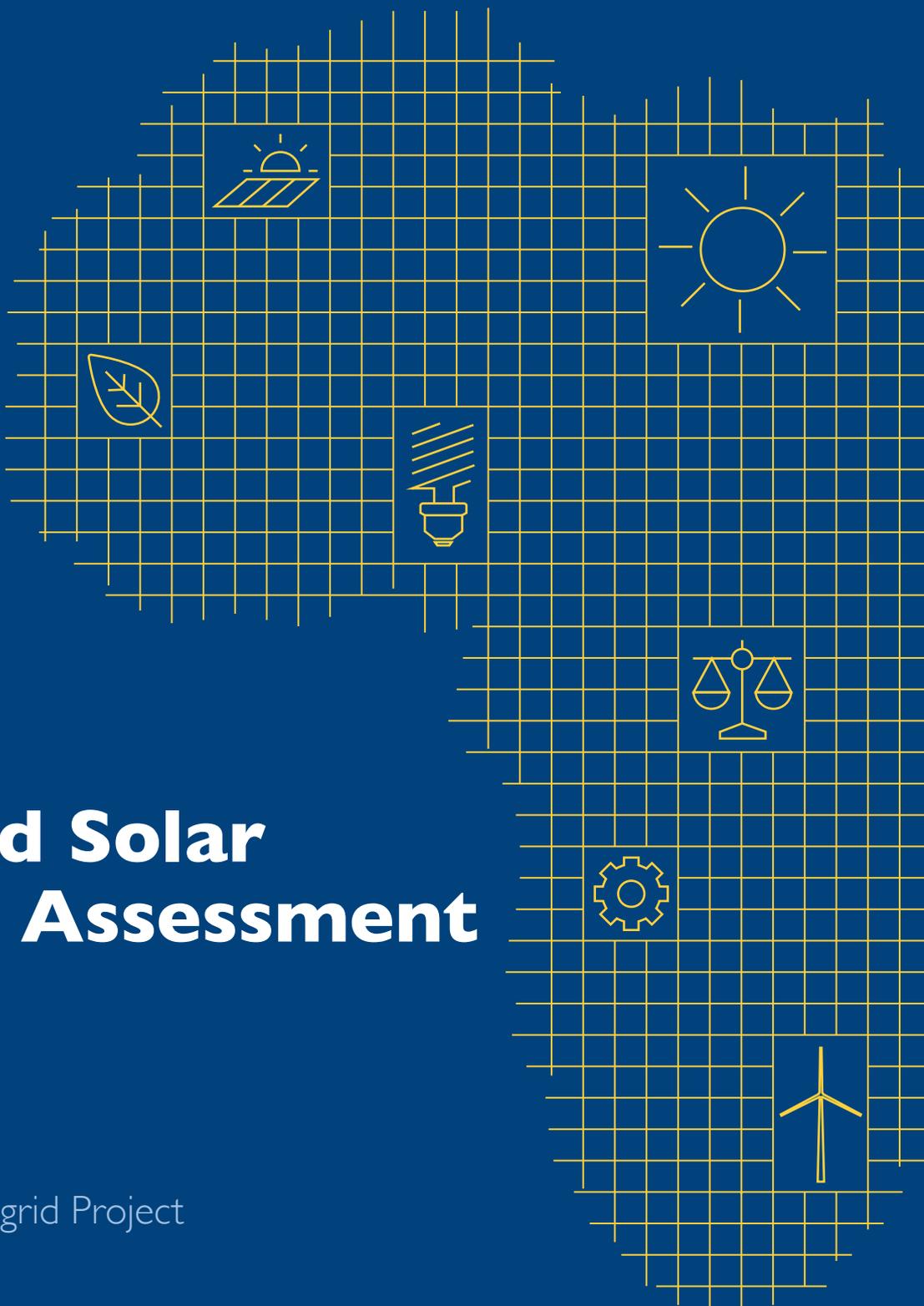




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OCTOBER 2020

Off-Grid Solar Market Assessment

Liberia

Power Africa Off-grid Project

ABOUT POWER AFRICA

The Power Africa Off-grid Project is a four-year program that launched in November 2018 to accelerate off-grid electrification across sub-Saharan Africa. RTI International implements the project in collaboration with Fraym, Norton Rose Fulbright, Practical Action Consulting, and Tetra Tech. Power Africa is a U.S. Government-led partnership that brings together the collective resources of over 170 public and private sector partners to double access to electricity in sub-Saharan Africa.

Power Africa aims to achieve 30,000 megawatts of new generated power, create 60 million new connections, and reach 300 million Africans by 2030.

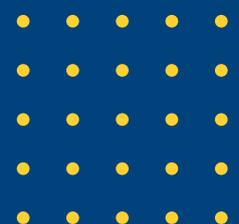
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ACRONYMS & ABBREVIATIONS

AfDB	African Development Bank
BGFA	Beyond the Grid Fund for Africa
BTG	Beyond the Grid
BWI	Booker Washington Institute
CBL	Central Bank of Liberia
CLSG	Côte d'Ivoire, Liberia, Sierra Leone, and Guinea
DESCO	Distributed Energy Service Company
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
EU	European Union
GDP	Gross Domestic Product
GHI	Global Horizontal Irradiance
GNI	Gross National Income
GOGLA	Global Off-grid Lighting Association
GTG	Growing the National Grid Program
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IPP	Independent Power Producer
kWh	Kilowatt Hour
LEAP	Liberian Energy Access Practitioner
LEC	Liberia Electricity Corporation
LEN	Liberian Energy Network

LERC	Liberia Electricity Regulatory Commission
LIRENAP	Liberia Renewable Energy Access Project
LLL	Lighting Lives in Liberia
LRA	Liberian Revenue Authority
LUL	Light Up Liberia
MCC	Millennium Challenge Corporation
MFI	Microfinance Institution
MME	Ministry of Mines and Energy
MMO	Mobile Money Operator
MW	Megawatts
NEEAP	National Energy Efficiency Action Plan
NEP	National Energy Policy
NGO	Nongovernmental Organization
NREAPs	National Renewable Energy Action Plans
NRECA	National Rural Electric Cooperative Association
NSL	National Standards Laboratory
OGS	Off-grid Solar
PAPD	Pro-poor Agenda for Prosperity and Development
PAYGO	Pay-as-you-go
PV	Photovoltaic
PPP	Purchase Price Parity
RCFI	Rural Community Financial Institution
REEEP	Renewable Energy and Energy Efficiency Partnership
RESMP	Renewable Energy Strategy and Master Plan
ROA	Return on Assets
ROE	Return on Equity
RREA	Rural and Renewable Energy Agency
SDGs	Sustainable Development Goals

SE4ALL	Sustainable Energy for All
SHS	Solar Home Systems
UN	United Nations
USAID	United States Agency for International Development
VOSIEDA	Volunteers for Sustainable Development in Africa
WAPP	West African Power Pool

INTRODUCTION

This report by the Power Africa Off-grid Project provides insights into the opportunities and risks associated with Liberia's off-grid solar energy market and gives companies, investors, governments, and other stakeholders a deeper understanding of the market.

This report:



Provides a comprehensive and detailed review of solar home systems (SHS), mini-grids, and other aspects of the off-grid solar value chain.



Includes details on policy and regulatory issues, the structure and historical context of the energy sector, and gender mainstreaming.



Includes a geospatial analysis that highlights existing infrastructure and potential areas for off-grid solar market expansion.



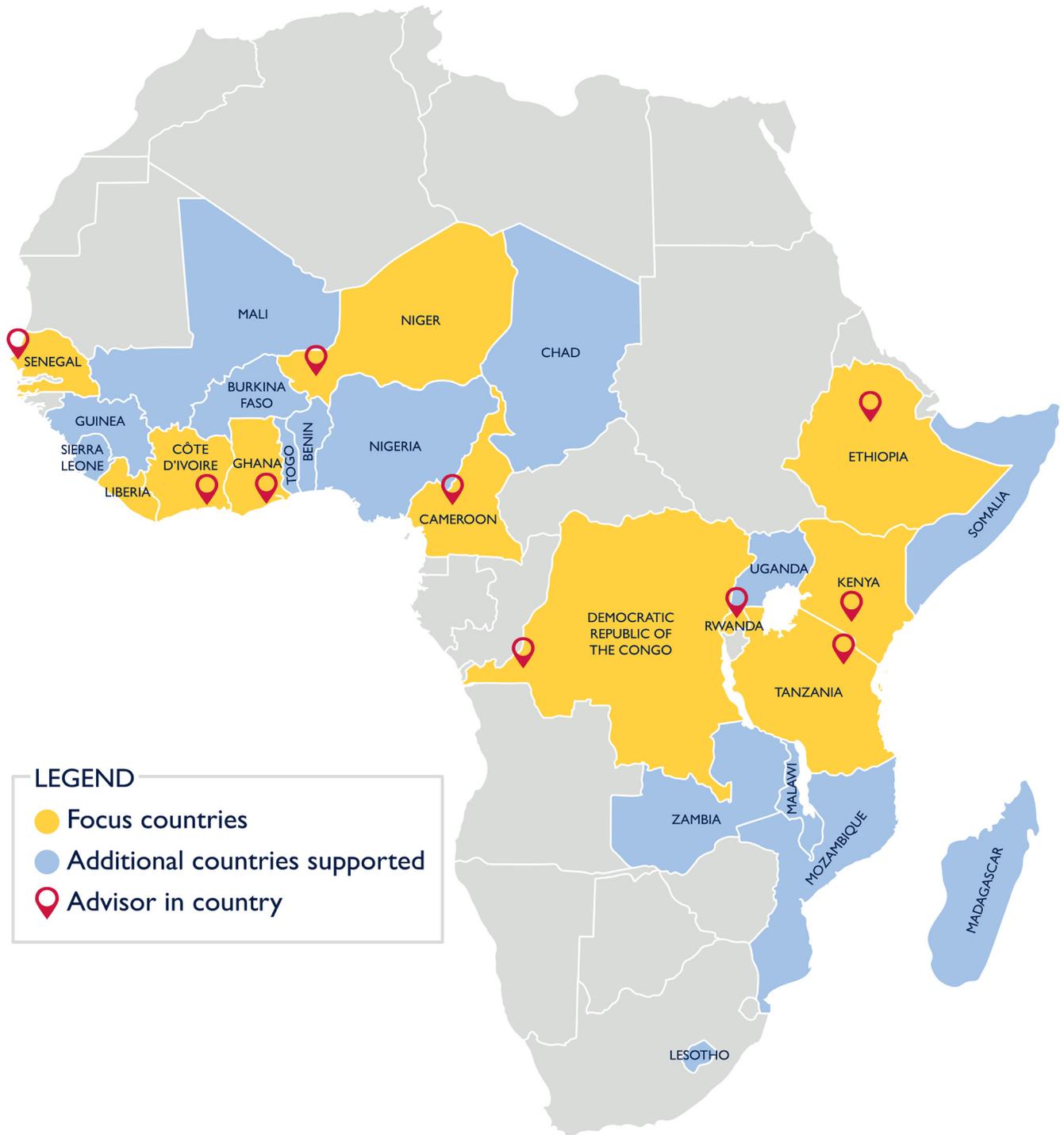
Supports planning and prioritization of activities across the Power Africa Off-grid Project's work streams of policy and regulations, market intelligence, business performance, access to finance, and cross-sectoral integration throughout sub-Saharan Africa.

The report provides a snapshot that can be used to determine market growth and dynamics that change over time. Insights include characteristics of Liberia's electricity sector, electrification targets, government regulations, donor-funded activities, and details on subsectors of the off-grid solar energy market. Additionally, this report includes expert knowledge from Power Africa lead advisors and information gathered from stakeholder interviews.

About Power Africa and the Power Africa Off-grid Project

Power Africa brings together technical experts with stakeholders from the public and private sectors to increase energy access rates in sub-Saharan Africa. The Power Africa Off-grid Project is a Power Africa project funded by the U.S. Agency for International Development (USAID). The goal of the Power Africa Off-grid Project is to provide support to private off-grid energy companies and make the markets in sub-Saharan Africa more attractive for investment and operations. The Power Africa Off-grid Project is implemented by RTI International, and headquartered in Pretoria, South Africa. RTI is an independent, nonprofit institute that provides research, development, and technical services to government and commercial clients worldwide.

FIGURE ES-I. THE PROJECT PROVIDES SUPPORT TO 26 COUNTRIES IN AFRICA



LEGEND

- Focus countries
- Additional countries supported
- 📍 Advisor in country

I EXECUTIVE SUMMARY

Liberia overview

Liberia is a West African country with a population of nearly five million. Poverty is widespread with 41 percent of the population living on less than \$ 1.90 per day. Table ES-I summarizes some of Liberia’s key socio-economic indicators.

TABLE 1. LIBERIA SOCIO-ECONOMIC INDICATORS

SOCIO-ECONOMIC INDICATORS	SUMMARY
Population	4,937,374 (2019, World Bank) (50.3 percent male residents, 49.7 percent female residents)
Population growth rate	2.4 percent (2019, World Bank)
Urban (Monrovia) and rural (Outside Monrovia) populations	28 percent urban 72 percent rural (2016, Master Plan) ¹
Population density	50 people per square kilometer (2018, World Bank)
Urban population growth	3.3 percent annually (2018, World Bank)
GDP (current U.S. dollars)	\$ 621.89 per capita (\$ 3.07 billion overall) (2019, World Bank)
GDP (2011 U.S. dollar purchase price parity [PPP])	\$ 906.71 per capita (\$ 4.29 billion overall) (2017, Penn World Tables)
GDP growth rate	-2.3 percent (2019, World Bank)
Poverty headcount (at \$1.90/day, 2011 PPP)	40.9 percent of population (2016, World Bank)

Liberia has one of the lowest rates of electrification in the world. Roughly 17 percent of the urban population and 2 percent of the rural population have access to electricity. Liberia experienced civil conflict from 1985-2003, which damaged 75 percent of the road and electrical infrastructure. Since 2003, Liberia has been working to rebuild its infrastructure.

In line with the Sustainable Development Goals (SDGs), Liberia is working to attain 70 percent electrification of the capital city and 35 percent of rural areas by 2030, but much remains to be done, particularly in rural regions.

¹ Rural and Renewable Energy Agency. Rural Energy Strategy and Master Plan for Liberia Until 2030. <https://gestoenergy.com/wp-content/uploads/2018/04/LIBERIA-RURAL-ENERGY-STRATEGY-AND-MASTER-PLAN.pdf>

Institutional landscape

Liberia's state-run energy sector is overseen by four key agencies: The Ministry of Mines and Energy (MME), the Liberia Electricity Corporation (LEC), the Rural and Renewable Energy Agency (RREA), and the Liberian Electricity Regulatory Commission (LERC). In addition, the West African Power Pool (WAPP) manages the cooperation of national electricity providers in West Africa.

- › MME oversees and develops policies governing the energy, hydrocarbon, and water sectors.
- › LEC is the state-run electricity utility.
- › LERC is an autonomous regulatory body that implements and oversees the regulation and licensing for generation, transmission, distribution, and trade of electricity.
- › The RREA is tasked with expanding access to electricity with renewable energy technologies by supporting the development of the commercial energy sector; facilitating project funding for energy projects; promoting renewable energy; and integrating energy into development planning across rural Liberia.
- › Through WAPP, Liberia trades electricity with Côte d'Ivoire, but it is also developing transmission infrastructure to facilitate trading with Sierra Leone and Guinea.

International donors have historically played a significant role in Liberia's energy sector and continue to be active. The World Bank, European Union (EU), African Development Bank (AfDB), USAID, GIZ, the Government of Sweden, and others are actively supporting the energy sector.

Outside of government and donor institutions, the Liberian Energy Access Practitioners (LEAP) Network is the first off-grid industry association, though it is volunteer-led and has limited capacity.

The education and training ecosystem is similarly nascent. While some programs exist at trade schools and universities in Liberia, the country lacks a sufficient pipeline of trained workers to support rapid expansion in the off-grid sector.

SHS sector overview

Pico-solar and solar home system (SHS) products are central to achieving universal electrification goals in Liberia. At its maximum extent, Liberia's national grid is only expected to reach 35 percent of the population by 2030. The SHS sector is still in an early stage in Liberia—Power Africa Off-grid Project technical advisors estimate that there are fewer than 20 companies active in the market. As of 2019, the only international company directly selling off-grid solar products in Liberia was Easy Solar.

The off-grid solar market in Liberia faces several barriers to growth along the value chain. Trade barriers increase the cost of importing products and quality control is not adequately enforced, resulting in unreliable products being sold and eroding trust in solar technology in general. Additionally, there is a shortage of technically capable workers that can readily enter the solar industry and companies lack the business management capacity needed to grow efficiently. Consumer awareness is low and there are few mechanisms in place (e.g. pay-as-you-go) to address the affordability of solar products.

Mini-grid overview

Mini-grids are an important solution for providing grid-like infrastructure to communities that are too remote to be connected to a central electricity grid. In Liberia, the Renewable Energy Strategy and Master Plan (RESMP) targets reaching 430,000 people with decentralized grids and mini-grids. Additionally, the government has identified 45 communities that are appropriate for mini-grid electrification. To date, most

mini-grid projects implemented in Liberia have been based on a cooperative or community model where the community owns and operates its own mini-grid.

The mini-grid sector also needs a well-developed enabling environment to attract private investment. The Government of Liberia recently adopted micro-utility regulations and is in the process of finalizing tariff regulations. This developing framework is expected to ensure cost-reflective tariffs and protections for mini-grid operators in the event of grid encroachment.

2 LIBERIA ENERGY SECTOR OVERVIEW

2.1 COUNTRY CONTEXT

2.1.1 PHYSICAL FRAMEWORK

Liberia is a West African country on the Atlantic Ocean, bordering Sierra Leone to the north-west, Guinea to the north, and Côte d'Ivoire to the east. Liberia is divided into 15 counties (see Figure 1). Liberia has one of the lowest rates of electrification in the world, with less than 12 percent of the population connected to the electricity grid operated by the LEC. This equates to around 17 percent of the urban population and 2 percent of the rural population, resulting in a total number of unelectrified households of around 815,000.² By 2030, Liberia aims to connect 70 percent of the capital city Monrovia and 35 percent of rural areas, in line with the Sustainable Energy for All (SEforALL) Initiative and the SDGs.³

FIGURE 1. POLITICAL MAP OF LIBERIA



Source: Power Africa

²Rural and Renewable Energy Agency. Rural Energy Strategy and Master Plan for Liberia Until 2030. <https://gestoenergy.com/wp-content/uploads/2018/04/LIBERIA-RURAL-ENERGY-STRATEGY-AND-MASTER-PLAN.pdf>

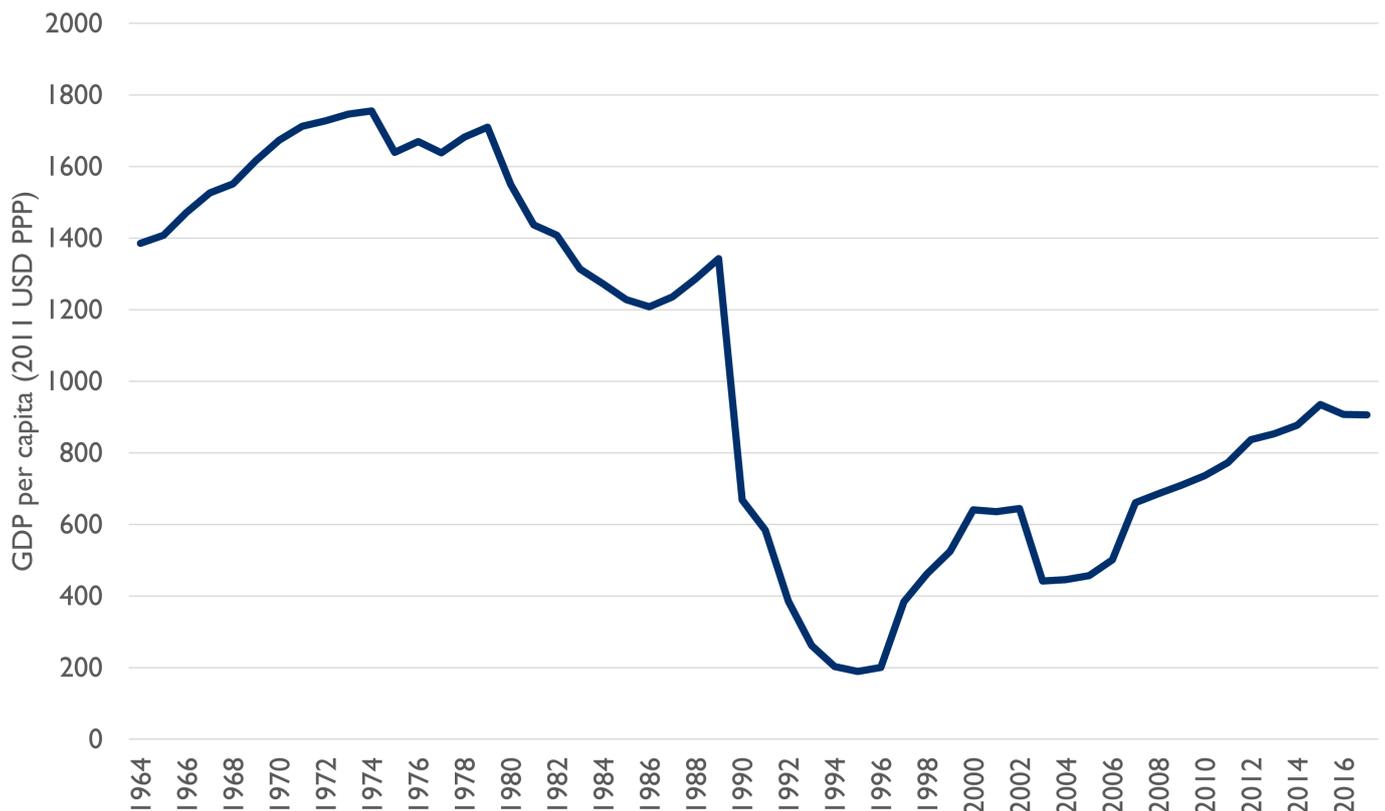
³Sandikie. 2015. National Renewable Energy Action Plans (NREAPs). www.se4all.ecreee.org/sites/default/files/national_renewable_energy_action_plans_nreap_-_liberia.pdf

2.1.2 SOCIO-ECONOMIC OVERVIEW

From 1955-1975, the gross domestic product (GDP) in Liberia grew 7 percent on average every year and neared middle-income status in 1980, making it one of the highest-income countries and an economic success story in Africa (see Figure 2).⁴ However, development was reversed by civil conflict, resulting in substantial destruction of critical infrastructure. In 1995, per capita GDP fell to its lowest level of \$ 189.⁵

In the 2005 elections, the True Whig Party lost power and economic growth began to accelerate, expanding the economy between 5 percent and 9 percent every year. The rapid economic growth was halted in 2014 by the outbreak of Ebola virus disease and a drop in global oil and natural gas prices. More recently, from 2017 to 2018, GDP grew by 1.2 percent, suggesting that Liberia’s economy is slowly recovering.

FIGURE 2. GDP PER CAPITA IN LIBERIA IN 2011 USD PPP, 1964-2016



Source: Penn World Tables 9.1, Data presented is real GDP using national accounts growth rates.

Vision 2030 is Liberia’s national plan to become a middle-income country by 2030, defined as a per capita Gross National Income (GNI) above \$ 1,005.^{6,7} In 2018, per capita GNI was \$ 610, contracting by 4.1 percent from the previous year. To reach middle-income status by 2030, GNI must increase 4 percent per year from 2018 to 2030.⁸ However, rising inflation is a serious barrier to reaching this goal. In 2018, consumer prices increased 23.5 percent.⁹

⁴ Republic of Liberia. 2015. Agenda for Transformation: Steps Toward Liberia Rising 2030. https://governancecommissionlr.org/doc_download/AfT%20document-%20April%2015,%202013.pdf?a4705305cd27e04fb1f66830e7e0ef9d=NzE%3D

⁵ Currency presented in 2011 USD PPP, as calculated by Penn World Tables.

⁶ GNI is a measure of income. GNI encompasses the income of all Liberians, regardless of where income is generated. GNI equals GDP plus the earnings of Liberians abroad. Note that GNI does not include income earned by foreigners in the country that are remitted back to their home countries.

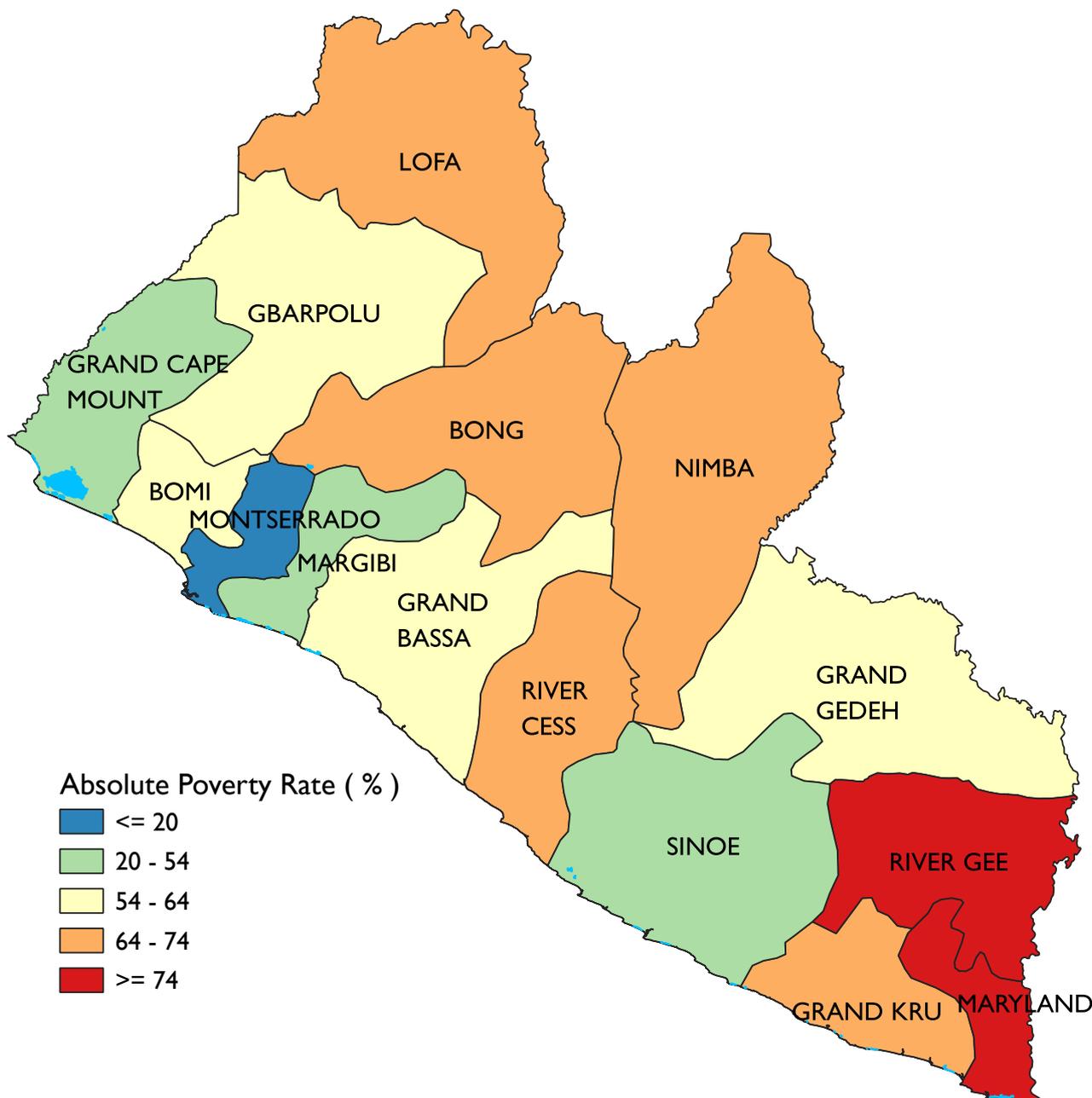
⁷ Republic of Liberia. Liberia National Vision 2030 - Summary Report. [https://governancecommissionlr.org/doc_download/VISION%202030%20summary%20for%20the%20conference%20\(25%20pgs\)%20for%20GC%20Website.pdf?a4705305cd27e04fb1f66830e7e0ef9d=NjQ%3D](https://governancecommissionlr.org/doc_download/VISION%202030%20summary%20for%20the%20conference%20(25%20pgs)%20for%20GC%20Website.pdf?a4705305cd27e04fb1f66830e7e0ef9d=NjQ%3D)

⁸ Republic of Liberia. 2018. Pro Poor Agenda for Prosperity and Development. <http://liberianconsulatega.com/wp-content/uploads/2017/07/PAPD-Pro-Poor-Agenda-for-Prosperity-and-Development.pdf>

⁹ Inflation, Consumer Prices (Annual %).

Poverty is widespread throughout Liberia (see Figure 3). In 2016, 41 percent of the population had an income of less than \$ 1.90 a day.¹⁰ The majority of employment in Liberia is informal. In 2016, 80 percent of the economically active population worked in jobs not regulated or protected by the state.¹¹ In 2015, the Decent Work Act, which applies to both the formal and informal sectors, raised the minimum wage from \$ 2 to \$ 3.50 for unskilled workers and \$ 5.50 for skilled workers.¹²

FIGURE 3. ABSOLUTE POVERTY IN LIBERIA



Source: Power Africa GIS; Republic of Liberia, “Pro Poor Agenda for Prosperity and Development.”

Agriculture is a key source of income for Liberians. In 2016, 35 percent of the population relied on agriculture to sustain their livelihoods.¹³ From 2012 to 2017 the agriculture and fisheries sector grew from 24 percent to 27 percent of real GDP.¹⁴ Further growth in the agriculture sector is a key part of Liberia’s future vision. A separate report from Power Africa reviews productive use of energy applications in Liberia.

¹⁰ Liberia - Poverty Headcount Ratio at \$ 1.90 a Day (2011 PPP) (% of Population).

¹¹ Republic of Liberia. 2018. Pro Poor Agenda for Prosperity and Development. <http://liberianconsulatega.com/wp-content/uploads/2017/07/PAPD-Pro-Poor-Agenda-for-Prosperity-and-Development.pdf>

¹² Daily Observer. 2018. MOL to Promote Decent Work in Liberia’s Informal Economy. www.liberianobserver.com/news/mol-to-promote-decent-work-in-liberias-informal-economy/

¹³ Republic of Liberia. 2018. Pro Poor Agenda for Prosperity and Development.

¹⁴ Ibid.

TABLE 2 SUMMARIZES KEY SOCIO-ECONOMIC INDICATORS IN LIBERIA.

TABLE 2. LIBERIA SOCIO-ECONOMIC INDICATORS	
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GDP (2011 USD PPP)	\$ 906.71 per capita (\$ 4.29 billion overall) (2017, Penn World Tables)
GDP growth rate	-2.3 percent (2019, World Bank)
Poverty headcount (at \$ 1.90/day, 2011 PPP)	40.9 percent of the population (2016, World Bank)
Life expectancy at birth	62.5 years (2016) (World Bank)
Languages spoken	English (official); Over 30 indigenous languages (CIA World Factbook)
Main exports	Rubber, diamonds, timber, iron, coffee, and cocoa (CIA World Factbook)

2.1.3 POLITICAL LANDSCAPE

Liberia was founded by former slaves from the United States and became Africa's oldest republic in 1847. In 1989, two decades of civil war began, ending in 2003 with the exile of Charles Taylor. Over 250,000 lives were lost, and two-thirds of the country's road and electricity infrastructure was destroyed.¹⁶ In 2005, Ellen Johnson Sirleaf was elected President of Liberia. President Sirleaf was also the first African female head of State and a 2011 Nobel Peace Prize Laureate.¹⁷ She served two terms, ending in January of 2018, when President George Weah was sworn in for a six-year term, marking the first peaceful democratic change of government in 73 years.

¹⁵ Rural and Renewable Energy Agency. Rural Energy Strategy and Master Plan for Liberia Until 2030. <https://gestoenergy.com/wp-content/uploads/2018/04/LIBERIA-RURAL-ENERGY-STRATEGY-AND-MASTER-PLAN.pdf>

¹⁶ Republic of Liberia. 2015. Agenda for Transformation: Steps Toward Liberia Rising 2030. https://governancecommissionlr.org/doc_download/AfT%20document-%20April%2015,%202013.pdf?a4705305cd27e04fb1f66830e7e0ef9d=NzE%3D

¹⁷ The Nobel Peace Prize. 2011. www.nobelprize.org/prizes/peace/2011/press-release/

Liberia's political structure is modeled after the United States, with three equal branches of government and the President serving as both the head of state and head of government. Liberia has both a Senate and House of Representatives, elected by popular vote for nine- and six-year terms, respectively. Senatorial mid-term elections are expected in 2020, with half of the 30 seats contested.¹⁸ Over twenty-five political parties are registered with the National Elections Commission of Liberia.¹⁹

Corruption is a challenge in Liberia, including patronage, nepotism, and cronyism. Transparency International gave Liberia a score of 32 out of 100 in the 2018 Corruption Perception Index (ranked 120 out of 180 countries).²⁰ Also in 2018, the Global Corruption Barometer reported that nearly half of Liberians feel that corruption has increased in the past year.²¹ The World Bank's Doing Business Index²² also sheds light on the challenges facing the private sector: In 2019, Liberia ranked 39th out of 48 countries in sub-Saharan Africa (175th out of 190 globally), with noted challenges in the areas that may affect the off-grid solar sector, including dealing with construction permits, protecting minority investors, trading across borders, and enforcing contracts.

¹⁸ World Bank. Liberia Overview. www.worldbank.org/en/country/liberia/overview

¹⁹ National Elections Commission - Republic of Liberia. www.necliberia.org

²⁰ For context, the average score in the Corruption Perception Index for sub-Saharan Africa was 32 out of 100.

²¹ Transparency International. Liberia: Overview of Corruption and Anti-Corruption. <https://knowledgehub.transparency.org/helpdesk/liberia-overview-of-corruption-and-anti-corruption>

²² World Bank. Doing Business. www.doingbusiness.org/en/data/exploreconomies/liberia#



3 ENERGY SECTOR

This section provides an overview of the Liberian energy sector, including key institutional stakeholders; historical generation and consumption; infrastructure; and an overview of policies and programs that affect the off-grid energy sector.

3.1 KEY PLAYERS

Government institutions, donor organizations, industry associations, and training institutions all play a key role in the present and future of the energy sector in Liberia. This section provides an overview of key players.

3.1.1 GOVERNMENT INSTITUTIONS

Four key government institutions oversee Liberia's state-run energy sector: the Ministry of Mines and Energy (MME), the Liberia Electricity Corporation (LEC), the Rural and Renewable Energy Agency (RREA), and the Liberia Electricity Regulatory Commission (LERC). In addition, the West African Power Pool (WAPP) manages the cooperation of national electricity providers in West Africa.

The MME²³ oversees and develops policies governing the energy, hydrocarbon, and water sectors.²⁴ Within the MME, the Department of Energy (DOE) has two arms—the Bureau of Hydrocarbons and the Bureau of Alternative Energy, which includes electricity.

The LEC is the state-run electricity utility. Support for the LEC is provided by the Millennium Challenge Corporation (MCC), the European Commission, the World Bank, and the African Development Bank (AfDB). Established in 1973, the LEC serves roughly 50,000 customers, of which 49,500 are residential and 500 are commercial.²⁵ The LEC manages and maintains the Mount Coffee Hydroelectric Plant and the Bushrod Island plant, which has several heavy fuel oil (HFO) generation units.²⁶

Established in July of 2015, the RREA is tasked with expanding access to electricity with renewable energy technologies by supporting the development of the commercial energy sector; facilitating project funding for energy projects; promoting renewable energy; and integrating energy into development planning across rural Liberia.²⁷ Notably, the RREA's mandate is not to manage any rural electrification systems, but to act as a facilitator to improve the enabling environment for developers and companies to provide a range of energy services in rural areas of Liberia. The RREA reports directly to the President and currently has about 20 staff, including ten with a technical focus that are paid for by USAID, the World Bank, and the Liberian Government.

RREA's flagship initiative has been the Lighting Lives in Liberia (LLL) program, which has been importing solar products for distribution to rural communities through private Liberian distributors. The RREA also plans to establish a rural energy fund (REFUND) to provide low-interest loans, grants, and subsidies aimed to make electricity more affordable for low-income consumers.²⁸

²³ The MME was known as the Ministry of Lands, Mines and Energy (MLME) until 2017.

²⁴ Republic of Liberia. Overview of the Ministry of Mines and Energy. <https://mme.gov.lr/about/>

²⁵ USAID. Engendering Utilities Partners Profile: LEC. www.usaid.gov/energy/engendering-utilities/partners/lec-liberia

²⁶ Sandikie. 2015. National Renewable Energy Action Plans (NREAPs). www.se4all.ecreee.org/sites/default/files/national_renewable_energy_action_plans_nreap_-_liberia.pdf

²⁷ Ibid.

²⁸ Ibid.

RREA has also started to identify informal diesel mini-grid operators in rural areas. This information may help donors target technical assistance, capacity building, and funding where there is preexisting, proven demand. RREA is also supporting the development of the Lofa Hydroelectric Project, which will be managed by LEC or an independent power producer (IPP).

While RREA has been an active supporter of the pico-solar sector for several years, it has also been a market actor—in addition to importing systems tax-free, RREA has paid transport and marketing costs for off-grid solar (OGS) companies. This approach has facilitated OGS companies reaching rural areas, but it has also distorted the market and made companies dependent on RREA. Most recently, RREA under its new Liberia Renewable Energy Access Project (LIRENAP), has been addressing this by supporting companies to carry out their own importation; obtaining their own import tax waivers; and developing their own distribution and marketing.

LERC is an autonomous regulatory body that implements and oversees regulation and licensing for generation, transmission, distribution, and trade of electricity. They also regulate tariff structures and are responsible for standards enforcement in the electricity sector.²⁹ LERC's overall aim is to protect Government, consumer, and investor interests by regulating the electricity sector. The 2015 Electricity Law in Liberia both created the LERC and stipulated that all regulatory activities by other agencies be transferred or coordinated with the LERC.³⁰ The key activities of the LERC include:

- › Providing licenses
- › Enacting the 2015 Electricity Law
- › Evaluating and approving electricity tariffs
- › Monitoring and enforcing regulations and standards³¹

The EU provides long-term technical assistance to LERC to support development of regulatory frameworks as well as guidelines and templates for various electricity market segments, including off-grid standalone and mini-grid systems. LERC has recently published several electricity regulations, including the micro-utility regulation, and has developed drafts of the electricity tariff regulation and the tariff methodology, which they are planning to finalize before the end of 2020.

WAPP is a cooperation of national electricity companies in the Economic Community of West African States (ECOWAS), with the goal of providing reliable energy to West Africans by creating a regional electricity market. Through WAPP, Liberia currently trades electricity with Côte d'Ivoire. In 2018, the Liberian House of Representatives ratified the Additional Financing Agreement for Côte d'Ivoire, Liberia, Sierra Leone, and Guinea (CLSG) Interconnection Project which will support the construction of 1,249 km of transmission line to connect the four countries.³² Figure 4 shows the current and planned WAPP grid in West Africa.

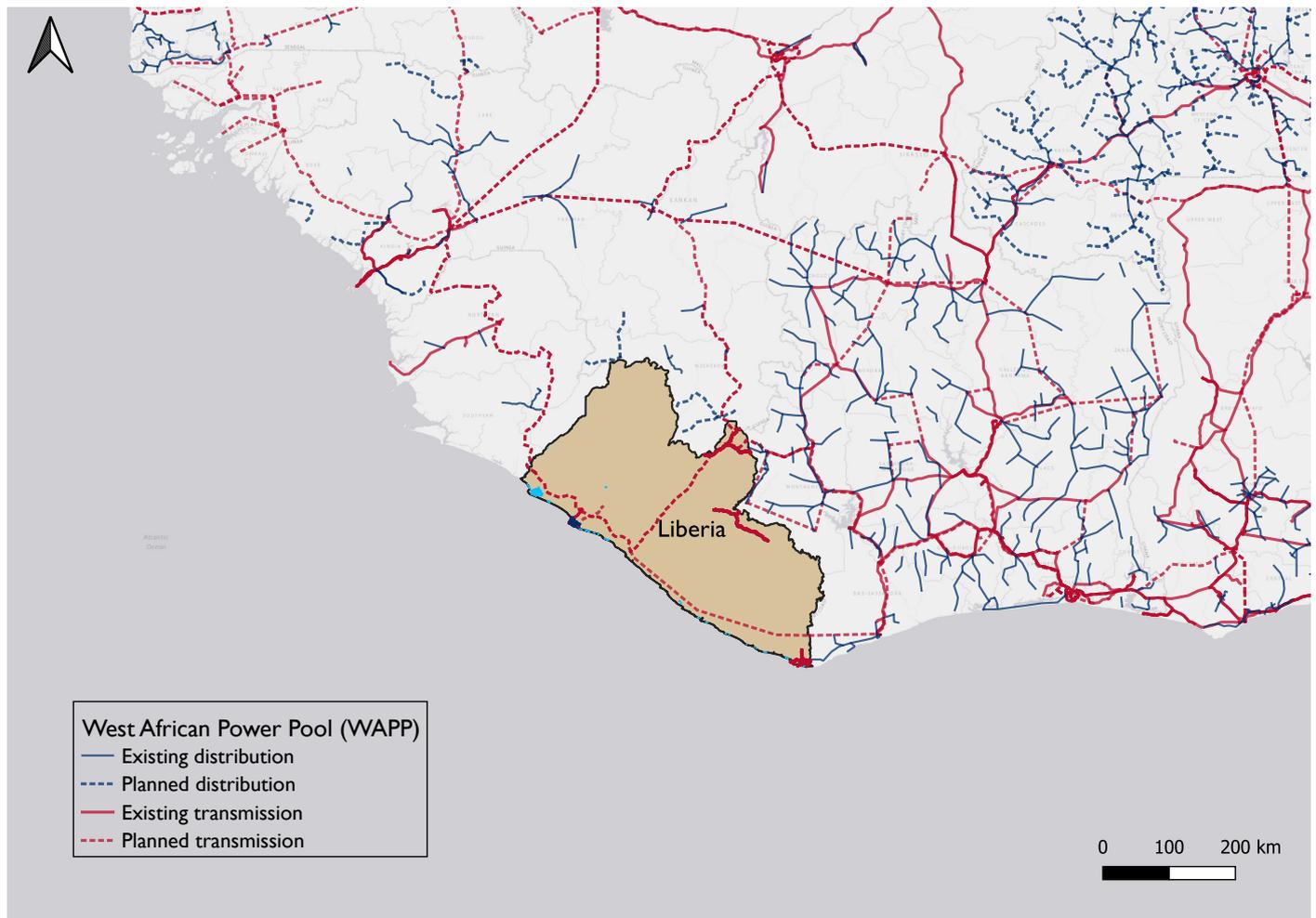
²⁹ Liberia Electricity Regulatory Commission. <https://lerc.gov.lr/>

³⁰ Republic of Liberia. 2105 Electricity Law of Liberia. https://lerc.gov.lr/pg_img/2015%20Electricity%20Law%20of%20Liberia-1.pdf

³¹ Rural and Renewable Energy Agency. Rural Energy Strategy and Master Plan for Liberia Until 2030. <https://gestoenergy.com/wp-content/uploads/2018/04/LIBERIA-RURAL-ENERGY-STRATEGY-AND-MASTER-PLAN.pdf>

³² West African Power Pool. www.ecowapp.org

FIGURE 4. CONNECTIONS TO WAPP



Source: West African Power Pool (WAPP) - 2017 ECOWAS GIS database from ECOWREX (via energydata.info)

3.1.2 INTERNATIONAL DONORS

International donors have historically played a significant role in Liberia’s energy sector and continue to be active. Table 3 highlights recent activities by donor agencies related to the energy sector but does not encompass all donor activities in Liberia.

TABLE 3. DONORS OPERATING IN LIBERIA

DONOR AGENCY OR ORGANIZATION	OVERVIEW OF ACTIVITIES
World Bank	The World Bank supported the establishment of RREA with a \$ 179 million investment and has been providing funding for the LLL program and the follow on LIRENAP.
European Union	The EU has supported the development and implementation of RREA’s Master Plan, including piloting solar projects at government facilities in rural areas. The EU is also supporting the establishment of LERC and provided funding for two off-grid projects for pico-solar and mini-grids (implemented by Mercy Corps and Plan International respectively). The EU’s Rural Electrification program in Liberia will support the electrification of up to three off-grid sites in Liberia.

TABLE 3. DONORS OPERATING IN LIBERIA, CONTINUED

DONOR AGENCY OR ORGANIZATION	OVERVIEW OF ACTIVITIES
African Development Bank	AfDB is developing a \$ 25 million SREP-funded project in the south of Liberia, with a focus on biomass technologies. Implementation began in late 2018. AfDB also has access to a range of potential funding mechanisms for local distributed energy service companies (DESCOs) or IPPs with sufficiently well-developed track records and business plans, with rates ranging from 5 to 15 percent, depending on the level of risk.
USAID	<p>Power Africa’s Liberia Beyond the Grid (BTG) program, coordinated by USAID and delivered by National Rural Electric Cooperative Association (NRECA), supported RREA by funding and supporting several off-grid pilot projects and providing capacity-building to develop mini-grid regulations and standards that form a part of RREA’s five year investment strategy. The BTG program concluded in 2019.</p> <p>In late 2019, the Power Africa Off-grid Project began operating in Liberia. The project provides tailored business support to off-grid solar companies; support for policy and regulatory development; and support for increased access to finance.</p> <p>The Liberia Agribusiness Development Activity (LADA) program has been supporting the commercial development of agricultural distributors, processors, and retailers with a focus on rice, cassava, vegetables, cocoa, and aquaculture. Support programs could coordinate with USAID by providing pilot funds to explore the potential for RE-powered agricultural processing equipment.</p>
GIZ	GIZ has been providing capacity building and technical assistance to RREA, as well as support to improved cookstove (ICS) companies in Liberia. GIZ also funds Renewables Liberia, a website that tracks the off-grid solar sector in Liberia. ³³
Government of Sweden	Through the Swedish Embassy in Liberia, Sweden has a \$ 10 million grant fund to support off-grid solar companies. The fund is currently being implemented by the AECF REACT SHS program. ³⁴ SIDA is also funding the Beyond the Grid Fund for Africa (BGFA) program in Liberia, with the pre-qualification stage launched in September 2020.

3.1.3 INDUSTRY ASSOCIATIONS

Liberian Energy Access Practitioner (LEAP) Network. LEAP Network is the first industry association focused on bringing together clean energy companies to promote increased energy access for low-income Liberians.³⁵ The establishment of the association was supported by Mercy Corps under the Light Up Liberia program. Although the network is still functioning and meets regularly, its secretariat consists of volunteers from off-grid companies with limited capacity and resources to support association members.

³³ Renewables Liberia. www.renewables-liberia.info

³⁴ ECREEE. 2019. Off-Grid Solar Market Assessment & Private Sector Support Facility Design - Liberia Report. www.ecreee.org/sites/default/files/ecreee_rogep_liberia_final_report_july_2019.pdf

³⁵ Renewables Liberia. Liberian Energy Access Practitioner Network. www.renewables-liberia.info/index.php/leap-network/about

3.1.4 TRAINING INSTITUTIONS, INCUBATORS, AND ACCELERATORS

Stella Maris Polytechnic. A post-secondary, private college in Monrovia that offers renewable energy courses covering solar and hydropower as part of its electrical engineering curriculum.

William V.S. Tubman University. University in Maryland County that offers a Bachelor of Science in Renewable Energy Engineering within the College of Engineering and Technology.

University of Liberia. University that offers coursework electric power systems in the Department of Electrical Engineering within the College of Engineering. The University of Liberia also operates the David A. Straz-Sinje Technical and Vocational College, which offers Associate Degrees in Electrical Engineering.

3.2 ELECTRICITY GENERATION AND CONSUMPTION

The LEC is the government utility responsible for the generation, transmission, and distribution of electricity in Liberia. The LEC has 131 megawatts (MW) of installed capacity from hydropower (88 MW), heavy fuel oil (38 MW), and light fuel oil (5 MW).³⁶ LEC's electricity tariff rate is one of the highest in Africa at \$ 0.35 per kilowatt hour (kWh), which is beyond the ability to pay for most low-income households.³⁷ The high price is in part due to LEC's continued reliance on expensive imported diesel fuel for generation, particularly in the dry season when hydro resources are low. In the future, LEC plans to source additional capacity during the dry season from Côte d'Ivoire over the regional grid CLSG line.³⁸

In addition to high prices, the electricity grid still suffers from significant technical and non-technical losses. Less than 23 MW of Liberia's installed generation operates daily due to limitations in the transmission and distribution infrastructure as well as an inadequate water supply for hydro plants in the dry season. The unreliability of the grid forces large facilities such as hotels, restaurants, and office buildings to run their own generators on-site. Additionally, the LEC estimates that 60 percent of power generated is stolen via illegal connections to the grid, costing an annual \$ 35 million.³⁹

Because grid electricity has historically been expensive and unreliable, grid electricity access is limited, and off-grid electricity makes up a significant portion of total electricity generation in Liberia. In 2015, less than half of Liberia's total electricity generation capacity came from the LEC electric grid.⁴⁰ Table 4 presents the breakdown of self-generation capacity.

The private sector also struggles to connect to reliable LEC power. As mentioned previously, Liberia ranked 175th out of 190 countries on the 2019 World Bank Doing Business Index, which captures the ease of conducting business considering the country's legal and infrastructural context. High costs and long waiting time to become connected to the grid were the leading reasons for Liberia's low rank.⁴¹

³⁶ Energypedia. Liberia Energy Situation. https://energypedia.info/wiki/Liberia_Energy_Situation

³⁷ USAID. Liberia Power Africa Fact Sheet. www.usaid.gov/powerafrica/liberia

³⁸ Liberia Electricity Corporation. <http://lecliberia.com/?p=2598>

³⁹ BBC News. 2018. Liberia Electricity Crisis: 'About 60% of Power Stolen'. www.bbc.com/news/world-africa-46452326#

⁴⁰ Sandikie. 2015. National Renewable Energy Action Plans (NREAPs). www.se4all.ecreee.org/sites/default/files/national_renewable_energy_action_plans_nreap_-_liberia.pdf

⁴¹ Republic of Liberia. 2018. Pro Poor Agenda for Prosperity and Development. <http://liberianconsulatega.com/wp-content/uploads/2017/07/PAPD-Pro-Poor-Agenda-for-Prosperity-and-Development.pdf>

TABLE 4. SELF GENERATION CAPACITY BY TYPE, 2015⁴²

TYPE	CAPACITY (MW)	PERCENT
Small scale industries, commercial administrative, and government	54.9	59.8
Iron ore mining concessions	13.71	14.9
Rubber concessions	11.75	12.8
Small and medium scale manufacturing	3.23	3.5
Petroleum companies	1.95	2.1
Small scale agriculture	1.96	2.1
Oil palm concessions	1.63	1.8
IPPs & others	1.59	1.7
Forestry	0.79	0.9
Gold mines	0.29	0.3
Total	91.78	100

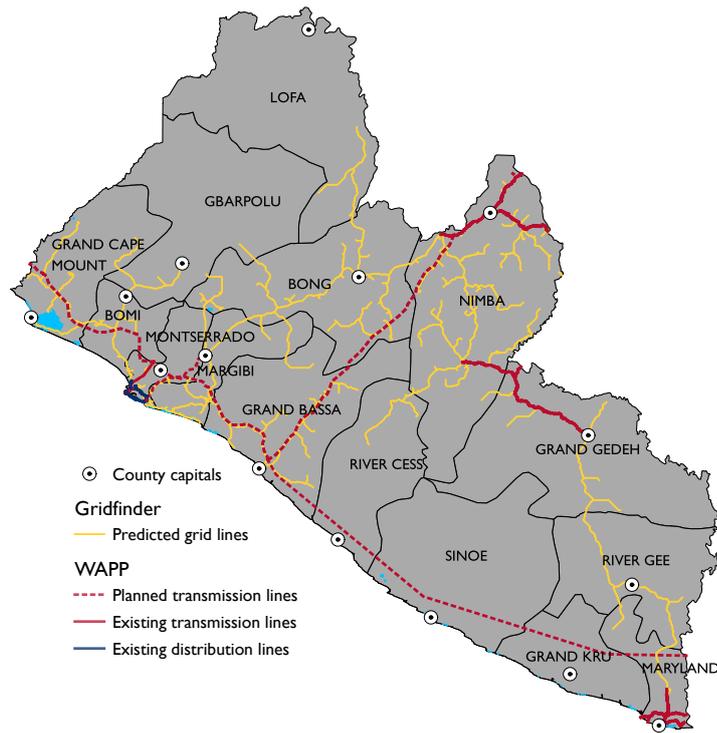
The current LEC grid reaches limited locales in Liberia (see Figure 5). Within Monrovia (Figure 6), grid infrastructure is more widespread, though most Liberians are still unconnected. In 2014, only 4.5 percent of Liberians used LEC power.⁴³ As of 2020, electricity access overall is estimated to be 12 percent (16 percent in urban communities; 3 percent in rural communities).⁴⁴

⁴² Sandikie. 2015. National Renewable Energy Action Plans (NREAPs). www.se4all.ecreee.org/sites/default/files/national_renewable_energy_action_plans_nreap_-_liberia.pdf

⁴³ Energypedia. Liberia Energy Situation. https://energypedia.info/wiki/Liberia_Energy_Situation

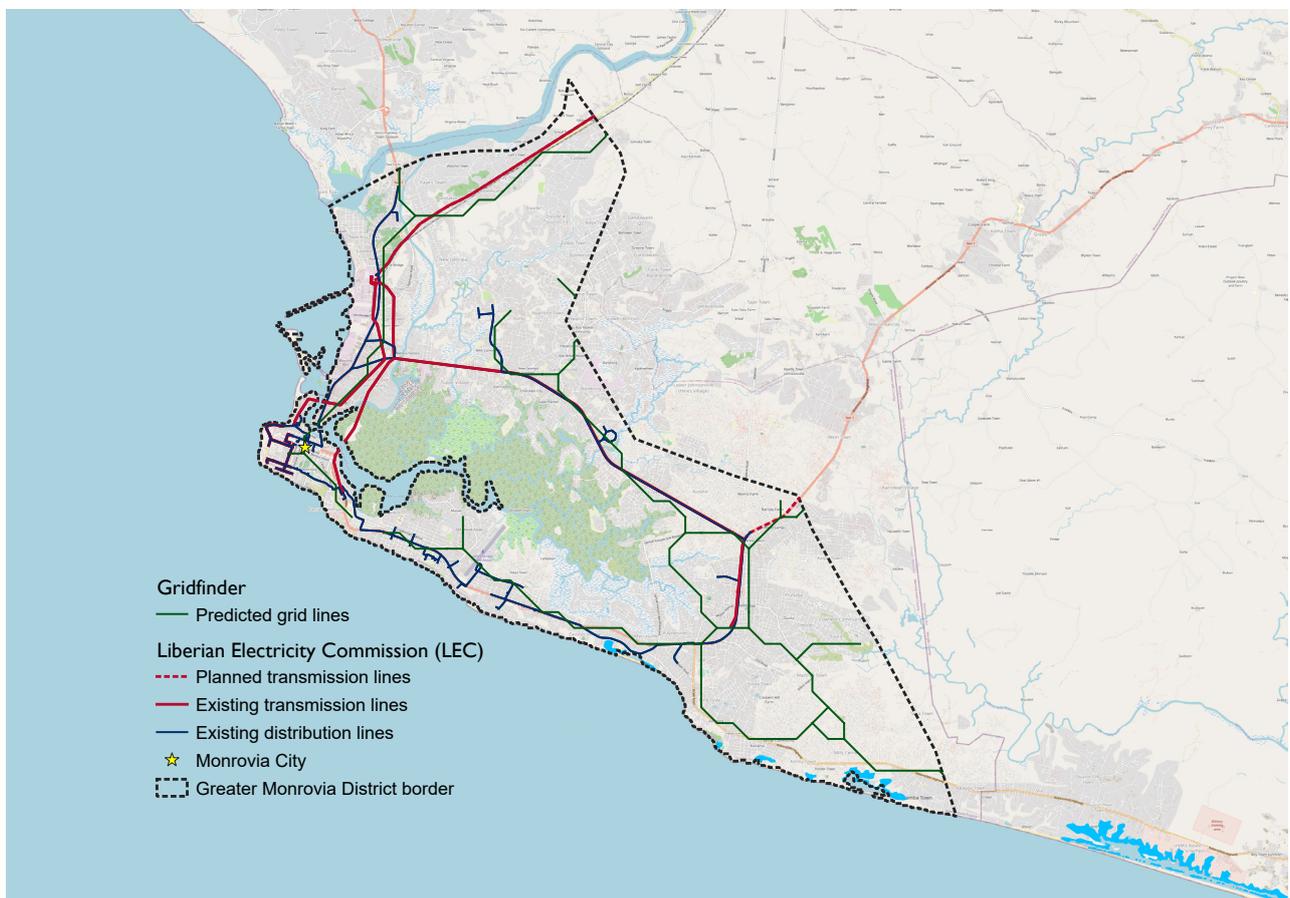
⁴⁴ USAID. Liberia Power Africa Fact Sheet. www.usaid.gov/powerafrica/liberia

FIGURE 5. ELECTRICAL GRID IN LIBERIA



Source: West African Power Pool (WAPP) - 2017 ECOWAS GIS database from ECOWREX (via energydata.info); Gridfinder - Predicted grid lines (2020); OpenStreetMap - Liberia Populated Places (2020) (via humdata.org; created County capitals)

FIGURE 6. ELECTRICAL GRID IN MONROVIA



Source: Liberia Electricity Commission existing grid (2012) (via energydata.info); OpenStreetMap - Liberia Populated Places (2020) (via humdata.org); Gridfinder (2020)

Biomass dominates household energy consumption (see Table 5). In 2010, 84 percent of total household energy consumption came from firewood, followed by charcoal.⁴⁵

TABLE 5. PRIMARY ENERGY CONSUMPTION BY FUEL TYPE, 2010⁴⁶

FUEL TYPE	GWH	PERCENT
Firewood	11,613	83.9
Charcoal	1,316	8.5
Petroleum	727	5.2
Fossil fuel	150	1.1
Other (Hydro)	40	0.3

Beyond biomass, some Liberians have access to off-grid electricity. Around 5 percent of households in Liberia use a community generator, 4.4 percent have their own generator, 3.9 percent use vehicle batteries, and 0.8 percent use other sources of electricity.⁴⁷

The cost of off-grid electricity varies widely (see Table 6). Some rural households are starting to purchase pico-solar and SHS, particularly since the start of the RREA's LLL project, although awareness and uptake in rural areas remains low. Prices range from \$ 4-5 for small lanterns, to more than \$ 100 for an SHS which can light several rooms and power appliances including phones, radios, and small televisions.

TABLE 6. ESTIMATED COST OF OFF-GRID ELECTRICITY BY SOURCE⁴⁸

SOURCE	ESTIMATED COST (USD/kWh)
Dry-cell batteries	\$ 74.01
Car batteries	\$ 8.43
Candles (for lighting)	\$ 8.27
Generator (diesel fuel)	\$ 3.96
Kerosene (for lighting)	\$ 1.53

3.2.1 WILLINGNESS TO PAY

There is limited publicly available information on the willingness to pay for energy in Liberia. NRECA International estimated that half of the Liberian population can afford to pay \$ 5.50 per month, 20 percent can pay \$ 10 per month, and 10 percent can afford to pay \$ 13 per month.⁴⁹ This finding emphasizes the importance of pay-as-you-go (PAYGO) schemes in making solar products accessible to most households.

Two other studies are worth noting. First, a World Bank survey found that respondents outside of Monrovia spend 10 percent of their expenditures on energy for light or cooking.⁵⁰ In 2016, the Lighting Lives in Liberia

⁴⁵ Sandikie. 2015. National Renewable Energy Action Plans (NREAPs). www.se4all.ecreee.org/sites/default/files/national_renewable_energy_action_plans_nreap_-_liberia.pdf

⁴⁶ Ibid.

⁴⁷ The World Factbook - Central Intelligence Agency. Liberia. www.cia.gov/the-world-factbook/countries/liberia/

⁴⁸ World Bank. 2011. Options for the Development of Liberia's Energy Sector. <https://openknowledge.worldbank.org/handle/10986/12607>

⁴⁹ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Gird-Solar-Liberia_TBI_November-2018.pdf

⁵⁰ Ibid.

Consumer and Retail Survey found that roughly 30 percent of men and women in Liberia found solar products affordable.⁵¹

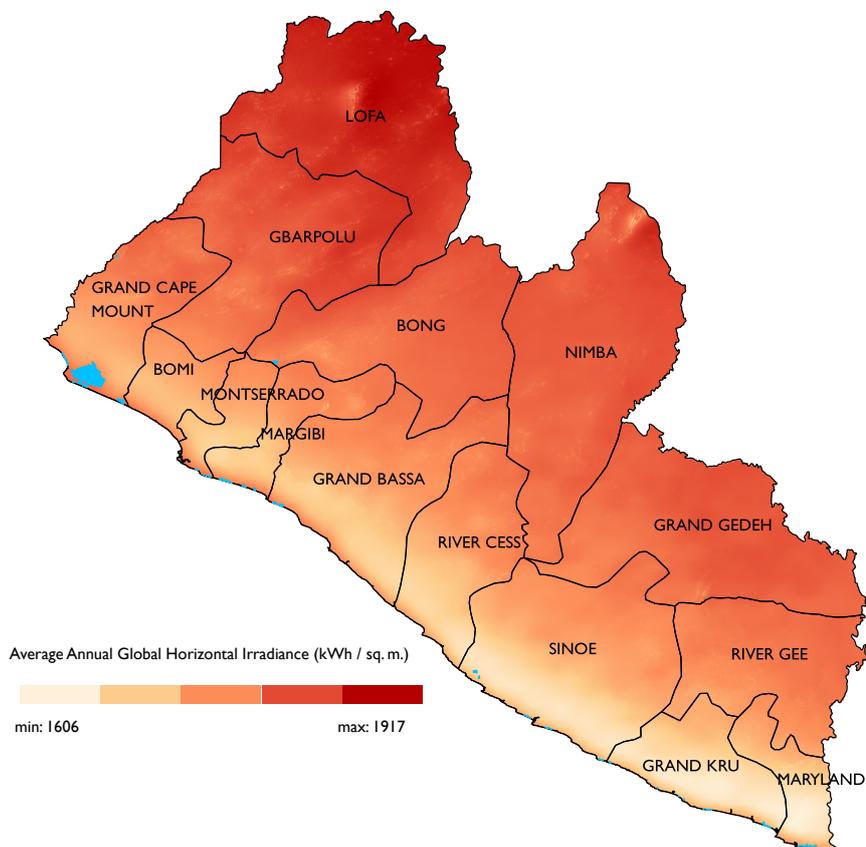
3.2.2 IN-COUNTRY ENERGY POTENTIAL

Liberia’s in-country energy potential comes primarily from hydropower, solar, and biomass.

Hydroelectric Power. Hydropower is a key source of potential energy for Liberia, though capacity varies substantially between the rainy and dry seasons. Total hydropower potential is 2,300 MW, with 88 MW currently installed. After being destroyed during the years of civil conflict, the Mount Coffee and Yandahun plants have since been reconstructed. While several other potential hydro sites with over 5 MW generation potential each have been identified, none have been fully exploited apart from Mount Coffee.

Solar. Solar energy is one of the most promising sources of energy in Liberia. Solar radiation ranges from 4 kWh/m² per day during the rainy season to 6 kWh/m² per day during the dry season, totaling 1,712 kWh/m² per year on average.

FIGURE 7. GLOBAL HORIZONTAL IRRADIANCE (GHI) IN LIBERIA



Source: Global Solar Atlas - Liberia GIS data (2019) (via globalsolaratlas.info)

Biomass. As one of the most forested countries in West Africa, biomass potential is high.⁵² In addition to the use of the forest itself for charcoal and firewood, there is potential to transform large amounts of waste from logging and rubber plants into additional biomass energy. An estimated 20 million m³ of waste could be available to produce charcoal from logging operations. Furthermore, 58,000 hectares of land are covered by large scale rubber plantations, generating approximately 81 dry tons of wood waste per active rubber plantation per year. As an example, the Booker Washington Institute (BWI), a vocational school in Kakata,

⁵¹ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Gird-Solar-Liberia_TBI_November-2018.pdf

⁵² USGS. Land Use, Land Cover, and Trends in Liberia. <https://eros.usgs.gov/westafrica/country/republic-liberia>

uses compact biomass generators from All Power Labs and locally sourced rubber plantation waste to power the school’s campus. Additionally, BWI is planning to eventually operate a mini-grid to serve the surrounding community.⁵³

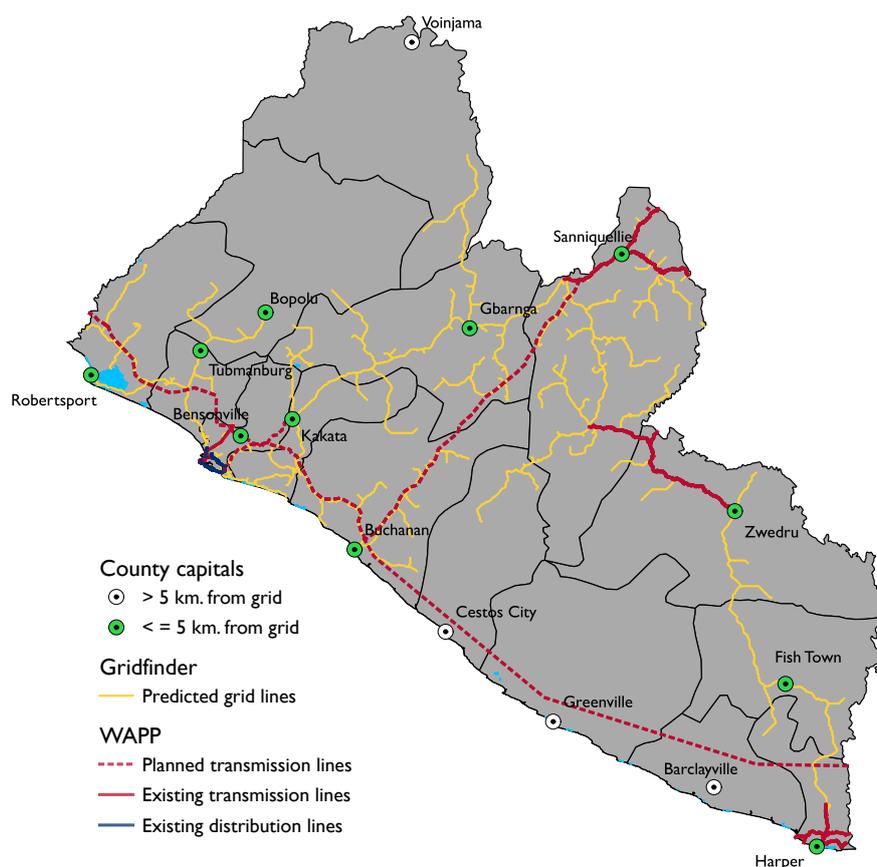
Fossil Fuels. All fossil fuels consumed in Liberia are currently imported and few oil companies remain in the Liberian market for discovery due to the expense and lack of past success.⁵⁴ Diesel and kerosene are the two most important fossil fuels for the Liberian energy sector.

3.3 ELECTRICITY INFRASTRUCTURE

Population centers (particularly county capitals) and critical services such as health and educational facilities are high-priority targets for Liberia’s electrification efforts. Figures 8, 9, and 10 show the location of county capitals, health facilities, and schools relative to the transmission and distribution grid. Each map shows existing and planned transmission lines from the WAPP data as well as predicted distribution infrastructure.

Most county capitals (11 out of 15), 73 percent of education facilities, and 84 percent of health facilities are within five kilometers of grid infrastructure, suggesting that grid electrification may be the most attractive option for extending access. However, more detailed data is currently not available to clarify true electrification rates on the ground. Additionally, the electricity grid in Liberia is unreliable and in poor repair, often making off-grid solutions more attractive, even near grid infrastructure.

FIGURE 8. LIBERIA COUNTY CAPITAL ELECTRIFICATION

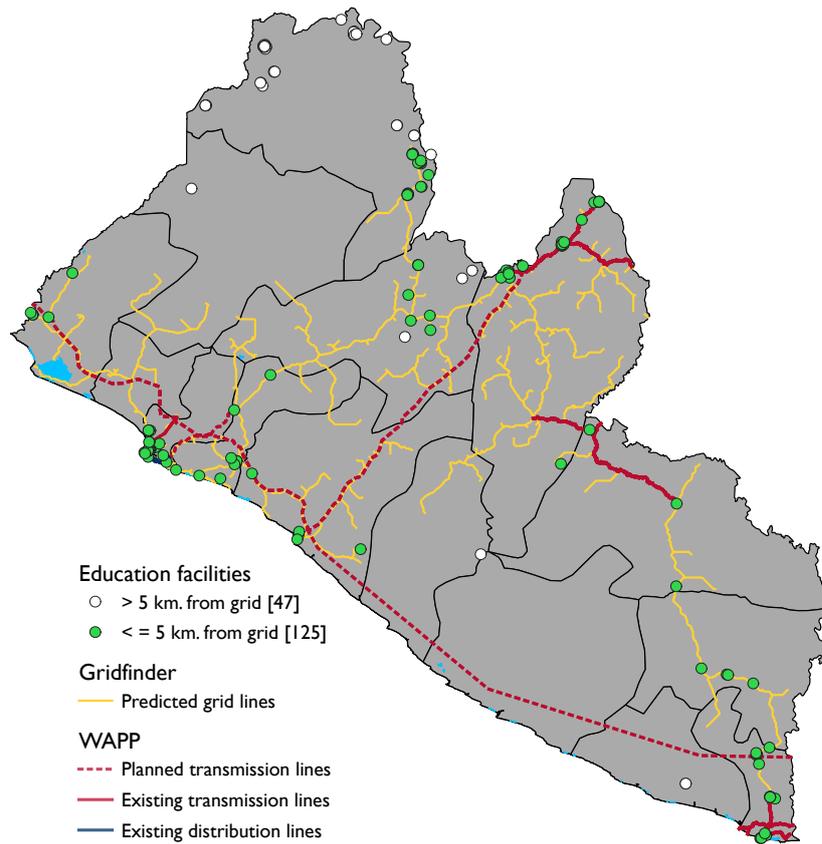


Source: West African Power Pool (WAPP) - 2017 ECOWAS GIS database from ECOWREX (via energydata.info); OpenStreetMap - Liberia Populated Places (2020) (via humdata.org; created County capitals); Gridfinder - Predicted grid lines (2020)

⁵³ All Power Labs. Booker Washington Institute. <http://www.allpowerlabs.com/people/gek-users/developing-world-electrification/booker-washington-institute>

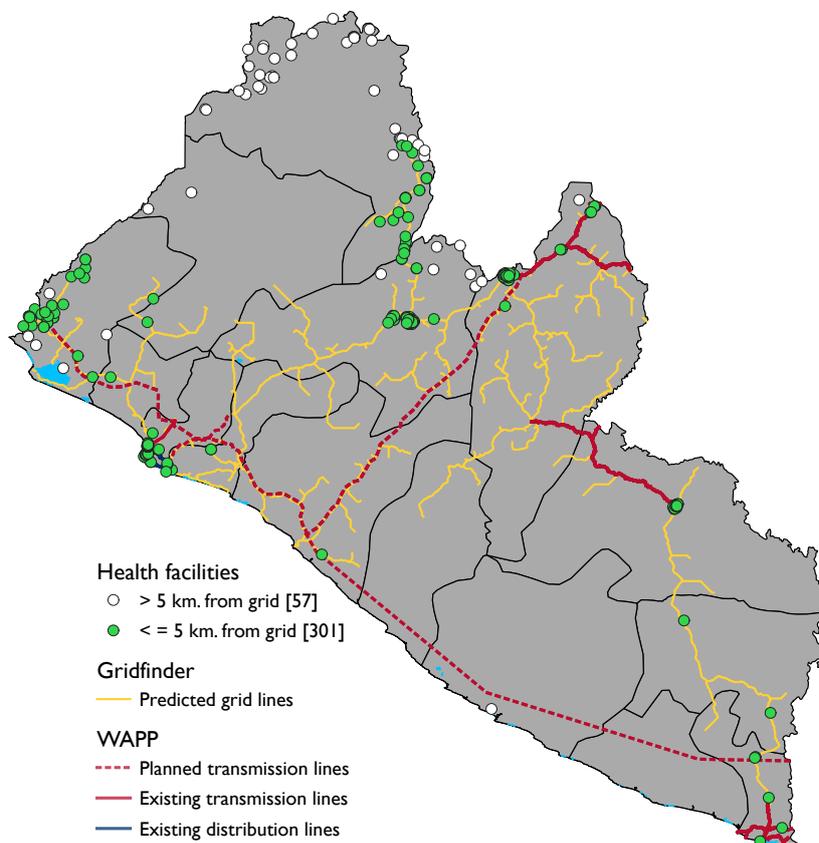
⁵⁴ Energypedia. Liberia Energy Situation. https://energypedia.info/wiki/Liberia_Energy_Situation

FIGURE 9. LIBERIA EDUCATION FACILITY ELECTRIFICATION



Source: West African Power Pool (WAPP) - 2017 ECOWAS GIS database from ECOWREX (via energydata.info); OpenStreetMap - Liberia education facilities (2020) (via humdata.org); Gridfinder - Predicted grid lines (2020)

FIGURE 10. LIBERIA HEALTH FACILITY ELECTRIFICATION



Source: West African Power Pool (WAPP) - 2017 ECOWAS GIS database from ECOWREX (via energydata.info); OpenStreetMap - Liberia health facilities (2020) (via humdata.org); Gridfinder - Predicted grid lines (2020)

3.4 POLICIES AND PROGRAMS

3.4.1 ENERGY PROGRAMS

Multiple energy programs have supported Liberia’s energy sector in the past and continue to support future development (see Table 7).

TABLE 7. PAST AND CURRENT ENERGY PROGRAMS

PROGRAM	GOALS AND ACTIVITIES	DURATION	FUNDER	IMPLEMENTER
Energizing Development Liberia (EnDev)	EnDev sought to strengthen markets by increasing quality in solar installations; sharing information on photovoltaic (PV) products; supporting the construction of solar dryers for cocoa farmers; improving cookstoves; and sharing technical expertise.	2012-2018	Netherlands, Germany, Norway, UK, Switzerland, and Sweden	GIZ
Light Up Liberia (LUL)	LUL sought to decrease poverty and increase standards of living in rural areas of Liberia by developing a model for solar mini-grid and energy distribution; increasing the availability of pico-solar products; and increasing access to financial products for renewable energy.	2016-2019	EU	Mercy Corps
Lighting Lives in Liberia (LLL)	LLL supported the development of a commercial market for Lighting Global certified solar products and sought to distribute 100,000 units of solar technology.	2012-2017	World Bank, GEA Trust Fund Grant	RREA
Mount Coffee Hydropower Rehabilitation Project	This project rebuilt the Mount Coffee Hydropower plant using modernized turbines after it was destroyed during the years of civil conflict.	2012-2017	Norway, Germany and the USA	Nine partners including Matitoba Hydro International
Beyond the Grid Fund for Africa (BFGA)	BGFA aims to electrify at least five million people in Burkina Faso, Liberia, Mozambique, and Zambia by 2025 by building renewable energy markets. \$ 10 million of the \$ 50 million total investment will be in Liberia.	2019-2024	Swedish International Development Cooperation Agency	Renewable Energy and Energy Efficiency Partnership (REEEP)
Liberia Accelerated Electricity Expansion Program (LACEEP)	LACEEP aims to increase electricity access; strengthen institutions in the electricity sector; and support government capacity building. LACEEP is targeting the connection of 16,300 new users in the areas between Monrovia and Kakata and replacing the LEC’s cost-intensive diesel generation with HFO-based generation.	2013-2020	World Bank, International Development Association	LEC and MME ⁵⁵
Liberia Renewable Energy Access Project (LIRENAP)	LIRENAP has three main components: Decentralized electrification for roughly 50,000 people in North Lofa county through a hydro-thermal hybrid mini-grid; technical assistance to strengthen rural electrification institutions; and SHS market development, including addressing trade barriers and demand-side constraints.	2016-2021	World Bank and the Strategic Climactic Fund	RREA
Regional Off-Grid Electrification Project (ROGEP)	ROGEP’s goal is to increase electricity access in 19 West African and Sahel countries, including Liberia, by focusing on supporting ongoing activities and increasing access to pico-solar, SHS, and standalone PV systems.	2017-2022	World Bank	ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE)

Source: Renewables Liberia, unless otherwise specified.

⁵⁵ ECREEE. 2019. Off-Grid Solar Market Assessment & Private Sector Support Facility Design - Liberia Report. www.ecreee.org/sites/default/files/ecreee_rogrep_liberia_final_report_july_2019.pdf

3.4.2 ENERGY POLICIES AND OBJECTIVES

Liberia's energy sector is governed by several energy policies and strategies.

- › Liberia's National Energy Policy (NEP) was published in 2009, establishing the Government of Liberia's goal that all Liberians will have access to affordable modern energy. The document outlines long term policy goals in four key areas: electricity access, quality, cost, and the enabling institutional framework. Since 2009, subsequent documents and policies have built on the NEP.
- › The National Renewable Energy Action Plans (NREAPs) outline targets to develop the renewable energy sector of Liberia from 2015 to 2030 based on the goals outlined in the NEP. NREAP also proposes adjustments to policy, administration, regulations, and financing. The NREAPs set the following targets by 2030:
 - » 100 percent of the rural population with access to renewable electricity (mini-grids or SHS systems).
 - » 504.13 GWh of electric power generation, with roughly 40 percent from renewable energy sources.
 - » 26 percent of the population using modern technology for cooking.
 - » 5 percent of diesel and fuel oil consumption from biofuels.
- › The National Energy Efficiency Action Plan (NEEAP) outlines policy to increase energy efficiency and decrease technical losses on the grid, aiming to help achieve targets set by the NREAPs. The NEEAP was prepared considering the ECOWAS Energy Efficiency Policy, which Liberia subscribed to in 2013. Policies set by the NEEAP are designed to reach the following objectives:
 - » Increase energy efficiency by 1,052 MW by 2030.
 - » Eliminate the use of incandescent bulbs by 2018.
 - » Reduce technical losses from distribution to 10 percent by 2024.
- › The Pro-Poor Agenda for Prosperity and Development (PAPD) is the second in a series of five-year plans to reach the goals outlined in Vision 2030, covering July 2018 to June 2023.⁵⁶ The PAPD is organized around four pillars: empowering the people, economy and jobs, sustaining peace, and governance and transparency. Affordable and clean energy is included as one of the goals in the second pillar.
- › Liberia is committed to making progress towards achieving the aims of the United Nations (UN) Sustainable Energy for All (SE4ALL) Initiative and the SDGs. Launched in 2011, SE4ALL focuses on three objectives in SDG 7: universal access to modern energy; doubling the global rate of improvement in energy efficacy; and doubling renewable energy's share in energy generation globally.⁵⁷

3.4.3 ELECTRICITY REGULATIONS

As mentioned in Section 3.1.1, LERC was established by the 2015 Electricity Law and is charged with overseeing the development of new electricity regulations in Liberia, with support from the international community and donor partners.⁵⁸ In September 2020, LERC published its electricity regulations. The tariff regulations and tariff methodology are still in draft form and currently going through public consultation. Once developers have registered with LERC, LERC will conduct assessments of all new energy projects and IPPs.

⁵⁶ Republic of Liberia. 2018. Pro Poor Agenda for Prosperity and Development. <http://liberianconsulatega.com/wp-content/uploads/2017/07/PAPD-Pro-Poor-Agenda-for-Prosperity-and-Development.pdf>

⁵⁷ ECREEE. Sustainable Energy for All (SE4ALL) Initiative. <http://se4all.ecreee.org>

⁵⁸ Sandikie. 2015. National Renewable Energy Action Plans (NREAPs). www.se4all.ecreee.org/sites/default/files/national_renewable_energy_action_plans_nreap_-_liberia.pdf

In addition to LERC's electricity regulations, imported solar products are required to meet quality standards. Liberia's National Standards Laboratory (NSL) has historically used the International Finance Corporation's (IFC's) Lighting Global standards, has recently endorsed the IEC TS 622257-9-5 for renewable energy and hybrid systems, but is now considering endorsing the International Electrotechnical Commission's (IEC) newly approved solar standards (IEC TS 622257-9-8), which supersede the Lighting Global standards.

Pico-solar companies are required to obtain a business license from the Liberian Revenue Authority (LRA) and pay all required taxes. According to interviews conducted by the Power Africa Advisors Program, regulations surrounding starting a new business in Liberia were not a major barrier to market entry for solar companies. The legal process requires three to 14 days.⁵⁹

3.4.4 RELEVANT ENVIRONMENTAL REGULATIONS AND PROCESS

All energy companies operating in Liberia are required to submit a project brief to Liberia's Environmental Protection Agency (EPA), summarizing operational plans and any potential environmental impacts. The potential impact determines whether a permit is required for the project. If a permit is required, the energy company must carry out a full environmental and social impact assessment (ESIA). Permits are required before project construction can begin and must demonstrate how the company will mitigate any potential negative impacts identified during the ESIA.

3.5 FUTURE ELECTRIFICATION TARGETS

The RESMP, published in 2016, outlines 92 projects organized under five main programs (see Table 8) to achieve the following three objectives:

1. Reach a rural electrification rate of 35 percent by 2030.
2. Electrify all county capitals, health facilities, and secondary schools by 2025.
3. Create a fund for poor and women-led households to get electricity through credit and subsidies.

Rural areas in the RESMP are defined as places outside of Monrovia, which covers 72 percent of the population. This definition is different than the 2008 census, which considered several county capitals to be urban.⁶⁰ The current strategy focuses on grid extension and mini-grid development to reach more remote population centers.⁶¹

RESMP also outlines renewable energy targets by 2030:

1. Renewables to account for 75 percent of electricity generated.
2. Installation of 150 MW of grid generation capacity from renewables other than large hydropower.
3. Incorporation of at least 60 MW of solar energy on the national grid.
4. Universal access to solar renewable lamps.

⁵⁹ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Grid-Solar-Liberia_TBI_November-2018.pdf

⁶⁰ Rural and Renewable Energy Agency. Rural Energy Strategy and Master Plan for Liberia Until 2030. <https://gestoenergy.com/wp-content/uploads/2018/04/LIBERIA-RURAL-ENERGY-STRATEGY-AND-MASTER-PLAN.pdf>

⁶¹ Ibid.

TABLE 8. RURAL ELECTRIFICATION STRATEGY AND MASTER PLAN PROGRAMS

PROGRAM	PROJECT DESCRIPTION	CORE OBJECTIVE	PLANNED CAPACITY
Growing the National Grid Program (GTG)	Reactivation of the Mount Coffee hydropower plant	Increase national electricity grid generation capacity	88 MW
	The 7.8 km, 33 kV cross-border transmission line between Liberia and Côte d'Ivoire	Provide electricity to settlements near the border	54.6 GWh
	225 kV interconnection between Côte d'Ivoire, Liberia, Sierra Leone, and Guinea	Connect communities located 3 km on each side of the CLSG lines through a shield wire technology	130 MW
	On-grid renewable IPP initiative - on-grid solar	Increase national electricity grid generation capacity through renewable energy	100 MW
Decentralized Grids Program (DG)	Development of transitional renewable energy or diesel low-voltage large, decentralized grids supported by renewable generation using renewable energy (hydro, wood, solar PV, palm oil, solar-diesel)	Electrification of the ten largest settlements not covered under GTG in each county in Liberia	22.5 kW to 60 kW capacity each
Beyond the Grid Program (BTG)	Stand-alone solar solutions for 75 communities	Electrification of communities which will not be reached by the national grid before 2025 and prioritizes community services and public buildings	2.2 MW
Other than Power (OTP)	Variety of approaches to enhance energy efficiency in buildings, appliances, cooking, and expanding liquefied petroleum gas storage and use	Promotion of efficient charcoal production, use of ICS, pre-paid meters installation, etc.	N/A
Building Capacity (BC)	Capacity-building and development to support RESMP goals	To facilitate achieving the RESMP targets by improving the enabling environment	N/A



4 SOLAR HOME SYSTEMS AND PICO-SOLAR

Pico-solar and solar home system products are central to achieving universal electrification goals in sub-Saharan Africa, particularly in rural communities and areas where grid electricity may be available but is unreliable. Pico-solar products are among the most affordable entry points to off-grid lighting and mobile phone charging, while SHS provide more comprehensive electrification for households, community facilities, and productive use.

The RESMP focuses on achieving electrification targets primarily through grid extension, decentralized grids, and mini-grids. The plan estimates that only 1 percent of the population targeted for electrification by 2030 will be through pico-solar and SHS. However, unless grid reliability improves, pico-solar and SHS are likely to form an important source of reliable electricity in areas that are targeted for grid electrification. This section provides an overview of the Liberian market for pico-solar and SHS.

4.1 COMMERCIAL OVERVIEW

The SHS and pico-solar industry is still in a relatively early stage in Liberia. The Power Africa Off-grid Project's technical advisors estimate that there are fewer than 20 companies active in the market. As of 2019, the only international company directly selling off-grid solar products in Liberia was Easy Solar.⁶²

Data on sales is limited; as of this writing, the most recent verified sales data is from 2017. Sales of SHS products are increasing after Ebola caused a dip in sales from 2014-2015. Since 2015, roughly 5,000 quality-verified sales have been made per year, mostly in urban areas. From 2012-2017, over 50 percent of sales were made in Montserrado county.⁶³

4.1.1 COMPANIES SELLING PICO-SOLAR AND SHS

Although there are currently around 20 companies offering pico-solar and SHS products in Liberia, most are still in the early stages of development, selling less than 50 systems per month. Urban and peri-urban sales dominate because it is more expensive for companies to reach rural markets and on average rural residents have lower incomes than urban residents.

In urban and peri-urban areas, West Coast Energy and Union Strong are the most active solar companies supplying larger systems to households, small businesses, and non-governmental organizations (NGOs).

In rural areas, LIB Solar, Easy Solar, Ecopower, and Liberian Energy Network (LEN) are the most active companies, selling a range of solar lanterns and small SHS. Additionally, Total (under its Awango brand) sells solar lanterns and small SHS through its network of 32 fuel stations. The product range is priced from \$19-\$117. Awango's smallest, cheapest lanterns are the most popular because Total does not currently offer credit or PAYGO plans.

⁶² Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Gird-Solar-Liberia_TBI_November-2018.pdf

⁶³ Ibid.

Table 9 provides additional information on a selection of companies selling pico-solar and SHS in Liberia at present.

TABLE 9. COMPANIES SELLING PICO-SOLAR AND SOLAR HOME SYSTEMS IN LIBERIA			
COMPANY NAME	YEARS OF OPERATION	PRODUCT RANGE	AREAS OF OPERATION
Alternative Energy and Liberia Energy Network	2009 – present	SHS and pico solar	Liberia, with a focus on rural and peri-urban areas
Easy Solar	2019 – present	SHS	Focus on rural and peri-urban areas
Eco Power Liberia	2017 – present	SHS	Liberia, with a focus on rural and urban areas
Lib Solar	2018 – present	SHS for households and public buildings	Focus on rural areas
Liberia Energy Network (LEN) 2	August 2011 – present	Solar systems	Focus on rural and peri-urban areas
Liberia Gateway	N/A	Solar products and cook stoves	Urban and rural areas
SJEDI Green Energy	2011 – present	Solar systems and ICS	Rural and urban
Sun Star Green Energy	November 2013 – present	SHS, solar lanterns, ICS	Urban and rural areas
Total Liberia Inc.	N/A	Pico-solar and small SHS	Urban and rural areas (selling in 32 fuel stations around the country)
Union Strong	N/A	Solar systems specializing in remote, commercial, and industrial applications	Urban and rural areas
West Coast Energy Liberia	March 2015 – present	Solar and power grid backup	Urban and peri-urban

4.2 BARRIERS TO MARKET GROWTH

The off-grid solar market in Liberia faces several barriers to growth across the value chain. Trade barriers increase the cost of importing products and quality control is not adequately enforced, resulting in unreliable products that erode trust in solar technology in general being sold. There is a shortage of technically capable workers that can readily enter the solar industry and companies also lack the business management capacity needed to grow efficiently. Finally, consumer awareness is low and there are few mechanisms in place (e.g. PAYGO) to address the affordability of solar products.

Table 10 explores the main barriers to growth in the pico-solar and SHS market in more detail.

TABLE 10. BARRIERS TO MARKET GROWTH FOR PICO-SOLAR AND SHS

BARRIER	DETAILS	POTENTIAL SOLUTION
Tariffs	In general, tariffs are a barrier to entry for most international companies. ⁶⁴ RREA partners receive a waiver of the 30 percent tariff levied on other imports. ⁶⁵	Introduce a tax and duty waiver for solar products.
Affordability	The upfront costs of SHS systems are often prohibitive for the average Liberian household. REEEP reports that a 6W SHS system with four lights, radio, and phone charger retails for roughly \$ 120. ⁶⁶	Consider introducing demand-side subsidies to help the lowest income households access solar products.
Quality standards	The NSL is currently working on getting IEC's new solar standards approved.	Continued support to NSL to get standards approved and implemented.
Consumer awareness of solar options	There is currently quite limited information about solar products, particularly in rural areas of Liberia.	Implement awareness-raising programs to spread information about solar products in Liberia.
Local technical capacity	There are limited solar experts in Liberia and solar companies often struggle to recruit suitable experts.	Support education and training facilities to build capacity.
Financing	When companies have tried to offer credit to overcome affordability barriers, their customers generally do not make repayments or the cost of collecting the repayments is prohibitively high. Households in Liberia are generally not used to taking out loans and ensuring they make their repayments. The micro-finance sector in Liberia is still in its infancy, particularly in rural areas and the issuing of loans to individual households.	Technical assistance and capacity building of the finance sector to start to develop new financing products for off-grid solar companies and products.

4.3 RELEVANT GOVERNMENT AND DONOR SHS AND PICO-SOLAR PROGRAMS

Table 7 in Section 3.4.1 introduced several government and donor programs investing in the off-grid solar sector in Liberia. This section explores programs relevant to the pico-solar and SHS markets in more detail.

Lighting Lives in Liberia (LLL). LLL started in 2012 by importing a range of solar PV lanterns duty-free and supplying inventory to 15 companies that were selling in rural communities. As of June 2018, over 35,000 quality-verified products had been sold, impacting an estimated 70,000 people.⁶⁷

While most products imported by LLL were sold on a cash basis, LLL also supported early experiments in offering credit for purchases. Several companies tried offering credit over a two to three month period, but found it difficult to get customers to make their repayments. To increase awareness of solar technology, LLL partnered with Mercy Corps to organize roadshows in several locations. However, the effectiveness of these efforts was limited by distributors' capacity to follow-up with potential customers afterwards.

While LLL certainly helped to make off-grid products more accessible to rural and low-income Liberians, the strategy of acting as an importer raises concerns that LLL distorted the market. By providing duty-free

⁶⁴ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Gird-Solar-Liberia_TBI_November-2018.pdf

⁶⁵ Ibid.

⁶⁶ REEEP. 2019. Beyond the Grid Fund for Africa - Liberia Stakeholder Consultation Workshop Outcome Report. <https://beyondthegrid.africa/wp-content/uploads/BGFA-Liberia-Stakeholder-Consultation-Workshop-Report.pdf>

⁶⁷ World Bank. Lighting Lives in Liberia. <https://projects.worldbank.org/en/projects-operations/project-detail/PI24014?lang=pt>

products to distributors, LLL provided short-term benefits at the longer-term cost of making distributors reliant on the prices LLL could secure.

Liberia Renewable Energy Access Project (LIRENAP). Following on from LLL, LIRENAP has supported RREA’s efforts to help local distributors obtain import tax waivers so they can begin importing products directly. While Liberia currently imposes a 30 percent tax on imports, companies supported by LIRENAP are eligible for a 100 percent duty waiver the first year; and the waiver declines in subsequent years. Additionally, companies supported by LIRENAP who transport solar products to rural areas are eligible for a small subsidy per solar system.⁶⁸

Other RREA initiatives. Outside of LLL and LIRENAP, RREA supports companies on imports by providing a subsidy for bulk quantities of quality-verified products. While there is currently no standard import tax and duty waiver for off-grid solar products, RREA is engaging the Ministry of Finance, the Ministry of Commerce, and the LRA to introduce a waiver in the future.

SIDA programs. AECF has recently finalized its REACT SSA Liberia window, funded by SIDA, providing grants to help several off-grid companies scale up their businesses and start attracting new investments. In addition, the BGFA launched its pre-qualification application process in September 2020 and will provide grants under two Lots, one on SHS and one on mini-grids.

4.4 FINANCE

The financial sector in Liberia is regulated by the Central Bank of Liberia (CBL), which provides oversight of all local banks. All banks are required to be registered with CBL and adhere to CBL regulations, including the management of foreign capital for lending within Liberia. Table 11 lists the institutions registered with the CBL as of 2018.⁶⁹

TABLE 11. FINANCIAL INSTITUTIONS REGISTERED WITH CBL

INSTITUTION	DEFINITION	NUMBER
Commercial banks	Large banks providing traditional banking services to individual customers and corporations	9
Rural community financial institutions (RCFIs)	Owned by communities providing savings, checking, loans, direct deposits, money transfer services, and payment of government salaries	12
Microfinance institutions (deposit-taking)	Provide small loans and savings accounts mainly to traders and small businesses	1
Microfinance institutions (non-deposit-taking)	Only provides small loans and not savings accounts	<5
Credit unions	Member-based institutions providing savings and credit extensions to rural areas	275
Informal village saving and loan associations	Saving clubs or groups not formally attached to the financial sector	1,450
Mobile money operators (MMOs)	Provide payment services through mobile money accounts	2
Insurance companies	Provide crop or health insurance	19

⁶⁸ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Gird-Solar-Liberia_TBI_November-2018.pdf

⁶⁹ Central Bank of Liberia. National Financial Inclusion Strategy 2020-2024. www.cbl.org.lr/doc/Liberia_NFIS_Dec23.pdf

4.4.1 CURRENCY

Liberia has a floating exchange rate system with Liberian and U.S. dollars being accepted legal tender. Currently, there are no restrictions on converting or transferring investment funds, profits, loans, and interest. Once registered as businesses with the LRA, companies can receive U.S. dollars without restrictions. There are several foreign exchange bureaus in and around Monrovia, although some are not registered with CBL.

The inflow of U.S. dollar remittances is one of the major sources of foreign exchange in the Liberian economy. The transfer of sums in excess of \$ 10,000 must be reported to CBL and no more than \$ 7,500 in foreign currency bank notes can be moved out of the country at any one time.

4.4.2 COMMERCIAL FINANCE

To scale off-grid electrification, off-grid companies will need to access large volumes of commercial debt financing. In total, nine commercial banks are registered with the CBL (Table 12).

TABLE 12. COMMERCIAL BANKS IN LIBERIA

BANKS IN LIBERIA	ESTABLISHED
Access Bank Liberia the Microfinance Bank	2009
Afriland First Bank Liberia Limited	2011
Ecobank Liberia Limited	1999
Global Bank (Liberia) Limited	2005
Groupe Nduom Bank Liberia Limited	2016
Guaranty Trust Bank Liberia	2009
International Bank Liberia Limited	2000
Liberian Bank for Development & Investment	1961
United Bank for Africa Liberia Limited	2008

Source: Central Bank of Liberia

The profitability of banks has grown over the past decade with both return on equity (ROE) and return on assets (ROA) turning from negative to positive between 2014 and 2016.⁷⁰ Despite promising growth in the Liberian finance sector, no commercial banks in-country have initiated loans in the energy sector. Commercial banks cite concerns about client creditworthiness, loan length, access to capital, sufficient deal flow, and access to foreign exchange.

Long-term partnerships between local commercial banks and microfinance institutions (MFIs) will likely be necessary to develop domestic, local-currency sources of financing to reduce foreign exchange risk (UNDP and ETH Zurich 2018). Additionally, most commercial banks only target loans of over \$ 200,000, while MFIs (which more commonly lend to consumers) generally cap loans at approximately \$ 7,000. This leaves a large gap that may leave smaller off-grid solar businesses without viable options to finance smaller scale projects.⁷¹

⁷⁰ Central Bank of Liberia. National Financial Inclusion Strategy 2020-2024. www.cbl.org.lr/doc/Liberia_NFIS_Dec23.pdf

⁷¹ Ibid.

4.4.3 INVESTORS

Off-grid companies, particularly Liberian companies with limited access to international investors, have found it difficult to find suitable investors. Several investors have been in early discussion with some off-grid companies, including Kiva, Sun Funder, Gaia, Venture Builder, and Trine, but no deals have been finalized to date.

4.4.4 CONSUMER FINANCE

In addition to financing off-grid solar companies, consumer finance is critical to enabling Liberian households and businesses to purchase SHS or pico-solar equipment. Access to financial services in Liberia has expanded over the last five years, primarily due to the introduction of mobile money. From 2011 to 2017 financial inclusion almost doubled from 19 to 36 percent. By 2024, the Liberian government aims to increase access to formal financial services to 50 percent, but multiple barriers pose a challenge, including:⁷²

- › Limited mobile money kiosks in rural areas.
- › Consumers lacking necessary documentation for opening accounts.
- › The prohibitive cost of digital financial services.
- › Weak credit infrastructure.

Weak credit infrastructure also poses broader challenges across the economy, leading to a general lack of consumer financing across all sectors, including energy. Where loans are made, most are limited to two years or less and banks are particularly cautious of loaning to households. Instead, most financing flows to existing small businesses' customers that have a track record with the institution.

Liberia's informal financial sector, on the other hand, is large. In 2018, 36 percent of Liberians accessed credit most often through a friend or family member. While there has been little partnership to date between the financial sector and off-grid solar business or consumers, ECREEE conducted a survey in 2019 of key players in the financial sector, including commercial banks and microfinance institutions. The survey found strong interest in beginning to support the sector both through commercial and consumer finance.⁷³

4.4.5 MICROFINANCE INSTITUTIONS

Liberia has a small microfinance sector relative to some of its regional neighbors.⁷⁴ Still, credit through MFIs is more readily available, particularly in rural areas, than loans from commercial banks. In 2014, there were 24.8 loan accounts with MFIs and 14.8 accounts with commercial banks per 1,000 adults.⁷⁵

Most MFIs only provide small loans ranging from a few hundred to a few thousand USD, typically using a group loan model with interest rates of around 3 to 5 percent per month. As of mid-2020, no MFIs have started lending for pico-solar or SHS purchases, although many have expressed an interest in learning more about the renewable energy sector. Experiences in other countries show that these institutions may be more flexible and innovative in lending for renewable energy than commercial banks.

Currently, there are 18 registered microfinance agencies operating in Liberia.⁷⁶ BRAC is one of the largest MFIs and operates in Nimba, Lofa, Grand Bassa, Montserrado, Margibi, and Bong counties. Most MFIs operate at a loss because of a lack of capital, technology, and manual payment systems.

⁷² Central Bank of Liberia. National Financial Inclusion Strategy 2020-2024. www.cbl.org.lr/doc/Liberia_NFIS_Dec23.pdf

⁷³ ECREEE. 2019. Off-Grid Solar Market Assessment & Private Sector Support Facility Design - Liberia Report. www.ecreee.org/sites/default/files/ecreee_rogep_liberia_final_report_july_2019.pdf

⁷⁴ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Grid-Solar-Liberia_TBI_November-2018.pdf

⁷⁵ Central Bank of Liberia. National Financial Inclusion Strategy 2020-2024. www.cbl.org.lr/doc/Liberia_NFIS_Dec23.pdf

⁷⁶ Central Bank of Liberia. Microfinance Institutions. <https://www.cbl.org.lr/2content.php?sub=214&related=32&third=214&pg=sp&pt=Microfinance%20>

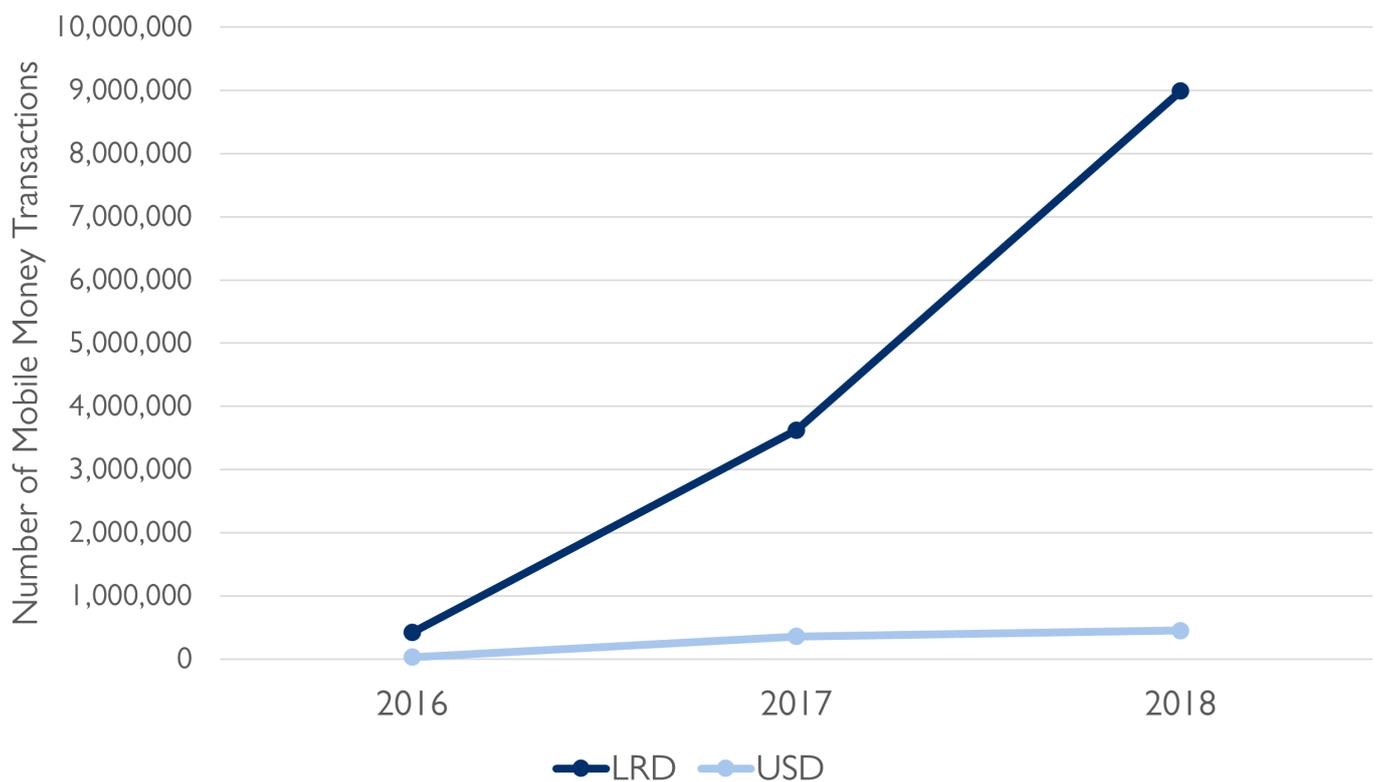
4.4.6 MOBILE MONEY

Expanding digital financial services, especially mobile money, can create new opportunities to better reach and serve women, lower-income populations, and other groups that are traditionally excluded from the formal financial system. Moreover, mobile money technology also plays a critical role in the application of off-grid solar solutions, particularly for PAYGO systems that rely on the interoperability between digital financial services and stand-alone solar devices.

Mobile money usage in Liberia has expanded over the past five years and is expected to overtake checks as the predominant form of non-cash currency exchange. In 2018, there were 11 million mobile money transactions, totaling \$ 272.9 million. In the same year, 6,995 agents were active, serving roughly 20 percent of the Liberian population.^{77,78} Most mobile money transactions use the Liberian dollar (LRD), not USD, reflecting the use of mobile money in the informal economy (see Figure 11).

MTN, which is the largest mobile service provider in Liberia, has coverage throughout all 15 counties and has over 1,000 active mobile money sales agents. MTN has also been in discussion with a solar PV payment platform, Lumeter, to start allowing mobile money payments for off-grid energy services. MTN supports mobile money for a variety of value-added services, including satellite television, electricity, and goods purchased at supermarkets and petrol stations. Orange, the other major mobile service provider in Liberia, is also starting to work with off-grid energy companies to offer similar services.

FIGURE 11. MOBILE MONEY TRANSACTIONS



Source: Central Bank of Liberia

4.4.7 PAYGO SYSTEMS

PAYGO platforms offer one of the most effective ways for solar companies to make off-grid solar products more accessible for rural and low-income households. In 2019, 24 percent of global sales were purchased through PAYGO, the highest historical market value recorded by GOGLA.⁷⁹

⁷⁷ Central Bank of Liberia. National Financial Inclusion Strategy 2020-2024. www.cbl.org.lr/doc/Liberia_NFIS_Dec23.pdf

⁷⁸ Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Grid-Solar-Liberia_TBI_November-2018.pdf

⁷⁹ GOGLA. www.gogla.org

In Liberia, PAYGO technology is still in the early stages of deployment. Both MTN and Orange have been providing mobile money services for several years, but service availability has been mainly limited to urban areas. While service availability is expanding into rural areas and some solar companies are beginning to use PAYGO, progress is slow. Many rural households still do not use mobile money because they lack sufficient mobile signal or access to mobile money agents.

4.4.8 GENDER MAINSTREAMING STRATEGY FOR SHS COMPANIES

Almost all active renewable energy companies in Liberia are currently owned and managed by men. Due to their relatively early stage of development, none of the companies have yet developed gender mainstreaming activities. Two exceptions are WE4SELF and Alternative Energy, which are woman-led and aim to empower local women. Both WE4SELF and Alternative Energy are supported by RREA and Mercy Corps, but operate multiple lines of business because solar sales are currently unprofitable.

USAID's Engendering Utilities program has partnered with the LEC to promote the inclusion of women in the energy sector. LEC aims to achieve 40/60 gender parity. As of 2018, 17 percent of the LEC's 850 staff were women.⁸⁰

In Africa, women report that the most critical barrier to entering the renewable energy sector are cultural and social norms, followed by a lack of skills and training.⁸¹ In Liberia, especially in rural areas, traditional gender norms prevent women from owning assets and other economic resources. For example, women in agriculture commonly own the crops, but not the land.⁸²

⁸⁰ USAID. Engendering Utilities Partners Profile: LEC. www.usaid.gov/energy/engendering-utilities/partners/lec-liberia

⁸¹ IRENA. Renewable Energy: A Gender Perspective. www.irena.org/publications/2019/Jan/Renewable-Energy-A-Gender-Perspective

⁸² Power Africa. Liberia Policy and Business Environment Study for the Off-Grid Solar Lighting Sector. http://www.renewables-liberia.info/files/Policy-and-Business-Environment-Study-Off-Gird-Solar-Liberia_TBI_November-2018.pdf



5 MINI-GRIDS

Mini-grids are an important solution for providing grid-like infrastructure to communities that are too remote to be connected to a central electricity grid. In Liberia, RESMP targets reaching 430,000 people with decentralized grids and mini-grids. This report includes an analysis of both decentralized grids and mini-grids.

RREA's five year Investment Plan has identified over 45 communities that are unlikely to be connected to the national grid and have large enough populations to be suitable for mini-grids. In off-grid communities with over 100 households in Liberia, well-managed solar mini-grids are the more efficient and cost-effective solution to supply households with power for lighting, a range of appliances, and productive uses of energy. However, it has been estimated that mini-grids need to sell at least 50 percent of generated power to productive use clients for mini-grids to be financially viable. These productive activities, such as the processing of agricultural products, act as anchor clients due to their ability to pay through their income-generation activities. These communities offer a great opportunity for mini-grid companies to target.

To date, most mini-grid projects implemented in Liberia have been based on a cooperative or community model where the community owns and operates the mini-grid. However, experience has shown that in such an early stage market like Liberia, particularly in very remote areas, the cooperative model is not sustainable. Communities often lack the capacity to manage and maintain the systems and collecting payment from one's own neighbors often proves difficult. Additionally, most cooperative mini-grids lack the necessary anchor customers to be sustainable.

The mini-grid sector needs a well-developed enabling environment to attract private investment. The recently adopted micro-utility regulation and the drafting of the tariff regulations are a very good indication that the Government will ensure cost-reflective tariffs and provisions to protect operators from grid encroachment.

Despite early challenges, mini-grids remain a promising opportunity for private developers, particularly in the many rural parts of Liberia that are unlikely to be reached by the grid. Table 13 provides data on a selection of mini-grids in Liberia.

TABLE 13. MINI-GRIDS IN LIBERIA

COUNTY	COMMUNITY	TECHNOLOGY	FUNDER	IMPLEMENTER	OPERATOR	CAPACITY	START DATE	STATUS
Bong	Suakoko	Hydro/Diesel	USAID	NRECA	Private Operator	1000 kW	2019	Planned
	Totota	Solar/Diesel		NRECA	Private Operator	25 kW	2016	Operational
	Totota	Solar	USADF	N/A	Private Operator	N/A	-	Planned
Lofa	Gbarway	-	USAID	-	-	24 kW	-	-
	Kaiha 2	Hydro/Diesel	World Bank	RREA	Private Operator	2.5 MW	2019	Planned
	Koiyama	Solar	EU	PLAN & Volunteers for Sustainable Development in Africa (VOSIEDA)	Local Cooperative	22.5 kW	2017	Operational
	Langbemba	Solar	EU	PLAN & VOSIEDA	Local Cooperative	31.1 kW	2017	Damaged by fire
	Mamikonedu	Solar	EU	PLAN & VOSIEDA	Local Cooperative	25.5 kW	2017	Operational
	Nyengbelahun	-	EU	PLAN & VOSIEDA	Local Cooperative	N/A	2017	Operational
	Sorlumba	Biomass (palm oil)	USAID	NRECA	Local Cooperative	25 kW	2017	In development
	Taninahun	Solar	EU	PLAN & VOSIEDA	Local Cooperative	28.5 kW	2017	Operational
	Yandohun	Hydro	World Bank	RREA	Local Cooperative	60 kW	2013	Operational
Margibi	Robertsfield Highway	-	-	-	-	10 MW	2020	MoU signed
Montserrado	Block Pad	Solar	EU	Mercy Corps	Private Operator	-	-	Planned
	Karto Town	Solar	EU	Mercy Corps	Private Operator	-	-	Planned
	Koon Town	Solar	EU	Mercy Corps	Private Operator	-	-	Planned
Nimba	Kwendin	Biomass (wood)	USAID	NRECA	Local Cooperative	60 kW	2016	Operational



6 CONCLUSION

At its maximum extent, Liberia's national grid is only expected to reach 35 percent of the population by 2030, making off-grid energy solutions critical to extending energy access to all Liberians, particularly in rural parts of the country. Even where grid electricity is available, service is inaccessible to some potential customers and unreliable for even more, creating an opportunity for off-grid solar companies to offer products that supplement or replace grid access.

Industry observers anticipate that early growth in the market for pico-solar and SHS will start in urban and peri-urban regions due to the higher concentration of wealth as well as finance infrastructure, such as mobile money kiosks and agents. Over the medium- to long-term, rural users may represent 70 percent of the pico-solar and SHS markets as off-grid solar companies expand operations and institutional structures to support access for low-income, rural communities. However, the off-grid solar sector remains in a relatively early state today and needs support in a range of areas:

Consumer awareness. Particularly in rural areas, awareness of off-grid solar solutions is limited and consumers are not informed about the benefits that off-grid solar products offer over other forms of lighting and energy.

Ability to pay. Most off-grid solar products remain out of reach for the majority of rural Liberians due to low incomes and low savings rate. This is compounded by a lack of financing to support payment plans that consumers can afford.

Last-mile supply chain. In general, transportation and logistics infrastructure is poor in rural Liberia, making the distribution of products logistically difficult and costly – especially in the wet season. Furthermore, there is a lack of distribution partners in rural areas to hold inventory and market off-grid solar products.

Access to Finance. There is very limited access to finance for off-grid solar companies active in Liberia, with no local financial institutions currently investing in the sector. Most off-grid solar companies have been reliant on grants and Government contracts and as a result have not been able to scale. Although some international investors are starting to look at companies in Liberia, most companies have not developed a large enough track record of sales to attract such investors.

Regulatory environment. LERC released the first version of its electricity regulations in September 2020, but tariff regulations are still forthcoming. A robust regulatory framework is critical to reducing perceived risk on the part of off-grid solar companies and investors. The mini-grid sector especially relies on a predictable regulatory environment to justify the significant up-front cost of developing a mini-grid.

Workforce. In general, the industry is young and many companies lack key skilled workers, including solar technicians, sales agents, marketing specialists, accountants, and managers. Government and donor institutions can provide a boost to the sector by supporting the development of a workforce pipeline.

In addition to this market assessment, the Power Africa Off-Grid Project developed a report focused on the market for productive use of energy products in Liberia titled *Assessment of Current and Potential Future Off-grid Productive Use of Energy Products – Liberia*.

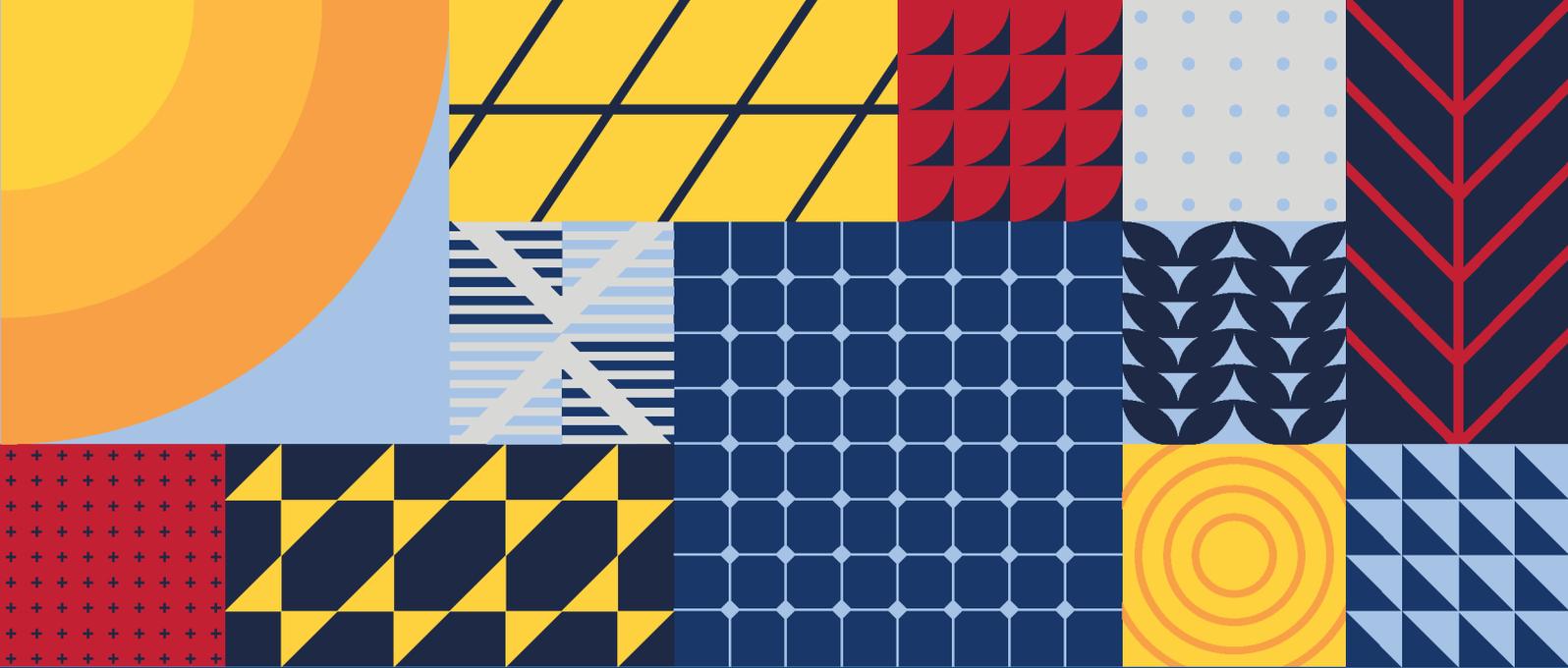
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