coordination of investment selection and oversight of studies, iv) preparation of the legislative and regulatory framework; iv) information and public awareness of the sub sector, v) technical inspection of the exploitation of resources, of the workers and of the safety conditions.
Statement for the Domestic Energy Development Policy in Guinea-Bissau (2005) (TESE, 2010)	The objectives of this document are clearly focused on the energy issues the country faces and therefore renewable energy can play a role in solving them. The general objectives of the policy are: i) Ensuring the domestic fuels' supply for urban and rural households, based on a participatory, integrated and sustainable management of the natural resources of the peasants' territory, modernizing and accelerating the replacement of wood trade, ii) improve the living conditions of rural and urban populations by means of developing modern technologies and activities that generate jobs and income; iii) Strengthening coherence, coordination and effectiveness of actions and develop the operational capacity of public, private, local actors in the implementation of activities to modernize the domestic energy sub sector.
Poverty Reduction Strategy (2005) (TESE, 2010)	Amongst the several objectives this strategy aims at achieving, the ones related to energy are "promote economic growth and the creation of jobs" and "increase access to social services and base infrastructures", which involve i) improving the energy production, distribution and management, rehabilitating the infrastructure of production and distribution, promoting a new tariff system with the introduction of "prepayment" ii) promoting and developing renewable forms of energy (solar and wind), through research activities aimed at developing an internal technological capability based on exploitation of local energy resources, (iii) increase the national coverage, (iv) promote the reform and institutional development of the sector through the adoption of a national electrification plan taking into account the national and sub-regional potential.
Energy Master Plan and Plan for Infrastructure Development for the Production and Distribution of electricity in Guinea Bissau (CABIRA-BCP, 2011)	These plans are currently under development. Several assessments and reports have been done on behalf of the Government of Guinea Bissau. These will serve as the base for the development of both plans that the Government will release. They involve carrying out the following tasks: - Data collection - The energy balance - Predicting energy needs - The study of the energy potential - Study of different scenarios. - The preparation of a development plan for domestic and alternative energy. - Financial projections. - Training of local stakeholders on the software that will be delivered.
COOPENER **(TESE, 2010)**	It is a program developed under the Intelligent Energy Europe programme, which aims at capacity building and training in the energy sector in developing countries. In this context two projects integrating Guinea Bissau were developed. The first one is Energy to alleviate poverty

	in the Sahel (IE4Sahel), which aims to build and strengthen the capacity of the Center for Research and Training in Energy and its role in fighting poverty. The second project, International Network for Sustainable Energy Access (RIAES), aims to alleviate poverty by improving and increasing the knowledge of experts in French-speaking countries of sub-Saharan West Africa.
National Strategy and Action Plan for Conservation and Sustainable Use of Biological Diversity (MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT, 2008)	It was passed on by the government on the 23rd April of 2004. This policy instrument sets out the national guidance and thematic areas for national intervention related to conservation and sustainable use of biological diversity within the framework of the implementation of the Convention on Biological Diversity. The following has been set out as national objectives by the Plan: protection of ecosystems; tree plantation and reforestation, optimisation of water resources, use of energy sources, fight against soil, coastal and estuarine erosion and strengthening of civil society participation through environmental education and training. The Plan also intends to strengthen the capacity for intervention of central and regional public administration in order to face the main environment related problems as well to systematic gathering and dissemination of the information that may serve as the basis for advancing the knowledge on the country. This is geared to find adequate solutions for issues relating to urban environment as whole.
Agriculture Policy and Development Document (MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT, 2008)	The Agriculture Policy and Development Document, passed in 1996 but revised in 2002, establishes the strategy and priorities in the field of agriculture production and research and it stresses the need for application of technological innovations without compromising the conservation of the genetic heritage of the country.

4.3 Institutional Framework and Players

Although the government of Guinea Bissau has no specific “regulatory or legislative framework in Renewable Energies”, it has included renewables in its “Poverty Reduction Strategy Paper (PRSP)”. The government of Guinea Bissau sees the promotion and development of Renewable Energies as an important factor for the development of the country. Renewable energy is also mentioned in the official gazette (Boletim Oficial da república da Guiné-Bissau número 26) as an area that the government and, more specifically the directorate of energy, needs to promote (SNV, 2011).

The government’s Ministry of Energy, Industry and Natural Resources (MEINR) regulates the electricity industry. The government intends to create a rural electrification agency and a regulatory commission. The MEINR is also responsible for regulation of the oil sector, the delivery of import and export licenses for all types of energy products and technologies, and for setting the monthly-reviewed electricity tariff structure. (REEGLE, 2012).

5 BASELINE PROJECTION OF GREENHOUSE GASES

Guinea Bissau ratified the UN Framework Convention on Climate Change on 27 October 1995. Guinea Bissau has submitted 2 national communications to the UNFCCC. The First Communication was submitted on December 1st, 2005 by the Ministry of Environment. The Second Communication was submitted on October 29th, 2011 by the same entity.

Several reforestation activities, rehabilitation of degraded lands, management of natural resources were carried out in order to fight the effects of climate change. It is therefore in this line that the country continues to support the principle of joint responsibility, but differentiated by encouraging each part of this process to assume its historical responsibility with regard to GHG emissions. It worth mentioning that the country is in the process of integrating the issue of climate change into strategies and policies for national development, which is one of the steps towards achieving of the Millennium Development Objectives, which is a lever to ensure a sustainable progress (Secretary of State for Environment and Sustainable Development, 2011).

According to the 2nd National Communication (2011), the total emission of CO_2 was estimated at 3,780.81 Gg of CO_2, of which 156.81 Gg CO_2 comes from the energy sector (4%) and 3,623.99 Gg CO_2 from land use change and forestry (96%). Emissions from land use change and forestry are compensated by absorption from the evolution of biomass *stocks* in forests and other woody formations and abandonment of farmed land for natural regeneration.

The 1st National Communication (2004) took as reference year 1994. In 1994, it was evident that CO_2 emissions represented about 91% of all GHG emissions in Guinea Bissau, and it was originated mainly by the energy sector, due to the consumption of liquid fossil carburant (oil derivate), from the forest’s biomass (wood and charcoal burning). Meanwhile, it was the agriculture and animal husbandry sectors that registered the largest emissions of CH_4 (93%), N_2O (100%), CO (98%), and NO_X (79%), in spite of the insignificancy of the registered values for N_2O and NO_X. (Secretary of State for Environment and Sustainable Development, 2004).

The informed emissions and sequestrations in both communications are:

Table 11: National Inventory of GHG Emissions in Guinea Bissau

Communications	Total GHG emissions and sequestration			
	CO_2 (Gg)	CO_2 sequestration (Gg)	CH_4 (Gg)	N_2O (Gg)
1st National Comm. (2004)	1,359.88	11,391.02	31.84	2.73
2nd National Comm. (2011)	5,780.07	3,623.99	107.53	4.24

6 RENEWABLE ENERGY STATUS, POTENTIALS AND OPPORTUNITIES

6.1 Summary

There are four renewable energy sources available in Guinea Bissau: solar photovoltaic, biomass, wind and water energy (both in terms of applying traditional hydroelectric plants or ocean (tidal) energy plants). Solar photovoltaic (PV) is by far the most exploited source in the country because it is the most sustainable one for rural areas to power schools, health centres, houses and offices and photovoltaic water pumping systems for potable water. It is only recently that biomass projects (improved cook stoves and biodigesters) financed by ECOWAS have appeared.

According to the socio-economic survey of 2011, most places are not supplied with electricity. For households served by electricity, the monthly household consumption is 22 kWh. Households, however, are favourable to host services for private electricity supply. They are willing to pay up to 5 000 CFAF[6] per month for the majority (38%) and up to 10 000 CFAF per month in some other cases (28%). The main economic activities that generate income are shops, small restaurants that sell fish, agricultural products and livestock trade (CABIRA - BCP, 2013).

Regarding geothermal energy, there is no information regarding studies or assessments on this field in Guinea Bissau. According to the International Geothermal Association (IGA) the most important geothermal areas are located around plate margins, such as Andean South American region, Iceland, or many Pacific Islands. This is not the case for Guinea Bissau and therefore the geothermal potential in the country is presumed to be low.

In reference to the costs of renewable energy technologies, the collected information and studies show that biomass energy from cashew shells would be the most attractive option as the resource is quite abundant in the country. In fact, there have been initiatives in the country focusing on this renewable energy. Also, hydropower energy is a well-developed technology that could be harnessed in Guinea Bissau.

6.2 Technologies' Costs in the ECOWAS Region

According to the ECREEE's report "Baseline Report for the ECOWAS Renewable Energy Policy (EREP)" published in October 2012, some of the renewable energy technologies are already competitive with other alternatives today while others will become competitive by 2020/2030. For countries having sufficient resources, biomass and small-scale hydropower (SSHP) are the best options, providing electricity at a cost that is compatible with the regional projects' price options. All the production costs for various technologies are summarized in the following figure for commercial and ODA financial conditions (ECREEE, 2012).

As it can be seen in Figure 11, capital costs for renewable energy are high whereas commonly used diesel options need a lower investment but, on the other hand, diesel generation systems rely on diesel fuel to operate, which significantly increases their operational costs. This is not the case for renewable energies since they rely on renewable sources with potentially no or very low "fuel" cost (especially in the case of wind and solar PV). The report mentioned in the first paragraph states that operating costs for a system based on diesel fuel appears to be about 20.4 c€/kWh.

[6] Currency in Guinea-Bissau: *Communaute Financiere Africaine franc* (XOF or CFAF)

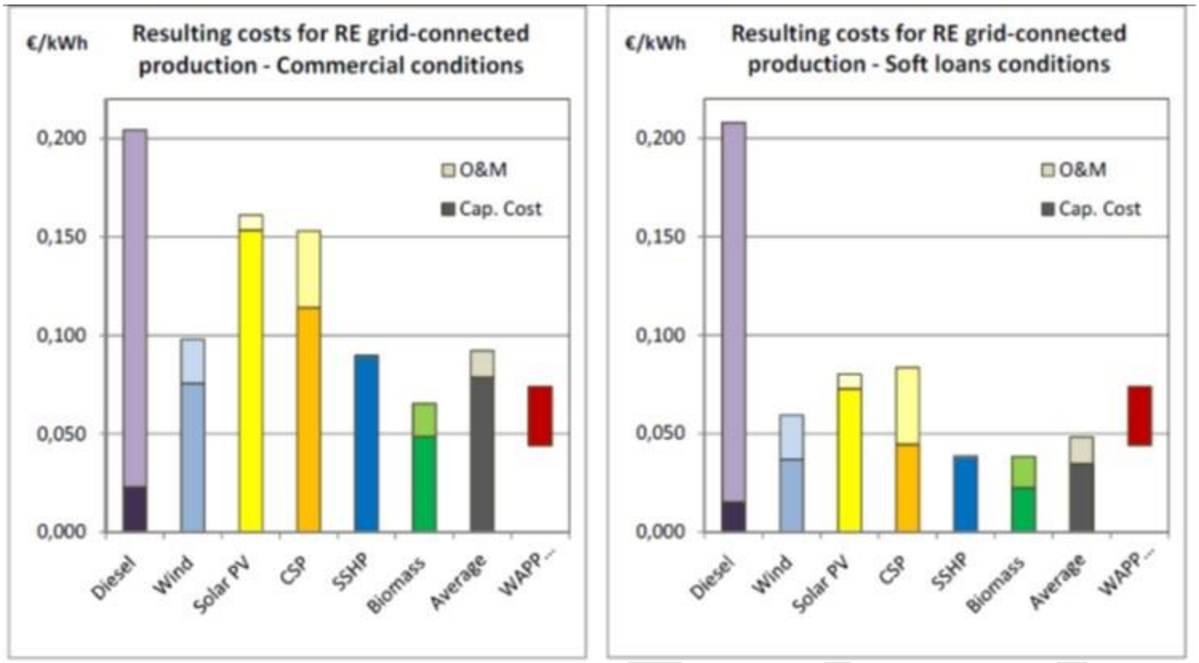

Figure 11: Technology various costs (commercial and soft loan conditions) (ECREEE, 2012)[7]

Small-scale hydro power and biomass options are the champions among the RE technologies. They are fully competitive with the assessed regional grid parity (black column labelled 'average') for both financial assumptions. Wind energy is becoming the second cheaper RE technology, however a few cents of Euros is more expensive than the 'grid parity'. At the present time, solar energy remains expensive. It can only effectively compete with high diesel thermal production costs when the resource is at its best. In the light of this analysis the priority must be given to biomass and small scale hydro power. Wind energy is interesting as a cheaper energy source but requires reserved capacity to be regulated. Solar remains the most expensive RE sources. Taking into consideration the expected evolution of price falls for RE technologies, incentives should be provided to initiate a learning process of integrating these resources and technologies in the panel of candidates for the future power supply (ECREEE, 2012).

The 2011 WAPP Master Plan project pipeline was adopted by ECOWAS in November 2011. The vision of the WAPP is to "integrate the national power system operation into a unified regional electricity market with the view to provide, in the medium and long term, the citizens of ECOWAS Member States with stable and reliable electricity supply at affordable cost. Therefore, the vision of the WAPP secretariat is to develop and put in place a cooperative power pooling mechanism for integrating national power system operations into a unified regional electricity market." The execution of the planned projects would increase the share of RE in the overall electricity capacity mix of the ECOWAS region from a level of 27% in 2011 (100% large hydro) to 36% by 2025. The major share of 28% would still be provided by large hydro. The "new renewables" would account for about 8%. The share of coal-based power generation would be 4% (ECREEE, 2012).

An IRENA Report on renewable power generation costs, states that with current prices for fossil fuels and conventional technologies, renewable technologies are now the most economical solution for off-grid electrification and for centralised grid supply in locations with good resources (IRENA, 2013). Figure 12 shows the range of LCOE for several technologies and the average LCOE for each region and for different types of renewable energy technologies.

It is clear that there are significant differences in the cost ranges for different technologies in different regions. This is driven by the very site-specific nature of renewable resources and project costs. A regional and country-level analysis of costs is therefore critical to understanding costs and their implications for policy makers (IRENA, 2013). The available data for renewable projects in Africa is thinner than for some other regions, but the costs follow a similar pattern to Latin America, with the exception that the LCOE of large hydro tends to be higher than for small hydro. Insufficient data is available to provide a definitive explanation of this finding, but poorer infrastructure, high grid connection/reinforcement costs for remote projects and multi-purpose dams probably all contribute. Collecting more data for Africa to verify if this data is accurate and the reasons for this is a priority (IRENA, 2013).

[7] WAPP: West African Power Pool initiative

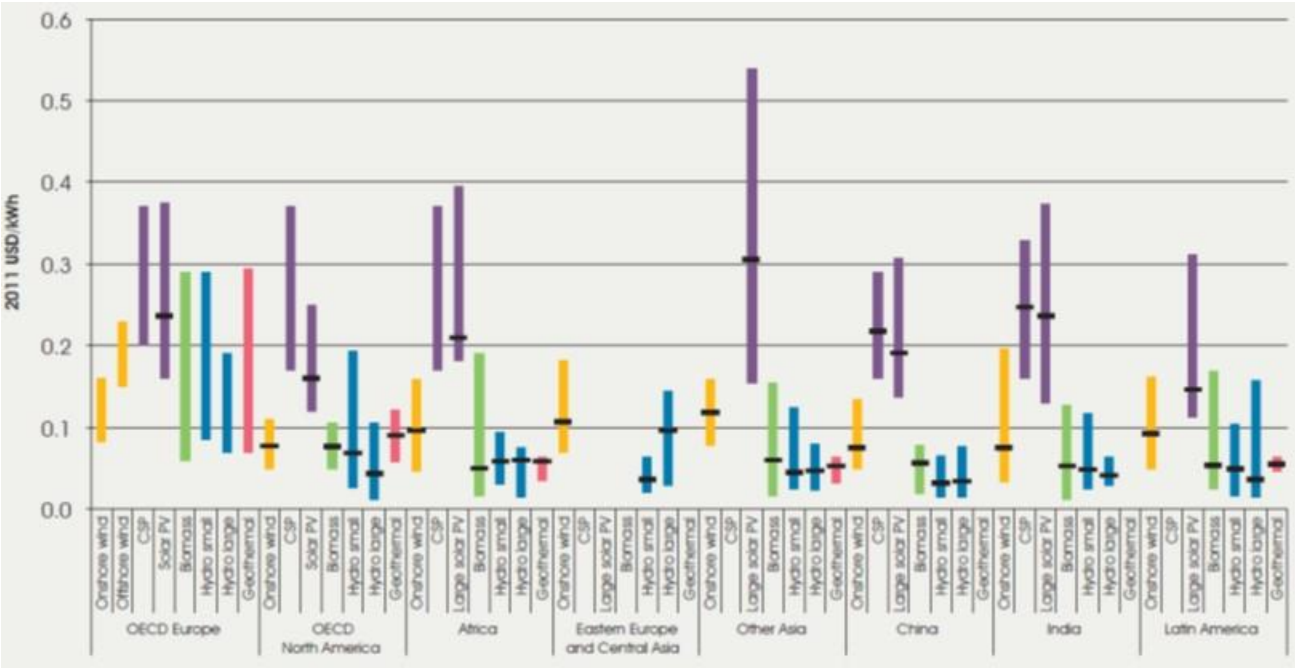

Figure 12: Typical LCOE ranges and weighted averages for renewable power generation technologies by region, 2012 (IRENA, 2013)

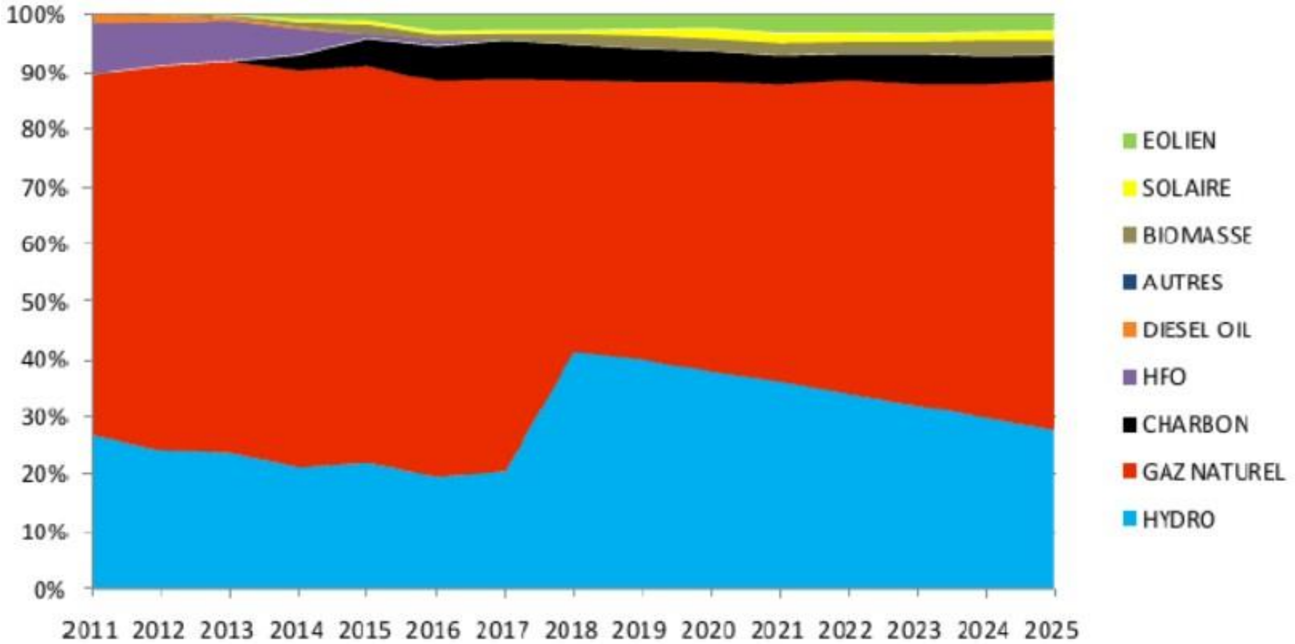

Figure 13: Electricity mix in the WAPP voluntary RE Scenario in terms of installed capacity (ECREEE, 2012)

The WAPP scenario aims at decreasing the marginal power generation costs in the ECOWAS region from a range between 4.4 c€/kWh and 22.2 c€/kWh in 2010 to a range between 4.1 EUR/cents to 7.4 EUR/cents per kWh in the period 2017-2025 (ECREEE, 2012).

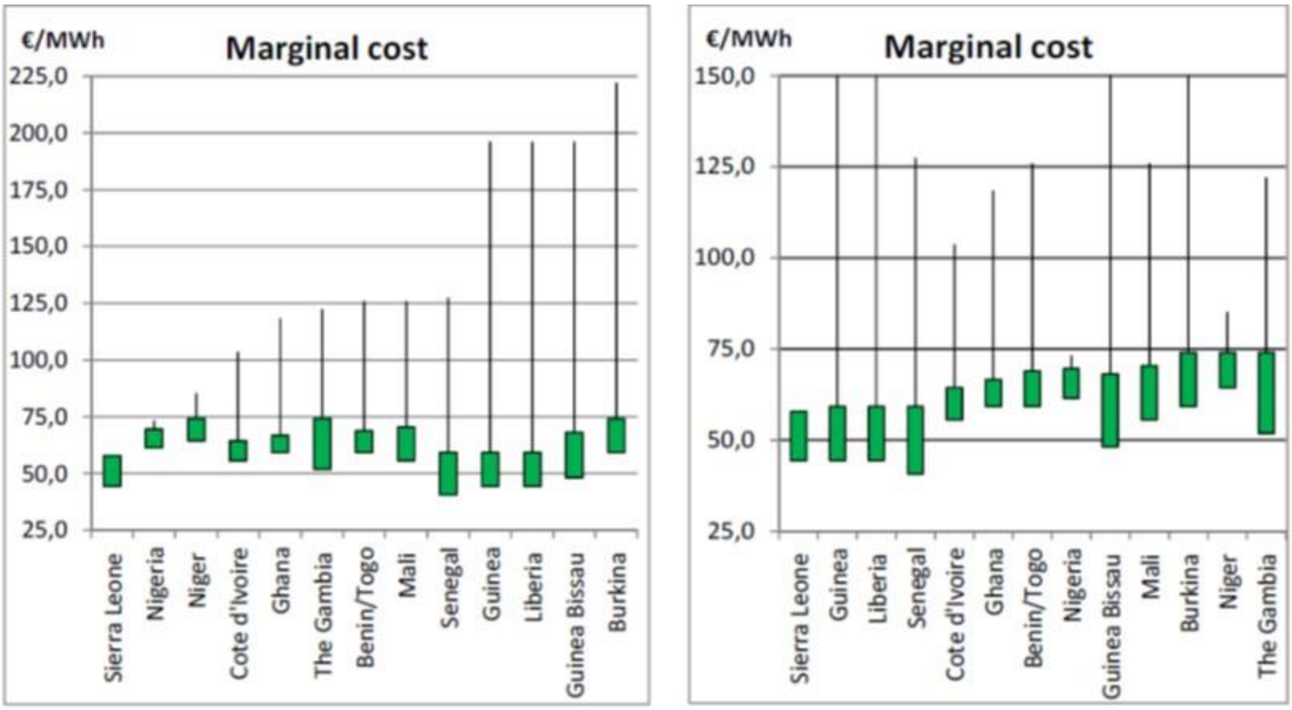

Figure 14: Development of the marginal generation costs in WAPP Master Plan (ECREEE, 2012)

The fine lines in the figure above indicate the actual level of generation costs in the respective countries. The green bars show the envisaged range of generation costs after implementation of the WAPP project pipeline in 2025. The cost range constitutes also a reference point for determining the competitiveness of the different available RE generation technologies in different countries. The second reference point is to compare the cost-effectiveness of RE production with oil-based thermal power production (e.g. diesel or heavy fuel) until the WAPP project pipeline is fully implemented. This reference point is also valid for the off-grid rural areas (ECREEE, 2012).

It is to be noted that the revised master plan volume 2 includes also an alternative "new renewable energy" scenario (around 3,650 MW of additional RE capacity to be installed - 20% from biomass, 40% from solar and 40% from wind). The conclusions indicate that a renewable energy scenario, with 10% of the total installed capacity could be covered by RE (excluding large hydro) by 2020. The scenario is economically robust for countries without hydro resources or access to natural gas. It is expected that the alternative scenario would incorporate very limited additional costs (around 2% increase on the kWh costs) (ECREEE, 2012).

There are several benchmarks in the ECOWAS region to estimate the competitiveness of RETs with conventional energy solutions in urban and rural areas. In the case of grid-connected projects, RETs compete with power generation costs in the range of 70 to 90 €/MWh in countries such as Cote d'Ivoire, Ghana and Nigeria. These countries mainly rely on large hydro and natural gas. In Gambia, Guinea-Bissau, and Cape Verde, which are dependent mainly or completely on oil products, the generation lie between 210 and 230 €/MWh. For decentralised RE solutions in rural areas the benchmarks are as follows (ECREEE, 2012):

- Small diesel generators: produce in the range of 250 to 300 €/MWh
- Grid extension: Grid based electricity costs with an additional marginal cost for distribution range from 10 to 56 €/MWh depending on the financing conditions

Electricity Tariffs:

As to electricity prices, Guinea-Bissau has one of the most expensive tariffs in the region, as indicated in Table 12.

Table 12: Electricity Tariffs according to EAGB, as of 2008 (Seck, 2009)

Tariffs for Households				
Level	*kWh*	*Price/kWh in CFAF (1 Euro = 655.957 CFAF)*	*Price/KVAH in CFAF*	*Power Tax CFAF*
1	0–50	78		1,000
2	51–200	161		2,000
3	> 200	322		2,100

Tariffs for Governmental Offices, Shops, etc.				
With meter	> 0	255	48	6,400
Without meter	> 0	320	48	6,400
Tariffs for Industry				
Single	> 0	165	50	50,000

6.3 Wind Potential

The report prepared by (CABIRA - BCP, 2012) presents statistical data on wind in Guinea Bissau for a period of 10 years. In the absence of local history from many weather stations, a numerical simulation has been applied. The model used is the PREVIMETEO model. PREVIMETEO uses numerical models of the U.S. NOAA (National Oceanic and Atmospheric Administration) large mesh, while the fine mesh model is calculated on CABIRA-BCP's own facilities in France. The modelling was based on the WRF (Weather Research and Forecasting) model with a 10 km-side mesh. The modelling process is as follows:

- Extraction of the initial data of a past day;

- Calculation of the numerical modelling for the hours on 24 hours of the day;

- Archiving files modelled that day;

- Move to the next calculation;

- Etc.

Through this process, there are 10 x 365 days of complete weather data. The meteorological wind is normalized, presented for 10 meters in height. Wind values (average or wind gusts) are given in meters per second and the directions in degrees (Figure 15).

The mean and standard deviation of wind are calculated from hourly data for the period concerned. For example, the average wind over the month of January is calculated from 10 year multiplied by 31 days of the month and 24 hours each day, 7440 values.

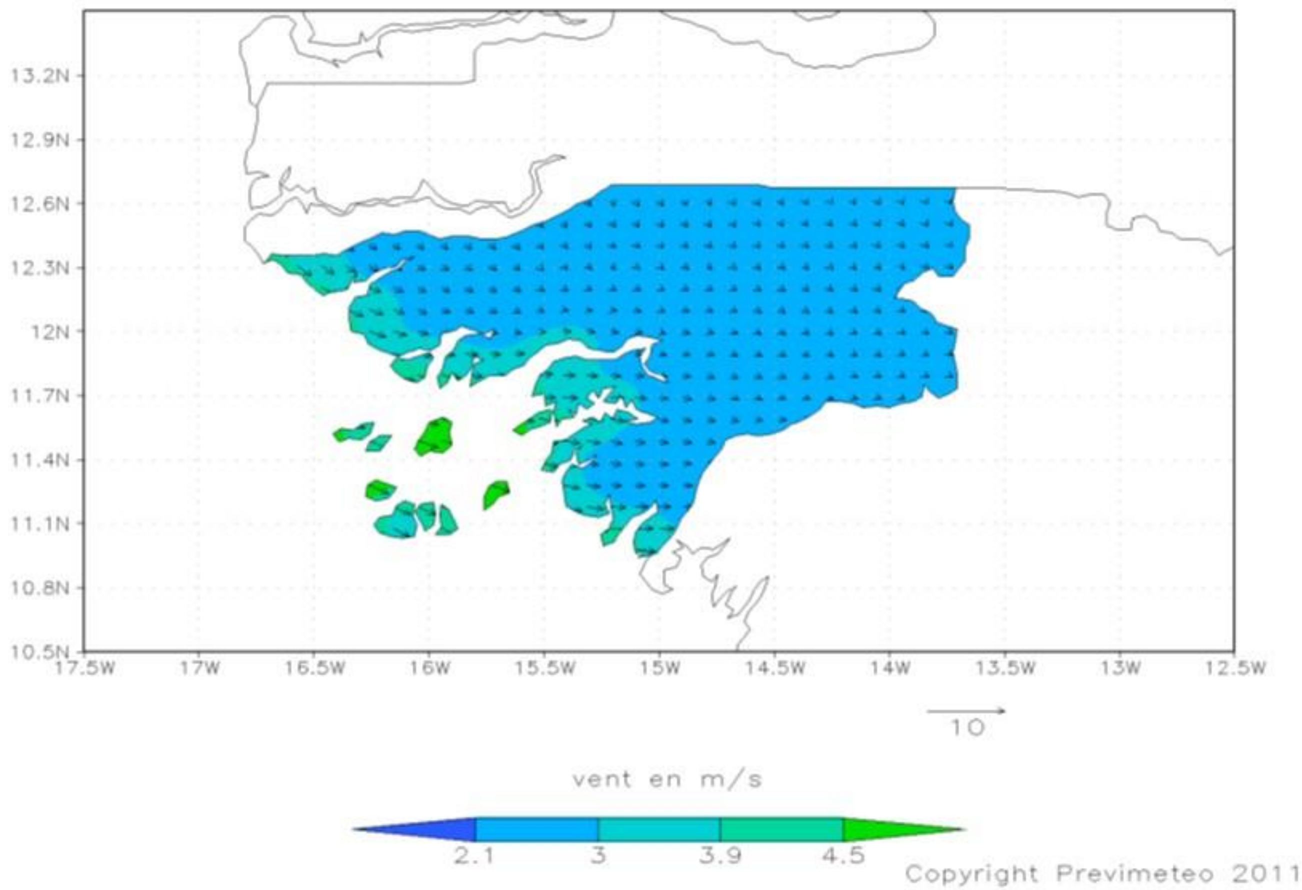

Figure 15: Wind resource map. Average for a 10-year period (CABIRA - BCP, 2012)

Only four complete weather stations located in Bissau, Bolama, Bafata and the Airport could provide complete information which included: wind speed, wind direction, temperature, solar irradiation, humidity, etc. Unfortunately, since the civil war of June 7th, 1998, these stations got damaged. Today, the only one still functional out of the 4 stations is the airport weather station (Handem, 2011).

No electrical wind turbines have been installed in GB and there are no projects planned in this area for the near future (Handem, 2011).

6.3.1 Feasible Potentials

The best locations for onshore wind turbine installations are elevated places away from big buildings because the wind blows faster at higher altitudes. Offshore installations near the land are also a good place to install wind turbines because the average wind speed is usually higher (less roughness than on land). In Guinea Bissau, it may be possible to exploit wind speeds throughout the year on the coast of the main land or between the islands and in the region of Boe where there are altitudes of over 200 m (Handem, 2011). In Guinea Bissau, the amplitudes of the observed winds require the use of small wind power. Indeed, the country's coastline offers some advantages for wind turbines. It was noted that the average values observed in the months vary between 3 m/s and 5.5 m/s. Thus, for a speed of 4.5 m/s, a farm of ten (10) wind turbines on coastal energy could produce 1,260 kWh/year with 200 kW at a cost of 151 million CFAF (CABIRA-BCP, 2012).

In accordance to EWEA a good wind speed site is defined as a coastal location with an average wind speed of 6.9 metres per second (m/s) at a height of 50 m above ground level. Medium and low wind speed sites have average wind speeds of 6.3 and 5.4 m/s respectively (EWEA). Therefore, Guinea Bissau would have low wind speeds. There is potential for studying winds on the coast, as identified in the Energy Master plan of Guinea Bissau.

6.3.2 Comparative advantage of technology

The average market price for the larger on-shore wind generator is about 1.25 M€/MW as the price for steel and copper has increased in recent years. In West Africa, the price is higher as the capacity of a single machine is presently limited to 850 kW due to the lack of heavy crane to install higher unit capacity. The price for the Cape Verde 25.5 MW wind farms presently installed is about 2 M€/MW. But it is expected that the price should decrease by the time to reach a level of 1.4 M€/MW in 10 years (ECREEE, 2012).

For smaller turbines, the investment costs differ from small wind chargers (from 15 W to 1kW with DC production) to small wind turbines (from 2 kW to 100 kW with AC production), and in relation to where they are produced. The prices for small turbines range from 2 to 3 €/W for the range 5 to 250 kW and from 3 to 3.7 €/W for smaller turbines and wind chargers. However, the Chinese market for this type of machines will boom in the coming years with a price that will be around 30% lower than the present price level (ECREEE, 2012). In the case of the farm mentioned in Section 6.3.1 the 200 kW plant has an investment of 151 million CFAF[8] which equals to €230,197 or 1.15 €/W.

Approximately 75% of the total cost of a wind farm is related to upfront costs such as the cost of the turbine, foundation, electrical equipment, and grid-connection and so on. Fluctuating fuel costs have no impact on wind power generation costs. A wind turbine is capital-intensive compared to conventional fossil fuel fired technologies such as a natural gas power plant, where as much as 40-70% of costs are related to fuel and operations and maintenance (EWEA, 2013).

For a coastal position, for example, the average generation costs have decreased from around 9.2 c€/kWh for the 95 kW turbine (mid 1980s typical turbine) to about 5.3 c€/kWh for a new 2,000 kW machine, an improvement of more than 40% over 20 years (EWEA, 2009).

Wind technology will be relevant to be combined with solar PV in off -grid areas having an acceptable wind potential (30%). It could provide energy at about 23 c€/kWh for fully commercial projects and a system loss of 25% (storage in battery) (ECREEE, 2012).

6.3.3 Potential local socio-economic added value

The use of renewable energy contributes to the reduction of fossil fuels combustion to produce electricity, thus reducing the dependency on imported energy and the impact of oil prices fluctuation on the economy of the country.

The implementation of renewable energy projects will create direct and indirect jobs, and facilitate the development and implementation of various economic activities (productive uses of energy) such as carpentry, ice factories, sewing workshops, etc.

Domestic use of renewable electricity can help improving the lifestyle and comfort of households through the use of electrical appliances and lights. The latter would enable students to study in a better environment and under better lighting conditions.

Using non-polluting electricity improves health conditions inside the households as air pollutants are reduced due to the avoidance of other fuels combustion inside the house such as candles or kerosene lamps.

[8] 1 EUR = 655.96 CFAF

The improvement of electricity supply (either by increasing energy offer or improving the service) may provide opportunities for street lighting, which especially at night would improve security and allow for the development of recreational and commercial activities (cultural events, shops).

6.4 Hydroelectric energy Potential

6.4.1 Feasible Potentials

The hydroelectric potential of the Guinea Bissau is estimated at 300.91 GWh with a minimum active power of 33.84 MW. This potential would be obtained with the implementation of two (2) hydroelectric dams, Cussilinta and Saltinho, and hydro-agricultural micro-dams. It is necessary to generate an investment of about 116.8 billion CFAF to achieve all hydroelectric projects in Guinea Bissau (CABIRA-BCP, 2012).

The site located at Saltinho was studied in 1983 by "Consultores para Obras, Barragens e Planeamento, SA (COBA)" and financed by UNDP. They estimated that the dam could generate 18 MW of electricity. The construction of the dam was estimated at that time to cost 79 million USD. Unfortunately, until today, the construction of the dam has not started. No official reason was given as for why it has not been constructed yet. However, according to some employees of the ministry of energy there are three main reasons: delay of the government to implement the project, the important distance from Saltinho to the main cities of the country and the lack of infrastructure to transport the produced electricity to the consumers (Handem, 2011). Recently, it has been detected that the evaluation of Saltinho hydroelectric site needs to be updated as the topography has changed since the '80s when the study was done. UNIDO hired a consultant to take care of this activity of which the report carried out in the end of 2013 is in Annex I.

Nowadays, the General Director of Energy sees the Saltinho project as a key contribution to the needed transformation of the electricity system in Guinea Bissau.

6.4.2 Comparative advantage of technology

In accordance to the ECREEE report "Baseline Report for the ECOWAS Renewable Energy Policy (EREP)", in those countries where resources are enough, hydropower can provide electricity at a cost of 44 €/MWh for large hydro (>30 MW) and 78 €/MWh for Small-scale hydro resources. Particularly for Guinea Bissau, hydroelectric plants would be a very important and valuable contribution to the energy shortages the country is facing, but they would also rely on the availability of grids to dispatch the generated energy, which is still the one of the main barriers the country needs to solve.

However, micro or pico-hydro schemes could be a good option that could help supply energy in rural or off-grid areas. Such projects demand a different engineering approach in comparison with larger schemes in order to keep designs flexible and costs realistic, and require a broad understanding of all the diverse technical and non-technical elements that contribute to it. In general, pico-hydro systems are below 5 kW and micro-hydro are up to 100 kW, capable of supplying small communities, single households or for productive uses of energy in rural areas.

In global terms, average investment costs for large hydropower plants with storage typically range from as low as USD 1 050/kW to as high as USD 4 215/kW. The upper end of this range represents projects that are difficult, far from existing infrastructure and/or include multi-use dams. The range of installed costs for small hydropower projects is wider and can be between USD 1 300 and USD 5 000/kW, although in developing countries costs can be as low as USD 500 to USD 600/kW at excellent sites. Adding additional capacity at existing hydropower schemes, or at existing dams that do not yet have a hydropower plant, is generally significantly cheaper than new greenfield plants, and can cost as little as USD 500/kW (IRENA, 2013).

6.4.3 Potential local socio-economic added value

The use of renewable energy contributes to the reduction of fossil fuels combustion to produce electricity, thus reducing the dependency on imported energy and the impact of oil prices fluctuation on the economy of the country.

The implementation of renewable energy projects will create direct and indirect jobs, and facilitate the development and implementation of various economic activities (productive uses of energy) such as carpentry, ice factories, sewing workshops, etc.

Domestic use of renewable electricity can help improving the lifestyle and comfort of households through the use of electrical appliances and lights. The latter would enable students to study in a better environment and under better lighting conditions.

Using non-polluting electricity improves health conditions inside the households as air pollutants are reduced due to the avoidance of other fuels combustion inside the house such as candles or kerosene lamps.

The improvement of electricity supply (either by increasing energy offer or improving the service) may provide opportunities for street lighting, which especially at night would improve security and allow for the development of recreational and commercial activities (cultural events, shops).

6.5 Solar Potential

Solar energy is the most abundant RE source. It is the production of energy directly from solar irradiation. This irradiation can either be directly transformed into heat or into electricity. The yearly irradiation ranges from 4.79 kWh/m²/day to 6.96 kWh/m²/day, with a yearly average of 5.87 kWh/m²/day. These data were obtained by (Handem, 2011) from the NASA Langley Research Center and are from 2002. On the other hand, the provisional report prepared by (CABIRA-BCP, 2012) explains that Guinea Bissau receives an average of 1,800 kWh/m² - 2,000 kWh/m² of solar energy per year. Per day, the country would receive between 4.93 kWh/m² and 5.48 kWh/m². Guinea Bissau has an excellent solar resource (see Figure 16) that can be used especially for off grid applications. It has been used for:

- Electricity generation with photovoltaic (PV) systems in rural households, schools, offices, hospitals, health centers
- Solar water pumping
- Solar telecommunication systems
- Specific solar water heating applications

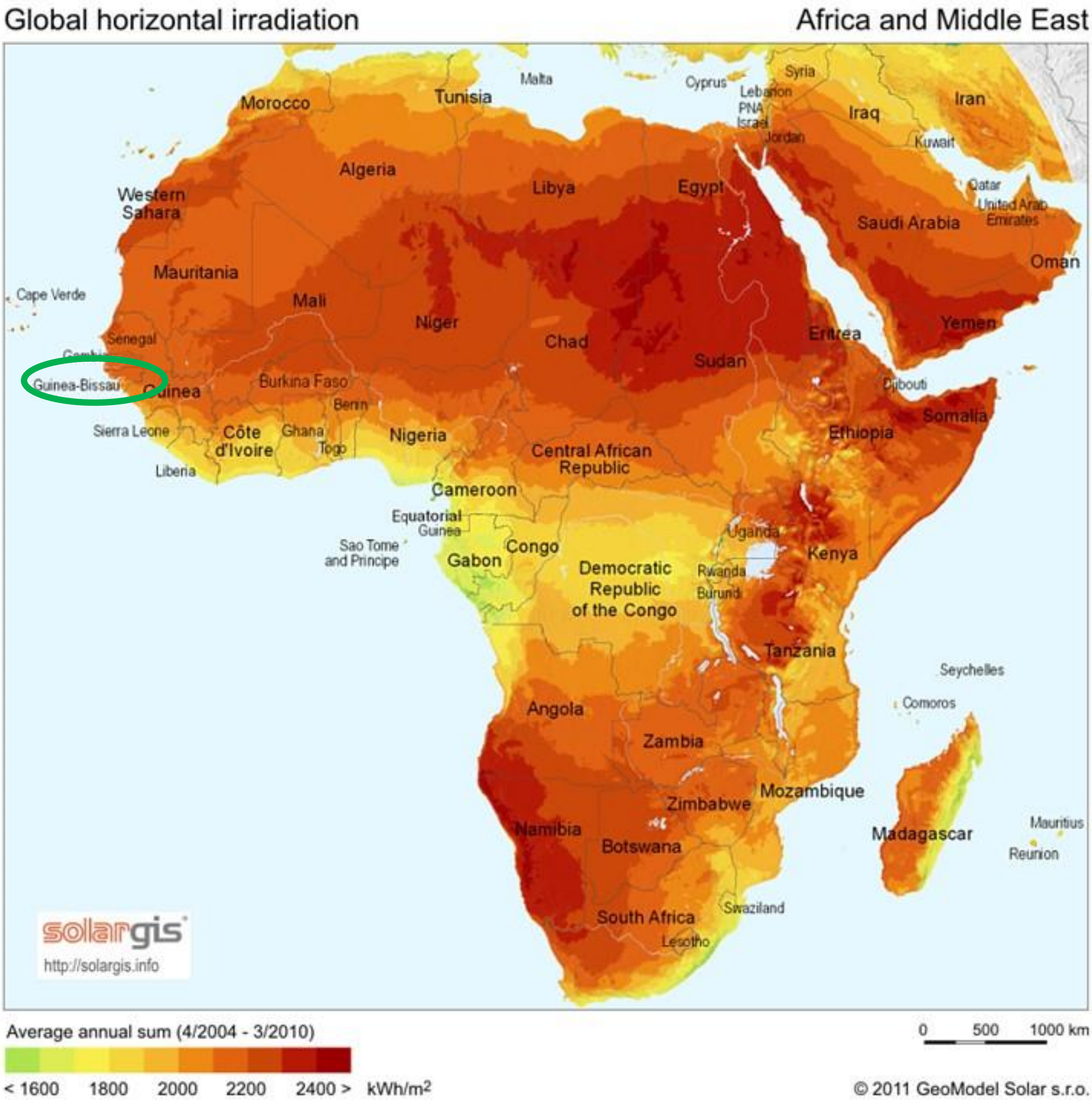

Figure 16: Solar resource map for Africa, see Guinea Bissau in green balloon – Global Horizontal Irradiation (SolarGIS © 2013 GeoModel Solar, 2011)

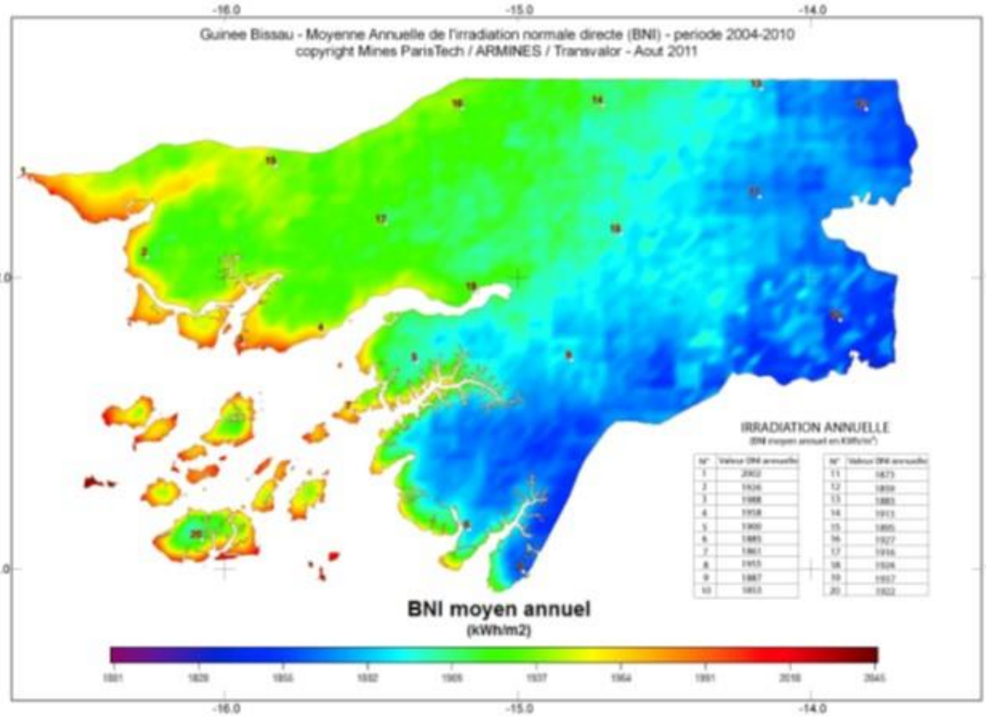

Figure 17: Average Annual Direct Normal Irradiation (DNI) in Guinea Bissau

It was found that the sun is stronger in the islands and on the coast (Figure 17), it weakens gradually as one moves towards the Southeast (CABIRA - BCP, 2012).

6.5.1 Solar Photovoltaic (PV)

Several projects involving solar PV panels are under development:

- ADPP explained that they are implementing an EU programme that aims at providing 2,400 farmers in 24 villages with solar water pumping systems (started in 2011 and will run through 2015).
- The Bambadinca project developed by TESE will include a 314 kW PV hybrid mini-grid plant.
- The Government of Guinea Bissau has signed a letter of intent with and American Company for the development of a 10 MW PV facility in Bissau.
- Afripêche solar PV or wind-solar PV plant for energy generation to produce ice blocks and thin ice

In accordance with the ECREEE Baseline report for the ECOWAS Renewable Energy Policy (EREP), at the present time, under commercial conditions, solar energy remains expensive in the ECOWAS countries. It can only match high diesel thermal production costs under favourable conditions. This means that PV would not be able to kick start the market without some financial support. The roof-top opportunity has to be compared with the consumer tariffs.

The average consumer tariff per kWh is relatively high in the ECOWAS area. It is about 13.6 EUR/cents on average, although there is disparity amongst countries. For example, in Cape Verde the consumer tariff reached a level of more than 30 EUR/cents per kWh. In countries such as Liberia and Guinea Bissau it is even higher (ECREEE, 2012).

The general benchmark cost for a typical solar power plant is about 2.7 M€/MWp, but recent projects in Mali and Burkina Faso show that the cost is closer to 3 M€/MWp. The connection costs to the grid are not included in the price. It is expected that very substantial cost reduction of up to 50% could take place by 2020. The price for PV in the ECOWAS region is still quite higher than the prices presently experienced in Europe. This is due to the narrowness of the market without real competition on price and/or quality and the niche position that the PV dealers have and possibly the lack of awareness and the recent drastic price regression (ECREEE, 2012).

Table 13: Price information on Solar PV (ECREEE, 2012)

	Present price (2012)	**Price assumptions in 2020**
Solar plant > 5 MW	3 €/Wp	2.2 €/Wp

	Present price (2012)	Price assumptions in 2020
Solar roof top (without batteries)	1.9 to 3.8 €/Wp[9]	3.3 €/Wp
Small PV plant /hybrid system	7.9-5.6 €/Wp	6.1-4.3 €/Wp
Solar home system	9 €/Wp	7.5 €/Wp

The report also presents a cost simulation for rooftop applications, using different capacity factors and interest rates (see Figure 18). In the worst-case scenario (low capacity factor and high interest rate for a PV rooftop system @ 4.6 M€/MW) the production cost goes up to almost 40 c€/kWh, and in the best-case scenario (high capacity factor and low interest rate for a PV rooftop system @ 3.3 M€/MW) they go lower than 10 c€/kWh. The consumer electricity tariffs shown in Table 12: Electricity Tariffs according to EAGB, as of 2008 for households ranges from 78 to 322 CFAF/kWh (equivalent to 12 c€/kWh to 49 c€/kWh, respectively), without considering taxes. For government offices, industries and commercial activities, tariffs are equal or higher.

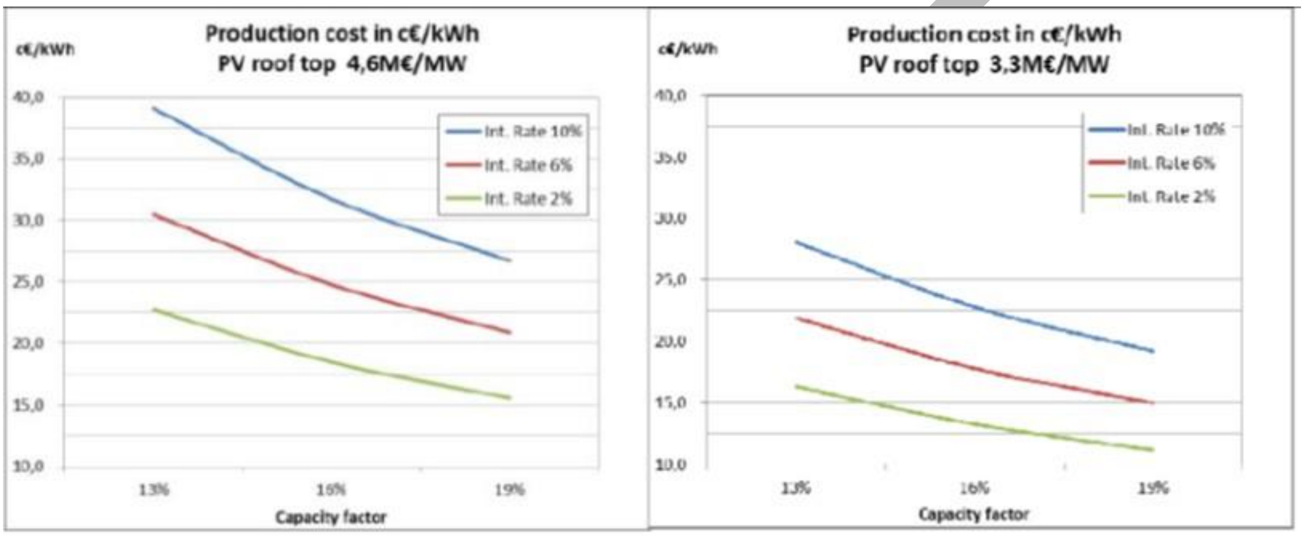

Figure 18: Costs Simulation for Roof Top Applications (ECREEE, 2012)

With lower investment levels due to lower costs which are likely to occur in the next 10 years, solar PV power from larger plants will definitely be more competitive than the diesel thermal alternative and will come much closer to the regional supply price. The major barriers for roof top applications are the actual price that only reflects the narrowness of the markets and the lack of regulatory framework. Here, the costs have to be compared with the tariffs applied to the different categories of customers, mainly the well-off domestic consumers that can afford the systems, the administration and industries (ECREEE, 2012).

6.5.2 Solar Water Heating

Guinea Bissau is a country with tropical climate. This means it is generally hot and humid, with little temperature fluctuation. Annual mean temperature is 26.3 °C. Basing on this fact, heating water for domestic use may not be a priority amongst the population, and especially in rural areas where people are used to consuming water at ambient temperature. However, the application of solar water heaters could be considered for hotels and hospitals, where a need for domestic hot water could exist for either tourists or medical use.

In general terms, with improved performance and lower cost, smaller solar water heaters have a payback period of 3 to 5 years. However, the diffusion of these systems has been slower than expected. In some developing countries, in fact, the solar water heaters have competitive difficulties due to the subsidization of LPG and electricity. However, in Botswana, for example, approximately 15,000 domestic solar water heaters were installed. About 4000 solar water heaters are used in Zimbabwe. In West Africa, the production of solar water heater remains a niche production with high price as consequence (400 to 600 €, when a cheap electric water heater costs 150 €) (ECREEE, 2012).

6.5.3 Potential local socio-economic added value

The use of renewable energy contributes to the reduction of fossil fuels combustion to produce electricity, thus reducing the dependency on imported energy and the impact of oil prices fluctuation on the economy of the country.

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[9] experience from several installations in Cape Verde

The implementation of renewable energy projects will create direct and indirect jobs, and facilitate the development and implementation of various economic activities (productive uses of energy) such as carpentry, ice factories, sewing workshops, etc.

Domestic use of renewable electricity can help improving the lifestyle and comfort of households through the use of electrical appliances and lights. The latter would enable students to study in a better environment and under better lighting conditions.

Using non-polluting electricity improves health conditions inside the households as air pollutants are reduced due to the avoidance of other fuels combustion inside the house such as candles or kerosene lamps.

The improvement of electricity supply (either by increasing energy offer or improving the service) may provide opportunities for street lighting, which especially at night would improve security and allow for the development of recreational and commercial activities (cultural events, shops).

6.6 Biomass Potential

There are several techniques to transform biomass into energy: **Thermal conversion** (some are direct: heat and fuel, some are indirect such as liquid fuel or combustible biogas) and **Chemical conversion** (anaerobic digestion, fermentation and composting). Production of energy from waste, is a very popular source of biomass worldwide. Nowadays, with the appropriate techniques and infrastructures, the waste of an entire city may be treated and used for energy production (Handem, 2011).

The energy sector in Guinea Bissau is characterized by a considerable prevalence of traditional energy for end-use consumption. According to K. Diombera (1999) forests provide over 90 % of the energy consumed in the country (CABIRA - BCP, 2012).

Guinea Bissau lacks updated data on the situation of its forest resources. The firm (CABIRA - BCP, 2012) provides a land use mapping in the *Plan Directeur Energétique* (Energy Master Plan). This first report (data collection) presents the methodology applied to update the cartographic data of the forest, and the preliminary results. The proposed methodology is divided into two phases. The first phase consisted of a desk study (literature research and digitalization of maps and image interpretation). The second phase consists of a field mission for data validation and correction / consolidation of the results of the interpretation of images. Then an analysis (longitudinal study) was conducted to measure changes in land use, particularly in the forest. Guinea-Bissau is a country of about 36,000 km^2. The total coverage of the country is made by 5 Landsat scenes that used data from the years 2005 and 2006. Forested surfaces in 1985, according to forest inventory done by National Atlanta Consult, involve about 2.034 million hectares, or 56% of the country. This area is divided into dense forest, semi-dense forest, rainforest and sub-humid forest in the south-west of the country and dry forest in the north-east of the country. We must add to these, mangroves that represent about 8% of the territory. In general, the environment is subject to various types of human interventions and thereby undergoes a process of degradation, faster or slower, depending on the area. For the whole wood vegetation comparing two forest inventories, a loss of 187,600 ha has showed, approximately 7.1% of the 1978 surface (CABIRA - BCP, 2012).

Table 14: Changes in forest area of Guinea-Bissau (CABIRA - BCP, 2012)

Year	Surface
1978	2.452.200 ha
1985*	2.317.284 ha
1987/1990	2.284.000 ha

**Palm groves and rupicolous forests were unsurveyed.*

Nearly 80% of the population of Guinea Bissau work in agriculture. It mainly produces rice, the main staple, and cashews. The cashew plantations ("Cashew nuts") extend over an area of 175,000 hectares and is increasing at an annual rate of 4%. Guinea-Bissau is the world's largest exporter of cashews in the rough, the second largest producer of cashew in Africa and the 5th worldwide. In 2008 Guinea-Bissau exported 93,000 tons of product (CABIRA - BCP, 2012).

6.6.1 Feasible Potentials

It is possible to identify 5 different sub categories of biomass energy sources: wood, waste, alcohol, fuel and landfill gases. The most ancient and still the most used today in African countries, is the wood coal and patches for cooking. In Guinea Bissau, it is the main source of biomass energy but not the only one (Handem, 2011). Wood energy through firewood and charcoal is the main domestic fuel, and represents approximately 90% of national energy consumption. To this already strong exerted by the country's energy needs pressure on forests, we must add the smuggling of charcoal to neighbouring countries (especially to Senegal) and the demand for wood from other sectors. This has resulted in overexploitation of Guinea Bissau's forests, resulting in a depletion of its resources. Available raw materials that could be used are agricultural residues and animal dung, especially given the very advanced state of degradation of Guinea-Bissau's forests, as it does not seem appropriate to consider the introduction of new crops for energy purposes (CABIRA - BCP, 2013).

Forests (fuel wood): It was noted that the dense forest (sub-humid forests, transitional forests and dry forests) no longer covers 19.34% of the national territory. Also, there was a sharp decline in 43.84 % of the forest compared to 1985. Forest products are made from waste from the forest itself to ensure balance due to logging activities officially authorized. The amount mobilized was 509 130 t in 2011, and the resulting residues were 50 913 t in the same year. The total consumption of fuel wood (firewood and charcoal) in Guinea Bissau in 2011 was 994 065 t. This value is much greater than the amount mobilized. The relationship between demand and normal supply mobilized is 195.25 %. This rate is the translation of a strong pressure on forests in Guinea Bissau, which means that eventually their depreciation is important and would cause a significant deforestation of the country.

Cashew as energy source: The calorific value of the cashew shell is higher than that of green wood and dry wood and therefore the shell of cashew is a fuel that can be valued. If Guinea Bissau transforms locally its entire production of cashew shells, they are expected to produce an amount of energy of 6,260 kWh / t (CABIRA - BCP, 2012).

In fact, the construction of a small power plant of 45 kW (±60 kVA) in Safim was mentioned which will be powered from biofuel obtained from waste of cashew nuts (Handem, 2011). Several tests have been conducted on the production of electricity from burning cashew shells through various pilot projects: SICAJU in Bissau (80 kVA), SAFIM in Safim (42 kVA) and LICAJU in Bolama (150 kVA) (CABIRA - BCP, 2013). The Safim plant is already installed but is facing several challenges with regards to water and grid availability.

According to FAO (Food and Agriculture Organisation of the United Nations) Statistical Division information, Guinea Bissau produced the following amounts in cashew nuts with shell during the last years (see Table 15):

Table 15: Cashew nuts with shell produced by Guinea Bissau during 2009-2012[10]

Product: cashew nuts with shell	Year			
	2009	2010	2011	2012
Area Harvested (Ha)	218,000	218,002	222,517	Data not available
Yield (Hg/Ha)	4,564	4,955	5,783	Data not available
Production (tonnes)	99,500	108,029	128,684	Data not available

With an average annual growth rate of 5%, the production of cashew is estimated to increase from 171 thousand tons in 2011 to 333,000 tonnes in 2025. Unfortunately, almost all of the major production is exported in raw form. The country is also the world's largest exporter of cashews in the rough. Processing (shelling) local nuts is still marginal. In 2010, it accounted for about 12% of total production. There are very few functional units or in construction. If Guinea Bissau transforms/process cashew nuts, the amount of shells generated from this transformation would have been of 119,609 tonnes in 2011, considering that the shell is 70% of the nuts, corresponding to a thermal energy of 2.7 TJ available for the manufacture of solid fuels.

Cashew apple and ethanol production: in 2011 the country produced about 683,480 tons of cashew apple. Generally, it is estimated that only 30% of the amount generated is used for apple juice production, and wine and *eau- de-vie*, while the remaining 70% is discarded. If the remaining 70% of apples could be used for the production of ethanol, the potential for ethanol production would be about 14 353 m^3 in 2011 figures, which corresponds to an energy of about 290 TJ in 2011.

Production of briquettes from agricultural residues: According to the results of the evaluation of the energy potential of Guinea Bissau, agricultural residues are abundant in various parts of the country, and are often left in the field. These could be used to produce briquettes to be used as energy source (CABIRA - BCP, 2013). The amount of agricultural residues that could be mobilized for the production of solid fuels in Guinea Bissau was estimated at 239,760 tonnes in 2011. There is a predominance of rice residues (35.4%) and cassava (34.8%), followed distantly by peanut residues (12.4%) and sorghum (7%). Residues of other types have low values (<5 %). The referred amounts correspond to a thermal energy of 2,220,950 TJ.

Satellite images of the country show two (2) strips producing regions of palm oil, which are Cacheu and Oio with 958 ha and 1010 ha respectively in 2011. It is revealed that the production of this product was about 80 000 tonnes of palm kernel oil, although it is not organized. So this amount corresponds to approximately 114,286 tons of palm oil. It appears that the total energy potential from the production of residues is 1278 TJ.

Biogas from animal waste treatment: A socio economic investigation done in Guinea Bissau states that there is no organized agro-pastoral activity capable of providing a significant amount of exploitable animals' dejections (CABIRA - BCP, 2012). However, it has been found during the 1st Mission to Guinea Bissau that there was a project financed by the UEMOA/CILSS that aimed to install 20 biodigesters in small farms. However the project only installed 12, and these, at the time of writing of this report, were not yet in operation.

Reported at the national level, the potential biogas slurry of Guinea Bissau in 2011 was of 241 million m^3. It could reach 753 million m^3 in 2025, corresponding to an estimated 9.40% average annual growth rate. The potential energy that would result therefore, could increase from 1,352 GWh to 4,216 GWh in the period between 2011 and 2025. Biogas can be used by households as a source of energy for cooking and lighting. Guinea-Bissau has experienced two pilot projects for demonstration of this technology. The first

[10] Table based on information from FAO: http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor

project, in 2005 with the financial and technical support of the Government of the Republic of China has seen the formation of 36 technicians of different state institutions and Non-Governmental Organizations in Guinea Bissau on the construction and management of bioreactors (or digesters). Under this project, two digesters and equipment for lighting and cooking have been installed in two households in the districts of Djolo and Empantcha in Bissau. Installations on the first project would all be abandoned, according to local actors. The second project is still on-going, and has started without doing a survey and evaluation of the households of the first project (CABIRA - BCP, 2013).

In addition to the small units installed in households for the production and use of biogas for cooking and lighting, there are nowadays larger units for the supply of electricity to multi-households communities. The study of the energy potential of Guinea Bissau has revealed the presence of large herds of animals mainly in the regions of Gabù, Oio and Bafata. These three regions seem most appropriate for mini power plants for biogas electricity to supply communities. For the success of this kind of initiative, which is innovative in the country, it is important to facilitate the collection of manure. An effective strategy for collecting animal waste generally consists of housing animals, which is not the common practice in Guinea Bissau (CABIRA - BCP, 2013).

6.6.2 Comparative advantage of technology

Biomass plants are competitive particularly if the feedstock is free of charge and available in sufficient quantity to operate at full capacity (ECREEE, 2012). This could be the case for the cashew nuts production in Guinea Bissau.

Considering Figure 12 it is shown that in the case of Africa, biomass technologies' LCOE weighted average lies below the rest of the regions' averages, and sets around 0.05 USD/kWh.

Biomass-generated electricity can be very competitive where low-cost feedstocks are available onsite at industrial, forestry or agricultural processing plants. In such cases projects can produce electricity for as little as USD 0.06/kWh in the OECD, and as low as USD 0.02/kWh in developing countries (in any region). The typical LCOE range for biomass-fired power generation projects is between USD 0.06/kWh and USD 0.15/kWh, but where expensive feedstocks, such as woodchips or pellets, are required in gasifiers where technology experience is lower, the LCOE would be higher (IRENA, 2013).

Globally, the least-cost generating opportunities for biomass are in developing countries, where large quantities of agricultural and forestry residues remain unexploited. These low-cost feedstocks, when combined with simple combustion technologies that can cost between USD 660 and USD 1 860/kW, can provide very competitive electricity for own-use and/or grid supply. In OECD countries, capital costs tend to be higher. The total installed costs of stoker boilers are between USD 1 880 and USD 4 260/kW, while those of circulating fluidised-bed boilers are between USD 2 170 and USD 4 500/kW. Anaerobic digester power systems have capital costs between USD 2 570 and USD 6 100/kW. Gasification technologies, including fixed-bed and fluidised-bed solutions, had total installed capital costs of between USD 2 140 and USD 5 700/kW. Co-firing biomass at low-levels in existing thermal plants typically requires additional investments of USD 400 to USD 600/kW. The cost of installing combined heat and power (CHP) plants is significantly higher than for the electricity-only configuration (IRENA, 2013).

6.6.3 Potential local socio-economic added value

The use of renewable energy contributes to the reduction of fossil fuels combustion to produce electricity, thus reducing the dependency on imported energy and the impact of oil prices fluctuation on the economy of the country.

The implementation of renewable energy projects will create direct and indirect jobs, and facilitate the development and implementation of various economic activities (productive uses of energy) such as carpentry, ice factories, sewing workshops, etc.

Domestic use of renewable electricity can help improving the lifestyle and comfort of households through the use of electrical appliances and lights. The latter would enable students to study in a better environment and under better lighting conditions.

Using non-polluting electricity improves health conditions inside the households as air pollutants are reduced due to the avoidance of other fuels combustion inside the house such as candles or kerosene lamps.

The improvement of electricity supply (either by increasing energy offer or improving the service) may provide opportunities for street lighting, which especially at night would improve security and allow for the development of recreational and commercial activities (cultural events, shops).

In addition, the residue from the production of biogas from cow dung can be used as fertilizer for the production of good quality forage for animal feeding. This will facilitate the housing of animals, and avoid or minimize conflicts between farmers and herders. The use of the treated residues as fertilizer may also result in improved crop and livestock productivity, and increase the income for farmers and ranchers.

In addition, this activity contributes to the reduction of GHG emissions, as well as to the uncontrolled and inappropriate waste disposal.

6.7 Ocean Energy Potential

Ocean or marine energy involves using the energy from the **tides** (potential energy, due to changes in sea level, or kinetic energy due to water currents) or from the **waves** for electricity generation.

6.7.1 Feasible Potentials

At the request of (CABIRA - BCP, 2012), a document was provided by the Bissau Harbour authority, published by the Hydrographic Institute of the Navy, to the attention of the Portuguese speaking countries and Macao in 2011. In the case of Guinea Bissau the information shows:

a. Maps:
   - Sites where tide was measured (Caio Island, Bubaque port, Cacheu port) and
   - The areas where the tides are to be obtained by interpolation (Biombo, Bissau, Jabada and Porto Gole) all along the Geba channel.
b. Tide tables for measurement sites (Caio, Bubaqueet and Cacheu ports)
c. Correlation tables for the tides in four (4) locations along Geba channel with the tides in Caio.

The sea levels shown in Table 16 refer to high and low tides only. To calculate the sea level in the intermediate times on the site in question, a sinusoidal curve is plotted to approximate the tides, enabling a quick and easy calculation of the levels.

The energy potential of tidal power is very low. The height drop registered in Guinea-Bissau remains below 5 meters. But hope remains with the development of tidal power plants with small capacity (2 MW), which is outstanding in Portugal.

Table 16: Sea level in four sites in Guinea Bissau

MAREES HAUTES					MAREES BASSES				
CAIÕ	BIOMBO	BISSAU	JABADÃ	PORTO GOLE	CAIÕ	BIOMBO	BISSAU	JABADÃ	PORTO GOLE
m	m	m	m	m	m	m	m	m	m
2.30	3.10	3.80	4.90	5.30	0.30	0.20	0.10	0.40	0.30
2.40	3.20	4.00	5.00	5.50	0.40	0.30	0.20	0.80	0.40
2.50	3.30	4.20	5.10	5.80	0.50	0.40	0.30	0.70	0.50
2.60	3.50	4.30	5.30	5.80	0.60	0.50	0.40	0.80	0.60
2.70	3.60	4.50	5.40	6.00	0.70	0.60	0.60	0.90	0.70
2.80	3.70	4.70	5.50	6.10	0.80	0.70	0.70	1.00	0.80
2.90	3.80	4.90	5.70	6.30	0.90	0.80	0.80	1.20	1.00
3.00	4.00	5.00	5.80	6.50	1.00	0.90	0.90	1.30	1.10
3.10	4.10	5.20	5.90	6.60	1.10	1.00	1.00	1.40	1.20
3.20	4.20	5.40	6.10	6.80	1.20	1.10	1.10	1.50	1.30
3.30	4.30	5.60	6.20	7.00	1.30	1.20	1.20	1.60	1.40
3.40	4.50	5.70)	6.30	7.10	1.40	1.30	1.40	1.70	1.50

The map shown in Figure 19 shows the potential for wave energy in all the world. For the Guinea Bissau area, the potential is very low.

A study conducted by the Department of Civil, Environmental and Architectural Engineering (DICAT) of the University of Genova, Italy and the ONLUS Programma Sviluppo 76 (PS76) which operates in Guinea-Bissau, in cooperation with the local NGO "Amigos da Guiné-Bissau" aimed at investigating the possibility to produce electric energy in Guinea-Bissau by means of exploiting the potential energy associated with tides.

A major natural resource of Guinea-Bissau is the high value of *tidal range* experienced on its coast, the *highest* along the West African coast. Moreover, the presence of tidal estuaries further enhances the tidal range: its maximum recorded value is 6.80 m in Porto Gole, on the banks of Rio Geba. The tidal stations located along the coasts of the country are shown in **Figure 20 (UNIVERSITÀ DEGLI STUDI DI GENOVA)**.

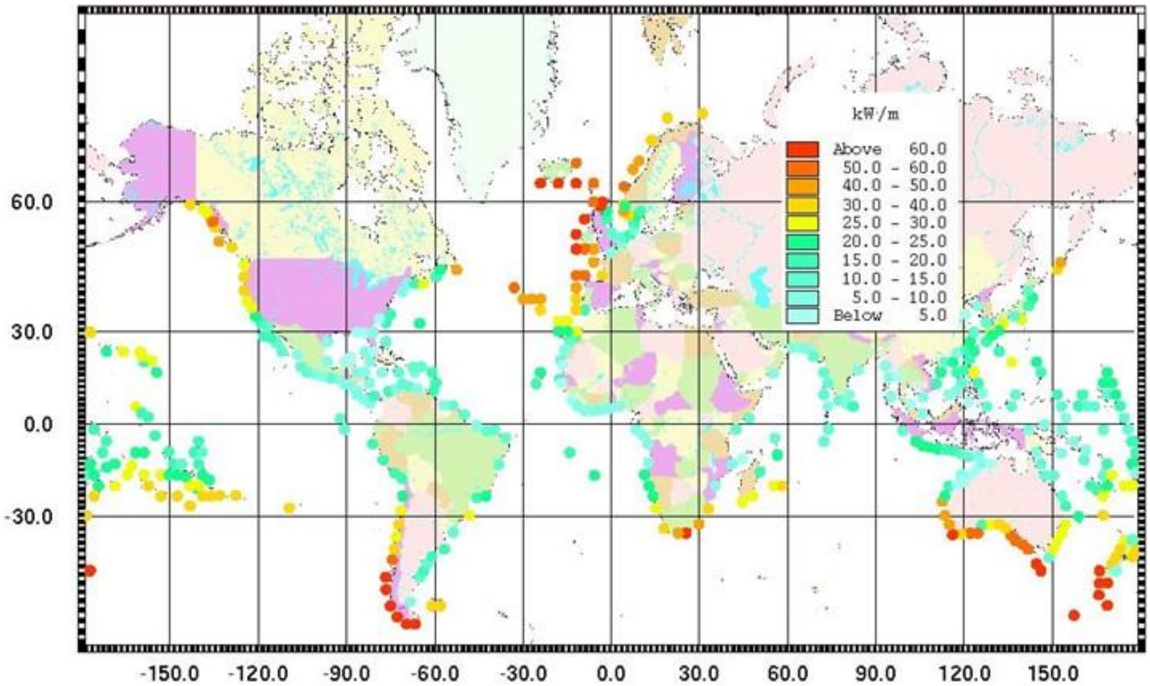

Figure 19: Wave energy map (Barstow, Haug, & Krogstad, 1998)

Figure 20: Satellite image of Guinea-Bissau with specified in red the tidal stations (©Google 2007) (UNIVERSITÀ DEGLI STUDI DI GENOVA)

The mentioned study carried out by Università Degli Studi di Genova mentions several sites for potential use of tidal energy:

- A barrage plant on the side of Rio Mansoa, near village of Fanhé. With an annual average tidal amplitude of 2.2 m, a basin surface area of 29 000 m^2 and a barrage length of 72 m, an average diurnal power potential of 126 kW can be estimated: assuming a 34 % efficiency, the average power output may reach 43 kW.
- A larger tidal plant near Bissau, using a minor tributary of the Rio Geba, as a basin. The barrage would be located at a distance of about 1 km from the capital Bissau, where the estuary width is smaller, in order to reduce the barrage length and decrease its cost. For this site, with an annual average tidal amplitude of 1.9 m, a basin surface area of 1.12 km^2 and a barrage length of 154 m, it has been have estimated an average power of about 1 MW.
- A large tidal plant near Porto Gole, where the recorded tidal range is highest. For this site, with an annual average tidal amplitude of 3.4 m, a basin surface area of 22.5 km^2 and a barrage length of 2 km, it has been estimated an average power of about 50 MW.
- Exploiting the power of tidal currents directly by installing one (or an array of) "free-flow" turbines. Various sites were investigated: along the Rio Geba, along the Rio Mansoa, close to Bubaque. The power output per turbine is fairly small but can be readily increased by installing an array of turbines.

Authors of the study suggest a systematic **field campaign** will have to be performed in order to make progress with the feasibility study for each potential site.

6.7.2 Comparative advantage of technology

Energy from tides is one of the best available renewable sources. In contrast to other clean sources, such as wind, solar, geothermal etc., tides can be predicted for centuries into the future; thus power outputs can be accurately calculated far in advance, allowing for easy integration with existing power networks. However, tidal energy is distributed over large areas, which makes its exploitation more difficult. Moreover, tidal power systems do not generate electricity at a steady rate, hence they are generally unable to meet peak demand (UNIVERSITÀ DEGLI STUDI DI GENOVA).

There are basically two ways of generating electricity from tides: by building a *tidal barrage* across an estuary or a bay experiencing high tidal range, or by extracting energy directly from *tidal currents* (UNIVERSITÀ DEGLI STUDI DI GENOVA). The cost of tidal energy is very site specific, and influenced by geography, distance to grid, and speed and volume of the current.

Additionally, in the case studied by the University of Genova preliminary cost estimates suggest that, since the present cost of 1 kWh produced by a diesel generator in Guinea-Bissau ranges about 0.38 € (neglecting the cost of the generator, its installation and maintenance), the tidal installations discussed would pay for themselves in a period of roughly 10 years. The feasibility of the above solutions is bound to increase with the rapid acceleration of the price of oil and with the foreseeable improvements of tidal plant technology.

The country that has had the most impressive ocean energy development is the UK. In the UK, while it is accepted that the country is rich in wave and tidal resource, the exact size of the practically accessible resource has been the subject of much discussion. The costs of accessing this resource have also been debated at length, with estimates of cost of energy varying from less than 10p/kWh[11] to more than 100p/kWh (Carbon Trust, 2011).

Tidal device baseline costs: estimates from the Marine Energy Accelerator (MEA) put the baseline cost of energy for tidal at 29p–33p/kWh for the first farms[12]. This reflects the modelled cost of energy from leading tidal device concepts at medium and high energy sites with depths of around 30 m (Carbon Trust, 2011). The baseline costs for wave and tidal energy shown by Carbon Trust refer to cost of energy (CoE) calculations using this framework, which takes into account all lifetime costs of a marine energy array, based on appropriate sites with good resource (all in the UK) such as that off the West Coast of the Uists for wave and with average conditions for tidal. Carbon Trust uses a discount rate of 15% for the base case numbers, to take some account of the risk involved in a marine energy project (Carbon Trust, 2011). The variation in the cost of energy is a function primarily of tidal energy density (kW/m2), but also depth and distance to shore. These factors influence multiple cost centres in a tidal energy device, including capital, installation and O&M costs.

6.7.3 Potential local socio-economic added value

The use of renewable energy contributes to the reduction of fossil fuels combustion to produce electricity, thus reducing the dependency on imported energy and the impact of oil prices fluctuation on the economy of the country.

The implementation of renewable energy projects will create direct and indirect jobs, and facilitate the development and implementation of various economic activities (productive uses of energy) such as carpentry, ice factories, sewing workshops, etc.

[11] Pence (British pennies) per kilowatt-hour

[12] First farms are modelled specifically as 10MW farms after 10MW of previously installed capacity. The range represents baseline costs at medium and high energy sites. Pessimistic and optimistic assumptions on technology performance and costs extend the range significantly

Domestic use of renewable electricity can help improving the lifestyle and comfort of households through the use of electrical appliances and lights. The latter would enable students to study in a better environment and under better lighting conditions.

Using non-polluting electricity improves health conditions inside the households as air pollutants are reduced due to the avoidance of other fuels combustion inside the house such as candles or kerosene lamps.

The improvement of electricity supply (either by increasing energy offer or improving the service) may provide opportunities for street lighting, which especially at night would improve security and allow for the development of recreational and commercial activities (cultural events, shops).

7 RENEWABLE ENERGY MARKETS AND CAPACITIES

7.1 Trends of Renewable Energy Investments and Business

There are several renewable energy projects being planned in Guinea Bissau. They have been visited during the first mission to the country. The most relevant ones are:

- SAFIM Biomass Plant – under development by DGE with UEMOA funding.
- Bambadinca – development of a 314 kW PV Plant by TESE.
- FRES PV project in Gabú for electrification
- The Government of Guinea Bissau has signed and letter of intent with and American Company for the development of a 10 MW PV facility in Bissau

There have been other relevant initiatives that involved RE but they are associated to health, educations or rural areas improvements projects, as for example the ADPP projects in Bissora (water pumping, PV for schools and food processing unit).

In addition, there has been some interest from developers in conducting projects, but the lack of a clear procedure and legal/regulatory framework for the PPA agreements that should take place impacts on the feasibility of the projects. Several MOUs have been signed with the government, but apparently no progress has been made.

7.2 Overview on main market enablers

7.2.1 Governmental Institutions

Ministry for Trade, Energy, Industry and Environment: The energy sector is under the supervision of the Ministry for Trade, Energy, Industry and Environment, which is also in charge of the promotion of renewable energy. A General Directorate of Energy (DGE) is in charge of the execution of this policy. Its tasks are the elaboration of the legal and regulatory orders, and their application. It is also entrusted with the promotion of new technologies. This Ministry also regulates the electricity industry. The government intends to create a rural electrification agency and a regulatory commission. The Ministry of Energy is also responsible for regulation of the oil sector. At the regulatory level, the Ministry of Energy delivers import and export licenses for all types of energy products and technologies. The Ministry is also responsible for setting the monthly-reviewed electricity tariff structure (REEGLE, 2012).

Directorate General of Energy: The governmental body in charge of promoting RE projects is the Directorate General for Energy. Up to now, however, all projects and incentives in the field of Renewable Energy (RE) were realised by the investors without any involvement of the Ministry of Energy or the Directorate General for Energy. In terms of feed-in tariffs and other mechanisms for the promotion of RE, there are no laws or regulations (REEGLE, 2012).

In terms of co-financing for the present UNIDO/GEF project the General Director of Energy enforced that the Ministry of Energy will provide co-financing of between 5-10% of the total value of the project. The General Director, also suggested to include the creation of the Regulatory Agency for the Electricity Sector. This goes along with the Ministry's activities as they have now created the Fuels Regulatory Agency and would like to create a similar agency for the electricity sector.

The DGE has the responsibility for establishing the national energy policy and to follow up its implementation as well as overseeing all activities related to the production of electricity and the companies in charge of the distribution of petroleum fuels. With regard to fuels, this responsibility is shared with the General Directorate of Forestry and Hunting (Direcção Geral de Florestas e Caça). The DGE, the EAGB (Company of Water and Energy), the DGFC, and the INITA have the technical responsibility for executing programs related to electricity, firewood and for research and development on renewable energy sources (TESE, 2010).

Directorate General of Industry:

Electricity is one of the main drivers of the industry sector as well as of the development of the country and therefore the Directorate General of Industry should play an active role with regards to electricity supply. The industrial sector is mainly composed of small to medium scale industries.

The main economic sector of Guinea Bissau is the production of agricultural products (peanuts, palm kernels, cashew nuts, rice), cotton, beer, soft drinks, timber and fish (Diplomatic & Consular Yearbook).

Ministry for Natural Resources and INITA (Instituto Nacional de Tecnologia Aplicada):

The development of local energy resources is controlled by the National Institute on Research and Applied Technologies (INITA) under the supervision of the Ministry for Natural Resources (REEGLE, 2012). INITA has been working in the biomass area, developing feasibility studies on the biomass potential in Guinea Bissau, as well as studying different resources to see if those could be used for energy generation (e.g. coconut, rationalisation of biomass consumption, production of biogas from biodigesters)

Ministry of Commerce and Tourism / Inspectorate General of Tourism:

Access to electricity is crucial for the development of tourism and thus the ministry of tourism should also be active in the electricity supply issues of the country. All hotels in Guinea Bissau use diesel generation back-up systems. Electricity costs constitute a large share of the operating costs. The current energy situation creates major constraints for the development of the tourism sector. There are numerous hotels and small pensions on the islands. For all of them, decentralised renewable energy solutions for electricity generation or solar water heating could be of interest. They would like to explore more the tourism on the main land but the unreliability of the electricity system, as well as the lack of coverage, make these investments very difficult.

Ministry of Agriculture:

The Ministry are negotiating with the Embassy of China on the commissioning and development of the PAGIR project (commissioning of 19 small hydro systems for irrigation for rice plantations in Guinea Bissau). The agricultural sector in Guinea Bissau is fundamentally agriculture for subsistence (production of food for own consumption), composed of small farmers that develop their products manually. Guinea Bissau are medium size exporters of cashews but the harvesting process is also done by hand.

Finance Ministry (Ministério das Finanças): The State Secretary of the Ministry of Finance, Dr.ª Tomásia Lopes Moreira Manjuba, referred that the present project seemed very important for the country, and thus that the Ministry of Finance would like to support the project in all the ways possible.

Chamber of Commerce, Industry, Agriculture and Services

The Chamber of Commerce, Industry, Agriculture and Services has been participating in the development of renewable energy as (i) it is part of the economic council where the private sector is present and (ii) through the support in the solar public lighting project promoted by the Government. In terms of the industrial sector: the sector is dominated by the cashew. The cashew processing industry has very high potential to be developed in the country. At the moment a big share of the cashew is exported without being totally processed, and the cashew exports represent 98% of the exportations of Guinea Bissau products. Associated with the cashew industry the Chamber of Commerce, Industry, Agriculture and Services has a Fund for the Promotion of Industrialization of Agriculture, which charges 50 francs CFAs/kg of nuts exported. The fund aims at being used to support industrialization activities to get financing from the banks at lower rates than the ones in practice (country rates are around 16-18% and the money is borrowed only for 2 years – the maximum). Mr. Tavares from the Chamber of Commerce, Industry, Agriculture and Services said that they would be interested in providing co-finance for the development of renewable projects in the industry sector, for either cashew processing plants or for the fish processing unit.

7.2.2 Utilities

EAGB – Electricity and Water of Guinea Bissau (Electricidade e Água da Guiné Bissau): The EAGB is a public company with administrative and financial autonomy. It is responsible for the production and distribution of water and electricity across the territory of Guinea-Bissau. Lack of resources and given the difficulties of the Company, its activity is limited to the city of Bissau. The Ministry of Energy supervises the EAGB through the Secretary of State for Energy (IDEA Consult International, 2013). Electricity is provided by EAGB, which controls the production, transmission and distribution of power in the capital, and sets the tariffs for electricity service throughout the country. Because of the failure of EAGB's supply, there is an estimated 20 MW of private capacity installed by large consumers such as embassies, international organizations, hotels and other institutions. There are also an estimate of 800-1000 small generators used in the residential sector. This is costly to the fragile economy of Guinea-Bissau in terms of competitiveness and has a negative environmental impact as small diesel generators are more costly and less energy efficient than larger utility-run plants. The customer base is very small because of the lack of public supply and there are only about 19,000 customers for electricity and about 7,000 for water. The electric system of Guinea-Bissau is managed by the Electricity and Water Company of Guinea-Bissau (Electricidade e Aguas de Guinea-Bissau, EAGB). EAGB is owned by the national government and is responsible for 90% of power production, with the remaining 10% originating from small, independent power producers (REEGLE, 2012).

7.2.3 Companies (consulting, manufacturers, service, IPPs)

Cashew Production Centre (CPC): There is a biomass vapour and electricity generation system installed that uses the cashew shells as fuel. Part of the vapour is used in the facility for its operations and another part is used for electricity production to supply the plant.

Solartec: Solartec was established in 1997 and they had been working, in partnership with the Ministry of Energy, on the installation of solar home systems, solar lanterns and solar water pumps in small villages under the UNDP that administrates the IBAS (India, Brazil and South Africa) project (also named the India, Brazil and South Africa fund). Solartec has developed a PV project named MORES. This project aims to provide electricity for a small village in Guinea Bissau. The total value of the project is €50,000 and they are looking for financing for 50% of the project in order to proceed with its implementation. The project will be co-funded by ECREEE through the ECOWAS Renewable Energy Facility (EREF). Solartec is currently working on establishing a project for Ilha do Reis.

Atlântico Minas – Potô SARL: They are now looking into explore a sand mine in Guinea Bissau and would be interested in installing renewable energy for electricity supply for the laboratory (10kW) and hotel buildings (10kW) (hotel will be used by the mine workers).

Afripêche: company's representatives explained that they would be very interested in renewable energy options as they have very high production costs due to the fuel consumption necessary for ice production in this fish transformation industry. Diesel consumption represents around 45% of the operation costs of the company.

GCAII, Bula Cashew Processing Plant: They use around 40 litres of fuel per day plus 20 litres for a bus to pick up the plant workers. At the moment they have two diesel generators installed. If they expand the plant, they will require around 100 litres per day, working only one shift, or 200 litres if they work 2 shifts per day. Cashew shells can be used as resource for energy generation.

AGROGEBA – Rice production: Agrogeba needs big quantities of fuel to process the rice (around 280,000 litters of diesel / month) and they need to reduce the cost of the process.

SAFIM Biomass Plant (45 kW): The aim of this plant is to produce energy for Safim village by means of combusting the cashew shells (biomass). It was considered under the Regional Biomass Energy Program of the UEMOA, which allowed the implementation of several pilot projects in its member states. Through this project, UEMOA intends to support Guinea-Bissau in the recovery of energy from cashew shell by creating value on a sustainable basis and ensure the rural electrification of villages with available renewable energy sources. The plant is already installed but is facing several challenges (water availability for the process and grid connection).

7.2.4 Banks and financiers

BAO, Banco da África Ocidental (http://www.bancodaafricaocidental.com/)**:** Its mission is to *"Strengthen confidence in the banking system and contribute to the development and modernization of the Guinean financial market by designing and marketing innovative products and services, in line with the expectations of stakeholders (shareholders, customers, suppliers, employees ...) and with the aggregating high standard of quality and expertise*". BAO aims at financing rentable projects from the commercial point of view. Public projects are not a target for the bank.

BOAD, Banque Ouest Africaine de Développement (West African Development Bank) is an international Multilateral Development Bank established in 1973 by the WAMU (West African Monetary Union) to serve the nations of Francophone and Lusophone West Africa. The BOAD is organised by the Central Bank of West African States and its eight member governments: Benin, Burkina-Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo. It is funded by member states, foreign governments and international agencies. Its headquarters are in Lomé, Togo. The BOAD released a revised mission statement in 2001, refocusing their funding on three development goals: poverty reduction, economic integration and promotion of private sector activity. (Wikipedia, 2013). In accordance to the Bank's database website there was only one energy-related project approved for Guinea Bissau. It was in July 2011, and was to strengthen the capacity of electrical energy generation by the construction of a new diesel thermal plant. Other projects were approved but they were not related to energy issues.

7.2.5 Academia (universities, training centres)

Preliminary list of Universities in Guinea Bissau:

- Universidade Amílcar Cabral (since 2008 suspended for three years): it is the only public university of the country and was funded in 2003
- Universidade Colinas de Boé: it is a private institution funded in 2003, after the Amilcar Cabral University.
- Universidade Lusófona (an extension of the Portuguese university of the same name): http://ulg.grupolusofona.pt/
- Universidade Jean Piaget (an extension of the Portuguese Institute Jean Piaget): http://www.funiber.pt/nossas-sedes/guine-bissau/
- **Action for Development** (Acção para Desenvolvimento - http://www.adbissau.org/):: this association has specialised courses directed at the installation and maintenance of PV systems
- **CIFAP** (Professional Centre of Guinea-Bissau - http://cifapbissau.wordpress.com/author/cifapbissau/): has courses on the installation and maintenance of PV systems.

None of the Universities has a curriculum that integrate RE technical and economic aspects. In Guinea-Bissau only the CIFAP and AD provide courses on the installation and maintenance of PV systems.

7.2.6 Civil Society (e.g. NGOs, women groups)

Most NGOs working in rural areas in the war against poverty are contributing to the expansion of RE especially solar photovoltaic. They are using photovoltaic panel to provide electricity in rural and peri-urban areas to power schools, health centres and hospitals and for water pumping (SNV, 2011).

Action for Development (Acção para Desenvolvimento - http://www.adbissau.org/): it is an NGO located in Bissau that has as amongst its general objectives the reinforcement and promotion of initiatives and activities that tend to the sustainable development of the population, encourages urban and rural population to get involved in activities that favour their socioeconomic development and interests (such as environment-friendly agricultural activities), amongst others.

They provide educational support for the community, and are especially focused on women and young people. Besides the courses that AD has available in Bissau City, they have been also doing courses in the rural areas, for example, at the moment they are participating in a capacity building activity for young people for the Bambadinca PV plant, that TESE is developing. The organisation is partially financed by the local Government as well as by the Portuguese Cooperation in Guinea Bissau, which has reduced its budget.

Ajuda Desenvolvimento do Povo para o Povo (ADPP - http://www.adpp-gb.org/): it is a NGO whose mission is the creation of Economic, Social and Cultural Development in the communities based on the Solidary Humanism and "people to people" approach, establishing projects through which development is implemented in key areas of Education, Health, Agriculture and mobilizing people for active participation. The objectives are assisting in cases of emergency and disasters; to help the natural victims of hunger, war, disasters, and accident of atomic origin, plagues and other catastrophes; to help and to transfer the people and to rebuild the zones affected by this type of disasters.

They are implementing an EU programme (which started in 2011 and will run until 2015, and has around 2,000,000€ of EU funding and 500,000€ of funding from the Spanish Cooperation). The project aims at providing 2,400 farmers in 24 villages with solar water pumping systems. They also have been working on the establishment of a processing centre for food and are looking into the possibility for developing a project using Jathropha to produce biodiesel.

Foundation Rural Energy Services (FRES): FRES is a foundation that fosters rural electrification in developing countries by setting up small-scale commercial electricity companies in areas without a connection to the national electricity grid. We offer to households and small companies access to electricity derived from solar energy. The availability of electricity contributes to poverty reduction and enhances the living conditions of the rural inhabitants. In early 2012, FRES established FRES Guinea-Bissau in Gabú, a province in the east of Guinea-Bissau that borders on Senegal and Guinea. The headquarters are located at the provincial capital, Gabú. The first clients were installed in early 2012, with full installation activities commencing in October. FRES is currently implementing an EU funded project that aims at supplying 3,000 solar home systems to the population near Gabú. FRES is now looking to develop a mini-grid hybrid PV project to be implemented in Guinea Bissau similar to the projects that they have been developing in Mali and in other African countries.

TESE - Associação para o Desenvolvimento/ Programa Engenheiros Sem Fronteiras (NGO): TESE creates and implements innovative responses that best promote social development, equal opportunities and quality of life, creating partnerships with public, private, and organization of civil society. TESE invests on a positive and pro-active attitude. They implement projects on the ground as responses to known social needs. Several projects were identified that can be analysed and be undertaken within the present GEF/UNIDO project.

Prosolia http://prosoliaenergy.com/: the organisation is currently cooperating with TESE in the solar project for Bambadinca.

7.2.7 Donors

Spanish Cooperation Agency (Agencia Española de Cooperación Internacional para el Desarrollo (AECID) http://www.aecid.es/es): Mr. Luis Bolea Berbé, representative in Bissau of the Spanish Cooperation, stated that AECID develops projects in the country in the areas of agriculture, education and water. In Guinea Bissau, they are not looking into developing projects in the energy field. Moreover at the moment all projects are in stand-by phase due to the current political situation in the country.

SNV, Dutch Organisation for Development: SNV has been present in Guinea-Bissau since 1979. During the 30+ years their work has evolved from using a donor approach to a strategy that focuses exclusively in the development of local capacities. SNV does not have a department or projects directly related with renewable energy as they act more on the agriculture, water and health sectors. Nevertheless, renewable energy is considered in their projects, as a need for the other sector's development.

Portuguese Cooperation in Guinea Bissau / Portuguese Embassy in Guinea Bissau: The Portuguese Cooperation provides co-finance for smaller projects than the one we presented.

- **CAMÕES – INSTITUTO DA COOPERAÇÃO E DA LÍNGUA, I.P. (CICL):** is a public institute, integrated in the indirect State administration, with administrative and financial autonomy and its own assets, which pursues responsibility of the Ministry of Foreign Affairs (MFA), under the appropriate supervision and guardianship of the Minister. The institute has provided co-financing for several projects in Guinea Bissau[13], which focus on health, education, and sustainable development. The Portuguese ODA to Guinea-Bissau has been following slightly decreasing trend in the last five years, reaching an average of 10 M € between 2008 and 2012.

UNDP in Guinea Bissau (http://www.gw.undp.org/): UNDP is involved in projects classified under four main lines: i) democratic governance, ii) poverty reduction; iii) environment; and iv) crisis prevention and recovery.

United nation agencies have been one of the main contributors for the deployment of renewable energy sources in Guinea Bissau. For the past few years, they have reinforced the use of solar photovoltaic in all projects that had an electrical energy component (to power electrical equipment or for water pumping in rural and semi-urban areas) (SNV, 2011).

ECOWAS Renewable Energy Facility (EREF)[14]: The ECOWAS Renewable Energy Facility (EREF) is a grant facility which is managed by the Secretariat of the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) based in Praia, Cape Verde. It provides grant co-funding for small to medium sized renewable energy and energy efficiency (RE&EE) projects and businesses in rural and peri-urban areas. The Facility undertakes regular demand driven call for proposals. During its first phase of operation (2011 to 2016), the EREF will test and sharpen its funding policy and find its comparative advantage in the West African market. In the second phase (2016 to 2020) the EREF will broaden its portfolio of financial instruments and support schemes (e.g. micro credits). The Facility was established with initial support of the Austrian Development Cooperation (ADC), the Spanish Agency for International Development Cooperation (AECID) and key technical assistance from the United Nations Industrial Development Organization (UNIDO). The Facility is open to other donor partners and is seeking further support for future call for proposals. The EREF is part of the annual work plan of ECREEE and fully integrated in its governance structure. There are two approved projects for Guinea Bissau in the list of EREF projects:

- To improve biomass use in Guinea Bissau through the promotion of energy efficient portable clay cookstoves in rural households (executed by ADPP GB)
- Rural electrification for Mores village (executed by Solar Tech)

ECOWAS Renewable Energy Investment Initiative (EREI)[15]: The ECOWAS Renewable Energy Investment Initiative (EREI) aims at mitigating financial barriers to investments in medium and large-scale renewable energy projects and businesses in the ECOWAS region. It assists member countries to make use of their individual RE potentials by providing support to develop a technical and economic feasible pipeline of projects and attracts the interest of possible investors and financiers. In the case of Guinea Bissau, two projects were submitted for assessment: Saltinho hydroelectric project (18 MW), and Solar PV plant (9 MW). In accordance with the Project Appraisal Report[16] published by ECREEE on August 2012 the hydro project is based on old data, and the solar project needs further work, particularly on land availability and solar resource assessment.

GEF Strategic Program for West Africa (SPWA)[17]: In an effort to bolster regional activities in the energy sector, the Global Environment Facility (GEF) Council, in 2008, approved the Strategic Programme for West Africa (SPWA). The program is coordinated by UNIDO in partnership with ECREEE. The main objective of the energy component of this programme is to increase energy access, promote energy efficiency and improve global environmental sustainability by focusing on four areas: end-use energy efficiency, sustainable agrofuel production and use, mini and micro hydro power, and mini-grids based on renewable energy for productive uses. With an investment of $39.86 million, the SPWA-Energy Component presently supports a portfolio of twenty-two renewable energy and energy efficiency projects (one regional project and twenty-one national projects) within the region. Formulated by GEF agencies namely: UNDP, UNEP, UNIDO and the World Bank, these projects are implemented by national authorities in the fifteen ECOWAS countries, Burundi and Chad. Amongst the projects of the SPWA energy component, ten have an explicit focus on renewable energy. Five of these include biomass, three include solar, two include wind, and five include small hydro power. There are no project for Guinea-Bissau under this programme.

EU: After the military has taken over the Government in 2010 the European Union has frozen its support to the country. In terms of energy, at the moment the EU Delegation is only operating through NGOs (such as TESE and ADPP). Most of the projects in the pipeline for Guinea Bissau were projects for reinforcing the grid network in Bissau City; funds from the EU were aligned for the construction of the grid ring (medium voltage) around the city as well as for the establishment of a low voltage grid connection to provide access to electricity to the population.

West Africa Economic and Monetary Union (UEMOA – Union Economique et Monetaire Ouest Africaine – www.uemoa.int**):** UEMOA has a component that provides financing for renewable energy projects and that it knows the projects that are being

[13]Full list of projects: http://www.instituto-camoes.pt/index.php?option=com_moofaq&view=category&id=744&Itemid=1588

[14] http://www.ecreee.org/page/renewable-energy-facility-peri-urban-and-rural-areas-eref

[15] http://www.ecreee.org/page/ecowas-renewable-energy-investment-initiative-erei

[16] http://www.ecreee.org/sites/default/files/documents/basic_page/erei_project_appraisal_report.pdf

[17] http://www.ecreee.org/page/gef-strategic-program-west-africa-spwa

developed in the country in the field. UEMOA Department of Energy and Renewable Energy has been working with DGE in renewable energy and energy projects. UEMOA mobilizes funds for projects in this area, when projects need large investments.

U.S. Assistance to Guinea-Bissau: The United States established diplomatic relations with Guinea-Bissau in 1975, following its independence from Portugal. Post-independence, the country has seen a mix of coups, attempted coups, civil war, assassinations, and democratic elections. The United States strongly condemned the April 2012 attempt by elements of the military to forcibly seize power, called for maximum restraint on all sides and the restoration of legitimate civilian leadership, and continues to work with its partners in the region and beyond as it monitors developments on the ground. Now that the Economic Community of West African States (ECOWAS) has returned Bissau-Guinean military factions to their barracks and a civilian government is in power, the United States is working with its partners and the Transitional Government of Guinea-Bissau to facilitate free and fair elections by spring 2013, and to promote basic reforms on governance, justice, and economic development. There is no U.S. Embassy in Guinea-Bissau. All official U.S. contact with Guinea-Bissau is handled by the U.S. Embassy in Senegal. Local employees staff the U.S. Office in Bissau, and U.S. diplomats from the Embassy in Dakar travel frequently to Bissau. Given the April 12, 2012 coup, the United States was obliged to terminate foreign assistance to the Government of Guinea-Bissau consistent with the requirements of section 7008 of the Department of State, Foreign Operations and Related Programs Appropriations Act for 2012. Previous limited non-humanitarian assistance focused primarily on the justice sector as well as demining and proper weapons storage programs (U.S. Department of State, 2012).

World Bank (http://www.worldbank.org/en/country/guineabissau): With the support of the World Bank, the Government is currently making efforts for the rapid restoration and improvement of electricity and water supply services in its capital city (REEGLE, 2012). The World Bank portfolio in Guinea-Bissau includes projects in rural development, coastal and biodiversity management, infrastructure rehabilitation and more. The current lending portfolio consists of five IDA-funded projects totalling around US$42.85 million equivalent, and focusing on multi-sector infrastructure rehabilitation, emergency electricity and water rehabilitation, bio-diversity conservation, community-driven development, and regional fisheries. Trust-funded grants - drawing on European Union funds, the State and Peace-Building Fund, and the Global Environmental Facility - provide an additional US$12.45 million for emergency food security, including rice production and school feeding/food-for-work programs in collaboration with the World Food Program (WFP), as well as coastal and biodiversity management, participatory rural development, and to provide technical assistance to the emerging extractive industries sectors.

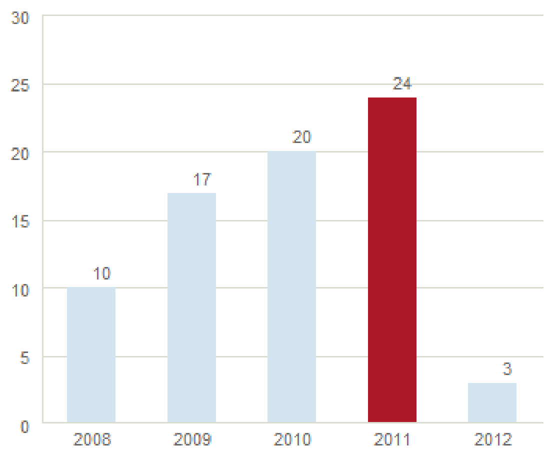

Figure 21: Lending - Guinea Bissau: Commitments by Fiscal Year (in millions of dollars)[18] (The World Bank, 2013)

The World Bank has also supported non-lending activities in Guinea-Bissau, and in recent years it has completed a Public Expenditure Management and Financial Accountability Review (PEMFAR), drawing in part on an EU-funded PEFA diagnostic and covering public financial management and procurement performance, as well as a review of public expenditures in education. An Education Country Status Report (in preparation of the EFA/FTI funding proposal), an Investment Climate Assessment, a Diagnostic Trade Integration Study, Country Economic Memorandum, and a Debt Management Performance Assessment were also completed during the last three years. The **International Finance Corporation (IFC)** made significant progresses prior to April, 2012, coup on three initiatives including a warehouse financing deal with a bank to facilitate export of cashews, a PPP project on EAGB jointly with the World Bank and an Investment Climate reform program also jointly with the WB. All three projects were put on hold due to the political situation (The World Bank, 2013).

[18]Amounts include IBRD and IDA commitments

8 ONGOING ELECTRIFICATION/IMPROVEMENT PROJECTS

8.1 Service Improvements

Name of the project	Description	Funding	Project Implementation
ECREEE/GEF/UNIDO	Promotion of Investments in Renewable Energy in the electricity sector and creation of an enabling environment for its replication in Guinea Bissau	8,000,000 Euros	Status : Preparation Date: 2013
Project for the construction of a transmission ring system of 63 kV around Bissau, European Commission	Construction of a transmission ring system of 63kV around Bissau with three energy injection points: Bôr, EAGB thermal plant and Antula.	23,000,000 Euros (financed by FED 10)	Status : Cancelled due to political instability Date: 2013
Multi-sector Infrastructure Rehabilitation Project (World Bank)[19]	The Multi-Sector Infrastructure Rehabilitation Project for Guinea-Bissau aims to increase the availability of urban power, water and roads infrastructure services. The project has the following components: Component 1: will finance technical assistance, local and international consultants, specialized financial and accounting software for the utility, and institutional development and strengthening support for the Ministry of Economy and, when it is established, for the Multi-Sector Regulatory Agency. Component 2: will essentially support a fast-tracked restoration and rehabilitation of power generation and distribution, and commercial operations in Bissau. Component 3: will finance the rehabilitation and reinforcement of water production systems in the city of Bissau, for the purpose of restoring a 24 hour a day water service to the entire population of Bissau. Component 4: will essentially include a limited rehabilitation of pot holes along a set of roads of 20-30 km in the City of Bissau. Component 5: will finance the operational costs of the Project Coordination Unit (PCU), including: (a) staff (consultants); (b) technical assistance and auditing costs; (c) office equipment and supplies; (d) office rental, utilities and related expenses; (e) accounting and office software; (f) vehicle maintenance costs, fuel and spare parts; (g) training; and, (h) coordination and study travel costs.	Ida Grant: 15,000,000 USD West African Development Bank: 5,000,000 USD	Status: Active Approval date: June 15, 2006 Closing date: March 31, 2014

Note: Most of the projects were cancelled due to the coup d'etat of April 2012, where the Guinea Bissau state was banned from the international organisations and partners.

8.2 Grid-Connected Projects

Name of the project	Description	Funding	Project Implementation
Construction of a PV solar thermal plant in Gardette and Mafanco SUNTROUGHENERGY	Solar photovoltaic plant of 10 MW in Gardette, HELIUS – I solar project Solar photovoltaic plant of 10 MW in, HELIUS- II solar project AC	28,958,000 USD 28,958,000 USD	Status :In preparation Date: 2013
Community programme of Access to Renewable Energies	Overall objective: Contribute to the Bafatá region to meet Millennium Development Goals, in particular MDG 1 and MDG 2, by providing a reliable and modern electricity service. Specific objective: Ensure sustainable access to electricity using renewable sources of the semi-rural centre	EUR 2,140,724	Status : in Execution Date: 2012

[19] http://www.worldbank.org/projects/P097975/multi-sector-infrastructure-rehabilitation-project?lang=en&tab=overview

	of Bambadinca, Guinea-Bissau		
Construction of the Bôr thermal power plant (55MW), BOAD	Construction of a new thermal power plant in Bôr: 1ª phase 15MW	30,456,000 USD	Status: In preparation Date: 2013

8.3 Off-grid/Rural Electrification Projects

Name of the project	**Description**	**Funding**	**Project Implementation**
Renewable energy for local development, Bissorã Sector, Oio Region, Guinea-Bissau	Overall objective: Improve the living standards and local economic conditions in rural, low-income areas of Guinea-Bissau. Specific objective: Introduce and establish renewable energy systems for local development in Bissorã Sector, Oio Region in Guinea-Bissau. **O1**: Increasing the number of solar and bio-fuel energy supplies in the rural areas. **O2**: Increasing human capacities to ensure that renewable energies are pursued in rural areas, wherever cost-effective. **O3**: Helping to protect the environment by promoting less reliance on non-renewable energy.	2,38,.008 EUR	Status : Implementation Date: 2012
Decentralised Rural Electrification project through solar power systems in the Regions of Bafata, Oio and Biombo, (GNB00079309)	The Rural Electrification programme through decentralized PV systems financed by the fund IBAS (India Brazil and South Africa) aims to improve the quality of life of populations framed in the intervention zone. The programme consists in the installation of solar equipment in schools, health centres, potable water supply, youth centres, public lighting, and supply of solar lanterns in 25 small villages.	596,305USD	Date: 2009-2013 Status: In finalization
Solar Component Home System, International Organisation North American International Organization in Dakar	The project consist in the implementation of photovoltaic systems in the villages of Mabonco, Sintcham Botche and Cambadju	TOSTAN International	Date: 2012 Status: Finished
Solar Home systems	Free distribution of solar systems for lighting in houses and small villages where the project is also acting in the areas of Health and Education.	Effective Intervention	Date: 2012 Status: Finished
Providing Solar Home Systems (SHS) to the rural and peri-urban population of the region of Gabú in east Guinea-Bissau on a fee-for-service basis	Objective: Improve the living conditions of Gabú region. The overall objective of the action is the provision of basic electricity to the rural population of the Gabu region. By making affordable electricity to the poor and rural population, the action aims to contribute to improving their living conditions. Access to electricity profoundly influences the quality of life, for example, allows that children who attend school to do their homework at night and that families use radios, televisions and mobile phones, thus improving the exchange of information. Also allows for increased safety at night. The action will also stimulate the local economy by encouraging the development of existing businesses and the creation of new businesses. Access to electric light extends the day: the shops and workshops will be open until later, increasing productivity and profit. On the other hand, access to		

	radio and television and, above all, to your phone, allows traders to get more information, particularly in relation to current market prices in the surrounding area. This is particularly important, since the city of Gabu is a trade centre in the region with Senegal and neighbouring Guinea. Finally, the action seeks to reduce the problems associated with the burning of oil. Access to replace electric lighting using the oil, thereby reducing the risk of fires and fumes indoors leading to respiratory problems. Specific objectives: 3000 clients in 4 years The proposed action involves the establishment of a company in Gabu for providing solar electricity to rural and not connected to the network local population. The specific objective of the action is of 4 years after the onset of action, about 3,000 households and businesses (approximately 27,300 people) use solar home systems (SSD) completely installed on a basis of payment for services rendered sustainable, allowing them to have a clean source of illumination and the use of mobile phones, televisions and radios.		

8.4 Cooperation Projects related with Renewable Energy

Name of the project	Description	Funding	Project Implementation
OMVG project: construction of hydropower plants in Kaleta and Sambagalou, and a transmission line of 225kV and in a second phase construction of two other hydropower project in Saltinho and Felou)	This regional project aims at exploring and valorising water resources (in the Gambia, Corubal and Geba rivers) through construction and exploration of hydropower stations and a transmission line for four countries: Guinea-Conakry, Guinea Bissau, Gambia and Senegal)	857,200,000 Euros	Status : In execution Date: 2012
SABER/UEMOA Decentralised rural electrification project (PRODERE)	This project aims at electrifying 48 villages through: installation of SHS in schools, youth centres and sanitary centres; public lighting and solar system for water pumping.	4,500,000 USD	Status: In preparation Date: 2013
ECREEE/GEF/UNIDO	Promotion of Investments in Renewable Energy in the electricity sector and creation of an environment for its replication in Guinea Bissau	8,000,000 Euros	Status: in preparation Date: 2013 Implementation of the project expected between 2014-2018

9 ADDRESSING EXISTING BARRIERS FOR RENEWABLE ENERGY MARKETS

This section identifies existing barriers and provides recommendations for addressing and mitigating them in order to increase the role of renewable energy within Guinea Bissau.

9.1 Financial Barriers

9.1.1 Table of barriers and recommendations to address them

Barrier	Description	Recommendations
Availability of financing instruments /	Financial institutions tend to lend money only to projects that are considered financially attractive. Due to a lack of information about the "attractiveness" of RE technologies,	Train banks and other financial institutions about the financial aspects of RE projects and how they can provide tailor-made financial instruments for

institutions in the country	they are usually reluctant to financing RE projects, which is also encouraged by the weak political and economic scenario of the country.	this type of projects.
High capital costs of RE solutions (affordability)	Although lower fuel and operating costs may make renewable energy cost-competitive on a life-cycle basis, higher initial capital costs can mean that renewable energy provides less installed capacity per dollar invested than conventional generation. Renewable energy therefore requires a greater level of financing for the same capacity. Of course this should always be analysed in a case by case basis as diesel generation costs keep growing and some renewable sources are decreasing, and therefore grid parity could be achieved.	In the cases where the initial capital cost of a RE is prohibitive, specific financial instruments should be considered, for what is also crucial to train financial institutions on how to better provide specific services.

9.2 Institutional and Regulatory Barriers

9.2.1 Table of barriers and recommendations to address them

Barrier	Description	Recommendations
Unstable political and economic environment in the country	After several years of economic downturn and political instability, in 1997, Guinea-Bissau entered the CFA franc monetary system, bringing about some internal monetary stability. The civil war that took place in 1998 and 1999 and a military coup in September 2003 again disrupted economic activity, leaving a substantial part of the economic and social infrastructure in ruins and intensifying the already widespread poverty. Following the parliamentary elections in March 2004 and presidential elections in July 2005, the country is trying to recover from the long period of instability despite a still-fragile political situation[20]. Unfortunately in 2010, the military took over the government and that generated a decrease in external aid (e.g. EU and Spanish cooperation). Guinea Bissau is currently preparing for democratic elections which will be undertaken under the oversight of UN. They will take place during March 2014[21] and will most probably improve the situation from then on.	Whenever possible try to plan projects than can be executed in several stages with concrete goals that could be achieved in relatively short periods of time to reduce the impact of economic and political instability.
Lack of a clear tariff structure	The selling prices of water and electricity in Guinea Bissau have remained frozen since 1997, despite the changes in the structure and levels of production costs that depend on oil prices. Inconsistencies are surprising when analysed by month or type of fare (Social BT, BT Normal, BT Business and shops and MT). An unclear tariff regulatory structure could negatively impact on the tariff setting for renewable energy generation.	Consider the provision of technical assistance to assess and suggest a regulatory framework for tariff setting in the country as well as for other needed procedures that can improve the management of the local energy market.
Insufficient policy and regulatory support for RE development	Currently there is no policy and regulatory framework established in the country that exclusively supports the development of RE. However, there are initiatives and plans that promote or intend to spread the use of RE, for example the "Plano Director de Energia" (Energy Master Plan), which is under development and the Poverty Reduction Strategy Paper. Moreover, the ECOWAS	Start working on strengthening the local policy and regulatory framework of Guinea Bissau taking into consideration the lessons learnt and experiences of other ECOWAS members as well as the plans and programmes approved by that organisation. Develop and make available a standard PPA as well as clear licensing procedures for PPP.

[20] https://www.facebook.com/pages/Guinea-Bis%C3%A1u/105534179480498?fref=ts#

[21] http://www.reuters.com/article/2013/11/15/us-bissau-election-idUSBRE9AE0Q420131115

	member states (including Guinea Bissau) adopted a regional policy for renewable energy which aims at increasing the share of renewables (excl. large hydro) to 19% of the overall electricity mix of the region by 2030.	The Ministry of Energy should develop an investment plan for RE that should be advertised and made available for the different market players in Guinea Bissau.
Insufficient institutional capacity	Currently the only governmental organisation in charge of renewable energy issues is the DGE, which also takes care of the rest of the energy-related issues that the country has to face. There is no specific group that focuses on the renewable energy aspects of the country. The government's Ministry of Energy regulates the electricity industry. The government intends to create a rural electrification agency and a regulatory commission. The Ministry of Energy is also responsible for regulation of the oil sector (REEGLE, 2012).	Provide the necessary training to the DGE people responsible for managing RE projects and initiatives. In addition to the creation of the rural electrification agency and the regulatory commission, it could also be considered the creation of a "working group" within the DGE that focuses only on RE, EE and sustainable use of energy.

9.3 Technological Barriers

9.3.1 Table of barriers and recommendations to address them

Barrier	Description	Recommendations
Insufficient renewable energy baseline data	The available information about the RE resources in the country is limited. There have been general studies for all the resources conducted by different organisations in different years. As biomass, especially from cashew, is one of the most easily available resources in Guinea Bissau it has been studied with more attention than the rest of the resources. Many of the studies that have been analysed during the preparation of this document state that further investigation and monitoring campaigns should be conducted in order to have more reliable information on a certain resource. This is particularly important in the case of those resources (e.g. wind) where, in order to study their feasibility, statistical data and a good background of on-site measurements are needed.	Plan monitoring campaigns for those resources that are more attractive. Coordinate with the organisation in charge of monitoring meteorological data. Start recording information on RE and keep a backup of the information as well as designation an entity responsible for managing that information.
Poor energy transmission and distribution grid	In accordance with the collected information, the electricity distribution grid often suffers power cuts and load shedding. It is insufficient to cover the geography/demand. Medium voltage lines are absent in Guinea Bissau (i.e. transmission lines) which complicates the possibility of importing energy from Senegal. In Niger, Burkina Faso, Benin, Togo, Liberia, Sierra Leone, Guinea Bissau, Guinea, and the Gambia, electricity access to rural areas is poor, around 2%. Furthermore, only less than half of the urban areas have electricity access. It is obvious that these countries have to develop their national grids. Some countries like Burkina Faso and Benin are extending theirs. These countries are depending greatly on the timely implementation of the regional projects with new large hydropower, CC gas plants and/or power line projects (ECREEE, 2012). Absence of power grids, impacts directly on the possibility of connecting more capacity, in spite of its origin (renewable or conventional). As an example, there are plans to build a 10 MW PV plant to be commissioned in 2014, but the current grid cannot	There are plans to upgrade the network in low and medium voltage. There is a new cross-border transmission project, the OMVG that will go through Senegal, Guinea, Gambia, and Guinea Bissau, with a total capacity of 315 MW planned for 2017. A suggestion is to identify options and opportunities that can speed up the upgrading process of the grid. If donor funding is reactivating now that the presidential elections are coming, then probably this could be one of the priorities. Moreover, consideration could also be given to off-grid options, which are already undergoing in some parts of the country (Bissora, Gabú), to reduce the percentage of not electrified households, schools and health centres.

	support that power. Unlike other RE, wind energy requires a more stable and reliable grid with some regulating capacities like hydro and thermal capacity to absorb in real time the fluctuation of a wind based power production (ECREEE, 2012). These factors limit the integration of new RE technologies to the grid.	
Insufficient technical capacity in the local market to identify, develop and implement renewable energy projects	There is a limited technical capacity to design, install, operate, manage and maintain renewable energy based modern energy services, mainly due to a lack of experience in this (new) field.	Capacity building and training programmes can be delivered to government officials that are involved in the energy sector. Moreover, RE knowledge should be created at university level (as referred there is no curriculum in the Universities that address RE). This will improve local capacity to address local issues related to RE implementation.

9.4 Information and Awareness Barriers

9.4.1 Table of barriers and recommendations to address them

Barrier	Description of barrier	Recommendations
Limited information on renewable energy technologies and opportunities	There is poor awareness of renewable energy technologies and the opportunities they can offer beyond the solar water pumping systems and other small rural PV applications (the exception could be the use of biomass from cashew shells). Therefore there is limited knowledge of the renewable energy market potential to be harnessed.	Improve the knowledge database by carrying out awareness raising campaigns and seminars to raise awareness of the different market players and enablers on RE technologies and opportunities.
Lack of access to information (for the general public)	In terms of the local population, as most of it is rural and in both urban and rural areas, there is a limited access to electricity, information channels are not accessible: people do not have easy access to radio, TV, internet, etc. that may allow them to be more informed about the benefits of renewable energy for rural off grid applications or for home applications (in spite of grid availability).	Look for alternative channels to start distributing information and raising awareness amongst the communities. Generate focus groups and space for discussion in communal meetings. Do surveys and find out the level of knowledge, interest and concerns of the people regarding the energetic issues. Build a website directly advertising RE opportunities and the benefits of this technologies for those who have access to internet.
Limited information available for IPPs on how to develop RE projects	This is part of the institutional limited capacities to produce a well-structured regulatory and legal framework that establishes the procedures that IPPs need to follow in order to generate and sell energy.	By addressing the institutional barriers, this barrier would be addressed at the same time. In fact, it could be beneficial to involve IPPs in certain parts of the decision-making process of creating the regulatory framework to enable a more productive environment.

10SUMMARY FOR INCLUSION IN GEF-UNIDO PROJECT

The GEF-UNIDO project has a limited budget and therefore should focus its efforts to ensure that the support provided is as effective as possible. Therefore from the above list of recommendations to help promote and develop the market environment for small to medium scale renewable energy systems the following activities are recommended for inclusion in the GEF-UNIDO project.

Investment on renewable energy projects

A number of investment projects with the potential for replication and scale-up. It is recommended that the investment projects include on-grid, mini-grid and off-grid projects since this will show the widest possible replication potential. The final number of projects will be determined by the projects eligibility and the availability of grants and co-finance. Significant technical and financial support should be provided.

The evaluation of these investment projects to prove their technical feasibility and commercial viability and the dissemination of this information is key to helping the market develop.

Scaling-up of RE projects

Identification of further RE projects and technical and financial assistance provided to support these projects and National Investment Strategy for Renewable Energy prepared.

Strengthening the legal and regulatory framework:

Revise the legislation in place for renewable energy. Provide assistance in the development of the NREPS and NREPs

Provide guidance /indication of secondary legislation that should be developed.

Register this GEF-UNIDO project as a NAMA

Strengthening institutional capacity

Provide training programmes as Train-the-Trainer programmes to ensure long-term sustainability

Provide capacity building to government institutions to allow it to become a focal point for RE

Provide training programmes direct to the potential market stakeholders covering the opportunities, design and development, operation and maintenance of RE projects.

Project Management

It is recommended that the project management office (PMO) for the UNIDO project is established within the DGE. It is intended that DGE with support from ECREEE will be the key agency for renewable energy promotion during and after the UNIDO project

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ANNEX I: TECHNICAL PAPER ON THE HYDROPOWER SECTOR IN GUINEA BISSAU (DECEMBER 2013)