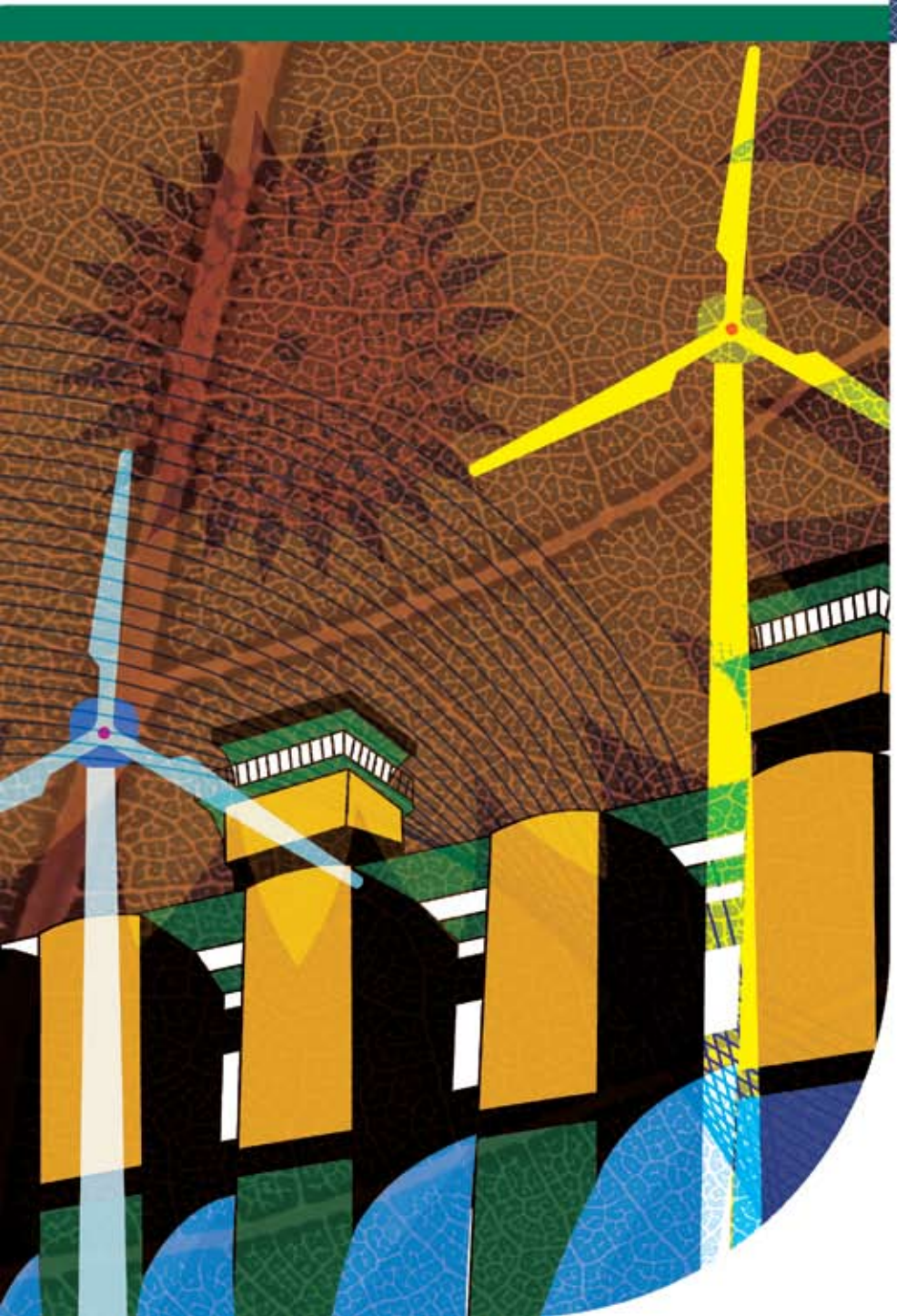
IRENA
International Renewable Energy Agency

# THE GAMBIA

## RENEWABLES READINESS ASSESSMENT 2013



## About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low carbon economic growth and prosperity.

**Authors:** Gauri Singh (IRENA), Safiatou Alzouma Nouhou (IRENA) and Mohamed Youba Sokona (IRENA)

## About RRA

A Renewables Readiness Assessment (RRA) is a holistic evaluation of a country's conditions and identifies the actions needed to overcome barriers to renewable energy deployment. This is a country-led process, with IRENA primarily providing technical support and expertise to facilitate consultations among different national stakeholders. While the RRA helps to shape appropriate policy and regulatory choices, each country determines which renewable energy sources and technologies are relevant and consistent with national priorities. The RRA is a dynamic process that can be adapted to each country's circumstances and needs. Experience in a growing range of countries and regions, meanwhile, has allowed IRENA to continue refining the basic RRA methodology. In June 2013, IRENA published a guide for countries seeking to conduct the process in order to accelerate their renewable energy deployment.

For more information visit www.irena.org/rra

## Acknowledgements

IRENA prepared this report in close collaboration with Yacob Mulugetta (University of Surrey), Abeeku Brew-Hammond and Edward A. Awafo (The Energy Center, Kwame Nkrumah University of Science and Technology), and Sambou Kinteh (independent consultant, The Gambia). The report benefited from review and consultations with the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE). IRENA wishes to thank the following experts for their insights and constructive guidance during the peer review process: Manuel Fuentes (IT Power - UK), Haruna Gujba (African Union Commission - AUC), Monica Maduekwe (ECREEE), Modou Manneh (Ministry of Energy, The Gambia), Hans Noteboom (Gamsolar Gambia), Bah Saho (ECREEE) and Frank Wouters (IRENA).

For further information or to provide feedback, please contact:
SAlzouma@irena.org or secretariat@irena.org

## Disclaimer

# THE GAMBIA

## RENEWABLES READINESS ASSESSMENT 2013

# FOREWORD

The Gambia, at present, is totally dependent on petroleum products for transport and electricity generation. This dependency has continued in spite of the existence of a formulated renewable energy policy, maintaining pressure on the national economy and ensuring a weak balance of payments. Given the volatility of international fuel prices, The Gambia has one of the highest electricity tariffs in the West African sub-region. The Renewables Readiness Assessment (RRA) for the Gambia could not, therefore, have come at a better time.

The availability of adequate, reliable, affordable and sustainable energy is a critical milestone in the socio-economic development of any country. While less than half of all households in The Gambia have access to electricity, over 90% are still dependent on solid biomass for cooking and heating. This has intensified poverty. Thus, a top priority in government energy policy to promote the deployment and use of renewable energy and energy-efficiency (RE/EE) technologies, in order to improve energy security and access to modern energy services. To fulfil this objective, the government has taken a number of steps: establishing The Gambia Renewable Energy Centre (GREC); adopting a policy of zero import duty on RE/EE technologies; and recently drafted a renewable energy law. These efforts have been constrained by inadequate financial, human and institutional resources, which remain major challenges, as highlighted by the RRA. Concerted efforts by all stakeholders are therefore needed to bring down these barriers.

In recognising the strong support of our traditional donors in the energy sector, it is our expectation that the International Renewable Energy Agency (IRENA) will share this RRA report with a wider spectrum of partners. Our hope is to attract more support, to reduce the constraints identified, and bring more investment, so as to facilitate rapid renewable energy deployment and broaden access to energy services, thereby improving economic growth and reducing poverty in The Gambia. We also have great hopes that the experiences gained in The Gambia will also provide helpful lessons for applying the RRA methodology in other countries. My own, admittedly personal, assessment is that the methodology has proven highly effective in defining the barriers to rapid renewable energy technology development.

**Hon. Teneng Mba Jaiteh,**
**Minister of Energy,**
**The Gambia**

# FOREWORD

The Africa High-Level Consultative Forum held by the International Renewable Energy Agency (IRENA) in July 2011 highlighted the need for technical support for African countries and regions to identify their renewable energy readiness. The Renewables Readiness Assessment (RRA) process stemming from this involves a holistic evaluation of a country's conditions and identifies the actions needed to overcome barriers to renewable energy deployment. This is a country-led process, with IRENA primarily providing technical support and expertise to facilitate consultations among different national stakeholders.

Since 2011, more than 14 countries in Africa, the Middle East, Latin America and the Caribbean, Asia and the Pacific Islands have undertaken the RRA process, which generates knowledge of good practices and supports international cooperation to enable the accelerated deployment of renewable technologies. The Gambia, in keeping with its strong and consistent support of IRENA's mission, is one of these pioneering countries.

As the RRA highlights, The Gambia has relatively high electricity tariffs. However, with an electricity network consisting of mini-grids, the country is well positioned to integrate solutions based on renewable energy. IRENA and several partners – with their understanding enhanced by the RRA process – have initiated studies to demonstrate the commercial viability of hybrid mini-grids in The Gambia and thereby attract investment.

IRENA would like to thank Minister Jaiteh and her team for their patience and generosity in hosting this study. Their engagement and input have exceeded expectations, and we are grateful for their important contributions, which have resulted in valuable insights for further RRAs in the 2014-2015 period. Additionally, this report will feed into other IRENA regional work, including modelling and analysis on planning and prospects for renewable energy in West Africa.

We sincerely hope that the outcomes of these RRA consultations will help The Gambia's to fulfil its aim to scale up renewable energy. IRENA stands ready to provide continuing support to The Gambia in implementing the actions identified.

**Adnan Z. Amin**
**Director-General, IRENA**

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# ACRONYMS

| | |
|---|---|
| ECOWAS | Economic Community of West African States |
| ECREEE | ECOWAS Centre for Renewable Energy and Energy Efficiency |
| FIT | Feed-in-Tariff |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GEG | Global Electrical Group |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit/ German International Cooperation Agency |
| GREC | Gambia Renewable Energy Centre |
| GTTI | Gambia Technical Training Institute |
| GWh | Gigawatt hours |
| IPP | Independent Power Producer |
| IRENA | International Renewable Energy Agency |
| kV | Kilovolt |
| kW | Kilowatt |
| LPG | Liquefied Petroleum Gas |
| MOE | Ministry of Energy |
| MOFEA | Ministry of Finance and Economic Affairs |
| MOFEN | Ministry of Forestry and Environment |
| MW | Megawatt |
| NAWEC | National Water and Energy Company |
| NGO | Non-Governmental Organisation |
| PAGE | Programme for Accelerated Growth and Employment |
| PURA | Public Utility Regulatory Authority |
| PV | Photovoltaic |
| RE | Renewable Energy |
| REAGAM | Renewable Energy Association of The Gambia |
| REMP | Renewable Energy Master Plan |
| RRA | Renewables Readiness Assessment |
| TJ | Terajoules |
| TWh | Terawatt hours |
| TES | Total Energy Supply |
| TOE | Tonnes of Oil Equivalent |
| UNIDO | United Nations Development Organization |
| WAPP | West African Power Pool |
| Wp | Watt Peak |

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# EXECUTIVE SUMMARY

The Gambia, located in West Africa, has an estimated population of 1.8 million as of 2012, with an annual growth rate of 2.7% per annum and the share of the urban population increasing from 37% in 1993 to about 55% today. With about 48.4% of the population currently living below the USD 1.25/day mark, The Gambia's Gross Domestic Product (GDP) grew steadily at an average of 6.3% in 2003-2010, but declined sharply (to -4.4%) in 2011. Biomass, including fuel wood, accounts for about 60% of the country's energy supply and more than 90% of household energy consumption, while petroleum products (liquefied petroleum gas for cooking; diesel and heavy fuel oil for generating electricity) account for 36%, and electricity for about 4% of energy supply. Over 65% of the population lacks access to electricity.

The Gambia has great potential to accelerate renewable energy use to power its growing economy. The government recognises that developing local and renewable resources is critical to meeting its economic and social objectives. It is promoting this development by creating the necessary policy space and developing appropriate regulatory and legal frameworks.

The Gambia needs to overcome its dual challenges of energy access and security of supply, which cut across all sectors and have an impact on all Gambians. Current biomass use is contributing heavily to land degradation and deforestation, and the pressure will continue to increase due to a growing population.

Electricity is a key challenge in terms of both quality and access. The existing power infrastructure in The Gambia is dilapidated and urgently needs modernising and refurbishing. Voltage fluctuation, spikes, blackouts, brownouts and other disruptions create concern for industrial, commercial and residential customers. The continued dependence on imported fuel for generating electricity is also taking its toll on the wider economy. In short, the energy system has become a burden on the Gambian economy and society – part of the problem of development rather than the solution. The status quo is unsustainable.

The Gambian government considers the provision of electricity to all as critical to inclusive economic transformation. It recognises off-grid renewable energy as a practical, potentially cost-effective alternative to

expanding the grid to every corner of the country. The government electrification strategy has embraced both grid-based and off-grid options.

Renewable energy systems are well positioned to play a critical role in addressing this growing energy demand for the following reasons:

- The Gambia has abundant renewable energy resources that could help meet growing demand. The Gambia has abundant solar energy resources across the country, a good biomass resource in most areas, and a modest wind regime along the coast. These resources can be developed to bring higher-quality energy services to populations across the country.

- Renewable energy safeguards energy access. The Gambia's use of locally available renewable resources will reduce its dependence on imported and expensive fossil fuels, which it can ill afford. There is already strong pent-up demand for energy, especially electricity. As national demand for electricity increases, it will be necessary to look into options that are affordable, reliable and have predictable cost attributes.

- Renewable energy costs have fallen significantly and are likely to continue declining. The increased dash for fossil resources is likely to push prices up, while increased renewable technology deployment pushes prices down, in line with progress in technology and economies of scale. This offers an opportunity for The Gambia to rethink its energy strategy.

- Off-grid renewable power can meet demand in unserved rural areas in The Gambia and can replace existing diesel-driven systems. The Gambia has yet to build its energy infrastructure in a planned and systematic manner. At the moment, much of its rural electrification programme relies on international donors. The national utility is struggling to maintain service to existing customers. As a distributed and scalable option, many renewable energy technologies are well suited to meet the need for power in remote areas.

- The Gambia needs to increase the available capacity supplied to the grid. Power produced through renewable systems can be fed into the grid in The Gambia, providing a clean and reliable power supply. The country already has some experience in this area. At present, the government is working on a Feed-in-Tariff (FIT) scheme, grid code modification and a standard Power Purchase Agreement (PPA) that would facilitate private-sector entry into The Gambia's power sector.

- The West African Power Pool (WAPP) represents an important opportunity for The Gambia. A large bulk of the power likely to be generated through the WAPP will be hydropower, a renewable energy resource. Given the scale of power produced through the power pool and Gambian power production and transmission challenges, The Gambia is expected to greatly benefit in terms of cheaper electricity supply.

The Gambia also needs to build up its technical and regulatory capacity. The level of skills in The Gambia is not sufficient for the magnitude of the energy challenge in the country. The government will need to revitalise its technical arm, the Gambia Renewable Energy Centre (GREC), to

provide scaled-up technology development, finance, regulation and management support. Further capacity will need to be built in research institutions and among community stakeholders.

Renewable energy development represents an area of tremendous opportunity for The Gambia. This Renewables Readiness Assessment report lays out the energy challenges that The Gambia faces today, along with ways the country has supported the development of renewable energy programmes. It shows the impact these programmes have had on the energy landscape, as well as the enormous constraints that still remain. The report provides information about the role of renewable energy in The Gambia so far and the policies that have been implemented to support renewable energy deployment. It also outlines the potential for renewable energy technologies to be integrated into the Gambian energy mix in a way that services the country's development priorities and goals.

## RECOMMENDED ACTIONS

A draft renewable energy bill was validated in December 2012, pending presentation before the National Assembly for adoption. A number of national stakeholders will play a part in rolling out the act. The Ministry of Energy is to recommend national targets for the use of renewable energy resources, the Ministry of Finance and Economic Affairs is to provide tax exemptions to renewable-energy equipment and renewable-based electricity, while the Public Utility Regulatory Authority is to implement a regulatory framework that includes defining the rules for pricing renewable electricity through FITs, as well as setting up and managing a renewable energy fund. This provides the legal foundation for efficient promotion of renewable energy resources and is considered a major milestone in delivering some of the key priorities in the Programme for Accelerated Growth and Employment (PAGE) 2012-2015; its enactment, therefore, would be worth speeding up.

The Gambia currently has no renewable energy technology standards. Most operators in the renewable energy sector, despite having a solid track record in delivering power-generation projects, are not complying with any specific standards. The renewables market is expected to expand and new entrants appear in the trading and system-installation market. The draft FIT scheme and PPA mention general codes and standards that should apply to renewable energy plants. However, it would also be worth creating specific standards and codes for renewable energy technologies, in order to ensure adequate quality, design, safety, and operation and maintenance of equipment (whether imported or locally manufactured).

Thus, the role of GREC will need to be redefined and its capacity developed further. As a knowledge hub within the Ministry of Energy, GREC could play a pivotal role in maintaining high standards of research and development activities. It could use its own human resources and work with non-governmental organisations (NGOs), the private sector and tertiary educational institutions. However, funding for the continuous support of research and development in the renewable energy sector has been discontinued. Adequate staffing was not maintained. The Gambia should therefore support the revival of GREC by entrusting the centre with a number of roles. These include scientific, technological and innovation research in renewable energy, promoting renewables for industrial uses, and building the capacity of installers

of renewable energy systems with proper certification. In order to attract qualified expertise for this purpose, the government of The Gambia will need to allocate a specific budget from internal sources. It will also need to support partnerships between GREC and well-established international centres of excellence in the renewable energy sector with similar mandate.

The Gambia has conducted solar and wind resource measurements at eight stations across the country. The study confirmed the existence of a good resource base, including considerable solar energy, some wind-power potential along the coast, and biomass, which could be used for improving the electrification rate and diversifying the electricity mix, as envisaged in the PAGE. Usually, sites are screened on the basis of a solar/ wind atlas, validated with measurements from meteorological stations, and monitored for about a year before wind turbines are installed. This procedure was not followed at the Gambian sites, given the country's poor meteorological intelligence. The government must create the conditions for attracting investments to strengthen the observation network, as well as make the necessary preparations to obtain a good understanding of the wind regime across the country. This will help in making informed decisions, including setting achievable targets, and will, furthermore, help The Gambia take advantage of the significant interest of private operators seeking involvement in the renewable energy sector.

The rural energy system, as it has evolved to date, is complex and not disposed to adequate planning and resource coordination. The upfront cost of renewable energy systems is a disadvantage in rural communities, with little income or funds to obtain electricity services. Soft loans can be attractive, with a small down payment being made on the total price, and the rest being paid over a number of years at a preferential interest rate. The draft renewable energy law, currently under discussion, supports the establishment of a renewable energy fund, which would be administered by the Public Utility Regulatory Authority and would provide financial incentives such as capital subsidies, production-based subsidies and equity participation. These would be available for mini-grid and off-grid renewable power systems for remote areas and islands and should attract private investment in the sector. The expected challenge would be to ensure that the renewable energy fund has sufficient resources to maintain the investment momentum. The government will need to employ a variety of creative fund-raising mechanisms to sustain the fund.

The Gambia has built credible human capacity in some renewable applications, such as solar photovoltaic (PV) and water-heating systems. However, as yet, there are no government or NGO-led public education programmes and no formalised technical training programmes. Capacity development for planning and implementing large-scale off-grid (and also on-grid) programmes will need to be increased if the promise of renewable energy resources is to be fully realised. Private-sector involvement will require multiple skills in energy analysis, engineering, finance and management in order to build a strong renewable energy business environment.

# I. INTRODUCTION

## COUNTRY BACKGROUND

The Gambia, with an area of 11570 $km^2$, is located in West Africa. It extends about 400 km inland along the banks of the Gambia River and is bordered by Senegal on three sides. The Gambia has an estimated population of 1.8m as of 2012, with an annual growth rate of 2.7% per annum and a population density of 120 people/$km^2$. The country is currently undergoing a rapid rate of urbanisation with the share of urban population increasing from 37% in 1993 to about 55% today (World Bank, 2013)

The Gambia's Gross Domestic Product (GDP) grew steadily at an average of 6.3% in 2003-2010, but declined sharply (to -4.4%) in 2011 due to sluggish tourism and unfavourable weather conditions. These led to a 60% drop in crop production (IMF, 2013). With a partial rebound in agriculture and strong performance in tourism, the economy showed signs of recovery in 2012. It continues to make further gains, with real GDP growth expected to reach 4.3% and 5.1% in 2013 and 2014 respectively (AEO, 2012).

The agriculture sector contributes approximately 25% of the GDP but employs nearly 75% of the population, provides 50% of the national food requirement and accounts for 70% of domestic exports. It is thus subject to wide fluctuations conditioned by external market situations (Africa Energy Outlook (AEO), 2012). The government has therefore prioritised the development of the agricultural sector by putting in place measures that will transform it into a market-oriented, modern and efficient sector. The service sector accounts for approximately 60% of GDP, within which tourism, re-export, trade and telecommunication have been the major drivers of growth and job creation. Telecommunications are well developed with a mobile penetration rate of 89% (well above the 53% African average).

Manufacturing, mining and quarrying remain the smallest component of the economy, accounting for 4.9% and 2.7% respectively of GDP in 2011. Despite government efforts to promote manufacturing, it has been stagnant for years. This can be explained partly by the small size of the market but also high energy costs, low investment and weak trade facilitation. Mining and quarrying exploration is in progress, as The Gambia is thought to be endowed with mineral products such as clay, silica sand, titanium, tin and zircon.

According to the World Bank (2013), net flow of foreign direct investment was around USD 36m in 2011, and reached a high point of USD 82m in 2006. The distribution of financial flows was mainly from real estate, construction and tourism. The net official development assistance and official aid received by The Gambia in 2011 amounted to USD 76m.

Poverty in The Gambia remains pervasive. It was placed 169th out of 189 countries in the 2012 Human Development Index (HDI) rankings. With about 48.4% of the population currently living under the USD 1.25/day (Gambian government, 2011), poverty alleviation is a national priority. Poverty incidence is the highest among households whose main income is derived from agriculture and fisheries. The government has developed a medium-term framework in the Programme for Accelerated Growth and Employment (PAGE) for 2012-2015 with the aim to accelerate pro-poor growth and generate efficient employment.

The government designed PAGE to focus on strategic areas of intervention linked to the Millennium Development Goals (MDGs). Acknowledging the importance of energy as a crucial input to economic development, PAGE has made energy access a strategic focus. It recognised that by providing affordable and reliable energy services to support small businesses and social services, the socio-economic conditions of the population can be improved and the MDGs achieved. The government plans to focus on modernising the electricity supply infrastructure, improving the existing regulatory framework and increasing the RE contribution in the energy mix.

## ROLE OF ENERGY IN DEVELOPMENT IN THE GAMBIA

As highlighted in PAGE 2012-15 and earlier development programmes, The Gambia needs to scale up its energy services, both in quality and quantity, to meet the country's social and economic development needs. Present per capita electricity consumption is 136 kilowatt-hours (kWh) per year against an African average of over 575 kWh and a global average of over 2770 kWh. This makes the average Gambian citizen among the lowest consumers of electricity in the world. What is more, over 65% of the population lacks access to electricity, and the level of suppressed demand in the national power sector is significant. This suggests that The Gambia needs to close the gap between electricity demand and what it is able to supply to its citizens.

More than 90% of Gambian households rely heavily on traditional biomass to meet their basic energy needs. This comes at a significant price. It means poor fuel quality, with the associated health impacts as well as an unnecessary amount of time spent in collection, though this is comparatively modest compared to other countries. The Gambia has ample biomass resources and a good potential to engage in sustainable harvesting for household fuel and possibly for generating electricity. It also has significant solar energy and modest wind resources along its coastal areas that can be successfully harnessed for power supply

and water heating. There is some experience in The Gambia of converting these resources into useful energy. This limited experience shows the untapped potential Renewable Energy (RE) technologies are well suited for both urban and rural energy applications. Indeed, the time is ripe for The Gambia to take advantage of critical global developments in clean energy sources, which are rapidly becoming cost-effective options. Furthermore, The Gambia's high oil import bills and financial losses experienced by its struggling energy utility imposes a burden on the national economy and is a handicap to growth. Developing its RE programme, opening the market to IPPs and upgrading grid infrastructure to reduce distribution losses (both commercial and technical) should therefore be a central development strategy.

The Gambia's future development will largely be determined by whether it takes full advantage of these opportunities. It has done well in solving a number of development problems in education, health and water services, and energy services have played a major role in this respect. To this end, there needs to be a major new programme to improve access to clean energy services for rural communities and enhance security of supply to its industries and other key economic sectors. This is part of The Gambia's aim to safeguard the welfare of its people and to its drive towards economic transformation.

Lack of access need not be a permanent problem for countries such as The Gambia. Indeed, many of the emerging economies that have now achieved universal access were once struggling with the same energy-related difficulties. In many of these successful cases, energy interventions in the social and economic sectors were implemented as part of a comprehensive development strategy. These two goals are not mutually exclusive but intertwined. For The Gambia, making a transition out of inefficient biomass use and imported fuel dependency will not be easy. However, it has an opportunity to deploy renewables and use energy efficiently as part of its effort to build a resilient energy system. This will require sound policies, an effective regulatory framework, robust and dynamic institutions and sustained capacity development programmes.

## RENEWABLES READINESS ASSESSMENT (RRA) PROCESS IN THE GAMBIA

A senior officer at the Ministry of Energy (MOE) with a thorough knowledge and experience in renewables was the RRA representative for The Gambia.

Following preparations by the national consultant and MOE, a representative from the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) wrote to the key institutions selected to be part of the technical/expert team. They were invited to the formal launch of the RRA at a kick-off meeting on 24 July 2012. The institutions who took part in the process are listed in section 3 of this report. The technical/expert team was divided into three thematic subgroups.

The subgroups met on 21, 22 and 23 August 2012 respectively, having had time to go through zero draft templates prepared by the national consultant in advance of their scheduled meetings. The subgroups reviewed the tentative list of 18 resource-service pairs suggested by MOE after discussions with the national consultant and retained them.

The 15 expert team members met in the third week of September 2012 to review the 18 templates. The team reduced the initial

18 resource-service pairs to 15. It further evaluated the 15 resource-service pairs and requested that they be subject to further scrutiny and prioritisation.

A national workshop held on 18 December 2012 prioritised the 15 templates and selected five manageable short- to medium-term priority resource-service pairs. The workshop also identified and recommended a set of seven concrete action points to resolve limited systemic, institutional and individual capacity constraints. Resolving these will create good synergies and have a positive cumulative effect on the country's readiness to scale up RE deployment. The five priority resource-service pairs and action points are detailed in section 3.

This report is structured in five substantive sections. Section 1 presents the introduction covering country background, IRENA RRA methodology and the RRA process in The Gambia. Section 2 presents the renewable and general energy context in the region. It includes an overview of the energy sector in The Gambia, its challenges and an overview of RE potential and use. It also provides a detailed discussion of the electricity sector. Section 3 explores The Gambia's energy institutions and the policy and regulatory framework as well as the conditions of financing and investment in the country. Section 4 presents the emerging concerns relating to solar/wind electricity (on-grid), a range of decentralised (off-grid) applications as well as the biomass sector. Opportunities and constraints that affect deployment scale-up are discussed along with the RRA findings. Section 5 presents the recommended action necessary for scaling up RE in The Gambia. The Annex presents a detailed account of the recommended actions identified by the RRA.

# II. ENERGY CONTEXT

## REGIONAL CONTEXT

The total population of the Economic Community of West African States (ECOWAS) region[1] in 2011 was about 309m and growing at an annual rate of about 2.6% (UNESCO, 2012). Per capita GDP remains low by world levels at USD 983, but variations between countries point to a wide range: USD 245-3171. Real GDP growth has generally remained strong over the past decade and reached 6.9% in 2012 due to good rainfall and positive developments in the mining and petroleum sectors (ECOWAS, 2013).

The West African energy system faces a number of interrelated challenges: low energy access, unstable energy security and increasing environmental degradation. Total primary energy consumption in the region is about 155m tonnes of oil equivalent (MTOE) per year (ECREEE, 2012). Fuelwood and charcoal account for the largest sources of energy, representing 77% of primary energy consumption. Petroleum products account for 22m tonnes of petroleum equivalent (MTEP) of consumption. As a whole the region consumes about 43 terawatt hours (TWh) of electricity. Sustained economic growth in the past few years has been accompanied by a growing demand for energy modernisation; governments are under pressure to enhance their energy production to meet growing demand.

Access to electricity in the ECOWAS region is low at 42% (ECREEE, 2012). Variations also exist between countries. Some, such as Ghana, Côte d'Ivoire, Cape Verde, Senegal and Nigeria, are doing better than others in extending electricity services to their populations. The volume of unmet electricity demand was approximately 7-10 TWh in 2006-2010 (ECREEE, 2012).

**1** ECOWAS is a regional group of 15 countries and was founded in 1975. Its mission is to promote economic integration in all areas of economic activity, particularly industry, transport, telecommunications, energy, agriculture, natural resources, commerce, monetary and financial questions, social and cultural matters. ECOWAS member states consist of Benin, Burkina Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

The electricity systems in West Africa also face challenges arising from existing supply capacities unable to satisfy growing demand. Furthermore, the region also faces the difficulty of raising sufficient funds internally or attracting outside investors willing to incur the high perceived risk for its electricity sector. Overall, unreliable power holds back the region's enterprises and impacts negatively on productive activities. Transmission and distribution losses are estimated to be around 30%, increasing electricity tariffs significantly. A number of countries in the region have some of the highest tariffs in the world with a regional average exceeding USD 0.20/kWh. The cost of providing backup power (typically USD 0.30-0.40/ kWh) handicaps productive industries. The World Bank (2010) estimates that blackouts reduce annual economic growth in Africa by 2%.

Concerns regarding energy access and security are not new in the region. Following the adoption of the first energy policy of ECOWAS, the region has been engaged since 1982 in developing an integrated approach of the energy sector. This would provide better access to modernised energy services for populations across the region. Several measures have been taken in this direction. Some of these are discussed below.

The West African Power Pool (WAPP) was established in 1999 with the aim of curtailing the power deficit prevalent in the region. It did this by integrating the operations of national power systems into a unified regional electricity market (cross-border trade flows). This is intended to facilitate stable, reliable and cost-competitive electricity supply to all ECOWAS citizens in the medium to long term. In 2006, the WAPP Secretariat was created and mandated to ensure the promotion and development of power generation and transmission facilities (www.ecowapp.org).

The Energy Protocol was adopted in 2003 by ECOWAS member countries. This is a legal framework aimed at promoting long-term energy cooperation. It is based on complementary relationships and mutual benefits to increase investment in the energy sector and develop energy trade in the region (ECOWAS, 2003).

The ECOWAS/West African Economic and Monetary Union (UEMOA) White Paper for a Regional Policy on Access to Energy Services to Rural and Semi-Urban Areas was adopted in 2006. Three targets were set for 2015:

i) 100% of the total population, or 325 million people, to have access to improved cooking fuels and stoves, including 9.2% to Liquefied Petroleum Gas (LPG) cooking devices

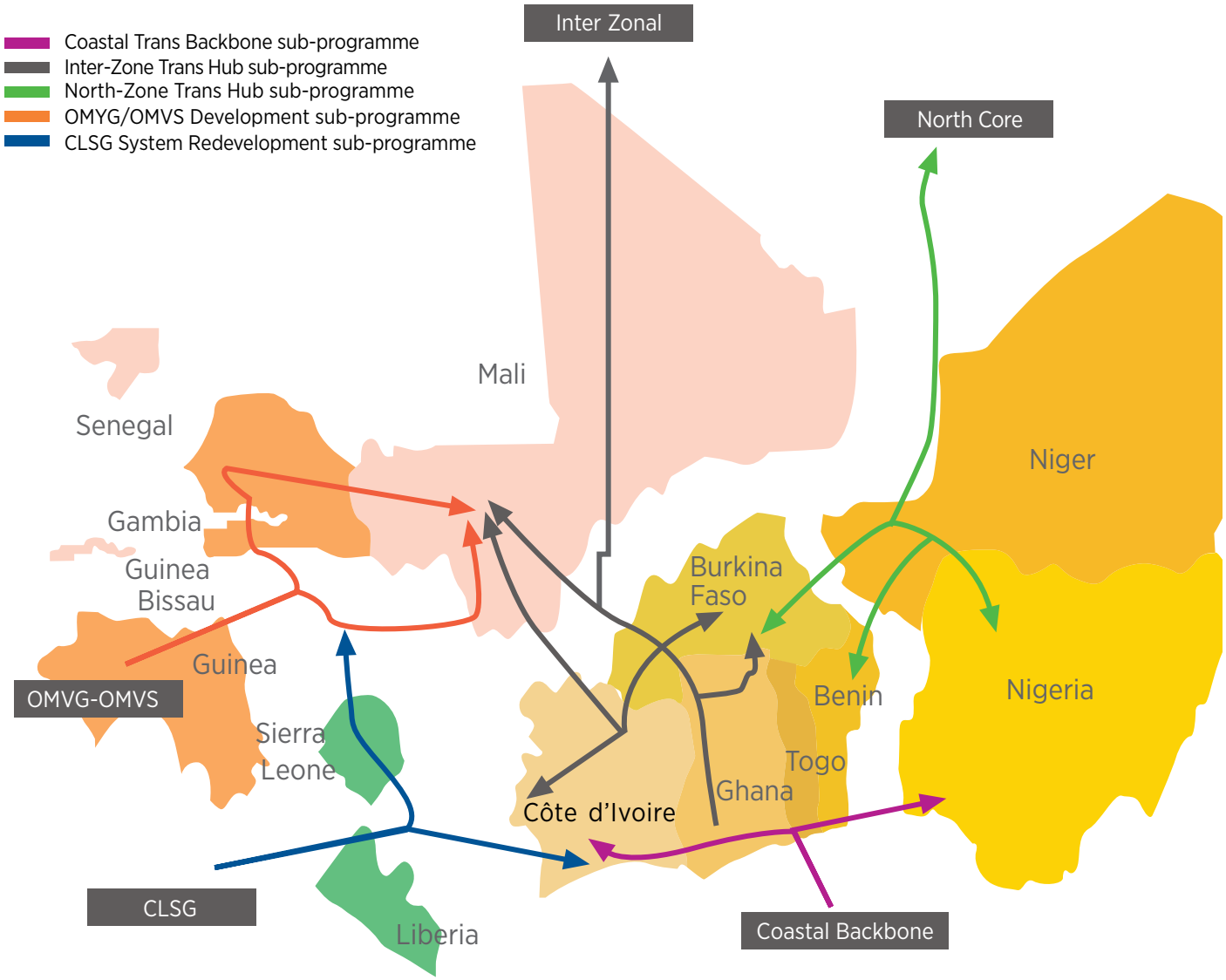
ii) at least 60% of people in rural areas to have access to productive energy services in villages, in particular motive power to boost the productivity of economic activities

iii) 66% of the population, or 214 million people, to have access to an individual electricity supply (ECOWAS, 2006).

The Regulatory Authority for Regional Electricity Sector of ECOWAS (ERERA) was created in 2008. Its aim was to ensure the regulation of cross-border exchanges in electricity and provide substantial support for national electricity regulators of member states (www.erera.arrec.org).

The ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) was established by the Council of ECOWAS in 2009. Its mandate was to promote measures to improve access to modern energy services, increase energy security and reduce adverse impacts on the environment. The creation of favourable framework condi-

**Figure 1**
WAPP regional sub-programmes.




Source: MOE, 2012b

tions and an enabling environment for RE and energy efficiency are viewed as tools to achieve these goals.

Much effort will be required to address the energy issues in the region and capitalise on the opportunities that clearly lie ahead. ECREEE developed and adopted in November 2012 the ECOWAS Renewable Energy Policy (EREP). The EREP is designed to make RE a vector for universal access to electricity by 2030. It is also intended to ensure a more secure and sustainable supply of domestic energy for cooking. This will meet the objectives of the ECOWAS white paper for access to modern energy services by 2020.

## WEST AFRICAN POWER POOL

WAPP is looking at developing a regional electricity market through successive stages:

**Phase 1**, starting in 2012, is when most regional transmission infrastructure is expected to be commissioned. This phase includes formalising trading arrangements, agreeing transmission pricing and strengthening the role of the regional regulator.

**Phase 2** is based on the preparations carried out during Phase 1. It should include bilateral agreements on transit through third countries, short-term exchanges through day-ahead markets, regional transmission pricing and regional system operator/market operator functions.

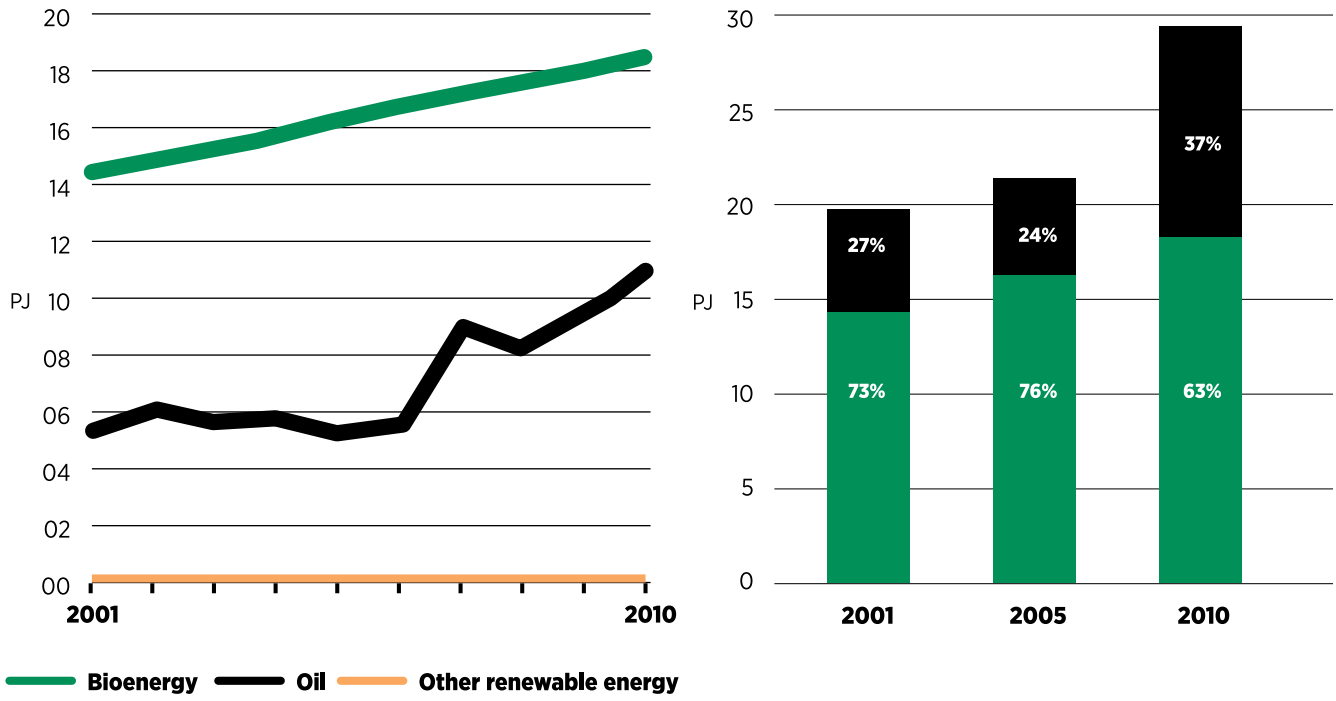
**Phase 3** reflects a long-term vision, which includes regional optimisation of operations. WAPP has approved a regional master plan for infrastructure development with timings for the different projects. This master plan is organised around 30 generation and 26 transmission priority projects with an objective of developing 10% RE (excluding large hydro). The implementation of the master plan will add an additional capacity of 10 000 megawatts (MW) and 16 000 km of transmission lines to the region. This would consist of an electricity mix of 21 hydropower plants, five thermal power plants and four RE plants (wind and solar)

From a purely economic standpoint, a number of countries would benefit from the opportunity to reduce costs they incur at present by importing more than half their power. Savings for countries such as Guinea Bissau, Liberia and Niger could range from USD 0.05/kWh to 0.08/kWh (Eberhard *et al.*, 2011). The largest beneficiaries of regional trade would be smaller nations that lack domestic hydropower resources. For these countries, it is estimated that the cost savings generated by regional trade could repay the required investment in cross-border transmission within less than a year. This depends on neighbouring countries developing sufficient surplus power to export.

Within the priority projects at the regional level, The Gambia would participate in both generation and transmission in its capacity as a member country of The Gambia River Basin Development Organisation (OMVG)[2]. Two generation and one transmission project are to be implemented in the subregion. These include a 128 MW hydropower dam in Senegal (Sambangalou) and a 240 MW hydropower dam in Guinea (Kaleta). It also includes a 225 kilovolt (kV) transmission line of 1 677 km that interconnects the four

**2** OMVG is a subregional organisation involving four countries (Gambia, Guinea, Guinea Bissau and Senegal) in implementing integrated development programmes in the subregion. It focuses on the rational management of common resources of The Gambia, Kayanfa-Geba and Koliba-Corubal Rivers.

**Figure 2**
Total Primary Energy Supply by Fuel




countries to the two generation plants. The government of Guinea has already launched the construction of the Kaleta Dam while the financial and economic analysis for the Sambagalou Dam is being concluded and is showing positive results.

## ENERGY SUPPLY AND DEMAND IN THE GAMBIA

The Gambia has a dual energy system containing co-existing traditional and modernised energy systems and practices. On the one hand, traditional biomass fuels and inefficient technologies dominate household energy needs. On the other, a modernised energy system uses electricity and more refined fuels as well as modern appliances. There is also an urban/rural split in terms of energy distribution and practices. However, the boundary between what is up-to-date and what is traditional is not clearly demarcated. For example, in urban centres in The Gambia, the simultaneous use of biomass fuels, kerosene or LPG is common, even in relatively high-income households. The fragmented nature of the energy system creates enormous challenges for policy makers and makes it difficult to overcome the energy challenge in an integrated manner.

In 2010, Total Energy Supply (TES) in The Gambia was 407 926 TOE. The energy consumption per capita in The Gambia in 2007 was 81 kilogrammes of oil equivalent (KGOE) according to figures from the Global Environment Facility (GEF) and the United Nations Industrial Development Organisation (UNIDO) in 2011. Biomass,

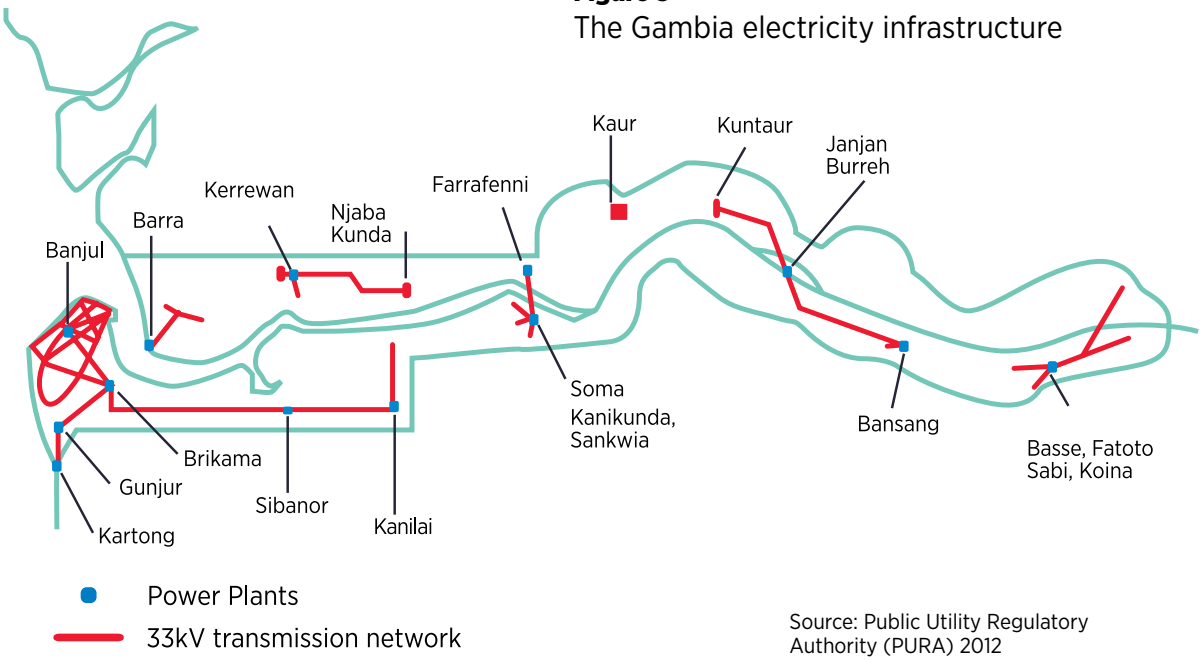
Kuntaur Wharf on the River Gambia.
Source: www.outsideonline.com

including fuelwood, accounts for about 63% of the country's energy supply, and for more than 90% of household energy consumption. It comes to as much as 97% in some rural areas.

Petroleum products consisting of LPG for cooking and diesel and Heavy Fuel Oil (HFO) for generating electricity account for 37%. The share of RE is negligible at 0.19% and is mainly solar. In 2006 The Gambia imported 128 000 metric tonnes (mt) of petroleum products. This had been an increasing trend since 1995 (figure 2). The two biggest energy consumers are households and the transport sector. LPG use has been increasing in urban areas, but only marginally. Its use has been largely constrained by its high cost.

Fuel imports cause major problems for Gambian policy makers as they use up what little foreign exchange the country generates. In 2009, the country spent USD 47m on petroleum imports. This amounts to a share of about 15.5% of total imports. Furthermore, the energy intensity of The Gambia is about 0.51, which is around the ECOWAS average but significantly higher than that obtained in developed and emerging economies. As an example, China's energy intensity amounted to 0.46, and the European Union (EU) and Japan had values of 0.11 and 0.09 respectively (ECREEE, 2012). The high energy intensity points to the fact that ample opportunities exist for The Gambia to engage in energy efficiency improvements (from production to end use).

**Figure 3**
The Gambia electricity infrastructure




Source: Public Utility Regulatory Authority (PURA) 2012

## ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION

The Gambia relies entirely on imported fossil fuel for electricity generation - mainly HFO - for the main power plants and diesel for the provincial power stations. These are operated by National Water and Energy Company (NAWEC) and Global Electric Group (GEG) - an Independent Power Producer (IPP).

Effective installed capacity in The Gambia is around 65 MW. This is divided into two generation and transmission categories. The first comprises the Greater Banjul area which is supplied by two large HFO power stations in Kotu (25 MW at peak load), Brikama (26 MW) and the Batakunku and Tanji wind power plants (120 kW/150 kilovolt ampere (kVA) and 900 kVA respectively). The Brikama, Batakunku and Tanji are IPP plants respectively owned by GEG and Gamwind. Electricity is transmitted from these stations for distribution via five radial 11 kV feeders and three 33 kV feeders. The second category of power supply comprises seven NAWEC owned small-scale power plants that operate on diesel generator sets, served by stand-alone electricity subsystems in the provincial centres (table 1). Together, these small-scale plants have an installed capacity of about 13.75 MW (PURA, 2013). Approximately 250 km of 30 kV transmission lines are installed in the provincial grids plus 135 km of MV/LV lines and 94 km of LV overhead lines.

Approximately 44% of the electricity produced is consumed by households. Small-scale industries, hotels and larger industries use approximately 39% and commercial entities about 8%. The remain-

**Table 1**
Installed electricity generation capacity and production per station in 2011

| Power station | Installed capacity, MW | Production, kWh |
|---|---|---|
| Kotu | 25.300 | 99 824 000 |
| Brikama | 26.000 | 119 834 000 |
| Essau | 0.400 | 507 660 |
| Barra | 0.480 | 982 710 |
| Kerewan | 1.920 | 507 660 |
| Kaur | 0.480 | 132 548 |
| Mansankonko | 1.400 | |
| Farafenni | 5.500 | 4 269 000 |
| Bansang | 0.600 | 1 482 300 |
| Basse | 2.800 | 4349 292 |
| Batokunku | 0.150 | 119 000 |
| Total | 57.40 | 232 008 170 |

Source: NAWEC, 2011

ing 9% is consumed by government and NAWEC (NAWEC, 2011). Demand for power continues to rise. In 2012, generation amounted to 232 gigawatt hours (GWh) against an estimated electricity demand of 621 GWh and is expected to exceed 800 GWh by 2020. This gap between demand and supply is further exacerbated by system losses of about 30%. Table 2 summarises the evolution of the structure of the electricity market in 2007-2011 in terms of consumer population, power sales, system losses, power and energy demand.

Load shedding is frequent. Its common practice for businesses, hotels and health facilities to rely on on-site diesel generation units and occasionally solar photovoltaic (PV) units when load shedding or outages occur. Data on these backup off-

**Table 2**
Evolution of the electricity market

| ITEMS | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Customer population | 75034 | 86349 | 103883 | 113845 | 98116 |
| System losses per household | 39% | 33.34% | 32.7% | 31.2% | 31.2% |
| Power demand MW | 88 | 90 | 108 | 126 | 132 |
| Energy demand MWh | 416 280 | 473 040 | 501 420 | 596 030 | 621 680 |
| Customer growth p/a % | 7.5 | 15.1 | 20 | 10 | -14 |
| Energy demand growth rate | 12.8 | 13.6 | 6 | 18.9 | 4.3 |
| Power demand growth Rate | 12.8 | 2.2 | 20.0 | 16.7 | 5 |
| Revenue growth rate | 51 | 19 | -3.0 | -7.3 | 12 |

Source: PURA (2012)

grid systems are not available. The resulting effect of this system underperformance is high tariffs for consumers and a rise in the number of back-up systems. It also weakens the financial position of NAWEC, thereby reducing its capability to raise sufficient revenue to expand the electricity system beyond the Greater Banjul area. This has wider economic implications. The lack of reliable, affordable power and the high cost of energy are seriously limiting investment in The Gambia and are limiting growth in productive sectors such as the agro-processing and manufacturing sectors (GEF/UNIDO, 2011).

**Table 3**
Electrification rate per region

| Regions | Electrification Rate |
|---|---|
| Banjul | 93% |
| Western | 22% |
| Upper river | 14% |
| Lower river | 12% |
| Central river | 7% |
| North bank region | 6% |

Source: MOE, 2011

National electricity access is about 35%, concentrated in the Greater Banjul area where access is about 93% (table 3). Recognizing the high suppressed demand and a weakness in the transmission and distribution network, NAWEC has projected the need for 75MW of additional capacity in the next three years. It also estimates a need for additional capacity of 135MW in 2014-2020 (government of The Gambia, 2012). The financial requirement between 2013 and 2015 will amount to USD 112.5m and USD 182m in 2016-2020. New transmission lines consisting of a 132kV power line between the two main power stations (Kotu and Brikama) are also planned in the Greater Banjul. They are expected to be in place by the end of 2013.

## COSTS AND TARIFFS

Following an extensive review, tariffs in The Gambia were increased by 17% in 2011. At present, consumers pay the highest electricity tariffs in the West Africa region at USD 0.28/kWh (table 4). This situation can be explained partly by the country's reliance on imported fossil fuels for electricity generation, as well as its poor transmission and distribution infrastructure.

**Table 4**
Comparison of tariff affordability in select West African countries

| Country | Effective residential tariff (US cents) @ 100kWh/month | 2009 monthly per capita GDP (USD) | % of monthly per capita GDP spent on 100kWh of electricity |
|---|---|---|---|
| The Gambia | 28.0 | 98 | 21.7 |
| Senegal | 23.8 | 139 | 17.2 |
| Burkina Faso | 20.0 | 103 | 19.5 |
| Cote d' Ivoire | 11.9 | 134 | 8.9 |
| Ghana | 8.2 | 128 | 6.4 |

Source: World Bank 2012, NAWEC 2012

Electricity generation and transmission costs are passed onto consumers, resulting in high tariffs. Nevertheless, tariffs are not reflective of costs, and the utility has been experiencing major financial difficulties. Resources allocated to cover operation and maintenance costs are inadequate.

The typical distance of villages from the grid in The Gambia is 5-25 km. The cost of transmission lines to connect these communities with low electricity demand to the grid could amount to USD 50 000-100 000/km. While this is a financial liability for the utility it opens a window of opportunity for decentralised generation. This is because the draft RE law also offers provision for RE-based entrepreneurs as it will make more economic sense than grid extension. Furthermore, grid connection fees can amount to USD 230-1800 (with a median cost of USD 600). This is a prohibitive cost for low-income households (Sanneh and Hu, 2009).

Substantial investments are needed to meet infrastructure and plant modernisation costs, although the greatest proportion of operating costs are due to the high fuel costs. A parallel strategy is also important to meet the needs of low energy - consuming communities located far from the grid. The Gambia has the opportunity to create a more cost-effective off-grid RE supply system. This could play a major role in reducing the nation's dependency on imported fossil fuel, diversifying the electricity mix and increasing access to energy services. The challenge is to develop a policy framework and functioning business models that attract investment into a mix of on- and off-grid electricity generation. To meet these requirements, the government has formulated several strategies. Its objectives are to rapidly expand installed electricity capacity, expand and upgrade the transmission and distribution networks and develop renewable sources of energy. This consists mainly of solar, wind and biomass.

Four important features characterise the energy sector in The Gambia. These include:

i) high dependence on imported fossil fuels

ii) the dominance of traditional biomass sources in the country's energy mix

iii) low access to modern energy services

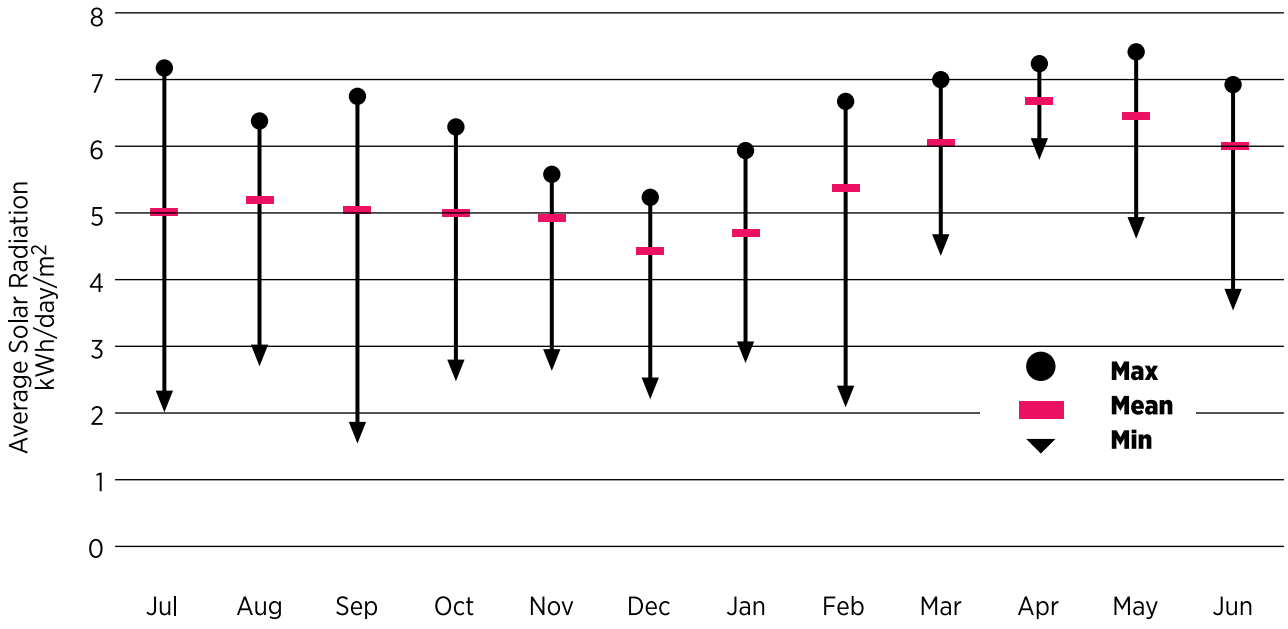
iv) limited investment in new assets and inadequate maintenance of old and ageing power facilities.

## RENEWABLE ENERGY RESOURCE POTENTIAL AND USE

The energy sector in The Gambia faces vexing problems. This country will have budgetary constraints for the foreseeable future due to its dependence on imported fuel and weak supply infrastructure to support the desired economic and social development. This difficulty is especially pronounced in rural areas, which are generally characterised by widespread poverty, low income, low demand and the inherent disadvantage of being further from the grid. For these communities, an increased reliance on local energy sources at a decentralised level is needed to meet emerging energy needs.

The Gambia has benefits from a good RE resource, including considerable solar energy and some wind power along the coast. It also has considerable land area classified as forest. At present, this provides biomass energy for a significant

**Figure 4**
Solar radiation in The Gambia




Source: Gambia REMP 2005

proportion of the population but could be managed more sustainably. A summary of the resource and potential available in The Gambia is provided below. It is based on the Renewable Energy Master Plan (REMP) drawn up in 2006 under the direction of the Energy Division of the Office of the President.

## SOLAR ENERGY RESOURCES

Solar radiation data was collected through REMP at eight measurement stations spread across the country. The study concluded that The Gambia enjoys high solar radiation in all regions with average solar radiation at 4.4-6.7 kWh/m$^2$/day (figure 4). The periods of high insolation are between March and May when the diurnal variation between the minimum and maximum radiation values is small. The lowest radiation values are in December and January, which coincides with the rainy season. Even during the rainy season, much of the country receives sufficient amounts of solar radiation at about 5 kWh/m$^2$/day. However, the solar radiation range is higher due to cloud cover. Low values are still good enough for solar energy applications.

Solar energy applications currently in use in The Gambia include: PV for off-grid applications and solar water heating for homes, hotels and community applications.

Numerous PV systems are in use across The Gambia for rural off-grid electrification and water pumping purposes in places unlikely to be reached by the grid. The government and donors have funded most

**Figure 5**
Gambia Global Horizontal Irradiance (GHI)


Source: IRENA Global Atlas

of The Gambia's PV investments as part of rural energy service projects for health clinics, schools, households and street lighting. With funding from the EU and the Japanese government, local private company Gam-Solar has installed solar pumping systems in about 80 villages. This provides clean potable water to more than 200 000 people.

There is little private sector activity in the solar PV sector, and active commercial markets are yet to develop. The government has encouraged the PV market by introducing a duty exemption for solar equipment. However, more policy and regulatory push would be needed to attract private sector participation in the PV field. The GEF/UNIDO study (2011) has identified a number of good opportunities in the PV sector, including the introduction of PV in some of the diesel-operated isolated grids

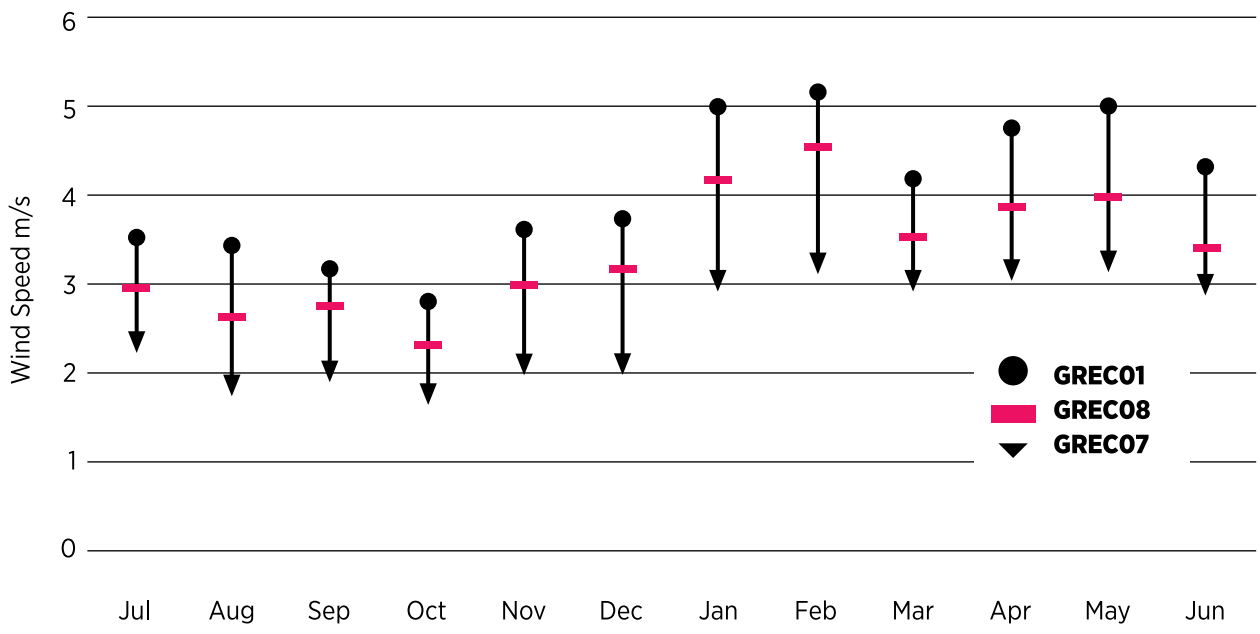
Maintainance work in progress at the Batokunku wind energy plant in The Gambia
Photo: M. Kottmeier Source: www.rural21.com

run by NAWEC in the provincial areas. Installing PV power plants at these locations could reduce the running costs of these grids, and allow expansion of the system to run for 24 hours a day.

Solar water heating systems have been operational in The Gambia for nearly two decades, and there is ample experience and expertise in the country for installing these systems. Gam-Solar has carried out numerous installations in hotels and community centres such as rural clinics. However with the exception of a few, most hotels continue to use electricity or fuel oil boilers to heat water.

Potential investment in grid-connected solar PV also exists in The Gambia as the falling cost of PV in recent years brings the

**Figure 6**
Monthly wind speed at 30m in three sites in The Gambia



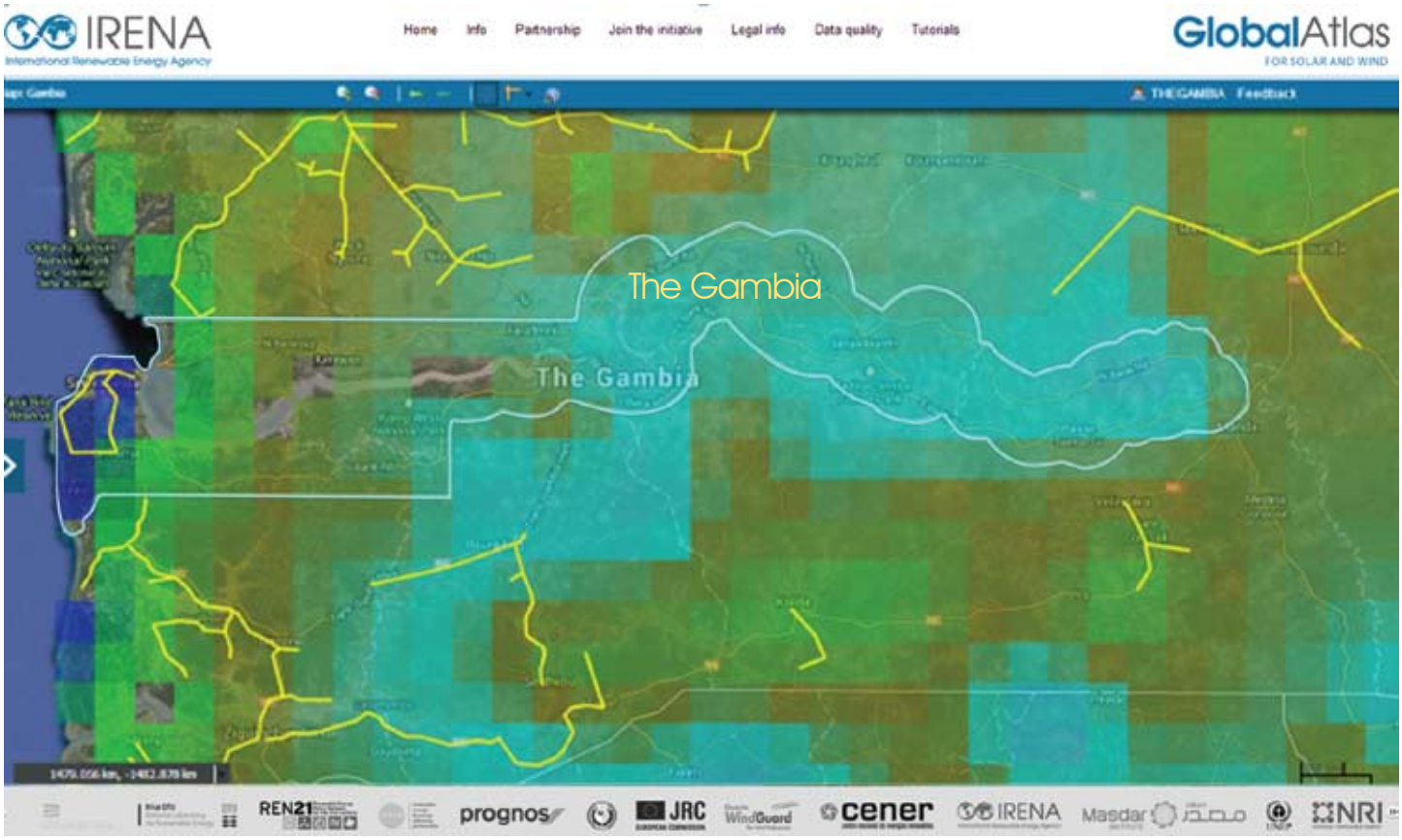

technology closer to grid parity in many parts of the world. The Gambia's high electricity generation cost is likely to excite investor interest in PV on the grid. However, grid PV remains a capital-intensive venture that will require government direction to create the appropriate institutional and regulatory framework. This would partly lower investment risks and therefore attract private sector players.

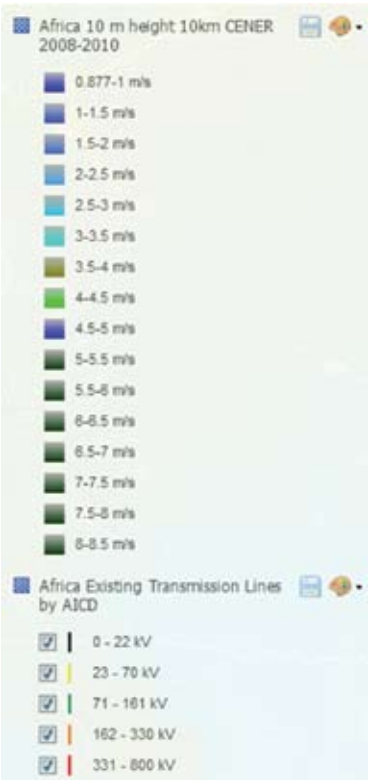
## WIND ENERGY RESOURCES

Wind potential in The Gambia was evaluated using data from the World Wind Atlas to prepare a Zero-Wind Map. This was further refined using data gathered from eight measurement stations throughout the country. Data were collected at 30m height over an eight month period including the Harmatan dry wind period. The study concluded that wind conditions are moderate in the interior part of the country (less than 4.0 m/s), but rise to average wind speeds of about 4.3 m/s mainly due to wind flow from the sea in the West. Figure 6 shows the wind regime in three of these sites.

While inland areas may be restricted mainly for wind pumping purposes, there is growing evidence that some coastal areas offer opportunities for grid-connected power generation. A combination of suitable wind turbine technology and the judicious integration of wind power to the existing grid in the Greater Banjul Area is an option. It is also important to highlight other limiting factors with regards to the engineering work associated with large wind generation plants with high turbine hubs. Transportation and craning infrastructure for large-scale wind turbines beyond 35 metres is at present not available in The Gambia. However, if the wind programme expands in future, this could be met by self-erecting turbines or by bringing in adequate cranes.

**Figure 7**
Gambia wind speed at 10m height




There is limited experience in wind-related energy projects in The Gambia. Much of the early work was restricted to village water pumping projects. In the 1990s, the Department of Water Resources (DWR) actively promoted the use of wind pumps along coastal villages with support from the EU. The pilot systems were installed in three villages, but their operation has been discontinued due to lack of proper maintenance, and pumping systems inappropriate for the local conditions. Several other wind pumps are in use across the country, mostly on private farms. This clearly indicates that capacity development in operation and maintenance (O&M) is critical for sustaining wind pumping programmes. Similar experiences are also observed in other parts of Africa.

In recent years, wind power has generated some interest in multilateral institutions, donors and The Gambian government. The Batakunku wind project was the first of its kind in The Gambia to generate electricity for local community use and supply surplus power to the utility. Annual generation is currently around 120 000 kWh. A follow-up project started up in August 2012 further north in Tanji.

## BIOMASS

The Gambia has a rich variety of woodland ecosystems, including forests, closed and open woodland, tree and shrub savannah, mangrove, riparian and fringing savannah. The Gambia's forest cover has declined from 60% in the 1960s to 43% of the land area today (Jarju, 2008). Its forest and woodland ecosystems supply about 85% of domestic energy requirements. Fuelwood accounts for more than 90% of household energy consumption and is often used in inefficient stoves. The REMP study conducted one of the most comprehensive fuelwood consumption investigations. It concluded that the standing stock of fuelwood would not be enough to meet future demand. In 2005 the technical potential for sustainable fuelwood production was about 209 000 tonnes/year for an aggregated demand of 734 400 tonnes/year resulting in a huge gap of about 535 000 tonnes/year (Jarju, 2008). This has led to overexploitation and degradation of native forest, as well as fuel imports from Senegal largely in the form of charcoal.

Given the favourable soil and climate as well as underground water conditions in The Gambia, there is ample opportunity to establish highly productive and intensively managed wood lots. These could replace wood imports and ease the pressure on natural forests. Although such

Source: Ministry of Energy, The Gambia

**Table 5**
Energy potential of agricultural residues in 2011

| Crop | Amount (mt/year) | Ratio residue/ kernel | Amount residue (mt/year) | Heating value (GJ/mt) | Physical potential GJ/year |
|---|---|---|---|---|---|
| Groundnuts | 83 858 | 0.43 | 25 157 | 17 | 427 676 |
| Millet | 87 234 | 2 | 174 468 | 17.6 | 3 070 637 |
| Maize | 23 613 | 3 | 70 839 | 17.5 | 1 239 683 |
| Sorghum | 20 556 | 2 | 41 112 | 17.6 | 723 571 |
| Rice paddy (straw residue) | 51 131 | 1.50 | 66 693 | 15.1 | 1 007 058 |
| Rice paddy (husk residue) | 51 131 | 0.15 | 6 669 | 15.9 | 106 041 |

Source: World Bank 2012, NAWEC 2012

planned and managed biomass schemes will not in themselves close the biomass gap, they could form part of a comprehensive and sustainable biomass programme. This would include improved cookstoves to reduce demand.

Apart from solid biomass, The Gambia produces a significant amount of agricultural residues that have the potential to make a meaningful contribution to energy needs. Most crops in The Gambia are subsistence crops (rice, millet, maize and sorghum) with groundnuts as the only cash crop. Agricultural production data provides the basis for calculating the annual amount of residues produced and their corresponding energy potential (Food and Agriculture Organization (FAO), 2011).

Millet and maize have the highest potential and this has been estimated at 3000 terajoules (TJ) per year and 1200 TJ/year respectively (table 5). However the residues for these crops are widely used for animal fodder and for various household uses.

Hence, the only real potential may lie in the use of groundnut residue through centralised groundnut processing facilities across the country. This would produce heat and electricity to meet local energy needs. Surplus would be sold to the grid.

Fruit and vegetable drying using a solar food dehydrator built by Solar Association Tiloo of Kanifing
Source: www.powerupgambia.org

# III. ENABLING ENVIRONMENT FOR RENEWABLE ENERGY

## KEY ENERGY STAKEHOLDERS AND INSTITUTIONAL STRUCTURES

There are numerous players in The Gambian energy sector. They include government bodies and parastatal organisations, Non-Governmental Organisations (NGOs) and associations as well as the private sector. Some of these play multiple roles in policy, regulation, finance, knowledge generation and advocacy.

### GOVERNMENT/PUBLIC-SECTOR INSTITUTIONS

The Office of the President plays a crucial role in receiving information from all the ministries as they relate to each specific energy objective. It has final authority on regulations, tariffs and IPP contracting.

The MOE, under the Office of the President, is tasked with the responsibility for establishing the policy and strategies for the energy sector. This includes electricity, petroleum products and RE. The MOE is aided by the Energy Unit (EU) and GREC who provide support on policy analysis and technical matters. The utility National Water and Electricity Company (NAWEC) and the IPP GEG work under the MOE.

The National Water and Electricity Company (NAWEC) owns all except the GEG power plant and operates the transmission and distribution network for the country. NAWEC is responsible for establishing and collecting electricity tariffs. It also establishes and administers Power Purchase Agreements (PPAs) with the private power producer and implements rural electrification projects.

The Ministry of Finance receives recommendations from PURA, evaluates the financial implications and makes recommendations to the president. The ministry is involved in pricing petroleum products especially for the transport sector. Liquid petroleum products provide a significant revenue stream for the national budget.

PURA is responsible for regulating the electricity, water and telecommunications sectors. This includes licensing and ensuring safety and quality standards as well as tariff reviews. PURA is actively engaged in drafting the RE bill and in formulating and communicating the FIT rules. It also acts as arbitrator between the responsible network utility and people generate or plant to generate electricity from RE resources.

The Ministry of Petroleum oversees upstream and downstream activities in petroleum resources, in particular exploration and marketing. The ministry oversees the quality of service and safety standards within the petroleum subsector. It is, however, unclear which ministry has oversight responsibility for LPG.

The Ministry of Forestry and Environment (MOFEN) is responsible for enacting forestry and environmental policies and legislation. Its forestry department is responsible for managing the country's forest resources. It plays a lead role in policy formulation and regulation.

The Department of Community Development (DCD) is under the Ministry of Local Government and Lands. It is responsible for promoting the efficient management of fuelwood resources through the promotion of substitutes and improved end-use appliances for firewood at the household level.

The department is also involved in community training activities in a wide range of sectors as well as research and dissemination of new and appropriate technology.

The Gambia Investment and Export Promotion Agency (GIEPA) has the primary function of investment promotion in The Gambia. Energy is among the eligible sectors in The Gambian investment code.

The Department of Water Resources (DWR) in the Ministry of Water Resources and Fisheries is actively involved in rural water supply using solar energy for water pumping.

## PRIVATE-SECTOR INSTITUTIONS

GEG is an IPP contracted by NAWEC to build, own, operate and maintain one of the two power generators in the Greater Banjul Area.

With a current membership of 17-19 enterprises, the Renewable Energy Association of The Gambia (REAGAM) promotes RE projects. These include small solar PV installations, solar thermal, micro hydro, cookstove improvements and the expansion of jatropha for oil production in The Gambia.

## UNIVERSITIES AND RESEARCH INSTITUTIONS

GREC advises government on RE and energy efficiency. It was set up to carry out adaptive research in RE and to develop and promote the use of RE and energy efficiency technologies in The Gambia.

University of The Gambia (UTG) is responsible for offering training programmes energy-related courses. It also carries out installation of community solar projects on a contract basis. It has limited research capabilities due to lack of resources.

Gambia Technical Training Institute (GTTI) is responsible for research, development and training in RE and energy efficiency appliances.

National Agricultural Research Institute (NARI) is responsible for research, development and dissemination of RE technologies, mainly solar and biomass.

Source: Ministry of Energy, The Gambia

## ENERGY POLICIES AND REGULATORY FRAMEWORK

PAGE is The Gambia's development strategy and investment programme for 2012-2015, geared towards accelerating pro-poor growth and generating employment. One of the important pillars of PAGE is the urgency to improve and modernise The Gambia's infrastructure through public and private sector investments in transport, energy and information and communications technology.

More specifically, PAGE established the goal of promoting the use of RE resources for electricity generation and actively pursuing fuel-switching from fossil to RE, particularly in rural areas.

There are four key laws and strategies in place that affect the energy sector: the Public Utility Regulatory Act (2001), Energy Policy (2005), Electricity Act (2005), and the GIEPA Act (2010).

The Public Utility Regulatory Act established PURA as the body responsible for the regulation of public utilities including energy services (electricity, petroleum and gas). The act was designed to enable licensing arrangements to be administered by an independent and self-funding regulatory body that protects the interests of the public utilities and consumers. The emergence of PURA has improved transparency and utility accountability. The Energy Policy (2005) stipulates the need to ensure a reliable and adequate supply of

energy at affordable prices. This is essential to stimulate necessary development in the productive sectors of the economy and to realise the development aspirations of The Gambia in an environment-friendly way. More specifically, the policy aims to

i) improve and expand existing energy supply systems through private sector partnerships with the public sector

ii) promote a domestic fuel subsector, which clearly focuses on sustainable management of forest resources

iii) widen the population's access to modernised forms of energy to stimulate development and reduce poverty

iv) strengthen institutional and human resource capacity and enhance Research and Development (R&D) in energy and

v) provide adequate energy security.

The policy has worked as a major step supporting the implementation of RE systems.

The Electricity Act of 2005 was passed to promote cost-effective generation, transmission and distribution of electricity, set standards for electricity services and determine appropriate tariffs. It also opened the generation sector to IPPs. The act designates PURA as the authority over licensing and tariff setting for electricity generation and sales. It also elaborates the framework that provides for the participation of the private sector in electricity generation while transmission and distribution still falls under the public utility's monopoly.

The GIEPA Act of 2010 has been a welcome addition to The Gambia's policy landscape. In relation to the power sector, The Gambian Investment and Export Promotion Agency (established under the GIEPA Act, 2010, formerly GIPZFA) provides incentives to enterprises. Priority sectors include RE from solar, wind, hydro and biochemical energy as well as LPG and electricity generation, transmission and distribution. Some of the incentives include a corporation tax holiday for a period of five years and a waiver on import sales tax relating to manufacturing plant. This would complement the much awaited RE law in making the energy playing field attractive to local and international investors.

During the course of 2012, the draft Electricity Strategy and Action Plan and the RE bill were developed by the ministry with the assistance of technical partners.

The draft Electricity Strategy and Action Plan considered different pathways for the national electricity sector including business as usual, enabling cross-border trade, renewable generation and reliability, and high RE integration. In order to help policy decisions the draft strategy recommends regional interconnection and a joint hydropower project with neighbouring countries. This allows for greater renewables integration in both the main and isolated grids. The plan is to integrate the isolated grids to the main grid over time.

The draft RE bill was validated in December 2012 and is to be presented before the National Assembly members for adoption. It will provide the legal framework for an efficient promotion of RE resources and is considered a major milestone in delivering some of the key priorities in PAGE 2012-2015. A number of national stakeholders will play a part in rolling out the act. MOE is to recommend national targets for the use of RE resources. The Ministry of Finance and Economic Affairs (MOFEA) is to provide tax exemptions to RE equipment

and electricity generated through renewable. Meanwhile, PURA is to implement the regulatory framework that includes defining the rules for pricing renewable electricity (FITs), setting up and managing the RE fund.

The RE fund objective is to provide financial resources for the promotion of RE by providing financial incentives, FITs, capital subsidies, production-based subsidies and equity participation. These will support both on-grid and off-grid initiatives and investments. An attractive FIT rate will be introduced for on-grid investors. Alternatively, they will benefit from a negotiated rate no higher than the alternative cost of electricity generation. For off-grid investors, it ensures that electricity from renewables and hybrid systems may be sold to end-users at approved electricity tariffs up to the current national retail tariff rates. This excludes generation facilities greater than 200 kW.

Source: Ministry of Energy, The Gambia

## FINANCING AND INVESTMENT

As with other countries in West Africa, donor assistance in The Gambia represents the majority of the energy sector investments. There are currently eight discrete projects at various stages of preparation/implementation. They are divided into three sets of energy sector development programmes, namely generation, transmission and distribution and RE development programmes. The financing institutions for these projects comprise banks such as the Islamic Development Bank (IDB), the Investment and Development Bank of ECOWAS (EBID) and the Arab Bank for Economic Development in Africa (BADEA). It also includes the OPEC Fund for International Development (OFID), the Economic and Social Development Bank of Venezuela (BANDES) and investors like GEF-UNIDO, the Danish International Development Agency (DANIDA) and the German International Cooperation Agency (GIZ). The total budget is USD 112.86m (USD 7.7m for the only RE project, two wind turbines of 900 kVA, developed so far). Government contributions towards these projects are in the form of counterpart funds mainly arising from internally-generated sources such as direct and indirect taxes, international trade taxes and non-tax revenues. The government also regularly borrows from international and local financial markets to finance energy projects.

In order to attract domestic and foreign investments in the main sectors of the economy including electricity generation/ distribution and RE, the government of The Gambia has adopted two main policies. These are the Investment Promotion Policy and the 2001 Free Zone Act.

The Gambia Investment Promotion and Free Zones Agency has been established and provides a mandate to lay out the investment promotion framework. The framework stipulates national treatment and equity participation of foreign investors by assuring them security of title.

It also guarantees against expropriation. Investors have also been offered an attractive incentives package including exemptions from import duties and tax holidays. Privileges arising from any existing or future customs union, free trade area, monetary union or similar international cooperation are also available to investors.

Under the Free Zone Act, free zones are being developed in selected locations. Activities and investment in these locations attract incentives for a period of 1-30 years depending on the duration of the licence. These incentives include, among other things, exemptions from capital registration payment and import duty on capital equipment, excise duty and sale of goods and dividend tax.

The financial market institutions in The Gambia are well positioned to play a key investment role in scaling up RE deployment. There are 12 commercial banks operating. These could act as a vibrant avenue for investment resources for private entrepreneurs in the renewable technology market.

Similarly, The Gambia Microfinance Network (GAMFINET), with a membership of 17 NGOs, can channel credit for the purchase renewable technologies by their individual members. While the majority of these NGOs are facilitators, five are currently active in savings and/or credit mobilisation with good track records and wide coverage in the rural areas. These are Reliance Financial Services, Social Development Fund, Gambians for Self Employment, Gambia Women's Finance Association and National Association of Cooperative Credit Unions of The Gambia.

The private sector in The Gambia has yet to show an inclination towards RE businesses. Local banks as well as microfinance institutions are averse to building a portfolio of RE projects since their understanding of technology risk is limited.

Moreover, most of the local banks lack capacity to plan, structure and appraise a RE project with appropriate financial instruments. Combined with inadequate awareness, this reinforces the perception of RE technologies as too expensive, lacking reliability and thus too risky.

This may change when the Renewable Energy Act comes into force, ushering in the RE fund. This will be the responsibility of PURA, providing financial incentives, FITs, capital subsidies, production based subsidies and equity participation to renewable-based electricity projects. Sources for financing the fund will include the national budget, multilateral and bilateral donors, donations, and various levies.

The money from the RE Fund would also be available for, among other things, the promotion of RE projects including capacity building for RE development. The government of The Gambia should take the opportunity to build the technical capacities of local financial institutions and the private sector as well as civil society. This will affect business opportunities within the sector.

A solar powered NGO farm in Nema Kunk in The Gambia
Source: www.risingshoots.com

# IV. OPPORTUNITIES IN DEPLOYMENT OF RENEWABLE ENERGY IN THE GAMBIA

The RE market is largely subject to the resources available and the technologies that can be employed to convert energy sources into services. This section is divided into different subsections focusing on different resources and conversion technologies, known here as service-resource pairs. In each subsection, the status of each particular subsector is reviewed, followed by the problems that need to be solved and concluding with a list of action points recommended by the RRA.

## GRID-CONNECTED RENEWABLE ENERGY OPTIONS

The grid remains an important way to reach large numbers of people at low cost. The situation in The Gambia is such that the grid is faced with formidable technical, institutional and financial barriers. Less than 35% of people are served by the grid, and the lack of reliable, affordable power is seriously hampering investment in The Gambia. This limits growth in critical productive sectors such as the agro-processing. A number of RE technologies are becoming increasingly cost-competitive. Their development could help unblock the impasse by enabling diversification of supply and building resilience in power infrastructure. This section considers wind and PV for The Gambia. They offer high immediate deployment potential.

### ON-GRID WIND

There is at present one grid-connected wind power generator with a capacity of 120 kW (150 kVA) that has been operating at Batokunku since 2009. There are also two 450 kW wind turbines at Tanji that started up in late 2012. All three were installed by a local company (Gamwind), and GEF/UNIDO provided part of the funds for the Tanji project. Uniquely, the turbines were acquired second-hand from Europe where they had been operating in a wind farm. They were refurbished in The Gambia. This explains why project lifetimes are reduced to 15 years instead of the 20-25 years average for new systems. The cost of acquiring these turbines is estimated to be 50-75% lower than new turbines of similar quality and size.

The investment cost for the plant at Batokunku was about USD 220 000 and is expected to have a lifetime service of about 15 years. At Batukunu,

**Table 6**
Tanji wind turbine power generation

| Reading date | Month | Monthly kWh to NAWEC | Monthly kWh from NAWEC | Monthly grid (hrs) | Difference hours | Grid (%) |
|---|---|---|---|---|---|---|
| 01/08/12 | July | 10 383 | 0 | 378 | 10 | 97.42 |
| 01/09/12 | August | 36 178 | 0 | 736 | 8 | 98.92 |
| 01/10/12 | September | 30 776 | 0 | 710 | 10 | 98.61 |
| 01/11/12 | October | 7 364 | 0 | 735 | 9 | 98.79 |
| 01/12/12 | November | 48 020 | 0 | 712 | 8 | 98.88 |
| 01/01/13 | December | 58 959 | 810 | 732 | 12 | 98.38 |
| Total | July-Dec | 191 680 | 810 | 4 003 | 57 | Av. 98.5 |

Source: Gamwind recording sheet (2012)

some 80% of the power produced is used by the village households who purchase electricity at 75% of the utility tariff. Meanwhile 20% is sold to the utility NAWEC. The benefits from this project have gone beyond just the provision of water and electricity. A variety of new employment opportunities have been created through self-help businesses.

The Tanji project had a capital cost of USD 577 000 and annual running cost of USD 36 000. The project is expected to generate a total output of about 572 000 kWh/year. Power is sold to NAWEC via a PPA at about USD 0.17/kWh, resulting in net income of approximately USD 59 000/year. The turbines in Tanji are Bonus 450 with a hub height of 35m and contain three blades with a rotor diameter of 37m. As part of the installations, two step-up transformers and a transmission line were constructed to connect with the coastal 33kV transmission ring operated by the national utility company, NAWEC. The project used historical wind data from the Batakunku wind measurements. Wind speed averages 5.51 m/s. In the first six months since the turbine started up, the system has transferred over 190 MWh of power to NAWEC against an annual target of 570 MWh (table 6). Referring back to figure 2.3, it is important to note that August to December is a period of low wind. It would therefore be interesting to see what the Tanji turbine will generate during the relatively high wind period between January and May.

Financial analysis for the Tanji project uses the assumption that all the power generated is fed into the grid at the utility tariff of USD 0.28/kWh instead of the actual selling price of USD 0.17/kWh. At that rate, the Tanji plant would generate an annual net income of about USD 124 000 or have a simple payback of about 9.1 years on investment. Further analysis was undertaken comparing the refurbished turbines against new turbines of the same capacity at market rates USD 1200/kW and USD 3000/kW[3] (IRENA, 2013a). The result shows a lower levelised cost[4] for the refurbished turbines at USD 0.13/kWh over a 15

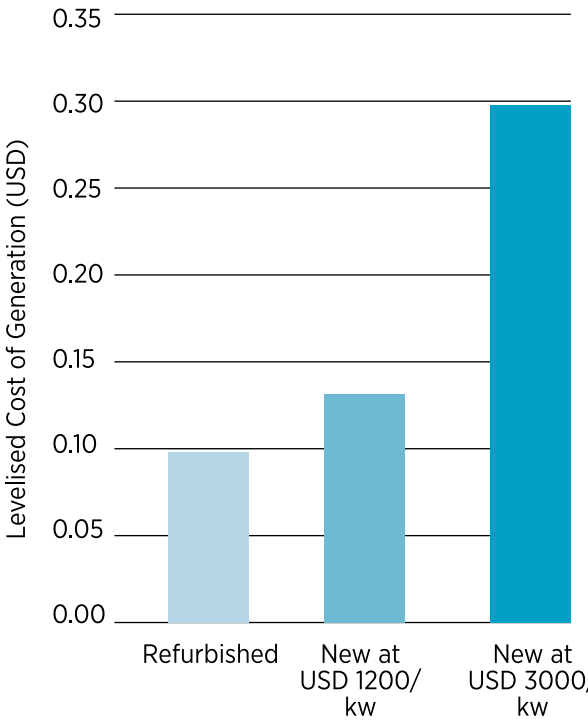
**3** Taken from IRENA Renewable Power Generation Costs in 2012. In figure 4.3, the total installed cost range of USD 1000-3000/kW is given as representative for Africa.

**4 Assumptions:** Capital cost of refurbished system = USD 577 000; capital cost of new systems = USD 1 200/kW and USD 3 000/kW; annual running cost = USD 36 000 (annual variable cost = USD 0.01/kWh + annual fixed cost = USD 30/kW); project time = 15 years; inflation =5%; discount rate =12%.

**Figure 8**

Levelised cost of generation with wind

Comparison of refurbished and new wind systems at different prices




year lifetime. It also shows a levelised cost of USD 0.15/kWh and USD 0.35/kWh for new systems over a 20 year lifetime (figure 8). The analysis also reveals that the cheaper option would yield a simple payback time of 11 years, and the more expensive wind turbine would exceed the payback period of its lifetime (20 years). This indicates that for more expensive wind options the introduction of a FIT would be necessary to attract investment. This demonstrates that, given the moderate wind regime, wind power is still a cost-competitive option, especially at the lower end of the capital cost price curve.

The Batokunku and Tanji projects are designed to address electrification for community use and for sale to the grid. Meanwhile, a new project is under development. This is part of the effort to support enterprises with access to electrification. It involves setting up a 450 kW wind turbine to support a fishing community to overcome high energy costs. This project is raising funds before being set up. The plant will have a capital cost of USD 298 000 and an annual running cost of USD 15 900. The interesting attribute of this project is that the electricity generated would be used for productive purposes at the Tanji Fishing Community. This community cooperative produces ice, runs chilled storage and a fish market and rents shops and fish-processing areas. The ice-making and chilling process at the fisheries is energy-intensive and uses approximately 715 000 kWh/year at a cost of about USD 170 000/year. This accounts for 80% of the production costs (GEF/UNIDO, 2011). The Tanji Fishing Community has agreed to provide 20% of the costs of the project while the rest would need to be obtained from various donors. The community believes that in the long run, the project will reduce its reliance on expensive electricity from the grid and provide significant annual savings. These can be reinvested to upgrade their operations.

Wind power generation offers an opportunity to improve the electrification rate by harnessing the use of locally available resources and diversifying the sources, as stated in PAGE. This necessitates the development of new business models that overcome the high capital cost often associated with RE systems. They lower investment risk in order to meaningfully engage the private sector. Although positive results have been obtained from the experiences in Batokunku and Tanji, the market for IPPs in the wind sector is yet to open up. The much-awaited RE law is expected to overcome some financial challenges through the introduction of a FIT, waiver on import sales tax and favourable corporation tax for RE developers. This would need to be complemented by a strong effort in two

areas: firstly, the construction of efficient administration and management capacity in the responsible government agencies. Secondly, skills would need to be improved in engineering, business, finance, and contract negotiations.

The wind projects have been designed with very limited wind data to properly assess the suitability of the sites for wind power applications. Usually, sites are screened on the basis of a wind atlas, validated with wind measurements from meteorological stations and monitored for about a year before wind turbines are installed. This procedure was not followed in The Gambian sites given the country's poor meteorological intelligence. The government must invest in strengthening its observation network and make the necessary preparations to obtain a good understanding of the wind regime across the country.

### ON-GRID PV

Solar resources in The Gambia are excellent, and thus offer the opportunity for deploying a range of solar technologies at utility-scale plants and distributed end-use applications. There has been a rapid fall in the cost of PV technology globally, enabling grid-based PV to achieve grid parity in a number of markets. It is fast becoming a genuine alternative for countries faced with the twin challenges of energy access and energy security. PV module prices have declined sharply from USD 3 700/kWp in 2009 to USD 1 200/kWp, making the Balance of System (BoS) a crucial determinant of solar PV system costs (IRENA, 2013a). These trends make PV a compelling product for end-users in countries such as The Gambia looking to reduce the exposure to the high cost and volatile fossil fuel market.

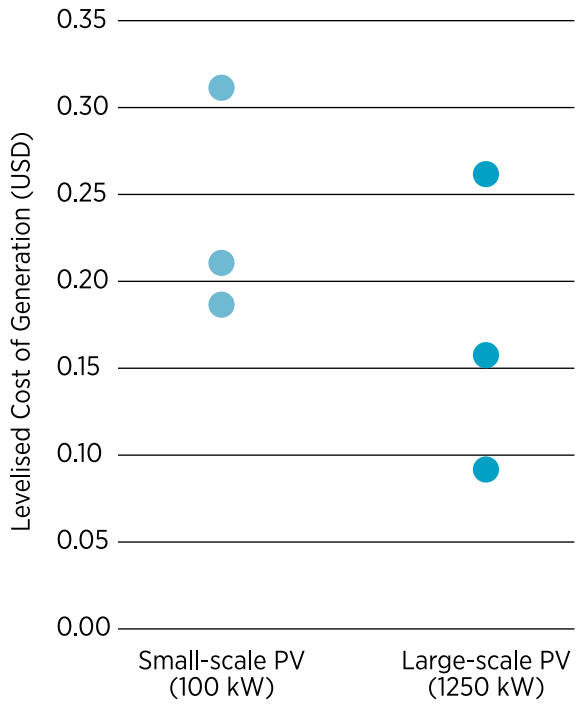
There is considerable experience of PV systems in The Gambia, but all of it is restricted to the off-grid PV sector, while there is no utility-scale PV system in country. Given The Gambia's specific power sector vulnerabilities, there is a growing interest among policy-makers in exploring the considerable economies of scale associated with PV-based grid developments. A pre-feasibility financial analysis of small-scale (100 kW) and larger scale (1250 MW) systems was undertaken to assess the cost of different size PV systems under resource and macroeconomic conditions in The Gambia. Generation costs were used from the latest IRENA study[5] as the basis for the cost assumptions for PV systems between USD 3000- 8000/kW. In both cases it was assumed that power is supplied to NAWEC at the current utility tariff of USD 0.28/kWh.

The analysis demonstrated a number of important features of PV grid systems in The Gambia. The payback period for the smaller system is 12-22 years depending on the per kWh system cost. Even more favourable figures are obtained for the larger system, which produces a payback period of 6-17 years. This is also demonstrated in the range of levelised cost results where the cost for larger systems are USD 0.10- 0.25/kWh while the smaller systems are USD 0.18-0.32/kWh (figure 9)[6]. This illustrates that the larger PV systems bring economy of scale benefits as the marginal cost of additional power implies a reduc-

**5** Adapted from IRENA Renewable Power Generation Costs in 2012. In figure 6.7, solar PV installed costs in non-OECD regions for utility-scale projects gives an average value of USD 3000/kW and a range of USD 2000-7000/kW. In this analysis, the USD 3000-8000/kW range is employed for The Gambia.

**6 Assumptions:** Capital range = USD 3000-8000/kW; annual O&M cost = USD 20/kW (for 1.25 MW plant size) and USD 30/kW (for 100 kW plant); inverter replacement at 10 yrs = USD 0.11/Wp; project time = 20 years; inflation =5%; discount rate =12%.

**Figure 9**
Levelised cost of generation of different scale systems in The Gambia




tion in unit costs. Furthermore, present generation costs for NAWEC fossil-based electricity is at USD 0.28/kWh. This makes the PV option attractive from a cost as well as security of fuel supply standpoint. Indeed, the bulk of the total cost of the PV systems is in the initial cost, while fossil-based systems have higher recurrent costs over the duration of their lifetime. However, as the cost of PV systems continues to fall, their value as a reliable and cost-effective option for power generation increases, particularly for periods of peak electricity demand during the day.

The RE Bill being debated at present provides for the acceleration of the development of RE resources through the establishment of a tariff system. This is the FIT for electricity produced from eligible renewable resources. It would need to be sufficiently attractive to draw serious investors. At the same time it would need to be pegged at a rate which will not adversely impact the final consumers of electricity.

## RRA FINDINGS

The RRA process has highlighted a number of technical opportunities and barriers facing the generation and transmission infrastructure in The Gambia. The process also brought to light some of the institutional, financial and capacity issues that continue to bedevil the power sector. These are discussed below.

## TECHNICAL CONSIDERATIONS

The power sector faces a dual dilemma. The first relates to the ongoing and (increasing) electricity supply shortages due to inadequate power generating capacity characterised by the aging and high operating cost of generating equipment. In addition to these technical shortfalls, the utility lacks adequate human capacity in critical areas such as power plant management. In 2011, about 99% of the total operating costs of NAWEC went into fuel and lubricants as well as energy payment from the fuel-based IPP (NAWEC, 2011). This left little resources for upgrades and critical refurbishments. The second dilemma relates to the issue of power quality as unplanned outages cause damage to electrical appliances. The present transmission and distribution network is composed of MV lines (33kV/11kV) covering 115km and 181 km respectively. These are dilapidated and not able to take significant additional power capacity without major upgrades and new transmission network development to connect additional generation. Variable generation from solar and wind sources will create further challenges for the energy system. The Gambia does not

have a grid code but this is essential to ensure RE can obtain priority access to the grid, while building in some flexibility in forecasting production.

In 2011, a loan agreement of USD 22m was signed between the government of The Gambia and Economic and Social Development Bank of Venezuela (BANDES) to upgrade, rehabilitate and expand the network. The first phase of the project has been completed and has already led to an 8% reduction in transmission losses. The project is in progress and is likely to significantly reduce losses and subsequently improve the finances of the utility. In light of these developments, the ability of the grid to integrate intermittent power generated by renewables would be higher. The assessment of the grid along with the evaluation of the RE economic potential should inform policy makers in setting RE targets that are both meaningful and achievable.

### SETTING RENEWABLE ENERGY TARGETS

The comprehensive RE bill is in the process of adoption. Section 4 stipulates setting up mid- and long-term national targets for deploying RE resources in electricity generation. The MOE would be the designated authority for proposing the targets. These would need to be tailored for a specific technology and/or defined in terms of addition to the electricity mix or capacity addition. The draft electricity strategy has made a recommendation that renewable resources contribute to 5% to the electricity generation mix by 2020. However, the basis for this target has not been made clear. The RRA underlines that the 2005-2006 solar and wind assessment study in The Gambia could serve as a good basis for evaluating the economic potential for wind and solar systems. This would provide some preliminary country-specific costs taking into account the recent decrease in RE technology costs (IRENA, 2013a costing study).

### TARIFF-SETTING

The technical suitability and economic viability of integrating renewables into the grid go hand in hand. A FIT scheme is currently under preparation in The Gambia. It has the support of the EU and is based on the specific policy and market framework of the country for wind, solar PV and biomass. These are identified as the most appropriate renewable power options in country in the short term. It is designed to improve the competitiveness of renewables and drive investment into the sector.

The design of the FIT was based on the avoided cost methodology given the fact that electricity generation is based on imported fossil fuel subject to market fluctuation. The proposed FIT is to be set at a ceiling price of 8.7 GMD/kWh (USD 0.26 /kWh) which is roughly equivalent to the current generation price of 8.5 GMD/kWh (USD 0.25 /kWh). It will be valid for 15 years from plant commissioning. In order to minimise impact on system stability, initially the maximum allowable plant size for solar PV and wind could be limited to 1 MW. Facilities greater than 1 MW would not be considered under the FIT scheme but could negotiate a PPA directly with the utility.

Setting up FITs equivalent to present generation costs is likely to cause an extra burden on NAWEC. It already borrows heavily from local banks at high rates to meet the current supply. Anticipating this challenge, the RE law will set up a fund to provide finance for the FITs and other RE commitments. This would be covered by annual contributions from the national

budget, registration fees from commercial organisations and individuals in the renewables sector, as well as grants for RE activities. Additional resources could be raised through the introduction of an RE levy on service sectors such as tourism and the banking sector that manage remittances. In 2010 The Gambia received up to USD 82m in remittances, according to Women World's Banking. The government could also consider working with international agencies to develop a credit line for community and small business RE or other power generation projects.

Although electricity generation has been opened to the private sector following the 2005 Electricity Act, only two IPPs have been established. This is due to the complexity of the permitting process for energy projects. GIEPA has nevertheless registered many energy project proposals involving the use of renewable. With its growing experience in diesel-powered and wind power IPPs, NAWEC has developed skills to foster fair relationships with IPPs. The practical experience gained could accelerate the establishment of many more RE projects by IPPs.

At present, the process of obtaining permits for RE projects means dealing with multiple players and institutional barriers. This can lead to significant administrative and transaction costs. This process needs to be simplified to ensure that project developers are not discouraged. Under the RE law, the MOE task will be to streamline permitting by simplifying the process and providing clear guidelines for land and water use among others. In addition, to stimulate private sector interest in the renewables sector, there is a need to develop a grid code with a favourable set of clauses for RE systems. Elements of a grid code are already emerging in the draft FITs and standard PPA which includes clauses for mandatory priority dispatch for renewable electricity as well as grid connection/access agreements. The grid code should consider near time or real time scheduling instead of the widely applied day-ahead forecast in order to meet the intermittency criteria of RE resources.

Capacity building for successfully concluding PPA negotiations and managing potential conflicts of interest in the future is also critical in project finance training. Guidance is necessary on international best practice in procurement, particularly in managing IPP and PPA negotiations. This needs to include the importance of managing potential conflicts of interest and ensuring appropriate separation from potential bidders.

### QUALITY CONTROL AND STANDARD SETTING

In addition of being the regulatory body, PURA is also in charge of conducting inspection and site visits to all power plants and network facilities. This is to inspect quality of service delivery and monitor health and safety standards. There are currently no RE technology standards in The Gambia. However, the draft FIT and PPA mention general applicable codes and standards that the RE plant should comply with. It would be worth creating specific standards and codes for RE technologies to ensure adequate quality, design, safety, operation and maintenance of equipment. GREC could take up this task and therefore its capacities should be built to facilitate the development of RE standards and certification of equipment as required. International cooperation could be facilitated by IRENA in this segment. PURA will have to build its capacity of relevant personnel in order to ensure it can make adequate performance appraisals of RE plants, as required in the RE law.

**Box 1**

## Power Up Gambia

THE SULEIMAN JUNKUNG GENERAL HOSPITAL located in the town of Bwiam sees over 20 000 patients every year and has a catchment area of over 100 000 inhabitants. Since 2006, the hospital has relied on three diesel generators, which it could only afford to run for 8-10 hours a day depending on fuel availability. They saved most of these hours for after dark because the staff and patients desperately needed the lights. The remaining 1-3 hours of electricity were used during the day, when the hospital was busiest. Without constant electricity, the hospital could not safely store medication or provide oxygen and incubators for infants as well as running the water pump. Hospital services grew considerably as did the electricity demand.

The hospital CEO and a non-profit called Power Up Gambia (PUG) raised USD 300 000 for the installation of a solar system to meet the hospital needs in a sustainable and cost effective way. GAM-Solar, the leading solar panel contractor in The Gambia, assessed the power requirements of the hospital. It concluded that 108 solar panels were required to provide the hospital with power, 90 for electricity and 18 for running water. In 2009, six PV tracking units with an installed capacity of 12 kWp were installed and have been powering the hospital ever since.

Over the past four years the hospital learned a lot about the opportunities and challenges of managing an off-grid solar system, especially issues related to electricity storage. While expanding the programme to other rural hospitals and clinics, PUG intends to connect the Suleiman Junkung General Hospital to the national grid. This was extended to the town of Bwiam in early 2013. It has a net meter arrangement with the utility to send excess solar power to the grid and draw it back at night. Net metering would save battery power for emergencies and load shedding, reduce wear on the batteries, lower the hospital's electricity cost and increase renewable power production to the grid. PUG intends to work on the business model, test it out and replicate it in other rural clinics with access to a grid.

For more information visit www.powerupgambia.org

A healthcare project powered by solar power in The Gambia
Source: www.powerupgambia.org

### ACCESS TO INFORMATION

One of the major barriers to attracting investment is RE project developer access to the required information for robust project proposals. The Gamwind and GEF-UNIDO pilot project developers have acquired considerable experience. Workshops and seminar training on these projects would provide practical foundations for future projects.

Given that The Gambia is changing its energy landscape, a communication strategy must be developed. It should involve key stakeholders, namely GIEPA, PURA, NAWEC, MOE and REAGAM. GIEPA and PURA should take the lead in communicating timely, detailed and commercially-relevant information to ensure the investment market is fully informed of opportunities within the country.

## OFF-GRID RENEWABLE ENERGY OPTIONS

The government of The Gambia places a high premium on providing its citizens access to electricity. With a less than 35% electrification rate at present and increasing demand for power for social and economic development, broadening energy access is an important policy. Grid extension has been traditionally associated with electrification options in The Gambia. However, there are limits to what can be achieved through the grid alone, especially in areas of highly dispersed populations, small loads and low load densities. Extending transmission lines to these areas will be financially prohibitive. Connection fees often approaching USD 1000 per household may be beyond the reach of most people in a country where about 48% are currently living on under USD 1.25/day. Clearly, an integrated approach as well as an understanding of the limits to conventional grid extension will be required to balance needs, population distribution, costs and resources. Some small-scale RE technologies are commercially maturing, such as PV, wind energy and biomass, and new and innovative service delivery mechanisms are surfacing. This means off-grid electrification has emerged as a viable alternative for electricity access, especially in areas too remote from the grid. The Gambian leadership has long recognised the need for a dual approach to energy provision. This includes expanding both on-grid and off-grid systems to accelerate access to modernised and clean energy services.

There is plenty of experience of off-grid PV electrification, water pumping and solar heating systems for hotels, clinics and households. Each of these will be explored below.

### OFF-GRID PV ELECTRICITY

The main decentralised RE system being promoted on The Gambian market for electricity is solar PV. It has been extensively used since the early 1980s for rural water supply and remote power for telecommunication facilities. About ten retail companies are active in The Gambia in PV for rural applications, and in 2004-2010 these companies installed a total cumulative capacity of 567.53 kW (table 7).

There is considerable potential for deploying solar home systems in The Gambia. The successful implementation of solar PV water pumping, solar home systems and PV-diesel hybrid projects in Darsilami, sponsored by the EU, is a case in point. With a population of 3 000 inhabitants, Darsilami is not connected to the grid and is at about 10 km from the grid line. The cost of establishing transmission lines at USD 90-100 000/km

**Table 7**
Solar power installation by major local companies in 2004-2010

| COMPANY | SERVICE | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| GAM-SOLAR | Electricity (kW) | | | | 24.205 | | 14.4 | 5.8 |
| | Water (kW) | | | | 281.42 | | 16.4 | 0 |
| P S ENGINEERING* | Electricity (kW) | | | | | 5.2 | 2.0 | 1 |
| | Water (kW) | | | | | 1.2 | 0.2 | 0 |
| ESEIM SOLAR** | Electricity (kW) | | | | | 1.77 | | 2.675 |
| | Water (kW) | | | | | 3.96 | | 3.75 |
| C & E SERVICES^ | Electricity (kW) | | | | | 11.52 | 2.352 | 2.516 |
| | Communication | | | | | 1.83 | 0.24 | |
| SWE-GAM | Electricity (kW) | | 1.95 | 3.2 | 0.15 | 1.16 | 0.0 | 0.98 |
| | Water (kW) | | 2.8 | 1.3 | 2.95 | 5.89 | 36.1 | 68.22 |
| SUN FACTORY | Electricity (kW) | | | | 16.95 | | 4.59 | |
| | Water (kW) | | | | | | 3.5 | |
| SANFOSI | Electricity (kW) | 3.38 | 2.63 | 0.37 | | | | |
| | Water (kW) | | | | | | | |
| CHYBON | Electricity (kW) | | 0.3 | | | | | |
| | Water (kW) | | | | | | | |
| REGIONAL SOLAR E^^ | Electricity (kW) | | | | 2 | 2.5 | 1.7 | 1 |
| | Water (kW) | | | | 1 | 4 | 3 | 2 |
| GAMBIA ELEC^^^ | Electricity (kW) | | 0.36 | | 2 | 2.5 | | 0.325 |
| | Water (kW) | | 0 | | | | | 0 |
| **GRAND TOTAL** | | **3.38** | **8.04** | **4.87** | **328.68** | **49.8** | **84.4** | **88.26** |

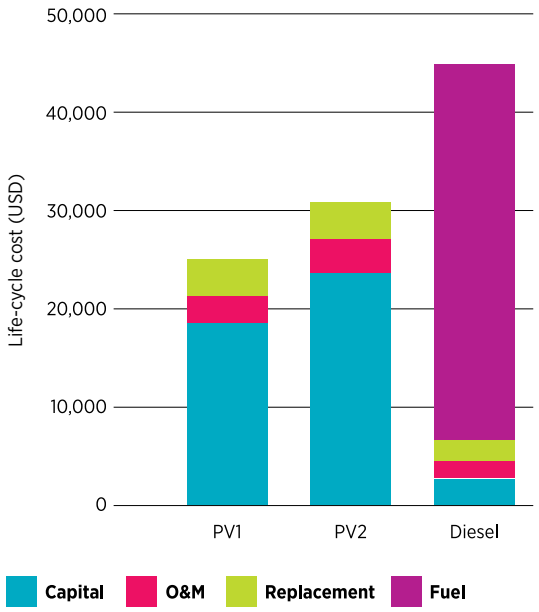
*Power System Engineering, **Eseim Solar Co. Ltd, ^Communication & Electrical Services,
^^Regional Solar Energy Co. Ltd, ^^^Gambia Electrical Co. Ltd

Source: MOE, 2011

was seen as too costly. Generation capacity in The Gambia would not be sufficient to meet the energy demands for small towns such as Darsilami. The project consists of 3 000 watt peak (Wp) PV, a 300 Ah battery and 9kW diesel components that supply continuous power to the Darsilami health centre. This is equipped with a vaccine refrigerator and small lab with medical devices for blood analysis and sterilisation. The diesel generator is used only during the rainy season and contributes less than 5% of the total energy mix. Other load includes water pumping, battery charger and electricity supply for public service providers. The hybrid system allows upgrades to 15 kW to bring electricity to 300 households, with a daily consumption of 200 KWh per household and with a total daily primary load of 60 kWh (Geipel, 2009).

Other community-based initiatives include the Solar Street Light Project. This resolves non-payment of street lighting bills by municipal councils and improves the NAWEC budget position while maintaining the security provided by street lights. This project's progress is detailed in text box 2. The success of the Street Light Project led to further feasibility studies. These examined potential programmes for solar home systems in rural households and other PV

**Figure 10**
Life-cycle cost comparison between PV and diesel for off-grid electrification




systems for social services (schools, clinics) and productive uses (rural telecommunication centres). It is expected that the African Development Bank (AfDB) would make loans available for the Solar Street Light project and provide grants for the solar home systems programme.

Solar PV and diesel systems should be compared on the basis of life cycle costs of providing the final service in order to account for the major operational differences between these systems. The four broad components of life cycle costs are initial costs, replacement costs, O&M costs and running costs (including fuel use). Two observations can be made from the life cycle cost comparison between two 3.2 kW PV systems and a diesel generator. This is used to meet the daily load of 11.5 kWh of a rural community (figure 10)[7].

Firstly, over a 20 year project life, the PV systems are significantly cheaper, with levelised costs of USD 0.29/kWh and USD 0.36/kWh, and the payback period is five years. In contrast, the diesel system is costlier over the longer term with a levelised cost of USD 0.53/kWh. Secondly, the 85% share of fuel cost for the diesel system and a share of capital cost of about 80% for the PV systems. Clearly, this has implications for rural households and communities in The Gambia who do not have disposable incomes to cover high upfront PV costs or cannot access adequate bank support. This will mean developing sound government policies, testing new business models and the introducing finance schemes designed to support off-grid renewable systems. The role of the new RE law and associated regulatory and financial instruments will be critical in creating a viable market supported by a sustainable financing mechanism.

One measure that PV systems have penetrated The Gambian market is the increasing numbers of shops in Banjul and the Greater Banjul areas that trade PV solar accessories and various system components. Solar panels in these shops range in size from 20-235 Wp, and controllers as well as efficient appliances can be readily obtained. This is a positive development in that PV systems are entering the mainstream market and having greater visibility. However, the unregulated nature of the market is letting in unlabelled equipment with no specifications. The government has passed The Gambia Competition Act and is expected to pass the Consumer Protection Act. These need to be given sufficient

**7 Assumptions:** Capital range = USD 3500-5000/kW for the PV module (system cost of USD 18 417 and USD 23 520); battery size = 1800 Ah (7 Deka Gel batteries at USD 700/unit) and replace every 7 years; inverter cost = USD 0.11/Wp and replace every 10 years; annual O&M cost = USD 20/kW (for 1.25 MW plant size) and USD 30/kW (for 100 kW plant); project time = 20 years; inflation = 5%; discount rate =12%.

**Box 2**

## NAWEC Street Light Project

**Started in 2006 to resolve**

- Non-payment of street lighting bills by municipal councils
- NAWEC budgetary difficulties
- Lack of security from street lighting

**Several centralised solar tracking systems supply poles with light**

- Makes cleaning panels easier
- Prevents damage from vehicle road accidents
- Replaces conventional street lights to relieve NAWEC financial losses from powering street lights without customer revenue
- NAWEC can extend its supply to more households & businesses

**Cost & achievement by 2012**

- Total cost of USD 216 467 (2006 exchange rate)
- 75 poles erected
- Tracking system of 6 substations of 2 100 Wp each completed

**Savings from 12 hour lighting period**

- Energy consumption per pole 490.55 kwh
- Annual saving per pole at USD 0.25 tariff rate = USD 120
- NAWEC annual saving for 75 poles = USD 9 000
- Project payback period 3.5 years

enforcement powers to safeguard the rights and welfare of consumers.

### OFF-GRID PV WATER PUMPING

Since 1990, steady progress in extending rural water coverage was made in The Gambia, and it was reported in 2010 that 80% of the country has now access to water. This would be sufficient to meet the Millennium Development Goal by 2015 (AMCOW, 2010). Access to an improved water source refers to the percentage of the population with least 20 litres per person/day within one km of the dwelling from an improved source. This could be a household connection, public standpipe, borehole, protected well and rainwater collector. In The Gambia, groundwater sources meet most of the potable water needs, hence energy use for pumping water is a critical input for water access. Handpumps, diesel generators, PV systems and some wind pumps are in use at present.

Ongoing and upcoming projects in The Gambia will improve access to rural water services. The Gambian government has recently initiated a large-scale Rural Water Supply Project, with the USD 4 875m from the Islamic Development Bank (IDB). This will provide 90 drilled wells with hand pumps and ten systems with a borehole, tank and pipe distribution network to ten communities. The government recently finalised and signed a USD 7m grant with

the AfDB for a rural water supply and sanitation project to be completed by 2014.

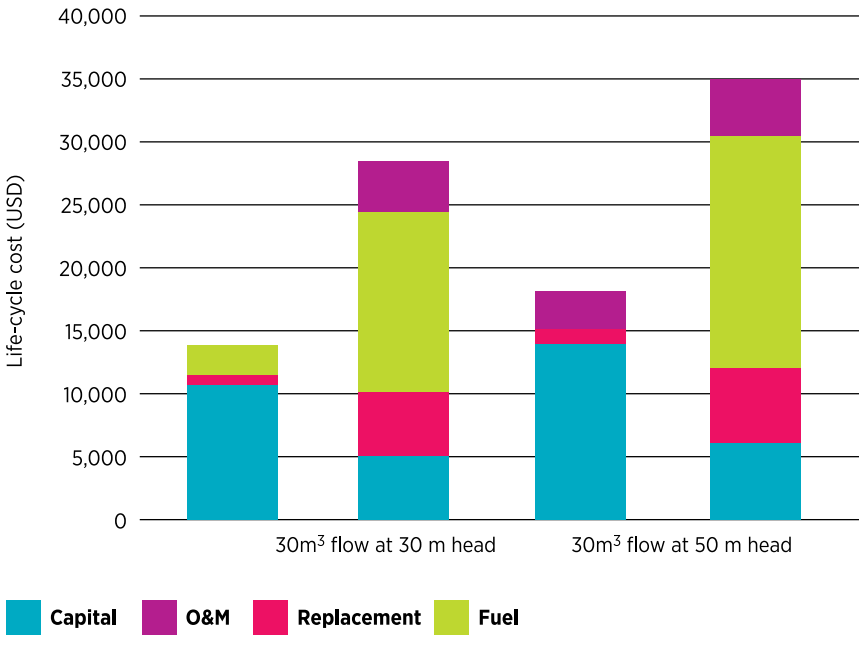
The project will provide 18 new solar-powered drilled boreholes and pumping units and elevated water tanks and distribution networks with public stand-taps. It will rehabilitate and upgrade four water supply facilities, provide sanitation in schools, rural health centres and markets. With funding from various development partners, a local solar firm, GAM-Solar, has installed smaller scale solar pumping systems in about 80 villages. They serve more than 200 000 villagers.

The source of the energy used is critical to the overall cost of water pumping systems. As PV prices are falling and the volatility of the fossil fuel market increases globally, PV pumps are rapidly becoming more attractive than the traditional pumps powered by diesel and gasoline.

In a life cycle cost analysis using country-specific data conducted for The Gambia it is shown that over the longer term, PV performs better than diesel (figure 11). It provides a more reliable alternative for a continuous water supply. This illustrates how emerging price trends and technology development favours PV over diesel. This is likely to continue into the future.

The need to provide water services is not limited to the household sector, but also extends to commercial and productive sectors. As The Gambia pushes to enhance its agricultural sector to improve food security as well as diversify its trade, the need for improved irrigation will assume greater importance. Affordable and reliable energy for pumping water for irrigation could play a central role in enabling smallholders to extend their production into the longer dry season. This would improve their earnings, transforming rural economies and

**Figure 11**
Life-cycle cost comparison between PV and diesel for water pumping at different depths



allowing them to play a key role in The Gambia's development plans as detailed in PAGE 2012-15. GAM-Solar has installed several agricultural solar irrigation systems funded by donor organisations and NGOs, such as the recent eight hectare drip-line irrigation project at Sifoe Farm.

## SOLAR WATER HEATING

Water heating is a major consumer of energy in The Gambia – mainly in hotels, clinics and some households. Significant savings can be made if hotels and other large institutions are able to capitalise on the energy savings opportunities from solar water heating systems, which have been around for several decades. The technology is mature, simple to repair and replicate, and heats water cost-effectively.

Conclusions were drawn as early as the 1980s that major hot water users could make significant financial savings by switching from diesel-powered and electric water heating systems to solar heating systems. The most common type of solar water heater in The Gambia incorporates a $2m^2$ flat-plate solar collector and a 300 litre storage tank, and has a payback period of less than one year.

Some hotels have already invested in solar water heating systems, due to increasing awareness of ecotourism practices and motivated by the high cost of electricity. Kombo Beach Hotel has installed a 6 000 litre solar water and hot water storage system. It is backed up by a thermal heating system using fuel oil in the event of a hot water shortfall from the solar system. However, the high initial investment cost has remained an obstacle for most hotels, although increasing numbers of smaller hotels located away from the grid are investing in solar heating systems.

Based on these experiences, the viability of solar water heaters in the resource and economic context of The Gambia is convincing. For a typical load like the Kombo Beach Hotel and a capital cost of about USD 15 000, the solar water heater could have a payback period of under 2.5 years. This is for a system with a lifetime service of 20 years (figure 11).

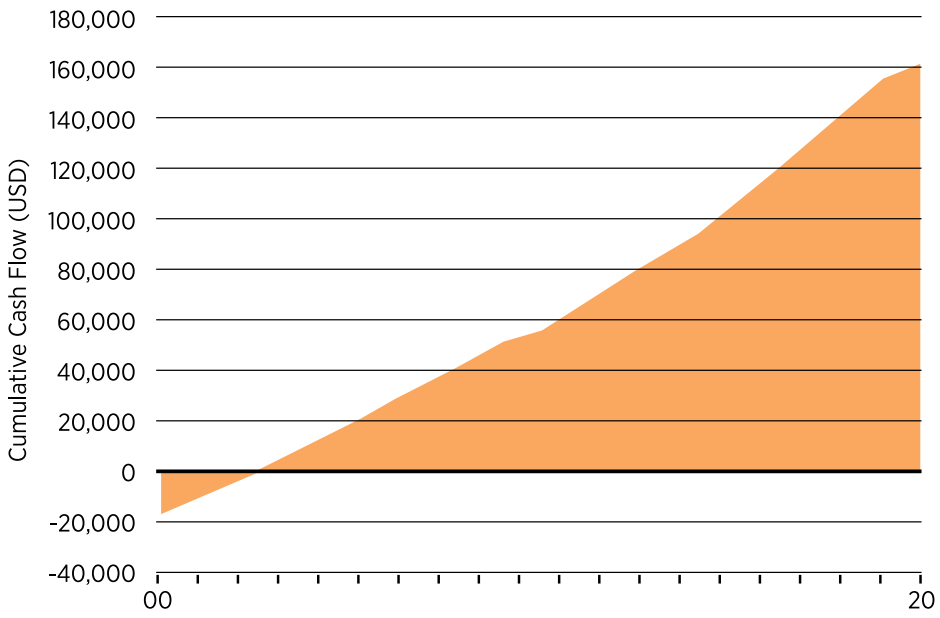
Continuing to rely on grid electricity would mean that water heating services are subject to higher costs and less reliable service delivery due to load shedding and other technical problems. Since one of the grid challenges is inadequate generation capacity, shifting the water heating load to solar means grid electricity could be freed up for other end-uses. It could release pent-up demand in various sectors.

Since 2000, considerable experience has been obtained and skills developed in solar heating systems in The Gambia. In 2004, the Ministry of Energy (MOE) developed a solar water heater using a converted electric water heater tank in collaboration with GTTI. This is significant because it means two types of solar water heating are available to households. They have a market price of about USD 400 for the flat white bed type and USD 630-2600 for the more expensive vacuum type.

While this has been a productive DoE/GTTI collaboration, it could have benefitted from a strong national promotion programme. This would have mainstreamed the technology to a wider end-user base beyond a few private initiatives.

Looking ahead, design regulations with a specific mandate for different sectors (industrial, tourism and households) to install solar water heaters would help the technology gain further traction.

**Figure 12**
Solar heater cumulative cash flow and payback period




## RRA FINDINGS

The RRA has demonstrated that off-grid renewable systems have already made a significant contribution to social and economic development in The Gambia. It is also important to note that decentralised RE development in The Gambia will not be a 'silver bullet' for universal access. It will, however, probably be an important component of any expansion in electricity access. The following are some specific findings from the RRA relevant to off-grid electrification.

## IMPORTANCE OF CLEAR RURAL ELECTRIFICATION STRATEGY

In The Gambia, as in most countries in the region, rural electrification campaigns were conducted using grid-based technologies. This is understandable since grid-based technologies enable lower cost connections to those closer to the grid. The challenge with a grid-based approach is that it will not reach remote or dispersed communities. It may even cause people to go to the grid rather than the grid come to them. The high electricity access in the Greater Banjul area when compared to the very low rates of access in other areas, points to this reality. Although the recent NAWEC electrification experience is encouraging, there is still a need for a clear rural electrification strategy. Despite electricity demand growth in the provincial centres, generation fell due to high operation and maintenance costs. This resulted in shorter electricity supply. Part of the challenge is that consumer tariffs in the provincial areas do not reflect costs (they are heavily subsidised). This has contributed to the NAWEC overall low financial strength and credibility.

A robust rural electrification strategy would be aligned with local (provincial) development plans. This would result in a more coordinated and effective approach in meeting the electricity needs of the rural population. The strategy should define short, medium and long-term access targets supported by technology specific targets within defined geographic areas for off-grid electrification. One way would be to introduce rural energy service concessions. This would allow an entity (private

sector, NGO, community organisation *etc.*) to exclusively serve one or more defined areas under a concessionary agreement.

The resource assessment carried out shows that provincial areas have adequate radiation all year round to enable renewables to play a significant role in off-grid electrification.

## ALIGNMENT OF RE BILL WITH IPP NEEDS

The draft RE law under discussion supports the establishment of off-grid RE/hybrid facilities run by IPPs. For systems up to 200 kW, the IPP would be allowed to charge electricity tariffs to consumers up to the national retail tariff. An IPP wishing to operate a larger system or charge electricity tariffs above the national retail tariffs would need to negotiate the terms with the regulator. The RE fund, which will be administered by PURA, would provide financial incentives such as capital subsidies, production-based subsidies and equity participation. These would be available for mini-grid and off-grid renewable power systems for remote areas and islands. This should attract private sector investment in the sector. The expected challenge would be to ensure that the RE Fund will have sufficient resources to maintain the investment momentum. The government will need to employ a variety of creative fundraising mechanisms to sustain the fund.

## ECONOMIC ASSESSMENT OF HYBRIDISATION

There is plenty of experience of a variety of technologies in The Gambia. It is important to document and assess the cost of single and combination (hybrid) technologies in the different regions. This produces dynamic data on the range of technologies and their performance under different conditions. The diesel-based mini-grid operated by NAWEC offers a compelling case for its hybridisation with RE sources. Since solar radiation is abundant throughout the country, detailed feasibility data on hybridizing the diesel mini-grids with solar PV would help to demonstrate the economics of these systems to potential investors.

## STANDARDS AND LABELS (ACCREDITATION AND CERTIFICATION)

The lack of accreditation and certification of RE technologies restricts the promotion of PV-based electrification and solar water heating. Most companies currently operating in The Gambia have a long and solid track record in delivering high standard projects. It is anticipated that the renewables market will expand and that possibly new entrants into the trading and system installation market will emerge. It is important to establish standards and labels for renewables equipment (whether imported or locally manufactured) and ensure their proper installation and operation. It is not clear who would oversee this important task.

## GREC CAPACITY DEVELOPMENT

The role of GREC will need to be redefined and its capacity developed further. As a knowledge hub of the MOE, GREC could play a pivotal role in maintaining high standards of research and development activities. It could use its own human resources and work with NGOs, the private sector and tertiary education institutions. However, funding for the continuous support of R&D in the RE sector has been discontinued. Adequate staffing was not maintained. This means GREC consists of only one full-time technician with an office at the REAGAM facilities plus some administrative support. As matters stand, GREC does not have a qualified expert that could fulfil its origi-

nal mandate of RE R&D and the provision of sound technical support to the MOE. The Gambia should therefore support the revival of GREC by entrusting the centre with a number of roles.

These include scientific, technological and innovative research in RE, promoting RE for industrial uses and building the capacity of installers of RE systems with proper certification. This was outlined in the RE bill. In order to attract qualified expertise for this purpose, the government of The Gambia will need to allocate a specific budget from internal sources. It will also need to support partnerships between GREC and well-established international centres with a similar mandate.

### AVAILABILITY OF SOFT LOAN SCHEMES OR OTHER CREDIT LINES FOR SOLAR PV

The upfront cost of RE systems is a disadvantage to rural communities with little income from obtaining electricity services. The rural energy system as it has evolved to date is complex and not disposed to adequate planning and resource coordination. Soft loans can be attractive. A small down payment of the total price is made and the rest paid over a number of years at a preferential interest rate.

In The Gambian context where bank loans come with an 18% interest rate, a grant from a multilateral agency or donor could be ring-fenced. This would get soft loan schemes up and running for household or community electrification purposes.

While this cannot be considered as a long-term funding solution, it could address energy for social development needs and may also serve to stimulate the renewables market in rural areas. The RE fund will be instrumental in providing finance to kick start subsidies and loan schemes.

### GENERAL CAPACITY DEVELOPMENT

The Gambia has built a credible human capacity in some renewable applications such as PV and water heating systems. However, as yet, there are no government or NGO-led public education programmes, no RE industry associations and no formalised RE technical training programmes. Capacity development for planning and implementing large-scale off-grid (and on-grid) programmes will need to be increased if the promise of RE resources is to be fully realised. Private sector involvement will require multiple skills in energy analysis, engineering, finance and management in order to build a strong RE business environment.

## BIOMASS FOR COOKING AND HEATING

A range of solid biomass resources are used in The Gambia, consisting of fuelwood, charcoal, agricultural residues and industrial wastes of agricultural origin. In the Greater Banjul area, much of the fuelwood and charcoal is imported from Guinea and southern Senegal. In rural Gambia, fuel is mainly gathered from community woodlands or shrubs near the villages. Officially, charcoal production has been banned by a presidential decree since 1977, but although the law is well articulated, compliance is low. Charcoal continues to be produced in several villages in the West coast region through often obsolete and inefficient production methods.

Amid growing concerns for sustainable supply of energy services to the household sector, a Household Energy Strategy (HES) was devised for the energy sector. It had the support of Comité Inter etats de Lutte contre la Secheresse au Sahel-Interstate Committee for Drought Control in Sahel (ICILSS)/PREDAS (Regional

**Box 3**

## Production and promotion of groundnut shell briquetting for cooking and heating

GreenTech is a private company established in early 2011 with the aim of improving the cooking fuel supply chain. The company produces and supplies high quality fuel briquettes from groundnut shell residues. It also researches, designs and markets fuel-efficient stoves, allowing end-users to save time, money and natural resources. GreenTech has a briquette production capacity of 800 kg/hr and supports the production of fuel-efficient stoves made from recycled metal by local welders. GreenTech's innovative stoves also emit less smoke than the traditional firewood alternative. These are especially beneficial to women and children, who are most involved in the cooking process. Fuel switching from charcoal in an open stove to briquettes in fuel-efficient stoves can save a family 60% of their cooking fuel cost.

The briquettes can also be used in restaurants, canteens or industries using heat from biomass for boilers or smokeries. Nevertheless, GreenTech realised that a lot of effort is still needed to sensitise and convince potential users of their environmental and economic advantages. The company received the SEED Award in 2011 and has since been approached by several institutions to present and demonstrate the products, service and concepts at national and international level. This has allowed the company to become a knowledge hub for biomass briquettes to establish decentralised, independent sales points.

For more information visit: www.greentechgambia.com

Programme for the Promotion of Domestic and Alternative Energies in the Sahel) and was approved by the cabinet in 2006. It was the outcome of four sector studies undertaken in 2004. These focused on household energy consumption, charcoal, charcoal briquetting from agro-industrial residues and community-based natural resource management.

Based on the HES recommendations in 2006, the MOE has outlined specific action points, including increased efficiency in the production and utilisation of forest resources. These are as follows:

- **Promotion and development of improved cookstoves.** In 2007, the MOE supported the local production, testing and dissemination of the JIKO improved charcoal stove through GREC. It was locally called Furno Jambar. Prior to this period, other improved cookstoves were promoted, including the metal ring for firewood. Local production of the Furno Jambar in The Gambia started after 2007.

- **Construction of a bulk storage facility for LPG.** The HES recommended an increased use in alternatives to fuelwood given concerns about woody ecosystem degradation. LPG was identified as one of the alternatives. In 2009, a new bulk storage facility for petroleum products of 51 000 tonnes was commissioned including 1000mt for LPG. Prior to this period, all LPG into the country was imported mainly from Senegal using truck tankers. The construction of bulk storage for LPG increased the security and reliability of

supply, but the high retail price for LPG remains an obstacle.

- **Production of groundnut shell briquettes**. Groundnuts are The Gambia's principal agricultural export crop. In the 1980s, the Groundnut Shell Briquette Project was initiated and a plant commissioned. It converted groundnut shells into fuel briquettes with a capacity of six tonnes of briquettes per hour as part of a household energy solution. However, the plant was not extensively used and the project failed due to household resistance to change. This was due to excessive smoke, stoves unsuited to briquettes, the absence of a widespread, intensive marketing strategy, and the relatively high cost of briquettes compared to wood and charcoal (DMCI, 2005). However, most of these problems could have been solved with commitment and a marketing and awareness-raising strategy about the advantages of briquettes. These include lower energy cost per calorie of heat provided. In 2009, the MOE, the Department of Forestry and GreenTech Company initiated the re-establishment of a groundnut shell briquetting plant with the intention of solving these problems (box 3).

### RRA FINDINGS

During the RRA, discussion focused mainly on improved cookstoves and forest/agriculture waste-based alternative fuels. A number of problems were identified that are specific to the biomass sector. They include:

i) the absence of a clearly defined policy on the use of biomass, including waste biomass and energy crops for various energy applications

ii) lack of institutional coordination and collaboration among stakeholders and with financial institutions

iii) absence of efficient cookstove standards as well as inadequate awareness-building campaigns to encourage behavioural change in energy usage. Some specific areas of intervention were identified during the RRA.

## ROLE OF THE RENEWABLE ENERGY LAW

The MOE is mandated to carry out an impact assessment for the use of biomass for electricity and other energy purposes (heating, cooling and transport fuel). This is to take place within one year of the RE Act coming into force in 2013. The assessment is to include among other things:

- The most appropriate use for waste biomass in relation to cooking fuel.
- Forestry and agricultural impacts of using different biomass energy sources for cooking/heating.
- The feasibility and economic impacts of using different biomass energy sources.

This assessment should mean a strategy for the sustainable use of biomass energy is drafted and adopted. The biomass strategy would ensure the sustainable supply of biomass-based cooking fuel and promote the use of alternative fuel as well as efficient cooking equipment/devices.

### DEVELOP/UPDATE MASTER PLAN FOR FUELWOOD SUPPLY

The stakeholders felt that the strategy should lead to the development/update of a master plan for fuelwood supply.

Source: Ministry of Energy, The Gambia

This should reinforce the current forest management plans and identify optimal ways to access/produce alternative fuels at affordable prices. It was also suggested that the strategy should have three main components:

i) promotion of improved cookstoves produced locally;

ii) promotion of biomass-based alternative fuel; and

iii) stronger sustainable production of fuelwood through community-based wood lot management.

## THE NEED FOR PUBLIC AWARENESS-RAISING

The sector is informally organised, and this is one of the major barriers preventing the rollout of improved cookstoves. It lacks adequate communication, sensitisation campaigns and advocacy. Some surveys have highlighted that the reluctance of households to use improved cookstoves is not only due to their cost. Other reasons are a lack of financial management and planning skills and different household spending priorities. Yet even when the life cycle cost of different stoves is assessed, briquettes stoves are more cost-effective than traditional stoves (GreenTech).

## TECHNOLOGY BARRIERS

The current stoves need further improvement for meeting users' requirements in terms of cooking time. Women complain that cooking with the improved stoves takes longer compared to open fire stoves. GREC could be designated as technical centre for working with users in designing and testing improved cookstoves to bring them in line with their design expectations. GREC technical capacity should be built and adapted to the technical challenges faced by The Gambia. End-user need to know more about energy, technol-

ogy and finance to enable them to adopt new technologies and use existing ones properly. This minimises the burden of high fuel cost and reduces time spent collecting fuelwood. Public communication or local community training could be provided through outreach workers.

### FINANCING MECHANISMS ARE CRITICAL

Mainstreaming improved cookstoves is fraught with challenges. Many failed examples testify to this reality. In countries where cookstove promotion had succeeded, there was strong collaboration between policy makers, the private sector and financial institutions to provide structure and coherence in the sector. The stakeholder mix should also include finance organisations such as microcredit institutions. These would be in a position to provide finance to serve low income groups. Existing wood retailers can also be used for marketing/communicating these technologies as they work within a strong national network.

## OPPORTUNITIES AND CONSTRAINTS FOR SCALING UP RENEWABLE ENERGY DEPLOYMENT

### ALIGNMENT OF ENERGY POLICIES WITH BROADER DEVELOPMENT PRIORITIES

The Gambia is pushing through a series of energy and development programmes to improve social and economic development. Its PAGE has the aim of accelerating pro-poor growth and generating employment. The programme also reserves ample space and attention to the development of the national infrastructure, including energy, as a way to meet these goals. On the energy front, The Gambia is now preparing a robust RE law.

This aims to expand RE through a variety of delivery mechanisms and business models. Introducing these policies is not easy in a country heavily reliant on fossil fuel, with growing demand for electricity and a weak transmission and distribution infrastructure. The Gambia is also taking a strong position in its energy policy and strategy to ensure the private sector plays an important role in developing the power sector. To realise this goal, The Gambia is preparing a series of regulatory instruments such as a FIT and bankable PPAs to meet RE sector requirements.

### WAPP EFFECT

West African regional power development work is progressing with a number of transmission and rehabilitation projects already completed. It is expected that The Gambia will benefit from importing more power than it will produce domestically. Furthermore, RE technologies are likely to play a major role in developing an integrated power pool. This is because their share in the region could amount to as much as 52% in 2030 if the cost of these technologies continues to fall and fossil fuel prices continue to rise (IRENA, 2013b).

For smaller countries like The Gambia, this could mean a reduction in the long-term marginal cost of power by USD 0.02–0.07/kWh (Eberhard *et al*. 2011). WAPP could usher in an era of cheaper and more secure power supply. This should be welcome, but cross-border power transmission will still require considerable investment, a high degree of collective ownership and a new terrain of engagement which has little precedent in Africa.

The effect of a highly interconnected power infrastructure on rural energy services in The Gambia is uncertain, as most people will continue to rely on decentralised

systems. There are clear opportunities for The Gambia. However, it is important to carry out a further assessment that considers the real implications of this for the whole range of energy users.

## IMPORTANCE OF LEADERSHIP

Policy makers across Africa have been among the last to embrace RE as a solution to their energy problems. They are often locked into crisis management on a day-to-day basis. The country's policy makers need to be persuaded that RE has a real future in the energy mix of The Gambia. They need to demonstrate this by their actions. The Gambia has already started this process by setting up a strong policy that includes RE as part of its energy future. It is in the process of building the institutional and legal framework that will help to deliver this promise.

The success of the RE mission will be judged by what transpires on the ground in generating tangible results, improving livelihoods and creating stability in the energy system.

The role of the public sector then becomes critical in balancing the wider medium-term needs of society and country with short-term measures sufficiently attractive to the private sector. This means building investor confidence by simplifying the business environment in which investment can flourish, and having clear and transparent governance.

One practical step would be to set out clear mechanisms for calculating the PPA tariff for renewables. This gives potential investors sufficient confidence to plan and finance projects with a full view of future revenues. Future investment only occurs if there is sufficient confidence that investors today are gaining good returns.

The Gambia has an attractive investment environment in tourism and other development sectors. It needs to broaden this to the energy sector. That means building its own capacity to implement its policies to promote and support RE. The right conditions need to be created to enable local manufacturing and/or assembly of renewable technologies.

## ENERGY EFFICIENCY AS A RESOURCE

Limiting energy losses along the power system chain, *i.e.,* from generation to end-use, is critical. This should form part of The Gambia's future energy strategy. High transmission and distribution losses (over 30% in The Gambia) worsen the energy security problem. They also deepen suppressed demand. Those with the ability to pay will turn to on-site generators. All these have economic, social and environmental costs.

The significance of energy efficiency is highlighted in The Gambia's 2005 Energy Policy. However, the country's struggle with generation and transmission has sidelined the tangible gains from demand-side measures. Investment in end-use energy efficiency (whether through technology intervention or awareness-raising) increases the availability of system-wide electricity generation and transmission capacity for other uses.

In other words, end-use efficiency can be considered a resource. It could provide energy savings comparable to the electricity generated by power plants. Due to the high capital cost of RE technologies, there are benefits in making demand-side efficiency improvements. They yield a greater impact per unit of investment in renewables. A sustainable energy economy thus requires major commitments to both energy efficiency and RE development.

Source: Ministry of Energy, The Gambia

## CAPITALISE ON OFF-GRID OPPORTUNITIES, BUILD KNOWLEDGE SYSTEMS AND PLAN AHEAD

Off-grid energy systems can play a significant role in electrification programmes in rural areas. However, more work is needed to ensure that prices are competitive and affordable. The range of pro-poor financing mechanisms needs to be tested and evaluated with this aim. It is therefore important to produce an inventory of experiences specific to The Gambia in terms of the range of delivery mechanisms and business models.

It is also important to assess whether the new regulatory and legal frameworks will act as enablers or obstacles to mainstreaming off-grid RE into the energy mix. This process of energy knowledge generation could help develop a dynamic techno-economic assessment framework for off-grid system design. This would take material sourcing, installation cost, available energy resources, energy storage options, robustness of design and social acceptance into consideration. It would help The Gambia develop its off-grid energy strategy through informed and tailored technical and business models compatible with local resources, institutions and economic factors. It would also be useful for private sector players as it would provide them with updated information about various technologies in the context of The Gambia. This role could be taken up by GREC.

## HIGH COST OF DEBT

For any given project, financial institutions will assess both the risks and returns of the project. Each individual risk is analysed and studied in terms of managing its potential impact on the project. Different risk categories include country risk, market risk, business risk, interest rate risk, project risk and foreign exchange risk. The Gambia provides a mixed picture when viewed against these risk categories. However, its banking system has been characterised

by high interest rates for some time. This is the fiscal policy for limiting inflation rate increases and maintaining stability in the national currency. At present, the bank loan interest rate stands at 18%. This will have an impact on the evolution of the RE market and the types of market players likely to play a defining role.

Numerous studies show that high interest rates and relatively short loans add significant amounts to the cost of RE investment. This situation places The Gambia in a difficult position. Even if the cost of debt servicing falls, access to low cost equity and limits on foreign exchange are likely to present additional medium-term barriers to growth in the RE sector.

There are a few paths The Gambia can pursue independently or in collaboration with other partners. The Gambia should strengthen its effort to bring to bear international funds as a means of providing soft loans with generous repayment terms, low interest rates and flexible timeframes.

This can be ring-fenced as a resource that is exclusively used to boost capacity, increase technology visibility, develop robust institutions and build experience in RE applications. The Gambia could involve its national development bank to finance RE projects with low cost and longer term financing. A programme of this kind would need to be seen as an important national development strategy.

The Gambia could continue to encourage external investors by offering an attractive investment environment such as tax holidays and waivers on import tariffs for components. These investors would, however, expect to set their own prices and would be inclined to make rapid returns on their investment, and this presents another challenge. Moreover, international players who have invested equity in the sector would expect to cash in their returns in scarce foreign currency while they sell electricity in The Gambian Dalasi internally.

The value of this longer term engagement is that energy would be treated as a means to achieving broader development objectives. The availability of reliable electricity supplies would translate into wider socio-economic gains.

The RRA identified a large number of issues with decisive implications for the effective deployment of RE resources in The Gambia. Some of these are specific to the five priority resource-service pairs for scaling up renewable deployment in the short- to medium-term. However, some are generic in nature. Section 5 summarises the key actions identified by the RRA.

Source: Ministry of Energy, The Gambia

# V. SUMMARY OF RECOMMENDED ACTIONS

The following table identifies seven recommended action points revealed by the RRA. They all apply to priority resource-service pairs. This action is not presented in any order of priority, and this rapid assessment is unlikely to produce an exhaustive list of measures needed. The detailed list of action can be found in annex I.

| ACTION | STEPS |
|---|---|
| **Speed up RE law enactment (by end 2013); include regulation on solar water heating systems** | • MOE to seek and obtain written agreement from all stakeholders on appropriateness, adequacy and suitability of the bill for enactment into law<br>• MOE to present to cabinet for approval following which it then presents it to the National Assembly for ratification<br>• Law signed into an Act by the President<br>• MOE ensures all activities needed to be carried by PURA for effective implementation of the Act are duly completed, signed by the minister as necessary and published |
| **Establish standards and labels for RE equipment** | • Engage with organisations with similar experience in other countries and regions (*e.g.* Morocco, Egypt)<br>• Begin process of developing nationally-specific standards and labels for different RE equipment<br>• Consult with PURA |

| | |
|---|---|
| **Establish standards and labels for RE equipment** | • Engage an RE expert with good track record in research to undertake an evaluation of past GREC activities and outline lessons learnt<br>• Bring in donor assistance to equip the centre, and explore mechanisms to obtain adequate continuous funding<br>• Improve centre staffing and build staff capacity<br>• Establish stronger ties with university and technical institutes in The Gambia and abroad |
| **Assess, update and validate solar, biomass and wind resource mapping** | • Undertake a robust gap analysis of data based on priority areas for RE development<br>• Identify assessment gaps relating to resource potential<br>• Identify, map and begin dialogue with stakeholders and existing data collection initiatives for including in the observatory currently being set up by ECREEE<br>• Establish a plan and protocol for data collection |
| **Establish RE Fund and identify sources of funding** | • Conduct feasibility study which defines the institutional, management, administrative and the regulatory frame works of Fund<br>• Develop guidelines for how fund will be utilised<br>• Initiate engagement with bilateral and multilateral donor agencies<br>• Establish RE Fund |

| | |
|---|---|
| **Build capacities of various stakeholders (policy makers, regulators and the private sector)** | • Map out capacity gaps across MOE, PURA, GREC, NARI, Rural Development Institute (RDI), REAGAM, RE Fund, private sector manufacturers and equipment suppliers at technical, management, regulatory and procurement levels<br>• Establish contact with international agencies and other countries which have developed these technologies to monitor development of standards and codes for power system installations<br>• Raise resources for capacity building |
| **Allocate land for RE use** | • Incorporate use of land for RE project as priority in the land use policy<br>• Develop land use maps<br>• Carry out detailed assessment of impact of land requirements for energy crop production, forestry and food production targets; identify land tenure rights wherever possible and incorporate into a land use policy<br>• Identify extent and basis of private company participation in energy crop production |

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# VII. ANNEX 1: DETAILED DESCRIPTION OF RECOMMENDED ACTIONS

The RRA process identified and recommended the action below. It is not given in any order of priority, and the list of action points from a rapid assessment is unlikely to be exhaustive. This action could improve the Gambia's readiness to scale up its renewables deployment. It is designed to be taken in the short- to medium-term, largely through decisions made by the government of The Gambia.

## Action 1: Speed up renewable energy law

| | |
|---|---|
| **Action** | Speed up RE law |
| **Resource-service pair(s)** | Centralised and decentralised grid electricity, all RE resources |
| **Description** | The RE bill preparation funded by the EU Energy Initiative has just been completed and validated. Bill enactment will be initiated and followed up by MOE, the line ministry responsible. As with all other bills, this may not require extra funding beyond the normal budgetary allocation of the implementing agency, MOE.<br><br>MOE is to be responsible for seeking and obtaining written concurrence of all stakeholders on the bill's appropriateness, adequacy and suitability for enactment into law. It would then present it to cabinet for approval following which it would present it to the National Assembly for ratification. Finally, the ministry will ensure it is signed into an Act by the president. The ministry will ensure all the activities needed to be carried out by PURA to effectively implement the Act are duly completed, signed by the minister as necessary and published. This may require financial expenses beyond the budgetary allocations of the ministry. These could be sought from available potential donor sources. |
| **Stakeholders** | MOE, cabinet, PURA, National Assembly, donors and all other stakeholders including REAGAM |

| | |
|---|---|
| **Timing** | By end 2013 |
| **Keys to success** | Enactment of the bill will require consensus on the terms of the text. Its effectiveness will depend on the extent to which it gives incentives for RE. The availability of funds to support its promulgation will be crucial and will depend in part on continued engagement with donors. |

## Action 2: Establish standards and labels for renewable energy equipment

| | |
|---|---|
| **Action** | Establish standards and labels for RE equipment |
| **Resource-service pair(s)** | Centralised and decentralised grid electricity, all RE resources |
| **Description** | The Gambia Bureau of Standards was established in 2010. However, there are no established standards and labelling requirements that aim to prevent the sale of unsafe and inefficient RE equipment and technologies.<br><br>The need for standards in RE equipment and technologies was recognised as early as 1982. Solar cook stoves, solar powered water and wind pumps were developed, promoted and continued to be promoted without any systematic attempt to standardise/streamline the technologies. Also, no quality control was actively introduced, especially for fuel efficiency, to guarantee satisfaction and avoid a negative reputation. One cannot over emphasise the need for standards and labels for RE equipment as part of a concerted effort to accelerate deployment of RE resources and technologies. Only through standardisation and labelling is the vendor, manufacturer or importer still liable for the safety of the RE equipment where testing and/or voluntary approval has not been sought. |
| **Stakeholders** | MOE, the Gambia Bureau of Standards, NAWEC, PURA, REAGAM and potential investors (private companies, utilities and commercial banks). |
| **Timing** | Early 2013 |
| **Keys to success** | Engagement with organisations with similar experience in other countries and regions (*e.g.,* Morocco, Egypt) |

## Action 3: Revive GREC

| | |
|---|---|
| **Action** | Revive GREC |
| **Resource-servicepair(s)** | Centralised and decentralised grid electricity, all RE resources. |
| **Description** | GREC was established in 1987 as the technical arm of the DoE in the field of RE and energy efficiency. Its primary function was to conduct adaptive research in RE, develop and promote the use of RE and energy efficiency technologies and advise government on RE and energy efficiency.<br><br>Since its establishment, the centre has organised a series of biannual energy shows and exhibitions, assessed and tested household energy appliances and carried out training in RE and energy efficiency appliances. It has also conducted sensitisation and communication campaigns and liaised with energy companies. However, due to limited highly-qualified personnel and equipment the centre has become dormant. Reviving the centre would thus require staffing it with qualified personnel supported by an RE expert on a technical assistance basis. It would also mean appropriately equipping it and allocating it an adequate continuous budget. |
| **Stakeholders** | MOE, DOE, PURA and MOFEA |
| **Timing** | 2013 |
| **Keys to success** | Engagement of an RE expert with a good track record in research, improved staffing, donor assistance to equip the centre and ensure adequate continuous funding. |

## Action 4: Assess, update and validate solar, biomass and wind resource mapping

| | |
|---|---|
| **Action** | Assess, update and validate solar, biomass and wind resource mapping |
| **Resource-service pair(s)** | Wind, solar and biomass for all applications. |
| **Description** | There is at present a broad understanding of resource availability and potential, but this is generally not sufficient to enable project development or a comprehensive assessment of potential. Similarly, there is some data collection from actual projects, but this is not comprehensive or centralised.<br><br>Comprehensive data will facilitate the implementation of the draft renewable energy strategy and future project development. Particular gaps exist in solar, wind and biomass; benefits could also be gained from an assessment of bioenergy potential. Likely action in implementing a mapping process could include:<br><br>- engage with existing initiatives for data collection, including observatory currently being established by ECREEE<br><br>- identify precise requirements for resource mapping, based on priority are as for RE development<br><br>- establish a plan for data collection<br><br>- explore the potential for funding ground measurement campaigns with multilateral/bilateral organisations |
| **Stakeholders** | MOE, NAWEC, ECREEE, project developers, GREC, NARI, DWR and donors |
| **Timing** | Mid-2013 for definition of requirements and protocol, on going for data collection |
| **Keys to success** | Technical and human resources available for data collection, identify and secure funds for data collection, establish a protocol for sharing data |

## Action 5: Establish renewable energy fund and identify funding sources

| | |
|---|---|
| **Action** | Establish RE fund and identify sources of funding |
| **Resource-service pair(s)** | Biomass, wind and solar for all applications |
| **Description** | One of the key objectives of the government's energy policy is to widen the population's access to modernised forms of energy so as to stimulate development and reduce poverty.<br><br>Communities who do not have access to the electricity network are one of the main groups with potential to benefit from renewable electricity support. However, community investment in the Gambia presents serious challenges. It is difficult for communities to access finance and develop the skills and knowledge required. Similarly factors like high initial costs, high private lending costs, commercial sustainability of members of REAGAM and financial and technical performance risks have limited the rapid expansion of enterprises. This is compounded by the lack of a fully transparent framework for private sector investment.<br><br>Establishing the RE fund providing soft loans, capital subsidies and other financial incentives for renewable generation projects as outlined in the draft RE law will thus be an essential. It will drive the acceleration of renewables deployment in the short- to medium-term. The government should identify specific internal sources of funding and lobby financial and development partners to further support the fund. |
| **Stakeholders** | MOE, MOFEA, donor community, cabinet, National Assembly and IRENA. |
| **Timing** | Mid-2014 |
| **Keys to success** | Feasibility study to identify internal niches of funding that could support the RE fund along with consultation with key bilateral and multilateral donor agencies to further support the fund. |

## Action 6: Build stakeholder capacity
(policy makers, regulator and the private sector)

| | |
|---|---|
| **Action** | Build stakeholder capacity (policy makers, regulator and the private sector) |
| **Resource-service pair(s)** | Off-grid and on-grid services, wind and solar resources |
| **Description** | The Gambia appears to have a shortage of relevant skills for the power sector.<br><br>Inadequate technical skills are felt at all levels: engineers, mechanics and technicians. Often these skills are recruited from outside the country, from the wider ECOWAS region or German, Lebanese or French expats. GEG employs around 60 expats, for example.<br><br>The MOE, NAWEC and PURA have also expressed a need for more capacity in the power sector. The MOE includes "capacity building for MOE, NAWEC and other stakeholders" as part of its draft Strategic Plan 2010-2014. Specific capacity-building programmes are not identified. Management and project finance training may be beneficial, particularly for managing IPP processes.<br><br>Furthermore, capacity building at the management, regulatory and procurement level will be important for MOE, NAWEC and PURA, as they lead and manage the transition to a fit-for-purpose power system.<br><br>UTG and technical training institutions will play a key role in continuously working with government and private sector to deliver capacity-building and training activities at several levels:<br><br>• At the academic level with the development of master programmes and the training of engineers, designers, *etc*.<br><br>• At the professional level, with their support in the capacity-building activities for professionals (installers *etc.*)<br><br>• At the grassroots level, by supporting awareness campaigns |

| | |
|---|---|
| **Stakeholders** | MOE, PURA, GREC, NARI, RDI, REAGAM, RE Fund, private sector manufacturers and suppliers of equipment, other technical, vocational institutes and the UTG and IRENA |
| **Timing** | From 2013 |
| **Keys to success** | Capacity-building activities and training programmes are essential to developing a national industry. Establishing contact with international agencies and other countries which have developed these technologies will be important. This will help monitor the development of standards and codes for power system installations. |

## Action 7: Allocate land for renewable energy use

| | |
|---|---|
| **Action** | Allocate land for RE use |
| **Resource-service pair (s)** | Solar, wind and biomass for on-grid/off-grid electricity |
| **Description** | Given the small size of the country, developing RE plants will mean setting up a robust procedure in consultation with all relevant stakeholders to allocate land suitable potential for the developing RE power plants. |
| **Stakeholders** | MOE, Ministry of Local Government & Lands and its technical departments of Community Development, Physical Planning and Lands and Surveys, MOFEN, Tourism Development Authority (TDA), legal advisor, NARI and NGOs including REAGAM. |
| **Timing** | By end of 2014 |
| **Keys to success** | - Identifying and responding to public concern relating to land use allocation and associated conflicts<br>- Inclusive participation of all stakeholders throughout the review<br>- An understanding of the need for land use policy and its implications |


**IRENA Secretariat**
CI Tower, Khalidiya (32nd) Street
P.O. Box 236, Abu Dhabi
United Arab Emirates
www.irena.org