

SIERRA LEONE



Ministry of Energy

Energy Directorate
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Expression of Interest to participate in the Scaling Up Renewable Energy In Low Income Countries Program (SREP)



The Bumbuna hydroelectric dam produces 50MW of electricity.

I. COUNTRY AND GOVERNMENT AGENCY SUBMITTING EXPRESSION OF INTEREST

This expression of interest is submitted by the Ministry of Energy on behalf of the Government of Sierra Leone. The focal point is:

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II. DESCRIPTION OF THE COUNTRY AND ENERGY SECTOR CONTEXT

General description and context

The Republic of Sierra Leone is located on the west coast of Africa, between 6°56'~10°N and 13°19'~10°16'W, with a total area of about 72,300 km² and a total population of about 5.48 million. Its capital is Freetown. The gross national income (GNI) per capita was US\$ 580 in 2012,¹ and the GDP was US\$ 3.796 billion for the same year. In 2011, more than 53% of the population was living under the national poverty rate². The 2012 Human Development Index ranked Sierra Leone 177 out of 186.

Sierra Leone was already one of the world's poorest countries when a devastating 11-year civil war began in 1991. The war destroyed most of the very little infrastructure that existed in the country in the late 1980s. Since the end of that war in 2002, the country has made significant progress, but massive problems remain. Roads and power generation and distribution are inadequate, plus the country struggles with low professional capacity in government, poor public financial management and extreme sensitivity to global economic downturns. Emphasis to date has been placed upon restoring generation, transmission and distribution facilities destroyed during the war. The country has not yet been able to devote attention to expanding the national grid.

Overview of the energy and electricity sector

Poor access to electricity is recognized as a binding constraint to long-term economic growth in Sierra Leone. Fixing this problem is a major focus of the PRSP 2, called the Agenda for Prosperity, which included a goal of "cheap, affordable energy for all". The national electrification rate remained below 10% in 2011; the majority of the interior does not have access to electricity, and the country's four major cities consume 90% of the available electricity. Biomass from fuel wood and charcoal still accounts for more than 85% of total energy use.

Before the war, Sierra Leone's installed generation capacity was about 120 MW. Nowadays, Sierra Leone has 90 MW of installed capacity, of which 86% is for Freetown. The hydroelectric facility at Bumbuna, completed in 2009, generates 62% of the country's power, and oil-powered facilities provide the remainder.³ Being seasonal, the Bumbuna hydropower plant produces less than 20 MW

¹ <http://data.worldbank.org/indicator/NY.GNP.PCAP.CD> - For comparison purposes, the average 2012 GNI for Sub-Saharan Africa was US\$ 1360, so more than twice of Sierra Leone's.

² <http://data.worldbank.org/country/sierra-leone>

³ Two thermal power plants at Kingtom (10 MW) and Blackhall Road (16.5 MW) that serve the Freetown western region area, and the 6 MW Goma run-off river hydropower station feeding the isolated Bo-Kenema system.

during the dry season. Currently, both the Bumbuna and Goma hydropower plants operate only at half capacity due to lack of maintenance and turbines needing a major overhaul. There is currently a high level of suppressed demand in the country. In fact, the mining sector primarily relies on captive generation to meet its large power needs. Non-mining customers are forced to resort to private standalone diesel generators. It is estimated that there are 33,000 generators currently in use that provide a capacity of approximately 180 MW.

Sierra Leone is currently experiencing a net deficit of power with average peak demand requirements of 300-500 MW and is in desperate need of new power sources. The country wishes to tap its great renewable energy (RE) resources to provide more reliable, secure and cheap electricity to boost its economy.

The estimated electricity consumption per capita is 30.50 kWh/year, while it reaches 88 Kwh/year on average in the rest of the ECOWAS region, and about 535 Kwh/year in Sub-Saharan Africa⁴. Grid power supply is restricted to Freetown, the capital, and a few major towns. Currently the country is not interconnected to the West African Power Pool, although the Guinea-Sierra Leone-Liberia-Ivory Coast interconnection project was approved in late 2013 and will link the four nations via a 225 kV transmission system by 2017. Supply in Freetown is insufficient and erratic whilst system losses are very high, principally as a result of the poor condition of the old and outdated distribution system. The national transmission system consists of only one radial 161 kV transmission line extending for 205 km from the Bumbuna substation to the Freetown substation and which passes through Makeni and Lunsar. Other than Freetown, the town of Makeni is electrified at 34.5 kV using the shield wire from the Bumbuna-Freetown line. The capacity of the Bumbuna-Freetown line is currently limited to 70 MW, while it is estimated that the distribution network in Freetown cannot evacuate more than 35MW of power, hence severely limiting the electricity supply in the capital city. Both transmission and distribution capacity is severely constrained due to high losses of over 38 percent. The low voltage levels in certain areas as well as the high level of fault occurrence due to the aging network equipment contribute to poor quality of supply. At present, black outs and load shedding are common place.

Demand for electricity is increasing significantly, principally as a result of major mining developments but also due to the need to power economic growth. An estimated 10% - 20% annual rate increase in power demand is foreseen in the coming 10 years. With the large-scale development of mineral resources in Sierra Leone and mechanized agricultural activities, power demand will increase more rapidly.

Energy access for rural communities is critical in a country like Sierra Leone where about 60% of the population lives in rural areas (UN data, 2012). Renewable energy technologies will play a critical role in increasing energy access in remote rural areas where grid extension is not economically viable. Therefore, the Energy Directorate has started designing renewable energy programs to achieve this objective. The SREP program will present a good opportunity for strengthening such programs and co-financing them in selected areas.

Renewable Energy Potential and Experiences

There is great renewable energy potential in Sierra Leone, though very little has been harnessed so far. In terms of hydroelectricity, beyond the Bumbuna hydro plant, a 10 MW mini-hydro is being proposed in the Moyamba District for which funding is being sought. Mini-hydros for the Dodo dam

⁴ <http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC>

in the Kenema District are also in operation. They are supplying electricity power to the East and Southern Provinces of Bo and Kenema during the rains with an existing installed capacity of 6 MW (that has the potential to be increased to 12 MW).⁵ Two 2.0 MW hydro plants are also currently under construction, one at the Charlotte village in Rural Freetown, and the other in Port Loko, Northern Province. A biomass-to-electricity plant is operational in Makeni (Addax Project), which is expected to generate 15 MW at completion. The first 5MW supply from Addax is expected to be available to the national grid in June 2014, as the first phase has been completed.

In terms of solar energy, the Barefoot College⁶ - which has been supporting the scaling-up of solar PV solutions in rural areas in India since 1989 – has started operating in Sierra Leone in the format of training of trainers. The College program aims at enrolling up to 50 female students on four-month residential courses in solar engineering at the Barefoot College in Rajasthan, India. The Sierra Leone government has invested about US\$ 820,000 in the project. The Barefoot College in India provided the solar equipment on which the college runs and the equipment for 10 villages; the Indian government sponsored the initial training as part of its south-south co-operation programme. This experience has great potential for scaling-up, especially in rural areas, which most need it.

An estimate done by the Economic Community Of West African States (ECOWAS) Centre for Renewable Energy and Energy Efficiency in 2013⁷ shows that small-scale hydro might represent 60% of the total renewable energy potential of Sierra Leone, while biomass might represent 30% and solar energy 10%. The report further highlights that “some of the ECOWAS countries, such as Sierra Leone, have the potential to become electricity exporters through further development of their medium and small scale hydropower resources by 2025.”

This potential, which has not been fully analyzed yet, includes:

- Hydroelectricity: Up to 2000 MW capacity in total, with sites ranging from 2 MW to 160 MW.
- Biomass: Potential is high from forest resources, plus 656,400 tons of crop waste annually. Total generation potential is 2,706 GWh. Potential feedstocks include rice husks and straw. There is also potential in terms of sugar cane.
- Solar: Average horizontal irradiation of 4.1 – 5.2 kWh/m²/day. (This data is in need of revision, as calculations were made from eight sites in 1996.)
The current installed capacity of solar PV is about 25 kW.
- Wind: The potential has not been explored; measurement studies are needed and may indicate areas of wind speeds reaching 12m/s but with an average of 3-5m/s.

Identified Potential Mini-Hydro Sites



Source: Extracted from a presentation made by the Minister of Energy & Water Resources; Hon. Prof. Davidson

⁵ A 6 MW solar farm is also being proposed to complement the Dodo hydro to supply electricity in the dry season.

⁶ <http://www.barefootcollege.org/>

⁷ Renewable Energy in West Africa, by the Regional Center for Renewable Energy and Energy Efficiency of ECOWAS, 2013.

According to the Master Plan of Hydropower Development, Sierra Leone (exclusive of the two international boundary rivers of Mano and Kolenten) has a hydroelectric power potential of about 2,000 MW mainly concentrated in Northern Province and Eastern Province. However, nearly all suffer from enormous flow variations between the wet and dry seasons. The Master Plan, however, is silent on potential resources under 2 MW. This is expected to be an area of huge potential for public-private partnerships and wider investment by the private sector. It should be noted that a project linking Guinea, Sierra Leone, Liberia, and Cote d'Ivoire via a 225kV transmission line will form the backbone of Sierra Leone's national grid. The line is going through sites that have been identified as having hydropower generation potential.

Renewable Energy Policy and Targets

The 2009 Energy Policy's objective is to "ensure the provision of modern energy services for increased productivity, wealth creation and improved quality of life for all Sierra Leoneans." There are no specific renewable energy targets in the Policy, but it contains a chapter on renewables.

In 2014, GOSL started preparing a new Renewable Energy Policy, which should be approved by the end of the year. This new policy will contain clear targets for the development of the sub-sector, and will be backed-up by a master plan that is also under preparation.

III. RATIONALE FOR SELECTED SECTORS FOR SREP FINANCING

A series of barriers and bottlenecks have been identified for the deployment of renewable energy in Sierra Leone. They are consolidated in the table below, with some preliminary ideas of mitigation measures to which the SREP could contribute.

Main Barriers and Constraints	Improvements and Mitigation Measures	Potential SREP involvement
Absence of adequate institutional framework. The key institutions for the sector have been the Ministry of Energy (with an energy directorate) and the national utility, which is being unbundled (composed of the energy generation and transmission company (EGTC), the energy distribution and supply authority (EDSA), and an asset management company). There is no institution dedicated to rural electrification or renewable energy. A Regulator (Sierra Leone Electricity and Water Regulatory Commission) is being set up and is not yet functional.	GOSL is currently strengthening its capacity in terms of renewable energy within the Energy Directorate of the Ministry of Energy. Discussions are ongoing for the creation of a rural electrification agency; the unbundling of the sector was approved through the 2011 Electricity Act; efforts are being made to make it operational. A World Bank supported project has been approved in 2013 that focuses on improving the operational performance of the national utility through management contract and other measures. A PPP unit has also been set up in the office of the Chief of Staff to promote the participation of the private sector in the development of the country. A Regulator is in the process of being set up and will be responsible for issuing licenses, promoting fair competition among public utilities and	While other ongoing investments support the utility efficiency and sector reforms, the SREP could build the internal capacity of the Energy Directorate with a strong RE unit.

Expression of Interest for Sierra Leone to Participate in SREP Program

	providing guidelines on tariffs.	
Absence of adequate policy and regulatory framework. There is currently no specific policy or strategy for renewable energy development, and no regulatory framework in place to guide investments in the sub-sector. The perception of project risks associated with legal and regulatory uncertainty will have to be resolved to attract private investors in the medium to long term.	A new renewable energy policy is being drafted and will guide the development of the sector. The related policy and regulatory measures will have to be designed in order to facilitate the scaling up of RE investments.	SREP could support the finalization of the renewable energy policy and design of relevant policy and regulatory measures.
Lack of access to capital and difficulty in attracting investors and financiers. Renewables are expensive, especially in Sierra Leone where transport difficulties and limited human capacity add to the challenge. There are no incentives for private sponsors to invest in the sector, and no clarity on how GoSL wants to make use of the private sector to develop renewables in the country.	The enabling environment will have to be improved and concessional financing provided in order to make projects commercially viable and hence mobilize the private sector and banks. An energy tariff study is under finalization and should give more visibility to private investors in terms of tariffs revisions. The new RE policy under preparation will clarify the role of the private sector for scaling up RE; PPPs will be facilitated and special incentives will be considered to encourage business generation in RE.	SREP could encourage the design of regulatory/fiscal incentives for private investors in RE (including Feed-in-Tariffs), and the SREP investments could be based as much as possible on PPPs.
High cost of projects. Capital requirements for renewables are steep anywhere in the world, given high capital costs. In Sierra Leone, due to the limited scale of projects and site access difficulties for off grids, project costs are expected to be even higher.	Lower cost methods using international best practices should be used. Strengthened capacity and lowered risk will also reduce project costs.	SREP could support the financing of projects and identify the most cost efficient options.
Limited affordability and high tariffs. Most households in Sierra Leone have little disposable income, so their ability to pay for electricity will be weak.	To increase affordability, capital investments should be substantially grant-funded. Low-cost electricity supply solutions should be developed, especially for meeting basic electricity needs. Income-generating opportunities should also be supported.	SREP will provide grant and/or concessional financing that will decrease the capital costs and make the proposed tariffs more affordable for Sierra Leoneans.
Limited human and institutional capacity. Emerging from a civil war that destroyed many institutions and much infrastructure and displaced many people, Sierra Leone is faced with severely depleted human and	GOSL intends to build the capacity of its staff for leading energy sector development.	SREP could provide on-the-job training on RE technologies and projects, starting from the basics and moving

institutional capacity for designing, developing, operating and managing energy programs, especially in the renewable energy sub-sector.		to the most specialized training.
Too little information of sufficient quality and duration on renewable resources. Data on renewable energy resources are limited, especially for mini hydro sites location. There is a lack of pre-feasibility studies for interesting sites that could attract private investors. Research and development capacities on renewables are weak.	Under the Energy Sector Utility Reform Project, an Integrated Resources Plan is under finalization and feasibility studies will be prepared for the most promising projects.	To complement the Integrated Resources Plan, SREP could support the financing of an RE assessment and mapping (especially for mini hydro and biomass potential) and complementary feasibility studies as need be.

Based on the information provided in the sections above, in terms of level of energy access, renewable energy resources and main barriers that need to be addressed in the sub-sector, the Government of Sierra Leone considers that SREP-funded interventions could complement other ongoing activities such as:

1. Improving the enabling environment for scaling up renewable energy investments, through building capacity in the Ministry of Energy with RE dedicated staff; finalization of the RE policy; design of RE specific policy measures and regulatory incentives to attract the private sector; RE assessment for mini-hydro and biomass resources; pipeline of bankable feasibility studies for RE projects, etc.
2. Design programs to meet the needs of rural areas, including mini-grids and off-grid options with mini-hydro, solar PV and biomass technologies according to the sites selected.
3. Support the co-financing of one grid-connected independent power producer project, with RET to be confirmed during investment plan preparation.

IV. ENABLING POLICY AND REGULATORY ENVIRONMENT

In the past decade, the country has made significant progress in terms of good governance. According to the Mo Ibrahim Index of African Governance, Sierra Leone improved in ranking from 48th (2011) to 30th (2012) out of 52 countries. Sierra Leone’s formal business sector is relatively small and gradually evolving, but the country is rated as one of the world’s top ten business reformers, moving from 176/185 countries, to 140/185 within a five-year period. The country has witnessed significant private sector inflows as foreign direct investment (FDI) has increased three-fold during the past five years. However, despite these gains, the most binding constraints for Sierra Leone’s growth are linked to the critical infrastructure gaps in energy and roads transport, which if not addressed adequately, will severely limit private sector growth.

So far, the 2009 Energy Policy and the National Electricity Act 2011 guide the energy sector. The latter paves the way to the unbundling and restructuring of the existing public utility company and

established two bodies: the Sierra Leone Electricity Generation and Transmission Company (the 'Company') and the Electricity Distribution and Supply Authority (the 'Authority'). The Company shall be responsible for the generation and transmission of electricity and the sale of electricity to the Authority, subject to a power purchase agreement. The Company will develop, construct and operate new government owned generating facilities or act as the Government's partner in a public and private partnership for the development of new generation projects. The Company will also develop, construct, own and operate future national transmission lines.

The Authority, on the other hand, shall be responsible for the supply, distribution and retail sale of electricity for the entire country except in areas in which a distribution license is issued to another appropriately qualified entity. The Authority shall purchase electricity from the Company and independent power producers subject to a power purchase agreement. The implementation of the National Electricity Act 2011 is being supported by the World Bank and DFID; it is expected that this reform will improve both efficiency and governance in the sector, especially through the performance management contract being put in place for the national utility management. SREP could provide support in defining standard power purchase agreements for different renewable energy technologies that will help attract private sponsors interested in RE.

Finally, the Sierra Leone electricity and water regulatory commission act, 2011, established the Sierra Leone Electricity and Water Regulatory Commission to regulate the provision of the highest quality electricity and water services to consumers. Among others, the Commission is responsible for issuing licenses, promoting fair competition among public utilities and providing guidelines on tariffs. It has the power to set tariffs and carry out regular reviews of the same. The Commission is currently being established.

Electricity tariffs in Sierra Leone are among the highest Africa. Yet, the public utility company cannot recover its operating costs and remains strongly dependent on government subsidies. This is because of its reliance on expensive thermal generation, the inefficiency of its transmission and distribution networks, and very high technical, commercial and collection losses. The average electricity tariff currently stands at US 28 cents/kWh. With high tariffs and low connection rates, electricity consumption is relatively low, and the large majority of the population is forced to rely on inefficient and polluting traditional fuels to meet their basic needs, such as kerosene for lighting and fuel-wood and charcoal for cooking, resulting in adverse impact on personal health and safety as well as on the environment. A detailed Integrated Resource Plan (IRP) and a tariff study have been commissioned by the Government of Sierra Leone and are currently being prepared. They should help adjust tariffs at a level that is economically viable while also more affordable for customers. Feed-in-tariffs might be considered with SREP support following the ongoing tariffs study. When the Sierra Leone Electricity and Water Regulatory Commission will be functional, it will be responsible for providing guidelines on tariffs. It shall have the power to set tariffs and regularly review them.

There are no specific incentives in place for private sponsors to invest in renewable energy in Sierra Leone. However, with the new renewable energy policy under preparation, some dedicated policy and regulatory measures will be developed to encourage private investments. This will be in line with the willingness of the president to encourage private investments in the country, which is reflected in the creation of the PPP unit at the level of the Chief of Staff. For now, it is the PPP unit that supports negotiations and signature of PPAs, but both the PPP unit and the Energy Directorate need their capacity to be strengthened in terms of PPAs negotiations; SREP will be mobilized to help on this and to design clear policy guidelines for investment in the RE sub-sector.

V. INSTITUTIONAL AND TECHNICAL CAPACITY

With regards institutional capacity for the implementation of such projects, the Ministry has established an Energy Directorate with competent and experienced engineers. The Directorate champions energy programs and coordinates activities in the sector. Its mandate is to increase energy access nationwide and provide policy guidance to the ministry, while also providing oversight of the day-to-day monitoring and supervision of all energy projects.

The Energy Directorate has already successfully implemented many donor-funded projects within the energy sector. In the past two years, it has received funding to the tune of US\$ 50 million to implement various energy projects.

A list of key energy projects – under implementation or completed – handled by the Ministry of Energy includes:

- ✓ Islamic Development Bank (IsDB) : Project for the reinforcement and extension of the medium- and low-voltage distribution network in Freetown;
- ✓ World Bank: Energy Access Project;
- ✓ African Development Bank (AfDB), World Bank, European Investment Bank and KfW: Cote d'Ivoire – Liberia – Sierra Leone – Guinée (CLSG) Project;
- ✓ Chinese Government: Construction of a 2 MW hydropower plant at Charlotte.

It is expected that the Energy Directorate would lead the SREP investment plan preparation. To ensure the successful preparation and implementation of the SREP program, capacity will need to be strengthened for staff to be able to handle renewable energy technologies and projects.

Sierra Leone will benefit from the lessons shared by the team from Liberia, a SREP pilot country, to design and implement a successful SREP program.

In terms of risks, a preliminary risks analysis has been done that will need to be refined in the context of the SREP investment plan preparation.

Risk	Description/Mitigation	Residual Risk
Legal and regulatory risks	A comprehensive legal and regulatory framework for renewable energy has yet to be established. There is no regulatory body or independent tariff-setting process, even though the law to set up such body has been passed in 2011. SREP will support the establishment of the required legal and regulatory framework for RE scaling up.	Moderate
Institutional capacity risks	Energy sector institutions are weak in terms of renewable energy expertise, and the whole sector is currently being structured. Institutional capacity shall be strengthened in order to facilitate the implementation of RE interventions.	High

Risk	Description/Mitigation	Residual Risk
Financial risks (risks related to financial viability of the sector/entities)	The electricity sector is financially dependent on donor contributions, but this is expected to change as the sector’s efficiency is being improved. Improvements in the regulatory environment that could be done with SREP support could also provide more certainty to financiers. However, successful business models for small hydropower projects, hybrid mini-grids and solar lighting systems will require a well-balanced program of grants and subsidies — tailored to each case — that guarantees their financial sustainability while incorporating incentives for quality service.	High
Private sector participation/investment climate	The absence of an adequate legal and regulatory framework, and the use of technologies new to the country are substantive constraints in mobilizing private investors. However, GoSL currently puts a lot of emphasis on mobilizing the private sector, with support from the PPP unit that was established in the office of the Chief of Staff. SREP could help create an enabling environment for investments by supporting the required legal and regulatory framework, the preparation and grant financing of projects, and the use and testing of diverse business delivery models that will help attract investors.	Moderate
Renewable resource uncertainty	Information on renewable energy resources is limited, but evidence indicates that hydropower, biomass and solar resources are available. SREP could support further RE potential assessment and feasibility studies to lower this risk.	Moderate

VI. PROGRAMS OF MDBS AND DEVELOPMENT PARTNERS

The scale of the challenges and the resources needed to transform Sierra Leone’s power sector and promote renewable energy calls for an integrated, long-term, programmatic approach. Coordinated, strategic and well sequenced donor support is critical to achieve scale and maximize added value. The World Bank has taken a leading role in systematically coordinating other development partners engaged in Sierra Leone’s power sector including, the International Finance Corporation, DFID, the Japanese International Cooperation Agency (JICA), the IsDB and the AfDB.

The World Bank is also funding the Sierra Leone Energy Access Project (US\$ 16 million) that focuses on energy access in rural areas, and the Sierra Leone Energy Sector Utility Reform (US\$ 40 million) that focuses on sector reforms and utility efficiency. The AfDB is co-financing the West Africa Power Pool in Sierra Leone through the Cote d’Ivoire–Liberia– Sierra Leone – Guinea Project (about US\$ 40 million), focusing on the interconnection of neighboring countries and including some rural electrification activities as well.

So far, development partners and multilateral development bank interventions are focused on the structuration of the sector, the extension of the grid at national and regional levels, and increasing generation capacity (but not specifically from renewable energy). These interventions will form a good basis for a successful SREP program that will nicely complement the ongoing interventions. They will do so by focusing on the development of the renewable energy potential as a way to increase energy access, improve energy security and mobilize private investors in the sector. The SREP program will have a great value added as compared to the ongoing interventions and will be in line with GOSL priorities for developing the sector.