Sierra Leone Power Consumption

Power Consumption in Sierra Leone

Sierra Leone consumed **13,386,542,000 BTU** (0.01 quadrillion BTU) of energy in 2017. This represents **0.00%** of global energy consumption. Sierra Leone **produced 1,234,542,000 BTU** (0.00 quadrillion BTU) of energy, covering **9%** of its annual energy consumption needs.

NON RENEWABLE (FOSSIL FUELS)
Power Consumption
94%
12,576,000,000 BTU

Oil : 12,576,000,000 BTU (94%)
Oil Reserves, Years left, Production, Consumption, Imports/Exports

Gas: 0 BTU (0%)
Natural Gas Reserves, Years left, Production, Consumption, Imports/Exports

Coal: 0 BTU (0%)
- Reserves, Years left, Production, Consumption, Imports/Exports

RENEWABLE AND NUCLEAR
Power Consumption
6%
1,234,542,000 BTU

Introduction

Very few people have access to electricity in Sierra Leone: Approximately 10% to 12% of the urban population and only around 2% of the rural population. Petrol or diesel generators are often used because most of the regions lack a stable public power supply. Kerosene, battery lamps or candles are mainly used for lighting. 96,8% of the population cooks with firewood or charcoal. There is significant potential for the use of renewable energy, particularly solar energy and hydroelectric power.

Energy Situation / Statistics

“Energy statistics are difficult to obtain in Sierra Leone, especially for renewable energy. Although the conventional thermal energy production and consumption patterns have been reported, no consolidated set of statistics exists for the total Energy situation of Sierra Leone.[1]

This is also reflected in international reports, such as the “Renewable Energy Statistics 2017” report by IRENA, where the solar power capacity for Sierra Leone is claimed to be 0MW.

EnDev has signed a MoU to assist the Ministry of Energy in Sierra Leone with data collection, but information is difficult to obtain, since different private sector stakeholders are reluctant to share data.

Sierra Leone's power sector is small, with less than 150 MW of operational capacity and roughly 150,000 connected customers.

The biggest grids are:

- The 161kv line that extends to Freetown and the surrounding Western Area , covering about 40% of their residents. The power is provided by the Bumbuna hydro power plant, situated aprox. 220km from Freetown.
- The Makeni grid, providing electricity to the town of Makeni in Port Loko District. The power is also provided by the Bumbuna hydro power plant.
- The 33kv electricity line, or Bo-Kenema, which provides electricity to the towns Bo and Kenema, the capitals of Bo and Kenema Districts in the southeast of the country.

The costs for electricity are highly subsidised by the Government and rate aprox. 1000 Leones (0,13 EUR) per kWh for private households, up to 0,23 EUR/kWh for industry.

Overall Energy Use

- 80% Biomass (mainly for cooking): Wood and Charcoal

- 13% Petroleum products (mainly for transport, lighting and private energy generation, all petroleum is imported)

- Grid connected energy accounts for the remaining energy
- Most of the energy is used in households

Sector	Biomass		Petroleum Products	Electricity (Grid Connected) (Thermal, Hydro etc.)	Total %
	Fuelwood	Charcoal			
Agriculture, Forestry, Fishing	1%	-	5%	2%	2%
Mining	-	-	9%	1%	2.5%
Industry/Commercial	3%	10%	12%	60%	21%
Transport	-	-	49%	-	12%
Household/Residents	96%	90%	25%	37%	62.5%
Total	100%	100%	100%	100%	100%

Source: Ministry of Agriculture and Food Security (2012), PMU (2012), MEWR and NPA-BKPS (2012).

Renewable Energy

“The country possesses vast potential in renewable energy in the form of biomass from agricultural wastes, hydro and solar power, which remain virtually untapped.”[2]

According to the “Renewable Energy Statistics 2017” report by IRENA there is a total capacity of 88 MW of Renewable Energy in the country, of which 56 MW are Hydro Power and 33 MW Bioenergy. However, as lined out above, data are incomplete. For example, Solar Energy is not included in the statistics.

According to the Ministry of Energy, the share of Renewables was 78,4% in 2013.

Ministry of Energy 2015, Sustainable Energy for All (SE4ALL) Action Agenda for Sierra Leone

Hydro Power

In Sierra Leone, hydropower is a major energy source, holding great promise for a country which possesses several rivers that could be exploited for electricity.

According to the German Bundesministerium für Wirtschaft und Energie, there is potential for 2.000MW of hydro power. Faktsheet Republik Sierra Leone. According to the German Bundesministerium für Wirtschaft und Energie, there is potential for 2.000MW of hydro power. Faktsheet Republik Sierra Leone More optimistic studies are the Power Sector Master Plan (1996), identifiying 27 potential hydropower sites with a total capacity of 1,513 MW. And a study conducted by UNIDO (Hydropower Potentials in Sierra Leone, UNIDO, 2013) that estimates hydropower potentials to about 5,000 MW covering 300 sites nationwide.

However, most of the others suffer from water flow rate variations between the wet and dry seasons. Yiben II, Bekongor III, Kambatibo, Betmai III, Yiben I and Bumbuna Falls are the most attractive in terms of generation cost. Furthermore, most of these hydropower sources remain virtually untapped. Although many of the rivers investigated fall under the small to medium hydro system (i.e. 1 - 100 MW) there is a potential for pico to mini-hydro systems (5 kW to 1MW).

Resources under 2 MW are expected to offer huge potential for public-private partnerships and wider investment by the private sector. In Sierra Leone, hydropower generation has accounted for a substantial part of the total electricity generation mix. Currently, hydroelectricity represents 59% of the installed grid-connected electricity generation capacity. Source: Energy policy of SL_FINAL for Print.pdf Renewable Energy Policy of Sierra Leone

Projects

According to the "Renewable Energy Statistics 2017" report by IRENA, Sierra Leone has 56 MW installed hydro power capacity.

- Bumbuna: The biggest hydro power plant is situated in Bumbuna, Tonkolili District, commissioned in 2009, 161kv transmission line and 250km line length between Bumbuna and Freetown, covering aprox. 40% of the capitals' residents. In wet season the Bumbuna hydro power plant generates aprox. 30-40MW and in the dry season 10-18MW, leading to frequent power blackouts in the months from February to April. Nevertheless, the importance of the hydro power plant is reflected on the 5.000 Leones note, depicting the Bumbuna reservoir. The city of Makeni is also provided with electricity from Bumbuna plant. In the end of 2017, the parliament of Sierra Leone approved the so called "Bumunba II", an extension of Bumbuna I, adding a further 143MW of power capacity.

- Dodo: A 6 MW run-of-the river hydro power plant, located in the Eastern Province, some 380 km from Freetown and 69 km from the headquarter town of Kenema. This plant, operated by the BKPS, is functional, and is a part of a regional grid connecting thermal power plants in Bo and Kenema.

- Bankasoka, Charlotte, Makali: In December 2017, the president commissioned the Bankasoka Hydro Dam in Port Loko town which will produce about 5 MW of electricity supply including Makali and Charlotte dams respectively. The Bankasoka (2MW), Charlotte (2MW) and Makali (120KW) were jointly constructed and wired by the Government and the Chinese Government, in partnership with UNIDO.

- Guma: The 2.4MW Guma plant, installed in 1967 in the Western Area, was decommissioned in 1982.

Solar Energy

In February 2017 Sierra Leone was the first African country to sign the "Energy Africa Policy Compact" with the Government of the UK. As part of the compact, the Energy Revolution initiative was launched, committing to reach 250.000 households with modern energy solutions by 2018. A task force was established and within government and private sector the focus shifted notably to renewable energy, especially solar energy.

According to the "Renewable Energy Statistics 2017" report by IRENA, there is no solar power capacity installed in Sierra Leone. Nevertheless, in the years from 2014 to 2018 some bigger projects have been implemented:

- Promoting Renewable Energy Services for Social Development (PRESSD) (2014-2018): Installation and operation of 3 solar mini-grids in Segbwema, Panguma and Gbinti, installation of SHS for aprox. 100 charging centres, 20 energy hubs for Agricultural Business Centres, 20 clinics, 12 schools, 12 finanical service associations. Equipment and training for 3 Energy Laboratories in cooperation with Polytechnics. Sales of Pico PV products through local retailers. Partners: European Union, Welthungerhilfe, Cooperazione Internationale, Energy for Opportunity, Oxfam.

- Rural Renewable Energy Project (2017-2020): Installation of a total of 50 smaller (6-36KW) mini-grids and 40 bigger (>36KW) mini-grids, located at health facilities. Development of private companies operation model. Partners: UNOPS, UK Aid.

- Installation of Solar Street Lights: The Ministry of Energy Sierra Leone has installed 8471 solar street lights in the fourteen district headquarter towns across the country. The facilities were handed over to the various district councils, city councils and local councils in 2017.
- The Ministry of Health is implementing the Expanded Programme on Immunization and has installed aprox. 900 solar powered fridges, donated by UNICEF, since 2003 for the purpose of cooling vaccinations across the country. The programme is currently replacing old fridges.

Smaller projects include:

- WASH Consortium:Implementation of solar water pumps for decentralized water supplies. Partners: DFID, Oxfam, Concern, Save the Children, Action against Hunger.

- Biodiversity Conservation Project: Solar Charging Centres to support Biodiversity Conservation. Partners: GEF, World Bank

- Apex Bank Solar Systems: Provision of SHS for Financial Service Associations and Community Banks. Partners: Kafeibu Constructions, IFAD.

- Advancing Partners and Communities: Solar systems for health facilities. Partners: USAID, JICA, JSI, ACF.

- Barefoot Women Solar College: Training centre, courses for illiterate women, installation of Solar Systems for communities. Partners: Barefoot Women, Ministry of Energy.

- Playhouse Foundation/EnDev: SHS for health facilities and schools in Kono and Kailahun.

- Rural Energy Activating Livelihoods (REAL):Provision of electricity and employment options (charging centre) to rural population. Partners. Environmental Foundation for Africa, EU.

According to the Ministry of Energy and Water Resources (MEWR), approximately 1460 kWh/m of solar radiation can be expected annually in Sierra Leone. [3] A more optimistic study undertaken by the Joint Research Centre (JRS) of the European Commission portrays Sierra Leone’s solar potential to be as high as 2200 kWh/m. [4]

Wind Energy

Sierra Leone's best wind velocities indicate a country-wide average of between 3 m/s and 5 m/s, increasing to approximately 8 m/s in some mountainous areas (Metrological Statistics, 2012). There is some indication that wind speeds of 12 m/s are possible in parts of the country, implying that wind energy could be a viable option in selected locations. Wind farms are for instance possible at certain locations such as along the coast line, at sea near the coast line and at some locations in the country.

With the low wind speed turbines now available in the market, there is a strong potential for the use of these systems in the rural areas especially in the north of the country. There is a known wind energy system of 5kw in Sierra Leone, located in the Bonthe District, along the south coastline area.

Biomass

Energy consumption in Sierra Leone is dominated by biomass, which accounts for over 80% of energy used. The largest source of biomass energy is wood fuel followed by charcoal [5] , while the use of agricultural crop residues and bagasse in the sugar industry remains limited. In addition, there is considerable potential (without impacting on food production) to produce bio-fuels from energy crops such as maize and cassava, and processing of charcoal into biochar.

According to IRENA report Sierra Leone has a capacity of 33MW, generated from Biomass. The theoretical potential for the use of Biomass is 2.706GWh, according to German Bundesministerium für Wirtschaft und Energie. It should be noted that the amount of residue is expected to increase as the Agricultural sector grows.

Sierra Leone puts almost all of its refuse to landfill sites. The energy content of the total domestic and industrial refuse disposed of in 2012 amounted to 594,000 tons per annum. Options for energy production from municipal waste should be examined including biogas projects as well as methane gas from landfills.[6]

Projects

The Addax ethanol project, close to Makeni, uses sugar cane to produce bio-ethanol for export and domestic use and for supply to the main Bumbuna-Freetown grid. Available power is said to be 15 MW. But in 2015 there were reports about the financial and operational trouble the company was facing in 2015.

In Port Loko district, at Magbass sugar cane industry bagasse was used to generate heat and electricity. A re-introduction would be favourable.

Biomass for Cooking

According to the 2015 Population and Housing Census [7]., 96,8 % of the population in Sierra Leone uses firewood or charcoal for cooking. Other sources, including gas, kerosene or electricity account for the remaining 3,2%. 64,7% of the households use firewood and 32,1% use charcoal on a national level. The percentages vary from district to district. In the Northern, Eastern and Southern regions, an average of 83,7% of the population cooks with firewood and an average of 14,5% uses charcoal . In the Western Region, where the capital Freetown is situated, 83,3% of the households use charcoal as the main source of energy for cooking, 8,9% use wood and 7,8% other sources. By way of conclusion, the main energy source for cooking in rural areas is firewood, the main energy source for cooking in urban areas, especially in Freetown, is charcoal. Families who cook with firewood make 3-stone-fires. In urban centres of Sierra Leone, the 3-stone-fires are gradually replaced by clay stoves and metal coal pots in parallel. But, it is noteworthy that 3-stone-fires still play an important role, even in urban centres, because the preparation of food with a longer preparation time (i.e. for festivities), is normally done with a 3-stone-fire.

The consumption of fuelwood is worsened by the widespread use of inefficient cooking methods, the most common of which is an open “3-stone-fire”. The rate of consumption of fuelwood far exceeds the replenishing rate to such an extent that desert

encroachment, soil erosion and loss of soil fertility are now serious problems in the country. The nation's 2.726 million hectares of forest and woodland reserves could be depleted within the next hundred and thirty-six years, if not properly managed. These would result in negative impacts on the environment, such as soil erosion, desertification, loss of biodiversity, microclimatic change and flooding. Most of these impacts are already evident in different ecological zones in the country, amounting to huge economic losses.

Wood fuel is the dominant and cheapest fuel available on the Sierra Leonean market; the production, transportation and sale of wood fuels are all undertaken by the private sector. There is no official government pricing regulatory body responsible for setting the prices of wood fuels in Sierra Leone.

Awareness on Improved Cook Stoves is still to be raised, even though many people in bigger cities cook with locally made clay stoves which save fuel compared to the traditional metal coal pots used in other West African countries.

Westwind Energy produces the "Wonder Stove" in a local clay and metal workshop in Freetown. It fulfills criteria for Improved Cook Stoves, according to tests that EnDev conducted.

Fossil Fuels

After Biomass, imported Petroleum Products are the next largest source of power at approximately 13%. Petroleum products importation has been done through refined products like Gasoline or Petrol, Diesel, Marine Fuel Oil, Kerosene, due to the absence of a domestic refinery. The Petroleum Products are consumed mainly in the transport and residential sector. Sierra Leone currently imports all its petroleum products. Petroleum Product importation volume per annum increased by more than 100% between 2000 and 2011. Petroleum products consumption averaged 184,290toe per annum. There is one big thermal oil plant with an installed capacity of 37MW. [8]

The government lifted the subsidy for petroleum products in the end of 2016. Under the new measures, the pump price for one gallon of gasoline and diesel increased from 62 cents to about 1.57 EUR.

Policy Framework, Laws and Regulations

The main recently ratified laws, regulations and compacts, concerning the Energy Sector, with a focus on Renewables at a glimpse are:

- The „National Electricity Act 2011" was one of the biggest recent changes in the Electricity Sector in Sierra Leone, unbundling the vertically integrated National Power Authority, that was created by an Act of Parliament in 1982, into two entities, the Electricity Generation and Transmission Company (EGTC) and the Electricity Distribution and Supply Authority (EDSA). Furthermore, trough the Electricity and Water Regulatory Act 2011, a regulatory body, the Energy and Water Regulatory Commission was established.

- The Sustainable Energy for All (SE4ALL) Action Agenda for Sierra Leone. The Action Agenda was part of an 2014 agreement of ECOWAS member states, that agreed on the

development of National Renewable Energy Action Plans (NREAPs) and SE4ALL Agendas. In its agendas, Sierra Leone outlined goals, such as the electrification of all district headquarter towns, increased installed power capacity, 1.229MW in 2030, increased access to Renewable off-grid solutions, but also objectives such as increased access to improved cooking technologies or improved charcoal production. The goals are outlined for 2020 and 2030 respectively.

- The Energy Africa Policy Compact. In February 2016, Sierra Leone was the first African country to sign the Energy Africa Policy Compact with the Government of the UK. As a result, the Government of Sierra Leone launched the Energy Revolution, a government-led initiative to promote the solar home system market with activities in the areas of Demand Creation, Technical Assistance for Businesses, Policy Reform and Access to Finance. The initiative is committing to reach 250,000 households with modern solar solutions by 2018 and achieve 'Power for All' by 2025. A DFID financed Power for All Campaign was launched and a "Energy Task Force Meeting" established.

- The Finance Act, 2017.pdf 2017 Finance Act guaranteeing Duty Waivers for imported solar products that fulfill IEC Standards. In practice, it is difficult for private companies to impose the measures, due to unclear administrative processes and long delays.

- The Energy policy of SL_FINAL for Print.pdf Renewable Energy Policy of Sierra Leone and the Energy Efficiency Policy of Sierra Leone, ratified by the Parliament in 2016 and launched in 2018, outlining the status of Renewable Energy in the country and objectives and measurements in the sector.

- In August 2017 the Millenium Challenge Coordinating Unit (MCCU), together with the Ministry of Energy, launched the "Electricity Sector Reform Roadmap 2017-2030)", with a vision for the Electricity Sector up to 2030.

- The National Energy Policy 2009 was reviewed but still needs ratification, as of beginning of 2018.

Institutional Set up in the Energy Sector

Some observations on the institutional set up of the (Renewable) Energy Sector in Sierra Leone are:

- The power sector has been unbundled into distinct actors for generation and transmission and for distribution and retail: The „National Electricity Act 2011" unbundled the vertically integrated National Power Authority into the Electricity Generation and Transmission Company (EGTC) and the Electricity Distribution and Supply Authority (EDSA). Furthermore, trough the Electricity and Water Regulatory Act 2011, a regulatory body, the Energy and Water Regulatory Commission was established.

- There is no separate Rural Electrification Agency. The Ministry of Energy has a Renewable Energy Department and works closely with the President's Recovery Priorities team. One of the priority sectors is Energy, with the key objectives to double acesss to electricity from 125.000 to 250.000 households and double the operational power generation capacity from 75MW to 150MW.

- Following the launch of the Energy Revolution, the private sector association Renewable Energy Association of Sierra Leone (REASL) was founded, comprising of aprox. 30 members in the beginning of 2018.

- There are three Government Learning Institutions that offer courses in Renewable Energy, the Government Technical Institute in Freetown, Kissy Dockyards, the Government Technical Institute in Magburaka and the Eastern Polytechnic in Kenema.

Donor/Programm Activities

The Rural Renewable Energy Project funded by DFID is supporting the construction of 94 solar mini-grids in Sierra Leone, amounting to an installed capacity of 5MW in rural communities and is expected to complete by December 2021. The three mini-grid operaters i.e PowerGen, Winch Energy and Energicity have already delieved 7000 connection in the first 50 sites in 2020[9]. To promote PEU of mini-grids, a Call for Proposal are closed in March and the awards are expected to granted in later half of 2020.

Mobile Power is also set to pilot battery rental for electric vehicles on mini-grids developed by Winch Energy[10].

Key Problems of the Energy Sector

- **Financing/Investment:** Especially lack of private investments, lack of economic incentives, support and implementation for PAYGO availability necessary, microfinance should be available for solar businesses, no fully functioning mobile money platform exists

- **Enabling Legal Framework:** Need for clear regulations of private sector participation in electricity generation, need for mini-grid licensing and concessions, need for standardized Power Purchase Agreements (PPAs), need for less bureaucratic process of receiving tax / duty waivers for private companies importing certified solar products, no Rural Electrification Agency exists

- **Infrastructure and Services:** Transmission and distribution infrastructure need to be improved, most parts of the country have no access to any grid, many distribution lines were destroyed during the civil war, old equipment is in place and needs to be replaced, poor energy efficiency, the existing network is very old and there are immense power losses in the generation, transmission and distribution, (40% transmission losses), generation capacity does not cover the demand, especially in the industry many companies are forced to rely on diesel generators , service standards of EDSA are poor, use of inefficient cook stoves / 3-stone-fires and kerosene lights/battery torches

- **Lack of accurate data:** lack of data collection in the energy sector, absence of detailed research

- **Lack of awareness:** Missing awareness on quality standards for solar, especially PicoPV products, missing awareness on Improved Cook Stoves , missing awareness on environmental benefits (climate change, health etc.) of solar and improved cook stoves, recycling programme for old batteries necessary

Further Information

- A much more detailed report on the energy situation is provided in the National Energy Profile of Sierra Leone, published by the UN in 2012
- For a full overview of energy policies see: Sierra Leone Energy Africa Compact, published by Energy Africa
- Useful IRENA mapping tool for seeing the wind and solar potential in Sierra Leone
- A website on the Renewable Energy Sector in Sierra Leone was developped by EnDev and partners Renewables Salone.
- Mini-Grid Market Opportunity Assessment: Sierra Leone, AfDB and SEFA, Nov 2019.

Sierra Leone Rural Renewable Energy Project (RREP) Presentation on June 2019

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