



## Investment Brief for the Electricity Sector in Liberia

### Overview

Liberia's economic growth is severely constrained by an insufficient supply of reliable and affordable electricity. The only on-grid electricity sold in the capital city, Monrovia, currently has an approved single tariff exceeding US\$ 0.50/kWh. The capital city of Liberia, Monrovia and the rural towns and cities has consequentially witnessed a proliferation of an estimated several hundred megawatts of mostly micro off-grid self-generators/sellers operating at an even greater cost. Electricity is, therefore, the single largest component of operational expenses in Liberia for large concessions, industries, and businesses that must have electricity and has also completely prevents new business establishments due to an inability to show projected positive returns on investment.

The Government of Liberia's (GoL) Ministry of Land, Mines and Energy (MLME) recently expressed interest in engaging the private sector in several specific renewable small scale and utility scale electricity generation concept projects. These projects may also need associated transmission and distribution investment from the private sector.

As a result, viable new least cost renewable electricity resources may be able to assist Liberia in lowering its electricity cost of service both on- and off-grid.

### Energy Demand and Supply Balance

Liberia's sole licensed utility, the Liberia Electric Corporation (LEC), presently has only 15 out of 22 one-megawatt (MW) units operating around the clock in Monrovia on diesel fuel at 3 sites as follows.

- Bushrod Island: 15 MW (15 engines of 1 MW each)
- Kru Town: 5 MW (5 engines of 1 MW each)
- Congo Town: 2 MW (2 engines of 1 MW each)

Additionally, GoL is pioneering the rehabilitation of the Mt. Coffee hydropower plant with support from GON, EIB and KfW.

Firestone Plantation Company, Inc. operates only a single small 4 MW hydro resource outside Monrovia which is also supplemented by diesel generated power during the dry-seasons. By the end of 2016, LEC's wet-season capacity will increase more than six-fold to nearly 140 MW if LEC can complete the Mt. Coffee hydroelectric plant renovation by then. The LEC's dry-season firm capacity is projected to increase up to 90 MW by then. The most recent report (2011) on the electric energy demand projections up to 2040 was issued by the World Bank and AFTEG in the report titled: *Options for the Development of Liberia's Energy Sector*. The evolution of electricity demand according to low and high growth scenarios would result in max 240 MW or min 112 MW of installed capacity in 2016. The threshold would be max 543 MW or min 302 MW for the year 2020.

### Planned Power Generation Projects

At present, no official country-wide master plan is available from GoL or MLME. However, there are several different studies that include different aspects of a master plan. Power Africa Liberia had prepared a current needs assessment paper that provides a comprehensive review of the energy sector and energy programs in Liberia. Other studies include:

- ECOWAS: Revised Master Plan for the generation and transmission of electrical energy. This plan focuses on international aspects in the context of WAPP/ECOWAS projects.
- NVE/Norconsult: Generation Option Analysis
- Norad: A Fast Track Comparative Analysis of the Various Power Generation Options Available to Liberia or Simplified Power System Master Plan - A Primer for Decision-making.
- LEC ELECTRIC Master Plan 2012-2014: For the greater Monrovia area, a master plan is being developed by LEC in cooperation with MHI and is updated on an annual basis
- RREA: RREA plans to develop a rural electrification master plan in the near future



To enable supply increases LEC is undertaking the rebuilding of the Mt. Coffee's 80 MW hydro plant (up to 20 MW firm in dry-season) and 38 MW of HFO generation at Monrovia's existing Bushrod Island facility. If these are achieved, LEC will have surplus electricity production capacity for Monrovia and its sub-urban areas by the end of 2017 for a few years and be able to continue connecting up to over 1,000 new customers monthly. The current electricity access is only about 2% of the Monrovia city population and the GoL Energy Policy has set electricity access targets of a minimum of 70% therefore; MLME and LEC are increasingly concentrating on grid extension and further grid rehabilitation to reach the rest of the city and its sub-urban areas. It will be decades, however, before LEC interconnects all its pre-war grid areas that are planned to be serviced by the above 2 generation concept projects identified by MLME. Additionally, existing self-generators would, at some point, like to reconnect to LEC; however, they are unlikely to do so until power is available year-around, and is much more reliable and affordable.

MLME, LEC and other stakeholders have identified hydro resources as the next least cost utility scale (up to 500 MW) generation resource to achieve a sustainable national power supply. The proposed Via River Reservoir and a series of downstream cascading dams on the St. Paul River if realized have the potential of 400 MW or more but are unlikely to start to be in-service until at least 2023 and may be least cost only if the hydro project is undertaken in its entirety. Water stored at a Via Reservoir would enable dry-season hydro generation to be on par with wet-season hydro generation for an entire cascade of dams including Mt. Coffee. The Via Reservoir is relatively costly if undertaken as a stand-alone project but can be cost effective if undertaken along with the West African Power Pool (WAPP) transmission line project that is planned to interconnect Ivory Coast, Liberia, Sierra Leone, and Guinea. With this, Liberia could become a net exporter of electricity.

MLME is also identifying additional generation resources to generate the near term capacity needed for the pre-2023 period. The GoL has economic development aspirations for unserved areas, particularly in the north and southeast and it has been contacted by a number of large potential industrial customers interested in such areas.

### **Planned Projects for Power Transmission, Distribution, & Supply**

The following projects are under development or under construction by LEC:

- Grid connection from Mt. Coffee hydropower plant to Monrovia (under consideration)
- Rural electrification along the CLSG line from Sierra Leone to Mt. Coffee
- Three corridor projects:
  - Kle corridor: from Monrovia to Kle (Bomi County)
  - Kataka corridor: from Monrovia to Kataka
  - RIA corridor: from Monrovia to Kataka via Harbel.

The interconnection projects with neighboring countries include the following:

- Local MV interconnections from Ivory Coast to Liberia
- Projects within the framework of West African Power Pool (WAPP) development Ivory Coast – Liberia – Sierra Leone – Guinea interconnection project (CLSG project) Interconnection from Liberia to Ivory Coast. The WAPP project provides for a second 225 kV interconnection between Liberia and Ivory Coast from Buchanan in Liberia to San Pedro in Ivory Coast.
- Local medium-voltage interconnection from Ivory Coast to Liberia in 3 areas in the border zone to Ivory Coast in the south of Liberia, a power supply system connected to Ivory Coast's 33 kV network has been developed and is currently under construction. The areas are located in the counties of Nimba (supplied at 6 localities), Grand Gedeh (supplied at 5 localities), and Maryland (2,000 supplied at 9 localities).

### **Potential for Private Sector Investment**

MLME is reluctant to rely solely on heavy fuel oil and diesel generation for all the near term generation capacity additions. While MLME is presently involved in numerous small renewable, and off-grid and mini-grid projects, it seeks more generation capacity to (i) permit the re-development of the export-oriented coastal ports in the southeast, (ii) serve those coastal areas and surrounding communities, and (iii) enable economic development catalyzed by iron ore mines, gold mines, rubber plantations, and palm oil industries among other potential developments.



Included among the potential private sector investment opportunities for electricity generation are the following projects.

**MLME has identified a potential private sector opportunity centered at Greenville on the southeastern coast and involving the greater Sinoe County.** Preliminary evaluation indicates that biomass powered generation with reciprocating engine back up fueled by imported gas has the greatest generation potential. MLME has the view that Liberia lacks the adequate wind speeds necessary for wind generation. Solar requires further study. To facilitate the potential project, MLME will evaluate the potential port and large customer demands and timeline and make preliminary estimates for an initial 30 MW electricity demand with the potential to grow to 350 MW. There is no existing electricity grid in the area and given demands on LEC elsewhere, it is likely that the private sector will be needed to build and operate the grid in the Sinoe County area. Although an expensive and low probability scenario, MLME alternatively has an interest in extending the expected 225 kV grid from Buchanan<sup>1</sup> to Greenville to promote and begin the establishment of a larger facility using liquefied natural gas and combined cycle gas generation. This complex proposition would also likely require a gas pipeline for back-up supply. MLME is considering the next steps at Greenville and is interested in discussions with the private sector to further shape concepts into a project. MLME is considering seeking expressions of interest and conducting a solicitation for this project.

#### **Renewable Energy Project for the Development of Off-Grid Power Supply in Margibi County, Liberia**

Connection of all customers in peri-urban and rural areas to the LEC's central grid is not possible at this time. Off-grid technologies--in particular those fueled with renewable energy sources--represent a viable option to quickly reach areas beyond the grid with electricity. The proposed Margibi County off-grid project is intended for an investor entity to enter into a Build, Own, Operate, and Transfer (BOOT) concession agreement with the Government of Liberia. The operator then builds an approximately 10–20 MW electric power plant (using solar, hydro, and/or biomass energy resources and technology options) for a large group of customers, such as Roberts International Airport (RIA), nearby businesses, the airport hotel, Firestone Plantation Company, Harbel community and its environs, nearby Ministry of Health & Social Welfare (MOHSW)'s Biomedical Research Laboratory, Shefflin military camp, Smell-no-taste community, the UN military base, Cutting Tree community, etc., and then it could possibly extend to Kakata City and other surrounding communities and towns including small and medium scale industries and service institutions (schools, clinics, hospitals, and offices) in the project area.

The project area is endowed with vast open land (estimated to be 3,500 acres) useful for utility size solar power facility, currently owned by the Government of Liberia (GOL). The Farmington River located in the project area has an existing 4 MW mini-hydro plant owned by the Firestone Plantation Company, which could be upgraded to higher capacity. The river has been studied and at least one other site of reasonable hydroelectric power potential was identified. The Firestone rubber plantation--the largest acreage in West Africa--and other rubber farms in the area could additionally provide waste wood enough to sustain a utility size biomass electric power plant. The 2008 Liberian Census report indicates that the project area (Margibi County) has the second highest county population density in Liberia and is accessible with good roads, industrial, agricultural, tourist and other guaranteed electricity market potentials. Since this paper is only a concept note about the viability of the proposed project, a more comprehensive analysis should be undertaken as soon as possible.

**MLME has identified a potential 3 MW opportunity for biomass near Mbaloma in the north which may require solar for biomass drying.** This potential project would complement the Kaiha River hydro project, at a minimum, by ensuring year-round power supply. The project still needs further study in the form of a pre-feasibility evaluation. Palm kernel oil, cake, shell, and husk represent a nearby potential biomass source from 10,000 existing planted acres. There is no existing grid in this densely populated area and the private sector may be needed to operate the grid in the three towns nearby after the Rural and Renewable Energy Agency (RREA) contracts for its rebuilding. Before its destruction during the civil war, LEC operated the mini-grid in the area so there is potential for LEC to be the off-taker. In order to facilitate the development, potential developers might require grant funding to undertake pre-feasibility evaluation.

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<sup>1</sup> Liberia's allocation of the West African Power Pool's (WAPP) Cote d'Ivoire/Liberia/Sierra Leone/Guinea (CLSG) transmission line under construction and expected to be in-service in 2018 is 18 MW on the line's first circuit rated capacity of 120 MW. Electricity will be transmitted from Ivory Coast into and through Liberia and to Sierra Leone and Guinea.



MLME has stated that these highlighted opportunities are not presently under evaluation by donor agencies. Norway, perhaps the most active donor in Liberia, has indicated its expertise extends to hydro generation only and is unable to provide grants to other generation resources. There are other private sector opportunities to provide electricity in residential scale distributed solar, small-grid systems, and large power systems for large mining operation and agricultural development projects in the country.

### **Private power generation**

At present, although no detailed data is available on private power generation, LEC is aware that there is a large number of power generator sets in Liberia based on High Speed Diesel (HSD). Most hotels, companies, international and other institutions have installed their own generator sets due to the fact that there is yet no available connection to LEC grid. The mining companies, which have big power demand, have included the right for their own power generation within their licenses, because they need a continuous and reliable power supply for their own facilities. All potential clients currently operating their own power generation facilities are interested in getting a grid connection wherever possible, because the cost of their own power production is very high, even in comparison with LEC's current high tariffs. An important aspect for power producers to connect to the grid is a reliable power supply from the grid.

There are also numerous small business and neighborhood grids in operation by self-generators. Such grids do not pay transaction-related taxes as might be required in order to comply with a license. Self-generators likewise are not required to comply with safety standards of a license even though fuel is stored in large quantities in close proximity to residences. While there is very limited information available, self-generation is estimated to occur at a scale more than ten-fold greater than LEC's existing generation base. This represents a large potential opportunity for LEC to expand its customer base, however, most potential customers will wait until LEC has demonstrated that the grid can provide reliable and affordable power year-around before switching to the grid. Switching to the grid will also improve neighborhood safety and help reduce localized noise and pollution.

### **Energy Sector Institutions**

The key public sector institutions and entities involved in the Liberian electricity sector are:

**Ministry of Lands, Mines and Energy (MLME)** - The MLME is responsible for national energy policy and master plans formulation, has a statutory membership on the Board of LEC, manages the RREA, and leads the concession granting process for electricity related private sector investments.

**Renewable and Rural Electrification Agency (RREA)** - The RREA is responsible for bringing modern energy services to Liberia's rural areas by serving on some projects as a contract administrator for rural construction. With the help of the Rural Electrification Fund (REFUND), which is now being set up, the RREA will administer electrification to rural areas. RREA is the focus of a significant donor-led capacity building effort already underway. See [www.rrealiberia.org](http://www.rrealiberia.org)

**Liberian Electricity Corporation (LEC)** - The LEC is responsible for producing electricity and operating its grid while maintaining its financial viability. It is responsible for maintaining, improving, and expanding its generation, transmission, and distribution system. Manitoba Hydro International administers LEC under a five-year management contract that was scheduled to run from 2010 to 2015 but has since been extended to 2016. Mt. Coffee will likewise be managed under a management contract. See [www.lecliberia.com](http://www.lecliberia.com)

**West Africa Power Pool (WAPP)** - In Liberia, WAPP is presently responsible for construction management of the CLSG 225 kV transmission line extending from Ivory Coast into Liberia and continuing on into Sierra Leone and Guinea.

### **Electricity Sector Enabling Environment & Recent Experience**

The primary mechanism which the GoL has relied upon historically for engaging the private sector is concessions. The GoL presently has 18 concessionaires across all economic sectors and is evaluating further enabling energy legislation. Pending approval by Liberia's Legislature is legislation that will further enable energy project development. Among the important issues under consideration is formalizing the issuance of licenses for electricity generation, transmission and/or



distribution. The private sector prefers licenses issued for a defined term or in perpetuity if compliance with license terms is maintained.

Under current law, concession agreements are burdened with many considerations that are better addressed outside of the power contract context.

Liberia has not created a utility regulatory commission. The private sector would prefer that an independent regulator be established at some point in the near future as international experience suggests courts generally lack adequate expertise to adjudicate the full range of legal issues in the energy sector. Compromise among all the stakeholders will be necessary regarding such issues as the timing of forming and empowering a Liberian utility regulatory commission.

A draft electricity law has been developed recently. The law is currently in an internal review and consultation process of MLME. If enacted, among other things, the law envisages the establishment of an independent regulatory authority and will also regulate private sector involvement in the power sector. Its ratification would lead to a further improvement of the overall legal and regulatory framework of the power sector and would thus contribute to the overall development of the power supply system.

International donor agencies and development finance institutions are very active in Liberia including donors from Norway, the European Union, the European Investment Bank, Germany, Japan, China, and the United States. In addition to ongoing grants provided for infrastructure projects, various necessary system studies are also underway. Examples of such studies include (i) a World Bank funded least cost electricity resource plan which is nearing completion, (ii) a European Union funded assessment of a Via Reservoir, and (iii) a Norway sponsored assessment of a small hydro resource in the north. USAID has a number of small renewable energy pilot projects nearing construction and has several small project concessions pending with the GoL.

USAID has approved 2 local banks to participate in its partial loan guarantee program and has instituted a program to strengthen local banks' institutional and human capacity. Local banks have familiarity with energy sector project finance as they currently lend to clients that self-generate, and they are seeking further lending opportunities for more efficient on-site generation.

In Liberia, USAID is also marshalling efforts related to "Beyond the Grid", a new Power Africa sub-initiative which leverages Power Africa's innovative transaction-focused model to facilitate future investment specifically relating to off-grid and small-scale energy solutions.

In the year ahead, great attention will be placed on developing public-private partnerships with domestic and international firms and technology providers who are interested in helping Liberia increase the access of reliable, affordable and renewable energy to under-served and rural communities. USAID is also working to expand the number of independent private power producers in Liberia.

LEC is considering an immediate increase in its tariff before potentially beginning to reduce rates after Mt. Coffee comes online. The lower cost of generation created by fuel savings will enable LEC to lower rates.

MLME has identified several project concepts for which it is seeking private investment and, thus, may be entering an era more favorable to the private sector.



For more information on Power Africa visit: [www.usaid.gov/powerafrica](http://www.usaid.gov/powerafrica)

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