



**WORLD BANK GROUP**



**ECREEE**  
TOWARDS SUSTAINABLE ENERGY

REGIONAL OFF-GRID ELECTRIFICATION PROJECT

**Off-Grid Solar Market Assessment & Private Sector Support Facility Design**

SIERRA LEONE REPORT

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## ABBREVIATIONS & ACRONYMS

AFD	Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
ASD	Africa Solar Designs
BSL	Bank of Sierra Leone
BWSEASL	The Barefoot Women Solar Engineering Association of Sierra Leone
CAPEX	Capital Expenditure
CAR	Capital Adequacy Ratio
CASA	Conflict Affected States in Africa
CDF	Co-operative Development Foundation of Canada
CHC	Community Health Center
CIM	Cordaid Investment Management
CRB	Credit Reference Bureau
DFI	Development Finance Institution
DFID	Department for International Development
DMO	District Medical Officer
EBID	ECOWAS Bank for Investment and Development
ECA	Export Credit Agency
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
ECOWREX	ECOWAS Observatory for Renewable Energy and Energy Efficiency
ECREEE	ECOWAS Center for Renewable Energy and Energy Efficiency
EDSA	Electricity Distribution and Supply Authority
EGTC	Electricity Generation and Transmission Company
EIB	European Investment Bank
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Program
EPC	Engineering, Procurement and Construction
EU	European Union
EUR	Euro
EVA	Energio Verda Africa
FAO	Food and Agriculture Organization of the United Nations
FAWE	Forum for African Women Educationalists
FGD	Focus Group Discussion
FI	Financial Institution
FX	Foreign Exchange
FSA	Financial Service Association
GBP	British Pound
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
GOGLA	Global Off-Grid Lighting Association
GoSL	Government of Sierra Leone
GSMA	Groupe Spéciale Mobile Association (Global System for Mobile Communications)
HC	Health Center
HDI	Human Development Index
HDX	Humanitarian Data Exchange
HFO	Heavy Fuel Oil
HH	Household

ICT	Information and Communication Technology
ICASL	Institute of Chartered Accountants of Sierra Leone
IEA	International Energy Agency
IEC	International Electrotechnical Commission standards
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IMF	International Monetary Fund
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
NPA	National Power Authority
NREAP	National Renewable Energy Action Plan
MCC	Millennium Challenge Corporation
MFI	Microfinance Institution
MITAF	Microfinance Investment and Technical Assistance Facility
MoE	Ministry of Energy
MoFED	Ministry of Finance and Economic Development
MPC	Monetary Policy Committee
MPR	Monetary Policy Rate
MTF	Multi-Tier Energy Access Framework
NACCUA SL	National Cooperative Credit Unions Association of Sierra Leone
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-Governmental Organization
NPA	National Power Authority
NPL	Non-Performing Loan
NSFI	National Strategy for Financial Inclusion
O&M	Operations and Maintenance
OGS	Off-Grid Solar
OSS	Operational Self-Sustainability
PAR	Portfolio at Risk
PAYG	Pay-As-You-Go
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PRESSD-SL	Promotion of Renewable Energy Services for Social Development-Sierra Leone
PUE	Productive Use of Energy
PV	Photovoltaic
RE	Renewable Energy
REASL	Renewable Energy Association of Sierra Leone
RFCIP	Rural Finance and Community Improvement Programme
RISE	Regulatory Indicators for Sustainable Energy
ROA	Return on Assets
ROE	Return on Equity
ROGEP	Regional Off-Grid Electrification Project
ROSCAs	Rotating Savings and Credit Associations
RREP	Rural Renewable Energy Programme
SEforALL	Sustainable Energy for All
SEFA	Sustainable Energy Fund for Africa
SHS	Solar Home System
SIFA	Stability Impact Fund Africa
SILNAP	Sierra Leone National Action Plan
SLAMFI	Sierra Leone Association for Microfinance Institutions

SLCB	Sierra Leone Commercial Bank
SLEWRC	Sierra Leone Electricity and Water Regulatory Commission
SLIEPA	Sierra Leone Investment and Export Promotion Agency
SLGEN	Sierra Leone Gender and Education Network
SLL	Sierra Leone leone (currency)
SME	Small and Medium-sized Enterprises
SPV	Special Purpose Vehicle
TA	Technical Assistance
TRC	Truth and Reconciliation Commission
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNICEF	United Nations Children’s Fund
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USAID-NREL	United States Agency for International Development-National Renewable Energy Laboratory
VAT	Value Added Tax
WAPP	West African Power Pool
WB	World Bank
WELD	Women Empowered for Leadership and Development
WHI	World Hope International
Wh	Watt-hour
Wp	Watt peak

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NOTE: The findings, analysis, conclusions and recommendations expressed in this report are those of the authors – they do not necessarily represent the views of ECREEE, the World Bank, or any of the individuals and organizations that contributed to this study.

## KEY DEFINITIONS

### ELECTRICITY ACCESS

For the purpose of this analysis, figures on national, urban and rural electrification rates are from the International Energy Agency (IEA) Energy Access Outlook Report, 2017.<sup>1</sup> Although local government authorities (energy ministries, rural electrification agencies, utilities etc.) may have different or more up-to-date electrification data, one single, uniformly-accepted source was necessary as a baseline to assess electricity access figures across all 19 of the countries analyzed under this regional market assessment.

There is no single internationally-accepted and internationally-adopted definition of modern energy access. The IEA defines energy access as “a household having reliable and affordable access to both clean cooking facilities and to electricity, which is enough to supply a basic bundle of energy services initially, and then an increasing level of electricity over time to reach the regional average.”<sup>2</sup> A “basic bundle of energy services” means, at a minimum, several lightbulbs, task lighting (such as a flashlight or lantern), phone charging and a radio. This definition of energy access serves as a benchmark to measure progress towards UN Sustainable Development Goal 7.<sup>3</sup> The IEA electricity access statistics presented in this report include household connections, either from a grid connection or from a renewable energy-based off-grid source; the approach excludes illegal connections. The data is sourced wherever possible from governments, supplemented by data from multilateral development banks, various international organizations and other publicly available statistics.

The Multi-Tier Energy Access Framework (MTF) is also used as a key reference throughout this report. Rather than measuring electricity access as a household connection to an electricity grid, the MTF views electricity access along a continuum of service levels (tiers) and according to a series of indicators, including capacity, availability/duration of supply, reliability, quality, affordability, legality and health/safety.<sup>4</sup>

### OFF-GRID / STAND-ALONE SOLAR

The term “off-grid” as it is widely used throughout this report (e.g. “off-grid sector”) refers to both mini-grids and stand-alone systems. When “off-grid solar” or its acronym “OGS” are used, this refers *only* to stand-alone solar systems and does not include mini-grids. The main focus of this market assessment is the stand-alone solar sector. While micro/mini-grids typically provide a small community with electricity, stand-alone solar systems are not connected to an electricity distribution system and typically include a battery, but may also be used in conjunction with a diesel generator, wind turbine etc. Stand-alone solar technology broadly includes the following:

- Pico solar/solar lanterns<sup>5</sup>
- Single module solar systems (DC)<sup>6</sup>
- Multiple module solar systems (AC)<sup>7</sup>
- Large solar systems (AC)<sup>8</sup>

In addition to providing electricity access, stand-alone solar products/systems also support a wide range of productive applications (e.g. solar water pumping, agricultural processing, milling equipment, refrigeration etc.).

<sup>1</sup> [https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_EnergyAccessOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf)

<sup>2</sup> <https://www.iea.org/energyaccess/methodology/>

<sup>3</sup> <https://sustainabledevelopment.un.org/sdg7>

<sup>4</sup> “Multi-Tier Framework for Measuring Energy Access,” World Bank ESMAP: <https://www.esmap.org/node/55526>

<sup>5</sup> Typically less than 10 Wp; all-in-one lighting and/or phone charging; enables partial or full Tier 1 electricity access

<sup>6</sup> Typically 11-100 Wp; capable of powering a few appliances (lights, mobile phone charging, TV, radio, fan etc.); often referred to as a “plug-and-play” solar home system when components are sold as a set; enables full Tier 1 or higher electricity access

<sup>7</sup> Typically 101-500 Wp; capable of powering multiple appliances; requires small inverter

<sup>8</sup> Typically greater than 500 Wp; most often used to power a large home; requires large inverter

Multi-tier Matrix for Measuring Access to Household Electricity Supply

		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5	
ATTRIBUTES	1. Peak Capacity	Power capacity ratings <sup>28</sup> (in W or daily Wh)	Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW	
			Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh	
		OR Services	Lighting of 1,000 lmhr/day	Electrical lighting, air circulation, television, and phone charging are possible				
	2. Availability (Duration)	Hours per day	Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs	
		Hours per evening	Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs	
	3. Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs
	4. Quality						Voltage problems do not affect the use of desired appliances	
5. Affordability						Cost of a standard consumption package of 365 kWh/year < 5% of household income		
6. Legality						Bill is paid to the utility, pre-paid card seller, or authorized representative		
7. Health & Safety						Absence of past accidents and perception of high risk in the future		

Source: World Bank Energy Sector Management Assistance Program (ESMAP)

## WEST AFRICA AND THE SAHEL

The term “West Africa and the Sahel” as it is used to throughout this report refers to the 19 countries covered by the first phase of the Regional Off-Grid Electrification Project (ROGEP). The countries include the 15 member states of the Economic Community of West African States (ECOWAS) – Benin, Burkina Faso, Cabo Verde, Côte d’Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo – plus Cameroon, Central African Republic, Chad and Mauritania.

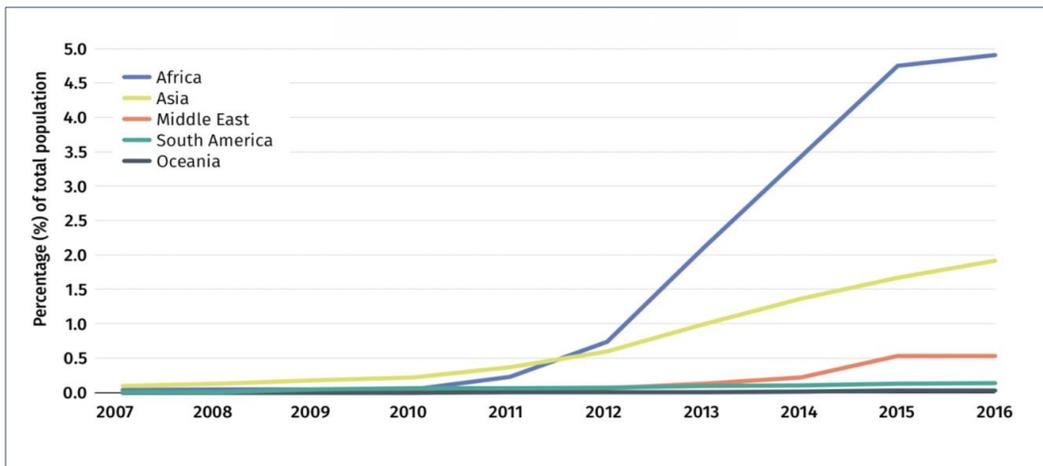


**EXECUTIVE SUMMARY**

**I. INTRODUCTION**

Access to electricity in Sub-Saharan Africa has improved significantly over the past decade. The number of people without access to electricity in the region stopped increasing for the first time in 2013 and has since declined.<sup>9</sup> Although grid connections continue to be the primary method of electrification, access to electricity through off-grid renewable energy systems has grown considerably. The use of off-grid solar (OGS) power is notably on the rise, with African countries accounting for most of the sector’s growth over the last decade (**Figure ES-1**). The pace of solar electrification has accelerated more rapidly in Sub-Saharan Africa than anywhere in the world.<sup>10</sup> In order to achieve universal electrification by 2030, the International Energy Agency (IEA) estimates that Sub-Saharan Africa will need more than half of new electricity access connections between 2017 and 2030 to be made through decentralized systems (mini-grids and stand-alone systems), with solar technologies representing nearly 60% of these connections.<sup>11</sup>

Figure ES-1: Off-Grid Solar Access Rate by Region



Tier 1 access and above

Source: International Renewable Energy Agency

Despite this progress, government efforts to increase electricity access in Africa have struggled to keep pace with rapid population growth and increasing demand. Many countries across the region must navigate the interrelated challenges of energy poverty, energy security and climate change (among other sociopolitical, economic and development challenges), which collectively slow the adoption of renewable energy and the pace of off-grid market growth. Rates of energy access remain particularly low in rural areas, where the electrification rate is less than 25% across Sub-Saharan Africa.<sup>12</sup> In part, this is due to the gap between the power sector’s infrastructure needs and the availability of necessary resources to expand grid electrification. Extending the grid to rural areas can be challenging due to significant transmission distances and low population densities.

<sup>9</sup> “Energy Access Outlook, 2017: From Poverty to Prosperity,” International Energy Agency, (2017):

[https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_EnergyAccessOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf)

<sup>10</sup> “Tracking SDG7 – The Energy Access Report 2018,” The World Bank, IEA, IRENA, UN Statistics Division and the WHO, (2018):

<https://openknowledge.worldbank.org/handle/10986/29812>

<sup>11</sup> Tracking SDG7 – The Energy Access Report, 2018.

<sup>12</sup> IEA Energy Access Outlook, 2017.

As of 2016, over 200 million people in West Africa and the Sahel – more than half of the region’s population – lacked access to electricity. This figure represents nearly one-third of Africa’s total unelectrified population. Rates of urban and rural electrification vary widely across the region, with the average rate of access nearly three times higher in urban areas.<sup>13</sup>

Despite these access deficits, the region is generously endowed with renewable energy resources – including hydropower, solar, wind and bioenergy. These resources are largely untapped, however, as investments in the power sector remain high-risk due to market instability, as well as a variety of political and regulatory risks. Other energy sector challenges include *inter alia* limited institutional capacity, poor utility financial performance, a shortage of local technical expertise and a lack of support from local financial institutions (FIs).

Until recently, diesel generators largely served as the expensive alternative both for rural electrification and for urban and peri-urban “bad grid” areas, where electricity was unreliable or only available for part of the day. However, the advent of decentralized renewable energy technologies, particularly stand-alone solar and mini-grid systems, offers opportunities to deliver clean and cost-effective off-grid solutions. Accordingly, policymakers are increasingly utilizing these options in electrification planning as they offer a reliable, flexible and relatively affordable complement to grid extension initiatives.

Solar energy is the most promising technology in the off-grid space, with three key trends converging to drive the industry’s growth: first, continued reductions in hardware and balance of system costs (solar modules, batteries, inverters, appliances etc.); second, a digital revolution, with mobile communication technology facilitating payments and monitoring; and third, innovation in private sector business models, such as pay-as-you go (PAYG) and third-party ownership of solar home systems (SHS), which offer energy as a service and remove previously prohibitive up-front costs for households.<sup>14</sup> As a result of these developments, the off-grid solar market is rapidly evolving and expanding.

In 2016, the OGS market reported global revenues of approximately USD 1 billion. This figure is expected to increase to USD 8 billion by 2022, with SHS representing the majority of this revenue growth and an increasing share of unit sales (**Figure ES-2**). Investments in the off-grid solar sector doubled annually between 2012 and 2016, increasing by 98% over this period. Between 2013 and 2017, East Africa represented 86% of the global PAYG market in terms of cumulative unit sales, followed by West Africa at 12% and Asia at 2%.<sup>15</sup> As the East African market becomes more crowded and solar companies expand their operations into West Africa, the region will account for a larger geographic share of the burgeoning global OGS market. Although the sector’s investment trends remain volatile, there is some preliminary evidence to suggest that this transition is already underway: in 2016, West Africa accounted for 34% of total funds raised, up from 9% in 2015, while East Africa’s share of funding decreased from 77% to 47% over the same period.<sup>16</sup>

<sup>13</sup> IEA Energy Access Outlook, 2017.

<sup>14</sup> “Derisking Renewable Energy Investment: Off-Grid Electrification,” United Nations Development Programme (UNDP) and ETH Zurich, (December 2018):

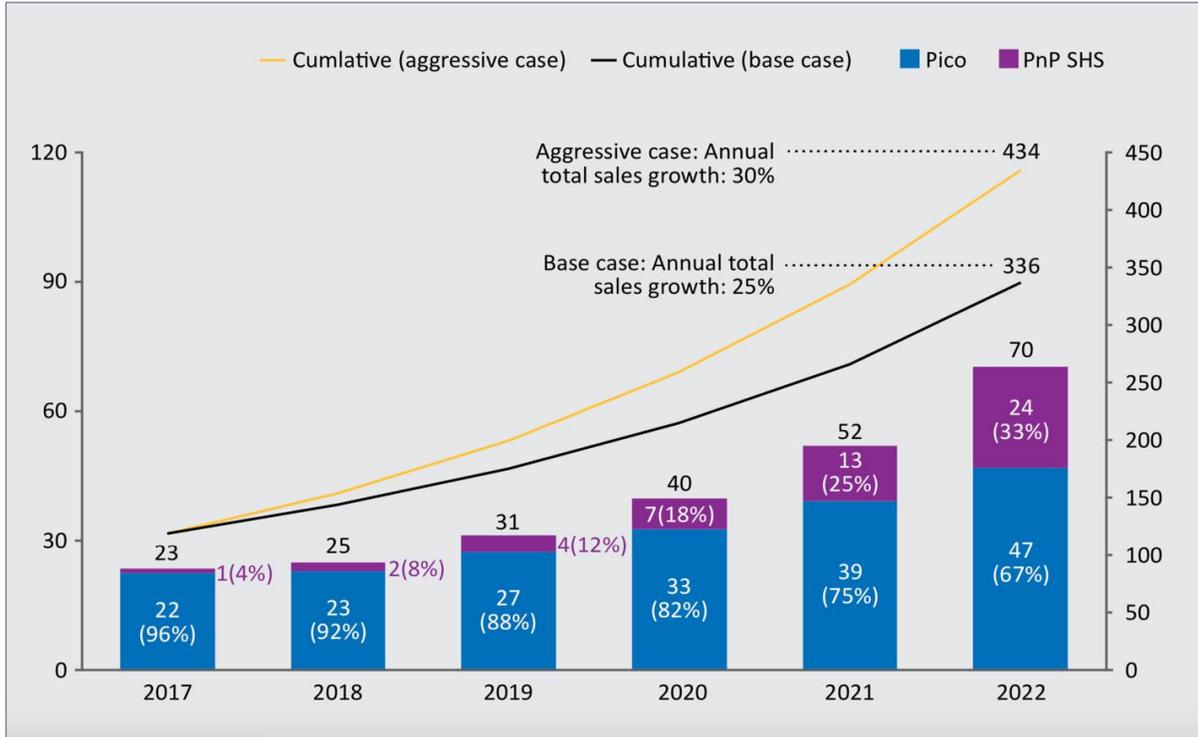
[https://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Strategies/DREI%20Off-Grid%20Electrification%20-%20Full%20Report%20\(20181210\).pdf](https://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Strategies/DREI%20Off-Grid%20Electrification%20-%20Full%20Report%20(20181210).pdf)

<sup>15</sup> “Off-Grid Solar Market Trends Report 2018,” Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018):

[https://www.lightingafrica.org/wp-content/uploads/2018/02/2018\\_Off\\_Grid\\_Solar\\_Market\\_Trends\\_Report\\_Full.pdf](https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf)

<sup>16</sup> Ibid.

Figure ES-2: Global Off-Grid Solar Market Forecast (million units sold)



NOTE: Left axis = annual sales volume; Right axis = cumulative sales volume; PnP SHS = Plug-and-Play Solar Home System

Source: Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP

Many international off-grid solar companies, including most of the industry’s leading players – BBOXX, Greenlight Planet, Azuri, d.light, Off-Grid Electric, M-KOPA Solar, Fenix International, and French utilities EDF and Engie among others – have recently entered markets in West Africa, joining international pioneers such as PEG and Lumos, which launched originally in Ghana and Nigeria, respectively, and both expanded into Côte d’Ivoire and Togo.<sup>17</sup> While these large international companies are well capitalized, there is a dearth of financing for smaller, early-stage companies that operate in nascent markets across West Africa and the Sahel. In fact, the top 10 global off-grid solar companies have received nearly 90% of investment capital since 2012, while early-stage companies often struggle to raise the necessary capital to accelerate growth.<sup>18</sup>

In order to scale off-grid electrification, OGS companies will need to access large volumes of commercial debt financing. In the longer term, partnerships with local commercial banks and microfinance institutions (MFIs) will also be necessary in order to develop domestic, local-currency sources of financing and reduce foreign exchange risk.<sup>19</sup> Partnerships with local FIs, whose understanding of the credit risk of local populations, may also reduce financing costs more rapidly compared to other methods (e.g. using debt from securitized receivables).<sup>20</sup> Although most financing currently comes from non-commercial sources (i.e. the

<sup>17</sup> Bavier, J., “Off-grid power pioneers pour into West Africa,” Reuters, (February 20, 2018):

<https://www.reuters.com/article/us-africa-power-insight/off-grid-power-pioneers-pour-into-west-africa-idUSKCN1G41PE>

<sup>18</sup> “Accelerating Energy Access: The Role of Patient Capital,” Acumen, (2018): <https://acumen.org/wp-content/uploads/Accelerating-Access-Role-of-Patient-Capital-Report.pdf>

<sup>19</sup> UNDP and ETH Zurich, 2018.

<sup>20</sup> “How can Pay-As-You-Go Solar Be Financed?” Bloomberg New Energy Finance, (7 October 2016):

[https://www.bbhuh.io/bnef/sites/4/2016/10/BNEF\\_WP\\_2016\\_10\\_07-Pay-as-you-go-solar.pdf](https://www.bbhuh.io/bnef/sites/4/2016/10/BNEF_WP_2016_10_07-Pay-as-you-go-solar.pdf)

international development community), global capital markets have the size and depth necessary to meet this investment challenge. Nevertheless, small investment sizes and other early-stage market investment risks are currently holding back abundant and low-cost private capital flows to the off-grid sector.<sup>21</sup>

In order to mitigate risks and spur investment, the OGS sector requires substantial policy and regulatory support. It is therefore important that governments send a clear signal to the private sector by integrating off-grid technologies into national development programs, electrification plans and electricity access targets. Governments should also adopt favorable policies, laws and regulations to boost private sector participation, including procurement and tax incentives, grants and subsidies, concession schemes, streamlined licensing and permitting procedures, and quality standards for equipment. Additional measures include public awareness raising, encouraging inclusive gender participation, and building local capacity at all levels (e.g. solar photovoltaic (PV) vocational training and technical certification programs, training for FIs to address unfamiliarity of lenders with off-grid solar sector, corporate and consumer financing needs etc.).

In addition, solar companies increasingly rely on mobile money platforms to scale their business, as mobile payments allow them to offer low-income customers new ways to access and pay for electricity through innovative business models such as PAYG. Mobile money services, however, are only just beginning to be deployed in West Africa and the Sahel. Solar companies are therefore limited by low levels of penetration and in some cases by country-specific regulatory restrictions.<sup>22</sup> Governments can take action to foster linkages between the off-grid solar, telecommunications and mobile money sectors to expedite the uptake of market-transforming technology platforms and business models.

Governments across West Africa and the Sahel have implemented a range of policies and approaches to support off-grid market development, including private concessions, Public Private Partnerships (PPPs), Rural Electrification Agencies (REAs) and Rural Electrification Funds (REFs), among other measures. Some countries like Senegal and Mali have adopted private concessions to scale up mini-grids in rural areas, while others, such as Nigeria and Ghana, have improved rural electrification largely through public investment.

To support these initiatives, ECOWAS adopted the ECOWAS Renewable Energy Policy (EREP) in 2013, which intends to achieve universal electricity access in the region by 2030. The EREP also aims to increase the share of the region’s rural population served by decentralized renewable energy services (mini-grids and stand-alone systems) to 25% by 2030. The ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE) is working with member states to develop and implement national policies and strategies with electrification targets through 2030 in line with the EREP, including Sustainable Energy for All (SEforALL) Action Agendas and National Renewable Energy Action Plans (NREAP), among other programs in support of renewable energy and off-grid market development.<sup>23</sup>

<sup>21</sup> UNDP and ETH Zurich, 2018.

<sup>22</sup> “Scaling Access to Energy in Africa: 20 Million Off-Grid Connections by 2030,” Scaling Off-Grid Energy: A Grand Challenge for Development, USAID, UK DFID, Shell Foundation, (2018): [https://static.globalinnovationexchange.org/s3fs-public/asset/document/SOGE%20YIR\\_FINAL.pdf?uwUDTyB3ghxOrV2gqvsO\\_r0L5OhWPZZb](https://static.globalinnovationexchange.org/s3fs-public/asset/document/SOGE%20YIR_FINAL.pdf?uwUDTyB3ghxOrV2gqvsO_r0L5OhWPZZb)

<sup>23</sup> ECOWAS Renewable Energy Policy, 2013:

[http://www.ecreee.org/sites/default/files/documents/ecowas\\_renewable\\_energy\\_policy.pdf](http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf)

## II. BACKGROUND AND CONTEXT OF THE ASSIGNMENT

In this context, with funding from the World Bank, ECREEE launched the Regional Off-Grid Electrification Project (ROGEP) in 19 countries in West Africa and the Sahel. The project aims to enhance shared capacity, institutions and knowledge in order to increase electricity access of households, businesses and public institutions using modern stand-alone solar systems through a harmonized regional approach. ROGEP has two main components/objectives:

✓ **Component 1: Accelerate development of a regional off-grid solar market:**

- (1A) Foster regional collaboration and promote a supportive enabling environment for the OGS sector;
- (1B) Provide entrepreneurship technical support to OGS companies at various stages of development (training to accelerate business growth and/or facilitate market entry);
- (1C) Provide entrepreneurship financial support to OGS companies at various stages of development (matching grants);
- (1D) Provide financing to remove barriers in challenging markets (market entry grants and performance grants to OGS companies operating in challenging markets)

✓ **Component 2: Facilitate access to financing for off-grid solar businesses:**

- (2A) Provide line of credit for OGS businesses via the West African Development Bank (Banque Ouest Africaine de Développement, BOAD) to be extended to local FIs for on-lending to local entrepreneurs (working capital for companies to finance equipment imports, receivables from PAYG schemes etc.)
- (2B) Implement contingent grant facility via BOAD to share risks with local FIs and encourage lending to OGS businesses.

In addition, the project intends to support a range of capacity building activities targeting public and private sector stakeholders to address existing policy, regulatory, institutional, financial, economic, business, technology and capacity related barriers. ECREEE will also assist each country with development and implementation of national programs and initiatives in the areas of renewable energy, rural electrification and energy access in line with the regional focus of the assignment.

Under the first phase of the project, an initial assessment of the off-grid solar market was undertaken in each of the 19 countries. The study focused exclusively on the stand-alone solar PV market and did not assess mini-grids (see **Key Definitions**). The scope of work was broadly divided into the following tasks:

- (1) Review the current enabling policy and market environment for the off-grid solar sector
- (2) Analyze the market for off-grid solar products and systems, including an estimate of demand from the household, institutional and productive use market segments and analysis of the supply chain;
- (3) Assess the willingness and capacity of national and regional FIs to provide commercial and/or consumer financing to the off-grid solar sector; and
- (4) Propose models to incentivize the private sector and FIs to support off-grid solar market development and to harmonize a regional market to achieve universal access.

Available geographic information system (GIS) data for each country supported the Task 1 and Task 2 analyses. A least-cost electrification analysis was undertaken utilizing geospatial mapping to assess the potential development of electricity access and grid coverage in each country through 2023 and 2030. The study estimated the total number of potential settlements, people and households electrified by on-grid, mini-grid or off-grid stand-alone solutions under each timeframe based on a series of indicators, including national electricity grid proximity, population density and nodes of economic growth. The assessment was

also performed for health facilities and education centers (although the analysis was limited by the availability and/or quality of GIS data for these market segments). The results of the analysis were used to estimate the share of the population suitable for off-grid stand-alone solar solutions over the analyzed periods and to assess corresponding potential demand from the household sector under the Task 2 market sizing.

Within the context of this assignment, a gender-focused analysis was also implemented in order to assess the level of female participation in each country’s off-grid energy sector. Each stage of the market study therefore analyzed inclusive participation and gender implications. A comprehensive gender profile is presented in **Annex 4**, including a summary of findings, as well as recommendations to improve gender equality and enhance women’s engagement in development of the off-grid sector.

To carry out these tasks, the project team utilized a combination of desk research, input from local country experts and feedback from engagement with a wide range of stakeholders at the country and regional levels. Interviews were conducted with policymakers, industry experts, and representatives from solar companies and FIs. Focus group discussions were also held in each country with key stakeholders from the four market segments analyzed under Task 2 (household, institutional, productive use and supplier). Focus group participants included representatives from government, the donor community, NGOs, solar companies, business and industry associations, academia, community groups, and women’s groups. In addition to the focus group meetings, surveys were administered in order to collect additional Task 2 market data, including (i) a survey of international solar companies to gauge their level of interest in the region; (ii) a survey of local solar companies and retail suppliers in each country to inform the supply chain analysis; and (iii) an assessment of an off-grid village in each country to better understand how solar is being utilized for productive uses. Under Task 3, a survey was administered to local and regional FIs to determine their level of capacity and interest in lending to the off-grid solar sector. A detailed description of the methodology used to carry out these tasks is presented in **Annexes 1-3**.

This report is organized into three sections that correspond to Tasks 1-3 described in the scope of work above (Task 4 was prepared in a separate report). **Section 1** covers the enabling policy and market environment for the OGS sector. This includes an overview of the status of the on-grid and off-grid markets, an analysis of off-grid energy policy and regulation and gaps in the existing framework, and a summary of off-grid development initiatives. The results of the least-cost electrification analysis are also included in this section.

**Section 2** estimates the potential market for off-grid solar products and systems by assessing potential demand from the household, institutional and productive use market segments (**Figure ES-3**), followed by an analysis of the supply chain. The household market sizing utilizes results from the least-cost electrification analysis, along with data on household income and energy expenditure, in order to estimate potential demand based on the number of households able to afford various OGS systems. Both the cash and financed market potential were estimated for 2018, 2023 and 2030.

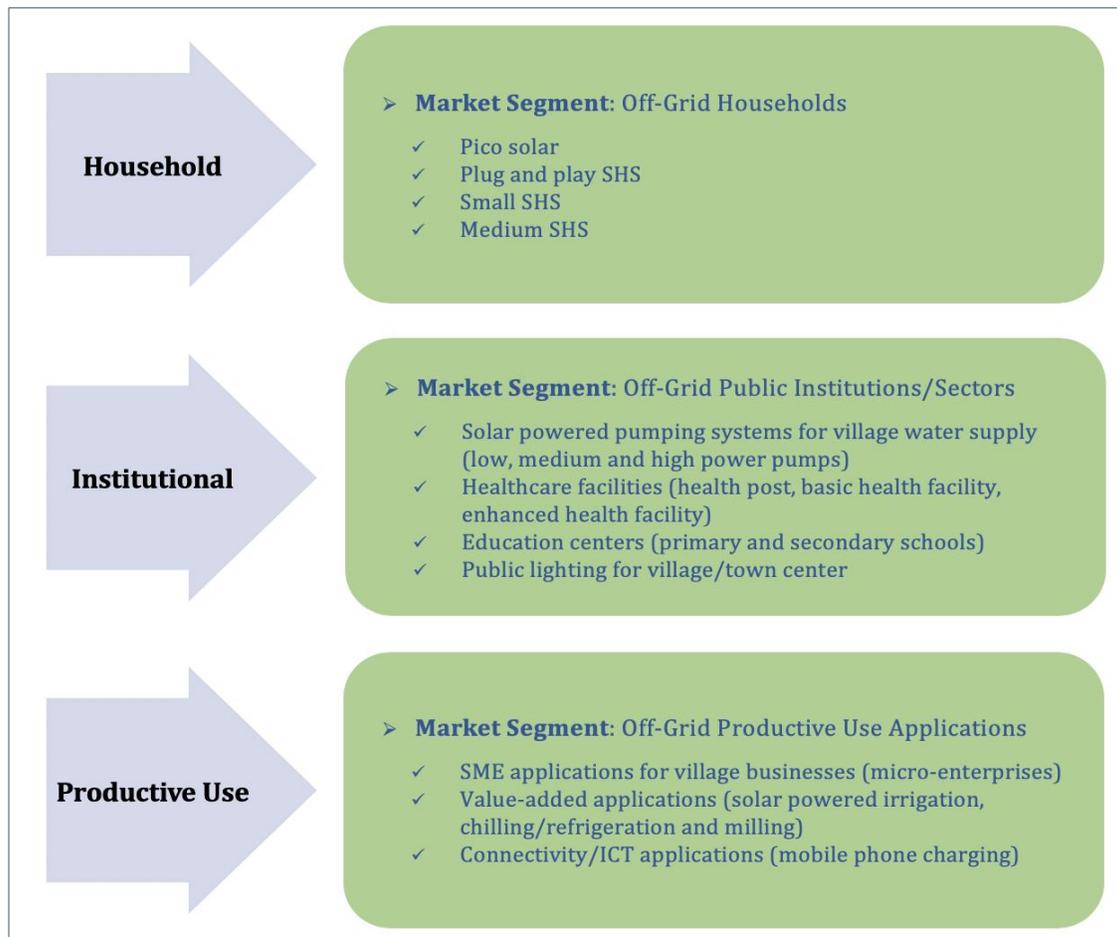
The institutional sector analysis combines available GIS data with secondary research to estimate potential demand based on assumptions about the electricity needs, usage patterns and associated costs of solar electrification of four public/institutional markets – water supply for off-grid communities, healthcare facilities, education centers (primary and secondary schools) and public lighting. Where GIS data was unavailable, per capita comparisons were made using data from similar countries to estimate off-grid solar demand by market segment (see **Annex 2** for country categorization). The productive use of energy (PUE) market sizing estimates potential off-grid solar demand for SME, value-added and connectivity applications. Feedback from stakeholder interviews and focus group discussions informed the analysis and

helped characterize each market segment’s consumer perceptions, interest, awareness, ability to pay and access to finance.

The Task 2 supply chain analysis presents an overview of key market actors, solar products and services, sales figures and business models, and includes a discussion of the role of informal market players and the impact of uncertified products. The analysis also addresses the capacity needs of the supply chain and describes specific areas of support where technical assistance is needed to accelerate market growth.

**Section 3** assesses the willingness and capability of national and regional FIs to provide commercial and/or consumer financing to the off-grid solar sector in each country. This section includes a summary of financial products for the off-grid sector, a comprehensive overview of each country’s financial market and commercial lending environment (including analysis of commercial banks, microfinance institutions and other non-bank FIs) and any programs supporting off-grid solar lending. This section also examines the scope of financial inclusion in each country and the impact of digital financial services and mobile money on access to finance. It concludes with the results of surveys that were administered to FIs in each country across the region.

Figure ES-3: Analyzed Off-Grid Market Segments



NOTE: SHS = Solar Home System; ICT = Information Communication Technology

### III. EXECUTIVE SUMMARY

The Government of Sierra Leone (GoSL) has made significant progress in consolidating peace and security in the country and in rebuilding the economy following its long civil war. Increased public investment in state-building, infrastructure projects and strengthening of macroeconomic conditions has led to improved economic growth following the 2014 Ebola outbreak, which caused massive disruptions to the country's development efforts. Economic growth is driven mainly by the mining sector, particularly exports of iron ore.<sup>24</sup> This growth has not translated into improvements for the majority of the population, however, as basic social services are inadequate, and poverty remains widespread. More than half of the population lives in rural areas and two-thirds of the country's labor force engages in subsistence agriculture.

Access to electricity remains an ongoing challenge. In 2016, approximately 90% of Sierra Leone's population – an estimated 6 million people – did not have access to electricity, with a disparity in rates of access between urban (12%) and rural (6%) areas.<sup>25</sup> Even where grid connections exist, power supply is often unreliable, with fewer than one-third of firms and households reporting reliable access to electricity when surveyed.<sup>26</sup> Off-grid electrification is a policy priority for the Government, which is committed to achieving universal electricity access by 2025. To date, the Government's efforts to establish a supportive policy and regulatory framework for the off-grid sector are progressing well, as Sierra Leone more than doubled its World Bank Regulatory Indicators for Sustainable Energy (RISE) energy access score between 2015 and 2017.<sup>27</sup> In the 2017 RISE evaluation, Sierra Leone ranked 11<sup>th</sup> among countries in West Africa and the Sahel.

With support from ECREEE, the Government has outlined its commitments and initiatives to develop renewable energy and meet its electrification targets in its SEforALL National Renewable Energy Action Plan (NREAP). In 2017, the Government published the Electricity Sector Reform Roadmap (2017-2030), which provides a detailed framework for development of the country's energy sector over three distinct periods through 2030 – recovery, transition and delivery – each with its own set of reform measures and actions to restructure the power sector and achieve long-term objectives. The roadmap includes a detailed plan to electrify rural areas that are beyond the feasible reach of the grid by utilizing off-grid renewable energy solutions (a combination of mini-grids and stand-alone systems). The strategy also calls for key institutional reforms including the formation of a Rural Electrification Agency and an Energy Management Fund.<sup>28</sup>

This report assesses the market opportunity for off-grid solar products and systems by estimating demand from the household, institutional, and productive use sectors in Sierra Leone (**Figure ES-4**). According to the assessment, there is a significant OGS market opportunity, with the annualized cash market potential in 2018 estimated to be USD 102.5 million. The productive use sector (USD 80.2M) makes up the majority of estimated demand, followed by the household (USD 19.1M) and institutional (USD 3.2M) sectors.

<sup>24</sup> "Sierra Leone Economic Outlook," African Development Bank, (2018): <https://www.afdb.org/en/countries/west-africa/sierra-leone/sierra-leone-economic-outlook/>

<sup>25</sup> IEA Energy Access Outlook, 2017.

<sup>26</sup> Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact," AFD and World Bank, Africa Development Forum, (2019):

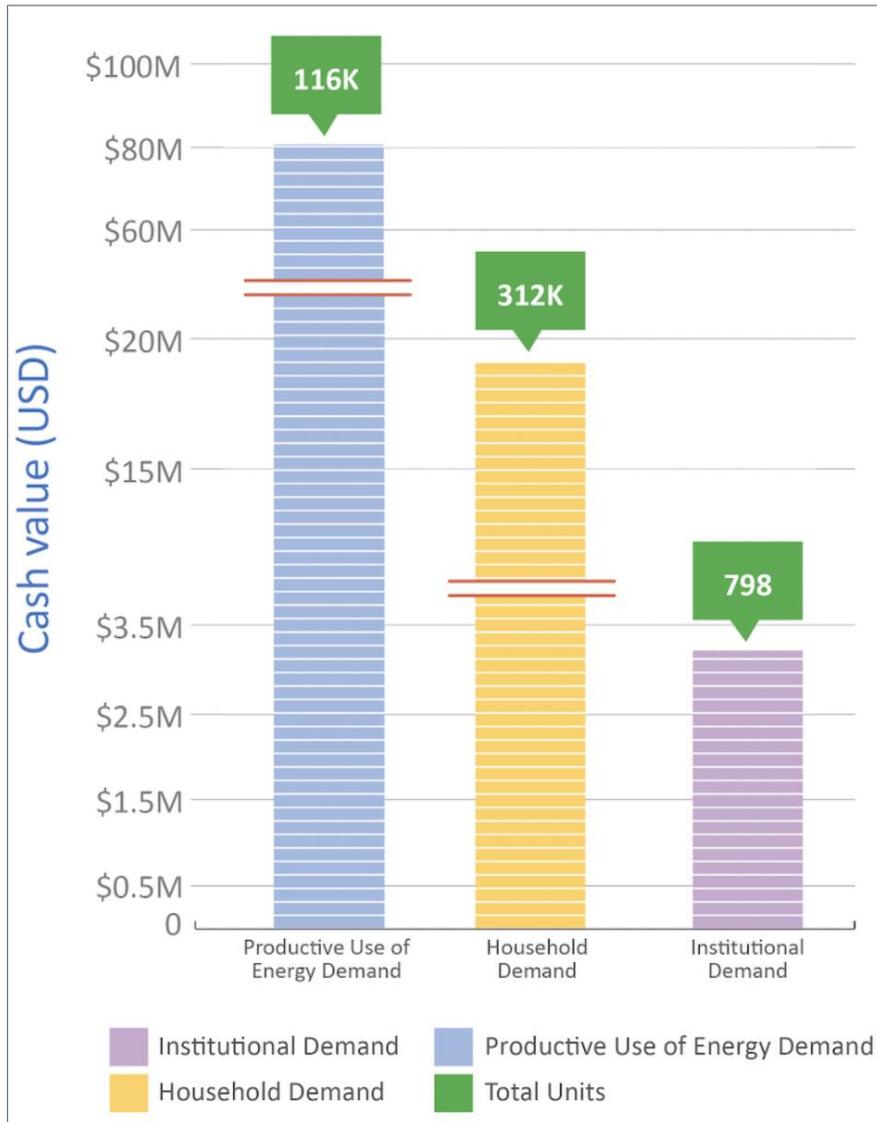
<https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y>

<sup>27</sup> "Policy Matters: Regulatory Indicators for Sustainable Energy," World Bank, (2018):

<http://documents.worldbank.org/curated/en/553071544206394642/pdf/132782-replacement-PUBLIC-RiseReport-HighRes.pdf>

<sup>28</sup> "Electricity Sector Reform Roadmap (2017-2030)," Millennium Challenge Corporation, (2017): <http://www.mccu-sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf>

Figure ES-4: Indicative Total Cash Market Potential for Off-Grid Solar Products in Sierra Leone, 2018

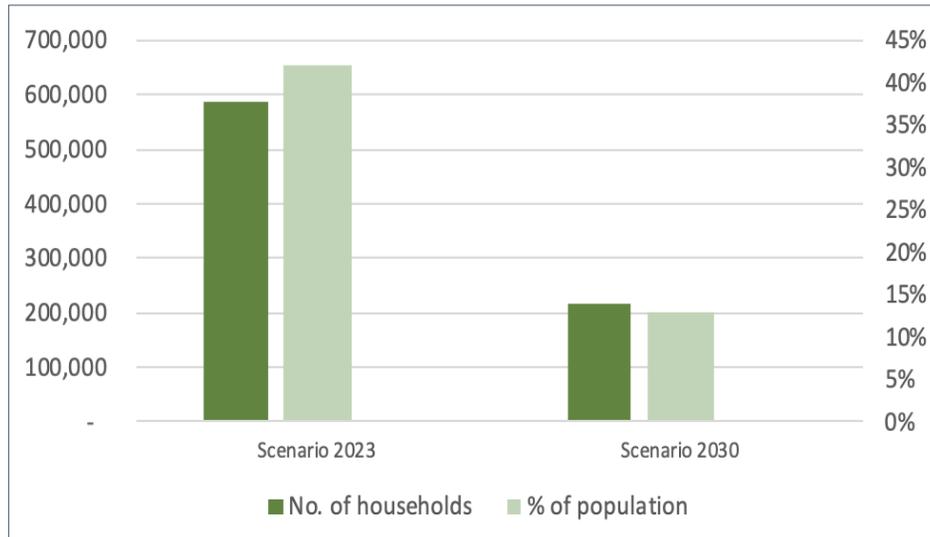


Source: African Solar Designs analysis

The least-cost electrification analysis found that by 2023, 695 settlements across Sierra Leone (373,496 households) will be connected to the main grid, representing 26.9% of the population. By 2030, this figure will increase to 5,461 settlements (1,031,290 households), equivalent to 61.9% of the population. These estimates are based on the assumption that all planned grid extensions will be completed by 2030.

In the off-grid sector, the analysis identified 8,064 settlements (585,908 households) and 42.1% of the population as suitable for off-grid stand-alone systems in 2023, decreasing to 2,939 settlements (216,581 households) and 13% of the population in 2030 (**Figure ES-5**). While the total size of the OGS market for households will decrease over time, it will also become more concentrated in remote regions in the northeast of the country. This trend has implications for long-term business models of the solar product market, which will need to consider broader distribution areas as the total number of off-grid households declines and becomes concentrated in areas far from urban centers.

Figure ES-5: Estimated Number of Households and Share of Population Suitable for OGS Systems in Sierra Leone, 2023 and 2030

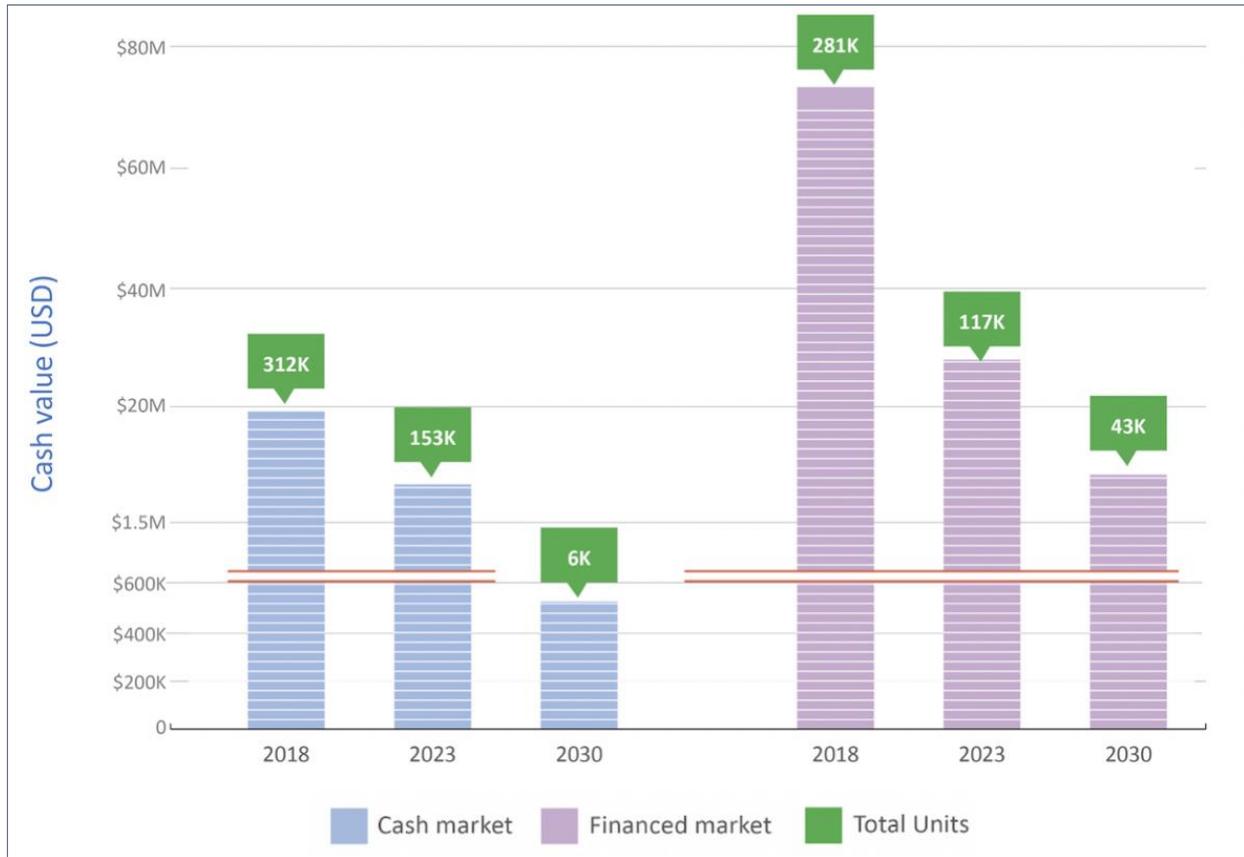


Source: Energio Verda Africa GIS analysis

According to the analysis, the annualized off-grid solar cash market potential for the household sector in 2018 is USD 19.1 million, with the estimated market value increasing nearly fourfold in size to USD 73.3 million with the addition of consumer financing (**Figure ES-6**). Consumer financing allows the poorest households to enter the market and those already in the market to afford larger systems.

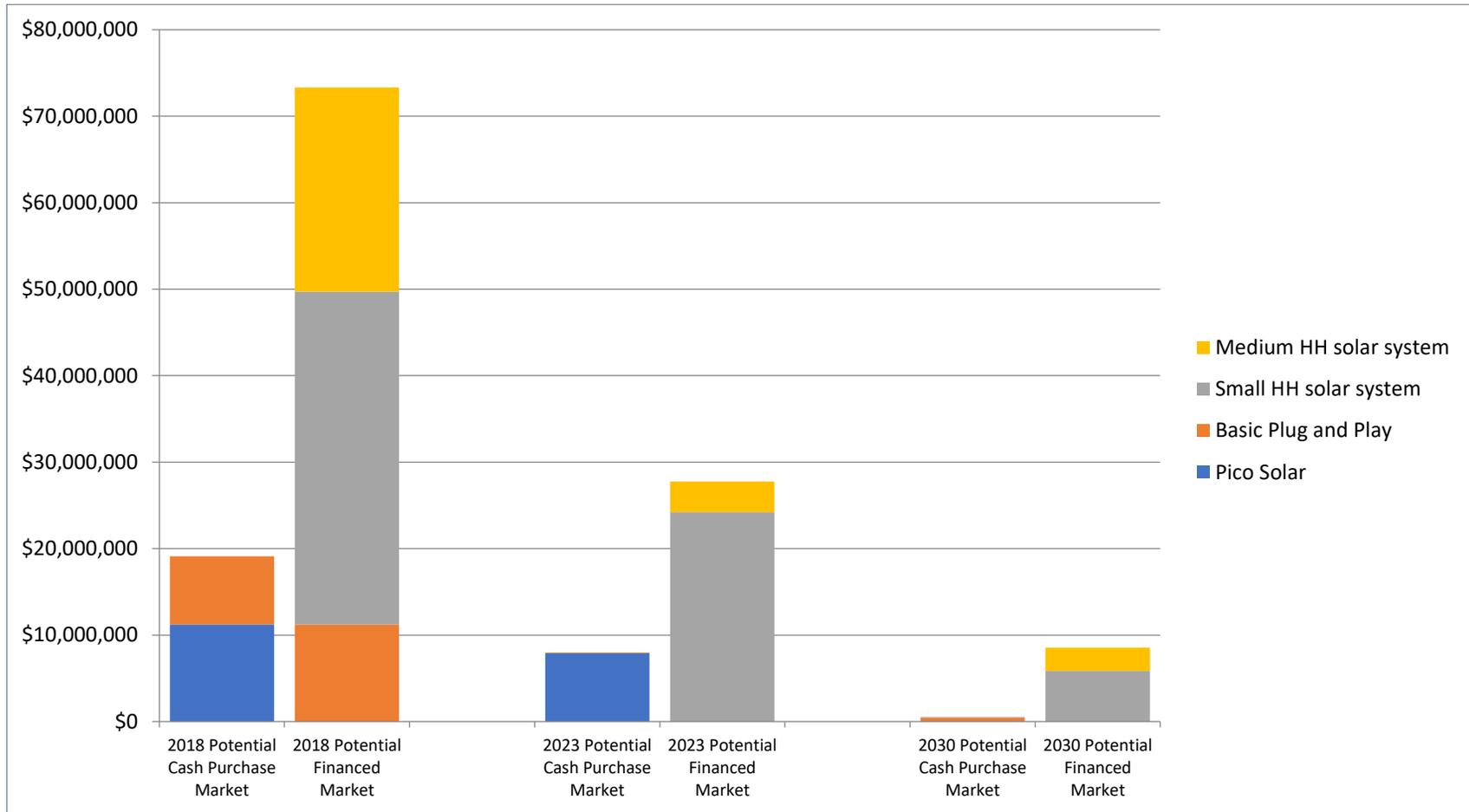
According to the assessment, the most common types of systems the market can afford on a cash basis are pico solar and small plug and play systems; however, this changes significantly with the introduction of financing (**Figure ES-7**). While affordability improves over time, households in the lowest income quintiles cannot afford any off-grid solar products without financing. Consumer financing will therefore prove critical for accelerating off-grid solar market growth and meeting electrification targets through 2030.

Figure ES-6: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector



Source: African Solar Designs analysis

Figure ES-7: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type



Source: African Solar Designs analysis

Figure ES-8: Estimated Off-Grid Solar Cash Market Potential for Institutional Sector



Source: African Solar Designs analysis

The estimated annualized cash market potential for Sierra Leone’s public/institutional sector in 2018 is USD 3.2 million (Figure ES-8). The institutional market segment with the largest potential is water supply (USD 2.2M), followed by education (USD 552K), healthcare (USD 356K) and public lighting (USD 55K). The water supply sector analysis identified off-grid water points such as boreholes and wells that could benefit from solar technology for water pumping. The healthcare sector analysis identified off-grid health facilities categorized by their size (from basic clinics to enhanced health facilities) that could be electrified by stand-alone systems. The education sector analysis identified primary and secondary schools that could be electrified by stand-alone systems. The public lighting analysis assessed the lighting needs for off-grid villages and market centers (excluding street lighting).

According to the analysis, the annualized off-grid solar cash market potential for the productive use sector in 2018 is USD 80.2 million (Figure ES-9). The estimated demand from value-added applications represents most of the PUE market potential (USD 76.9M), followed by applications for connectivity (USD 2.9M) and SMEs (USD 363K).

Figure ES-9: Estimated Off-Grid Solar Cash Market Potential for Productive Use Sector



Source: African Solar Designs analysis

The value-added applications that were analyzed include solar pumping for agricultural irrigation, solar powered milling and solar powered refrigeration. The assessment utilized a series of inputs, including data from the UN’s Food and Agriculture Organization on national agricultural production, as well as applicable solar technologies to support income generation for small shareholder farmers (i.e. solar pumps, mills, and refrigeration systems). Access to energy for agriculture is critical for the country’s economic development, particularly given the sector’s importance to GDP.

Off-grid solar power supports a wide range of connectivity applications, including mobile phone charging, wi-fi servers, banks, mobile money kiosks, and telecommunications towers. Mobile phone and internet connectivity are also necessary pre-cursors to mobile money and PAYG solutions in the off-grid solar sector. The market sizing examined mobile phone network coverage as well as rates of mobile phone

ownership and mobile internet penetration to estimate the market potential for mobile phone charging enterprises (stations/kiosks).

The calculation of the estimated off-grid solar market for SMEs focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit significantly from extended working hours and the use of modern appliances/machinery. The estimated demand for this market segment is therefore intended to provide a baseline for future research, as a more robust analysis would be necessary to assess realistic demand from all SMEs.

It should be noted that the Task 2 market sizing assesses the total *potential* demand for off-grid solar, as well as variables that affect demand, such as changes in population density, household income, expansion of national grids and access to finance, among other factors. This data will support policymakers and practitioners as they assess market potential over time. However, the quantitative demand estimate has not been revised to reflect *realistic* market potential. Many other factors and market failures will prevent the full realization of this total market potential, and these will vary by market segment.

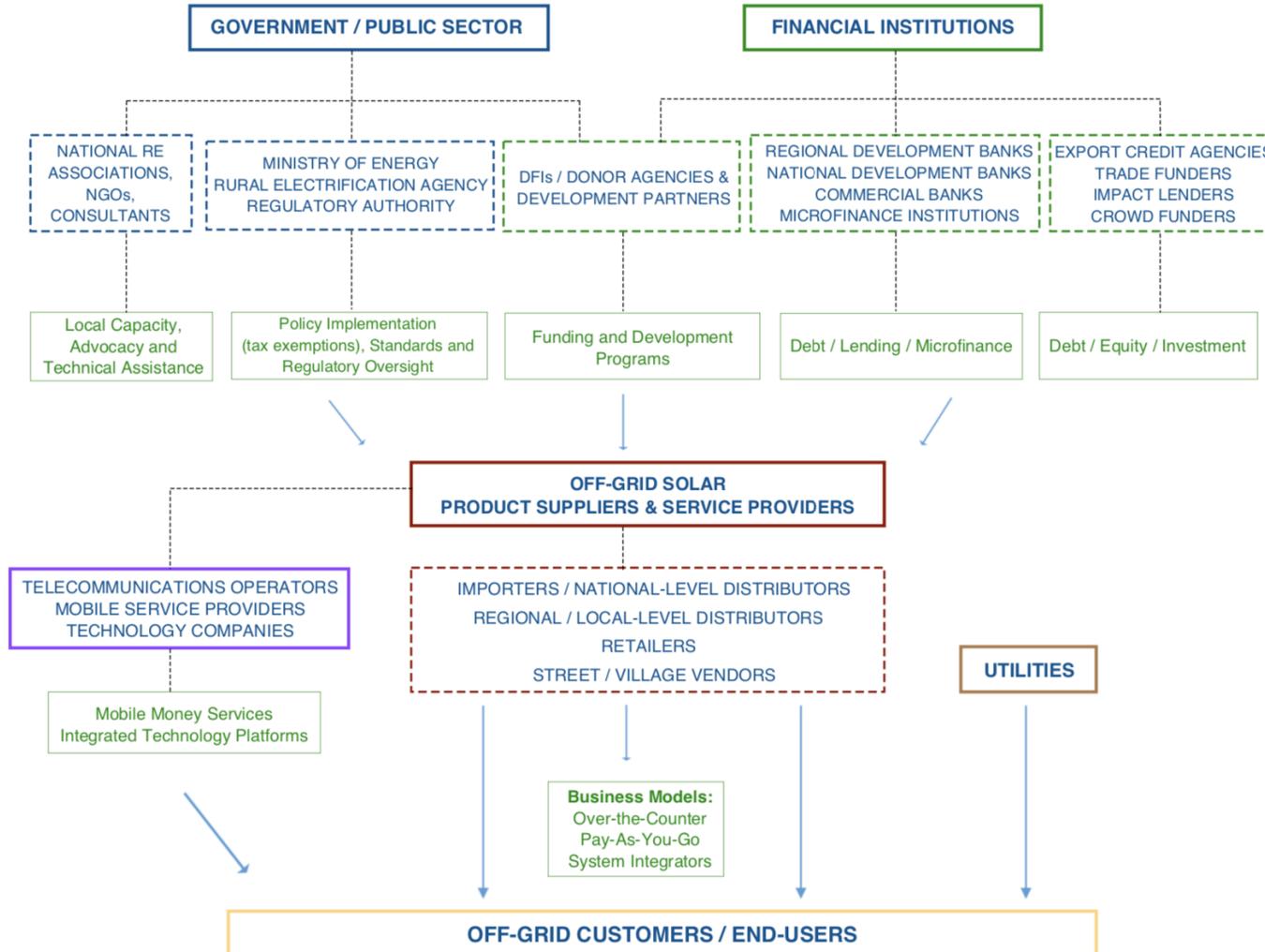
For household demand, the off-grid solar market is already tangible. Still, many factors will affect household demand for solar products, such as distribution realities, consumer education, competing economic priorities for households, financial shocks, etc. The institutional market will be affected largely by government and donor budget allocations along with the potential for community-based finance. The productive use market is perhaps the least concrete. Considered a relatively new market segment for the off-grid solar industry, productive use market dynamics are not yet well understood. The ability to realize potential productive use market demand will also be affected by many of the factors that commonly determine enterprise prospects in the country, including infrastructure, rural distribution, marketing, access to finance, insecurity, regulation, etc. The data presented in this report is intended to provide a baseline for future research.

Following the estimates of market demand, this report analyzes the supply chain for off-grid solar products and services in Sierra Leone, which includes a wide range of stakeholders, including importers, distributors, wholesalers, retailers and end-users (**Figure ES-10**). The country has a small but quickly growing solar market, which is made up of both formal and informal companies that offer a variety of solar products and systems and deploy several business models. Rural households make up the main market for OGS products in the country, as the demand for lighting products and household electrical appliances is growing. Nevertheless, urban households, both electrified and non-electrified, are also a key consumer market, as they may have greater ability to afford solar products and systems.

The off-grid solar supply chain faces several barriers, including competition from the informal market. The widespread sale of low-quality, uncertified products undermines consumer confidence in solar equipment, undercuts the prices of sellers of quality-verified products and hinders overall OGS market growth. There are also a number of interrelated challenges and capacity building needs of the supply chain, including financial, capacity, awareness and regulatory challenges.

Sierra Leone's nascent solar market is poised to grow if requisite technical assistance is provided to the supply chain. To operate effectively, companies need a significant amount of both local and international technical and financial expertise, as well as an ability to make practical decisions about their operations. Companies must manage a number of technical competency requirements, including the selection of business models, importation and distribution channels, solar PV technologies, as well as the design and implementation of associated marketing instruments and related initiatives.

Figure ES-10: Off-Grid Solar Market and Supply Chain Overview



Source: GreenMax Capital Advisors

Local industry and supply-chain stakeholders who participated in the Task 2 focus group discussions and surveys identified the following key barriers to and drivers of OGS market growth in Sierra Leone:

Key Barriers to Off-Grid Solar Market Growth
• Low consumer purchasing power and lack of consumer financing options
• Low levels of consumer awareness of solar solutions, particularly in rural areas
• Lack of financing for solar companies
• Informal sector competition and market spoilage
• Lack of local capacity/qualified technicians to maintain systems
• High transaction costs associated with equipment inventory, distribution, importation, taxation etc.
• Insufficient or fragmented market data on consumer electricity needs, usage or experience
Key Drivers of Off-Grid Solar Market Growth
• Strong off-grid electricity demand
• Government policy and action is supportive of the industry, which helps attract substantial/sustained investment to the market
• Growing penetration of mobile money services allows OGS companies to increasingly utilize integrated technology platforms and innovative business models to offer PAYG consumer financing solutions to the market
• Extensive private sector engagement in development of the off-grid sector, with companies adopting new business models and strategies to attract external investment and expand their operations
• Strong donor presence and support from the international development community provides confidence that the market will continue to receive financial, policy and technical support necessary to develop (e.g. CEADIR)

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

Access to financing is critical for off-grid solar market growth. Solar companies need financing for working capital needs, while off-grid solar consumers need financing for the purchase of systems. This report analyzes the willingness and capacity of national and regional financial institutions to provide financing to businesses and consumers in Sierra Leone and throughout the region to support development of the OGS sector. In addition to commercial banks and microfinance institutions, impact investors and crowd funders are also active in several markets across the region.

Financial inclusion remains a significant challenge in Sierra Leone. In 2017, only 20% of the population had an account with a formal financial institution or with a mobile money service provider, compared to an average of 33% in the West Africa and Sahel region and 43% in Sub-Saharan Africa. There is also a significant financial inclusion gender gap in the country, as women in Sierra Leone are 10% less likely than men to have an account at a financial institution or with a mobile money service provider.<sup>29</sup> Levels of access are lower for women (15.4%), the poorest 40% of the population (12.9%), and those living in rural areas (14.4%). The use of formal financial services remains especially low, with only about 5% of the population making use of formal institutions for borrowing or saving.<sup>30</sup> In an effort to address this issue, the Bank of Sierra Leone (BSL) launched the National Strategy for Financial Inclusion (NSFI) 2017–2020 with the objective of making financial services available, accessible and affordable to all Sierra Leoneans and MSMEs, and support inclusive and resilient private-sector-led growth.<sup>31</sup>

Although access to banking and financial services through formal institutions remains limited, Sierra Leone is experiencing a rapid increase in the availability and usage of digital financial services and mobile

<sup>29</sup> Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., “The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution,” World Bank, (2017): <http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf>

<sup>30</sup> “Sierra Leone Financial Inclusion Project: Combined Project Information Documents / Integrated Safeguards Datasheet,” World Bank, (November 2018): <http://documents.worldbank.org/curated/en/311571542650741656/pdf/Project-Information-Documents-Integrated-Safeguards-Data-Sheet-Sierra-Leone-Financial-Inclusion-Project-P166601.pdf>

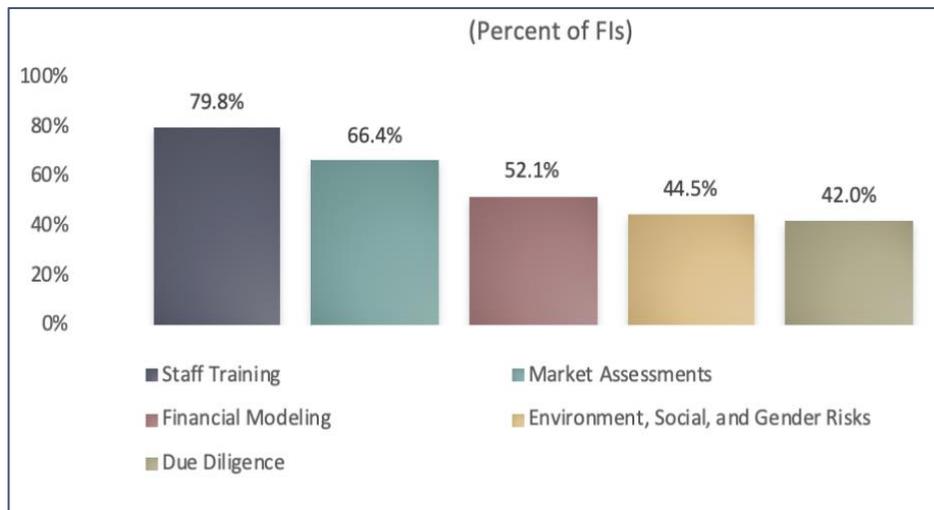
<sup>31</sup> “Sierra Leone: Privatization on the horizon in the financial sector,” Leading Edge, (February 27, 2018): <http://www.leadingedgeguides.com/privatisation-horizon-financial-sector/>

banking. The NSFI has made digital financial inclusion a priority, while the GoSL has taken a number of legislative and regulatory actions to foster growth of the country’s telecommunications and mobile sectors. Expanding digital financial services, especially mobile money, can create new opportunities to better serve women, the lower-income population, 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 PAYG systems that rely on the interoperability between digital financial services and stand-alone solar devices.

While there are several donor and DFI-funded programs and initiatives that have provided financing to support development of Sierra Leone’s off-grid solar market, these funds have not been channeled through local commercial banks or MFIs. ROGEP is therefore a pioneering initiative in the country, as it endeavors to boost OGS lending via engagement with local financial partners. Local FIs are increasingly becoming more aware of the opportunities in the off-grid space as a result of donor-funded initiatives such as USAID’s Climate Economic Analysis for Development, Investment, and Resilience (CEADIR) program.

According to the Task 3 survey of financial institutions in Sierra Leone and across the region,<sup>32</sup> there is strong interest to provide financing to the off-grid solar sector. Respondents identified loan guarantees and credit lines as the most important measures to reduce market entry risks for lenders and stimulate FI engagement in the sector. Surveyed FIs also identified several areas of internal capacity that require improvement in order to lend (or increase lending) to the OGS sector (**Figure ES-11**). The most common need among FIs was training for bank staff, which includes *inter alia* assistance to originate deals and appropriately assess the credit risk of off-grid solar firms and projects, due diligence support to qualify products and approve vendors, and targeted support for new lenders to the sector with product structuring and development as well as building deal-flow. Technical assistance for solar enterprises (as is envisioned under Component 1B of ROGEP) will also be necessary, as entrepreneurs often do not have proper financial management and accounting systems in place, are unable to present quality financial models and lack the expertise required to structure their companies to take on debt obligations.

Figure ES-11: Financial Institution Needs to Increase Off-Grid Solar Lending



Source: Financial Institution survey; Stakeholder interviews; GreenMax Capital Advisors analysis

<sup>32</sup> The results are based on feedback from a total of 121 FIs (including commercial banks, microfinance institutions and other non-bank FIs) that were interviewed across the 19 countries.

Gender inclusiveness is also a key component of this market assessment, and the key findings of the gender analysis are presented throughout this report. Given that the off-grid market is only beginning to emerge in Sierra Leone, women are not yet highly engaged in the sector. The overall lack of inclusive participation in the off-grid space is attributable to a wide range of factors. A 2018 survey conducted by IRENA found that nearly three-quarters of respondents cited cultural and social norms as the most common barrier to women's participation in expanding energy access, which reflects the need for gender mainstreaming (**Figure ES-12**). More than half of the women surveyed in Africa identified a lack of skills and training as the most critical barrier, compared to just one-third of respondents globally.<sup>33</sup>

The same survey found that access to necessary technical, business or leadership skills development programs was the single most important measure that could be taken to improve women's engagement in energy access. Over half of survey respondents also highlighted the need to integrate gender perspectives in energy access programs, mainstream gender in energy policies and to enhance access to financing for women (**Figure ES-13**).<sup>34</sup>

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<sup>33</sup> "Renewable Energy: A Gender Perspective," International Renewable Energy Agency, (2019): [https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA\\_Gender\\_perspective\\_2019.pdf](https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf)

<sup>34</sup> Ibid.

Figure ES-12: Key Barriers to Women’s Participation in Energy Access

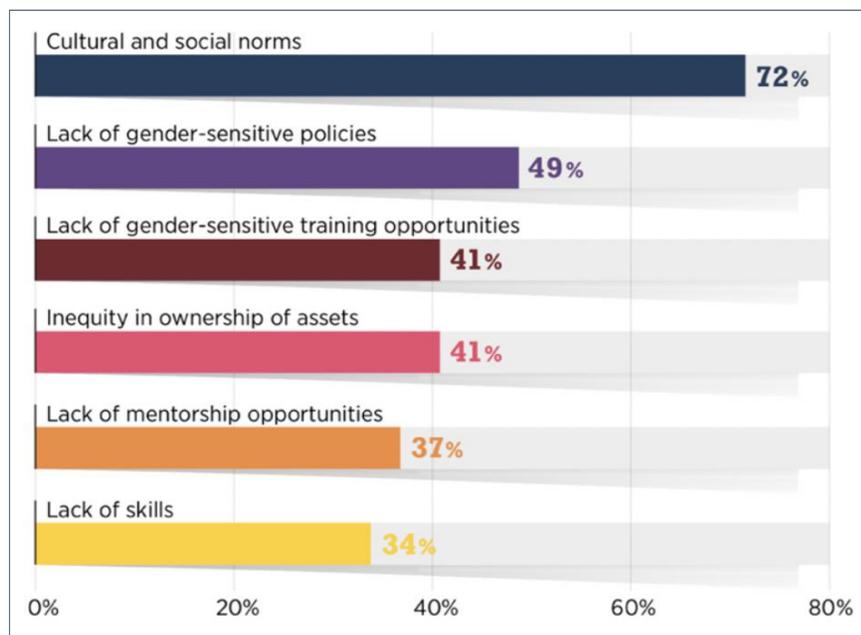
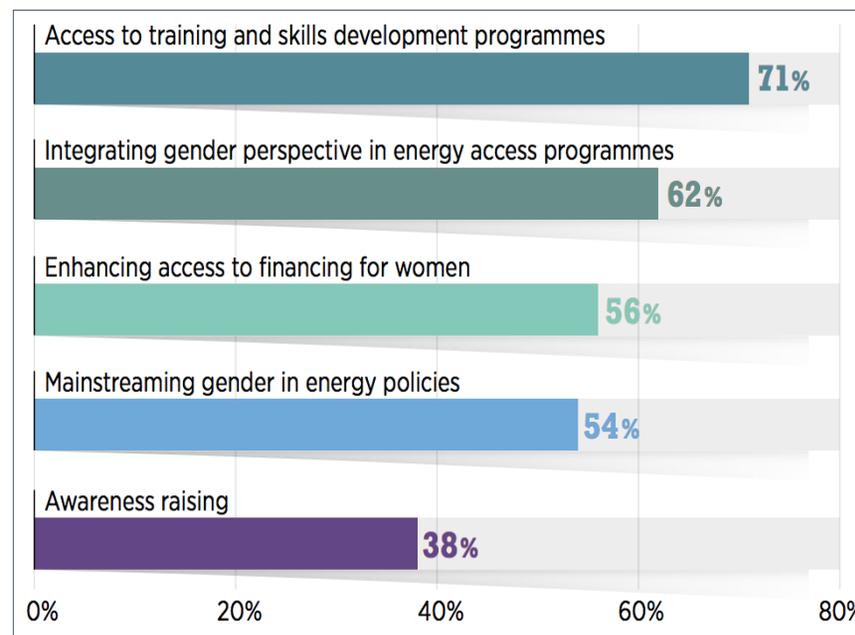


Figure ES-13: Measures to Improve Women’s Engagement in Energy Access



Source: International Renewable Energy Agency

The gender analysis undertaken in Sierra Leone corroborated many of these findings and revealed several interrelated challenges that women face in the off-grid sector, including lack of access to skills development, technical capacity building, and education/training; lack of access to capital, asset ownership, collateral and credit (e.g. to start a business); and low rates of financial literacy due to a lack of education and information available to women on access to financial resources.

A number of initiatives exist that seek to address some of these challenges and help improve gender inclusion in the country’s energy and off-grid sectors. For example, in 2018, ECREEE partnered with AfDB to launch a regional workshop to advance the participation of women in the renewable energy sector. The program intends to address the lack of female inclusion in the energy value chain, as women represent only 2% of energy sector entrepreneurs in West Africa. The joint initiative ultimately seeks to develop a pipeline of investment-ready, women-owned energy businesses across the region, including in Sierra Leone.<sup>35</sup>

<sup>35</sup> “Feasibility study promotes women’s participation in energy transition,” ESI Africa, (7 May 2018): <https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/>

## I. STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT

This section begins with a brief introduction of key macroeconomic and social indicators in Sierra Leone (**Section 1.1**). This is followed by an overview of the country’s existing energy sector (**Section 1.2**), with a focus on the status of energy access, including an assessment of both the on-grid and off-grid markets, a least-cost electrification analysis and a review of gender policies. **Section 1.3** examines national energy policy and regulation vis-à-vis the off-grid solar market, including detailed analysis of the existing framework for stand-alone systems<sup>36</sup> in Sierra Leone as well as gaps in the framework. **Section 1.4** is a summary of all relevant national and donor-funded development initiatives in the off-grid sector. **Annex 1** provides an overview of the Task 1 methodology.

### 1.1 Country Overview

The Government of Sierra Leone (GoSL or “the Government”) has made significant progress in consolidating peace and security in the country and in rebuilding the economy following its long civil war. Increased public investment in state-building, infrastructure projects and strengthening of macroeconomic conditions has led to improved economic growth following the 2014 Ebola outbreak, which caused massive disruptions to the country’s development efforts. Real Gross Domestic Product (GDP) growth was estimated at 5.7% in 2017, driven mainly by the mining sector, particularly exports of iron ore.<sup>37</sup> This growth has not translated into improvements for the majority of the population, however, as basic social services are inadequate, and poverty remains widespread. More than half of the population lives in rural areas and two-thirds of the country’s labor force engages in subsistence agriculture.

Table 1: Macroeconomic and Social Indicators

Population	7.5 million <sup>38</sup>
Urban Population	40.7% of total
GDP	USD 3.7 billion
GDP growth rate	5.7%
GNI per capita*	USD 510
Unemployment rate	9.1% (2014)
Poverty rate	52.9% (2011)
Urban	31.2%
Rural	66.1%
Currency	Leone (SLL)
Official language	English
Natural resources	Iron ore, diamonds, gold, bauxite



\* World Bank Atlas method (current USD)<sup>39</sup>

NOTE: All figures from 2017 unless otherwise indicated

Source: AfDB and World Bank

<sup>36</sup> NOTE: The term “off-grid” as it is widely used throughout this report (e.g. “off-grid sector”) refers to both mini-grids and stand-alone systems. When “off-grid solar” or its acronym “OGS” are used, this refers *only* to stand-alone systems and does not include mini-grids

<sup>37</sup> “Sierra Leone Economic Outlook,” African Development Bank, (2018): <https://www.afdb.org/en/countries/west-africa/sierra-leone/sierra-leone-economic-outlook/>

<sup>38</sup> 50.5% Female/49.5% Male

<sup>39</sup> “World Bank Open Data: Sierra Leone,” World Bank, (2017): <https://data.worldbank.org/country/sierra-leone>

## 1.2 Energy Market

### 1.2.1 Energy Sector Overview

The Ministry of Energy of Sierra Leone (MoE) is the public authority responsible for the electricity and water sectors. Other institutions involved in the energy sector include the Ministry of Finance, the Ministry of Planning and Economic Development, the PPP Unit in the Office of the President, the Ministry of Health and Sanitation, the Ministry of Agriculture and Forestry, the Ministry of Trade and Industry, the Ministry of Local Government and Rural Development and the Ministry of Works and Public Assets. In 2016, the Government instituted reforms to the electricity sector and unbundled the National Power Authority (NPA) into two utilities – Electricity Generation and Transmission Company (EGTC) and Electricity Distribution and Supply Authority (EDSA). An independent regulatory authority, the Sierra Leone Electricity and Water Regulatory Commission (SLEWRC), was also established.

Table 2: Institutional and Market Actors in the Energy Sector

Institution	Role in the Energy Sector
Ministry of Energy (MoE)	Ministry responsible for developing policies and programs for the provision of affordable and sustainable energy services for the population of Sierra Leone
National Power Authority (NPA)	National authority responsible for generation, transmission and distribution of electricity throughout the country until 2016 (currently non-functional, unbundled into EGTC and EDSA)
Sierra Leone Electricity and Water Regulatory Commission (SLEWRC)	Independent regulatory authority responsible for formulating, implementing, monitoring quality and compliance, providing tariff guidelines, licenses and implementing regulatory frameworks for the safe, secure, affordable and reliable supply of water and electricity in Sierra Leone
Electricity Generation and Transmission Company (EGTC)	State-owned company that responds to the MoE and is responsible for generation and transmission of electricity as well as selling electricity to EDSA
Electricity Distribution and Supply Authority (EDSA)	National power authority that responds to the MoE and is responsible for developing modern and efficient electricity distribution infrastructure that meets the energy requirements for industrial, commercial and domestic customers through upgrading and expanding the existing network, expanding the prepaid metering systems and training staff for effective utility management and maintenance for the national distribution and supply network
Public Private Partnership (PPP) Unit	Unit in the Office of the President of Sierra Leone, responsible for structuring PPP projects, providing technical and legal support to the Ministries and local councils in pursuance of PPP agreements and promoting best international practices for private sector participation in achieving sustainable infrastructural development
Renewable Energy Association of Sierra Leone (REASL)	Trade association of private sector engaged in renewable energy and focused on the development of an efficient and thriving renewable energy market in Sierra Leone

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

### 1.2.2 Electricity Access: *Grid and Off-Grid*

Energy access rates in Sierra Leone are among the lowest in Africa. In 2016, an estimated 91% of the population – about 7 million people – did not have access to electricity, with a significant disparity in rates of access between urban (12%) and rural (6%) areas.<sup>40</sup> The Government intends to achieve universal access by 2025.

<sup>40</sup> “Energy Access Outlook, 2017: From Poverty to Prosperity,” International Energy Agency, (2017): [https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_EnergyAccessOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf)

### 1.2.2.1 Off-Grid Market Overview

In 2017, the Government published the Electricity Sector Reform Roadmap (2017-2030), which provides a detailed framework for development of the country’s energy sector over three distinct periods through 2030 – recovery, transition and delivery – each with its own set of reform measures and actions to restructure the power sector and achieve long-term objectives. The roadmap includes a detailed plan to electrify rural areas that are beyond the feasible reach of the grid by utilizing off-grid renewable energy solutions (mini-grids and stand-alone systems). The strategy also calls for key institutional reforms including the formation of a Rural Electrification Agency and an Energy Management Fund.<sup>41</sup>

The Rural Renewable Energy Programme (RREP), funded by the UK Department for International Development (DFID) (GBP 33M) and implemented by the UN Office for Project Services (UNOPS), aims to increase access to electricity in rural areas of Sierra Leone. In its first phase, the RREP funded solar PV electrification of 50 community health clinics (6 kW systems) scattered throughout the country (**Figure 1**), which were subsequently extended to mini-grids with a capacity of 16-36 kW. In its second phase, the project electrified an additional 40 mini-grids (health centers and communities), with sizes varying between 40-200 kW and based on a private sector co-financing arrangement. For the first 50 sites, the project is entirely financed by grant funding with no recovery of the capital through tariff.<sup>42</sup>

Outside of public sector initiatives, several private solar companies have been active in Sierra Leone’s off-grid market (see **Section 2.4.3**). Companies mainly sell stand-alone solar systems to customers in rural and peri-urban areas, taking advantage of favorable import and sales tax exemptions, which have fostered development of a pico solar industry, with micro-grid and small utility-scale projects set to follow.<sup>43</sup>

### 1.2.2.2 Demand and Supply/Generation Mix

Table 3 : Electricity Sector Indicators, 2017<sup>44</sup>

Sierra Leone’s power sector is relatively small, with slightly over 150 MW of installed capacity operated by EGTC. About half of the current installed generation capacity comes from thermal power, with hydropower making up most of the balance, along with a 15 MW biomass power plant at Makeni.<sup>45</sup> EGTC intends to increase generation capacity through several new hydropower, thermal and utility-scale solar Independent Power Producer (IPP) projects.<sup>46</sup>

Installed Capacity	155 MW
Thermal	77 MW
Hydropower	63 MW
Renewable (non-hydro)	15 MW
National electrification rate (2016)	9%
Urban electrification rate	12%
Rural electrification rate	6%
Population without access	6 million
Households without access	1.2 million
Electrification target	Universal access by 2025

Source: Bloomberg New Energy Finance, IEA and World Bank

Economic expansion in mining, agriculture, industry and hospitality services is accelerating electricity demand. As demand grows, increasing installed capacity will be critical to meeting the country’s development objectives and improving rates of access. To achieve its target of universal access by 2025,

<sup>41</sup> “Electricity Sector Reform Roadmap (2017-2030),” Millennium Challenge Corporation, (2017): <http://www.mccu-sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf>

<sup>42</sup> Stakeholder interviews, 2018

<sup>43</sup> “Sierra Leone Country Profile,” ClimateScope, Bloomberg New Energy Finance, (2017): <http://global-climatescope.org/en/country/sierra-leone/#/enabling-framework>

<sup>44</sup> See **Section 2.1** for more details on households/population without access to electricity.

<sup>45</sup> “Regional Progress Report on Renewable Energy, Energy Efficiency and Energy Access in the ECOWAS Region,” ECREEE, (2016): [http://www.ecreee.org/system/files/ecreee\\_report\\_-\\_regional\\_monitoring\\_framework\\_2016\\_0.pdf](http://www.ecreee.org/system/files/ecreee_report_-_regional_monitoring_framework_2016_0.pdf)

<sup>46</sup> ClimateScope, Bloomberg New Energy Finance, 2017.

the GoSL plans to exploit untapped hydropower potential, with supplemental contributions from solar capacity (**Table 4**). In addition to on-grid improvements and extensions of the network, off-grid solutions will be critical to meet national targets and to provide electricity to the country’s rural population.

Table 4: Current and Planned Installed Capacity<sup>47</sup>

Installed Capacity (MW)	2017	2020 (planned)	2030 (planned)
Thermal	77	no data	no data
Large hydro	50	510	935
Small hydro	13	42	126
Solar	-	73	95
Wind	-	2	5
Bioenergy	15	41	68
<b>Total Installed Capacity (MW)</b>	<b>155</b>	<b>-</b>	<b>-</b>
Total thermal	77	no data	no data
Total renewable energy	78	668	1,229

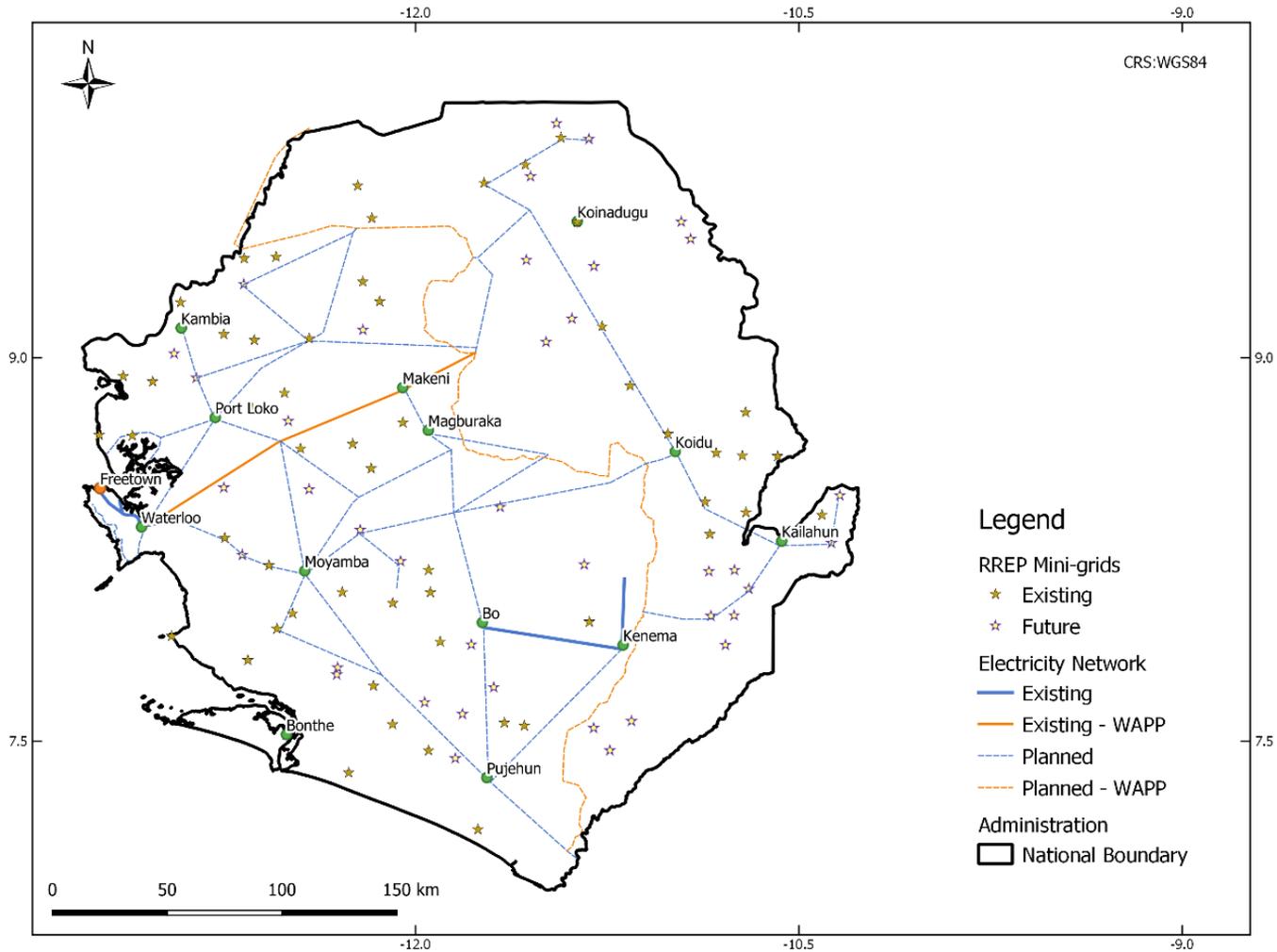
Source: SEforALL National Renewable Energy Action Plan

Due to the high cost of imported fossil fuels used for power generation, electricity tariffs in Sierra Leone are among the highest in the region, with an average rate of USD 0.28/kWh.<sup>48</sup> Sierra Leone uses a tiered social tariff system to support low-income customers. Electricity tariffs are not cost-reflective, however, and EGTC does not generate enough revenue to invest sufficiently in network extensions or in the maintenance of grid infrastructure.

<sup>47</sup> “Sierra Leone National Renewable Energy Action Plan,” ECREEE / SEforALL, (2015): [https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country\\_PANER/Sierra\\_Leone\\_National\\_Renewable\\_Energy\\_Action\\_Plans.pdf](https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_PANER/Sierra_Leone_National_Renewable_Energy_Action_Plans.pdf)

<sup>48</sup> “RISE Sierra Leone Retail Tariffs,” World Bank, (2018): <http://rise.worldbank.org/country/sierra-leone>

Figure 1: Off-Grid Solar PV Mini-Grids<sup>49</sup>



Source: Energio Verda Africa GIS analysis

<sup>49</sup> Mini-grids developed under DFID-funded Rural Renewable Energy Programme (RREP)

### 1.2.2.3 Transmission and Distribution Network

In addition to the country's power supply deficit, transmission and distribution bottlenecks remain major impediments to expanding access to electricity. EDSA and EGTC struggle to provide reliable service due to insufficient transmission and distribution infrastructure (**Figure 2**). The national distribution network only extends to Freetown and the surrounding vicinity, including two other isolated areas (Bo-Kenema and Makeni). Moreover, the overall quality of the power supply is poor, with high technical and commercial losses on the transmission and distribution grid leading to unreliable power supply (**Figure 3** and **Figure 4**). High fuel costs for thermal plants, which represent over half of total electricity costs, combined with poor revenue collection are major contributors to utility liquidity problems.<sup>50</sup>

Overall, a significant gap exists between the infrastructure needs of the power sector and the availability of resources to invest in grid maintenance and extension to rural areas. To improve the electrification rates and grid stability, the MoE has drafted a national grid development plan to 2030. The plan also includes funding for widespread adoption of distributed / off-grid solar systems in rural areas. Over 200 MW of renewable off-grid and mini-grid projects have been identified, while additional hybrid off-grid and pico-hydro rural systems await further feasibility studies to fully scope out the extent of the market.

The plan also focuses on grid maintenance and rehabilitation and includes integration with the West African Power Pool (United Nations Development Programme) to secure additional power supply.<sup>51</sup> The WAPP-CLSG System Redevelopment Sub-program – a regional transmission project that will connect Côte d'Ivoire, Liberia, Sierra Leone and Guinea (CLSG) – is another investment partly being funded by the World Bank among other Development Finance Institutions (DFIs) that plans to connect rural communities along the HV lines with step down low-voltage lines.<sup>52</sup>

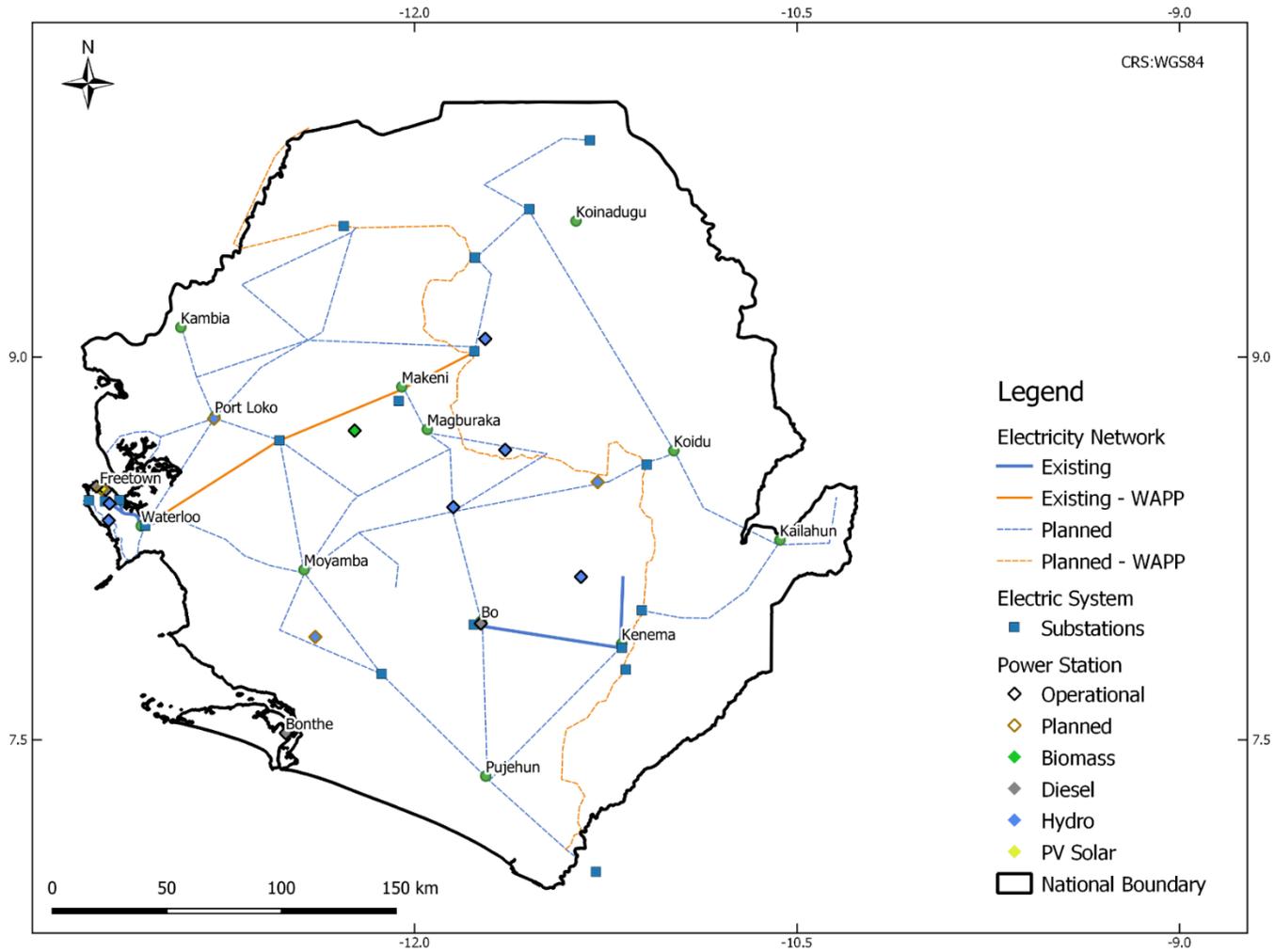
<sup>50</sup> "Sierra Leone Energy Access Project," World Bank, (2018):

<http://documents.worldbank.org/curated/en/363601517844858680/pdf/ICR-Main-Document-P126180-2018-01-30-16-27-02012018.pdf>

<sup>51</sup> "Sierra Leone Country Profile," ClimateScope, Bloomberg New Energy Finance, (2017): <http://global-climatescope.org/en/country/sierra-leone/#/enabling-framework>

<sup>52</sup> "West African Power Pool: CLSG Power System Redevelopment Sub-Program," World Bank, (2018): <http://siteresources.worldbank.org/INTENERGY2/Resources/exercise.pdf>

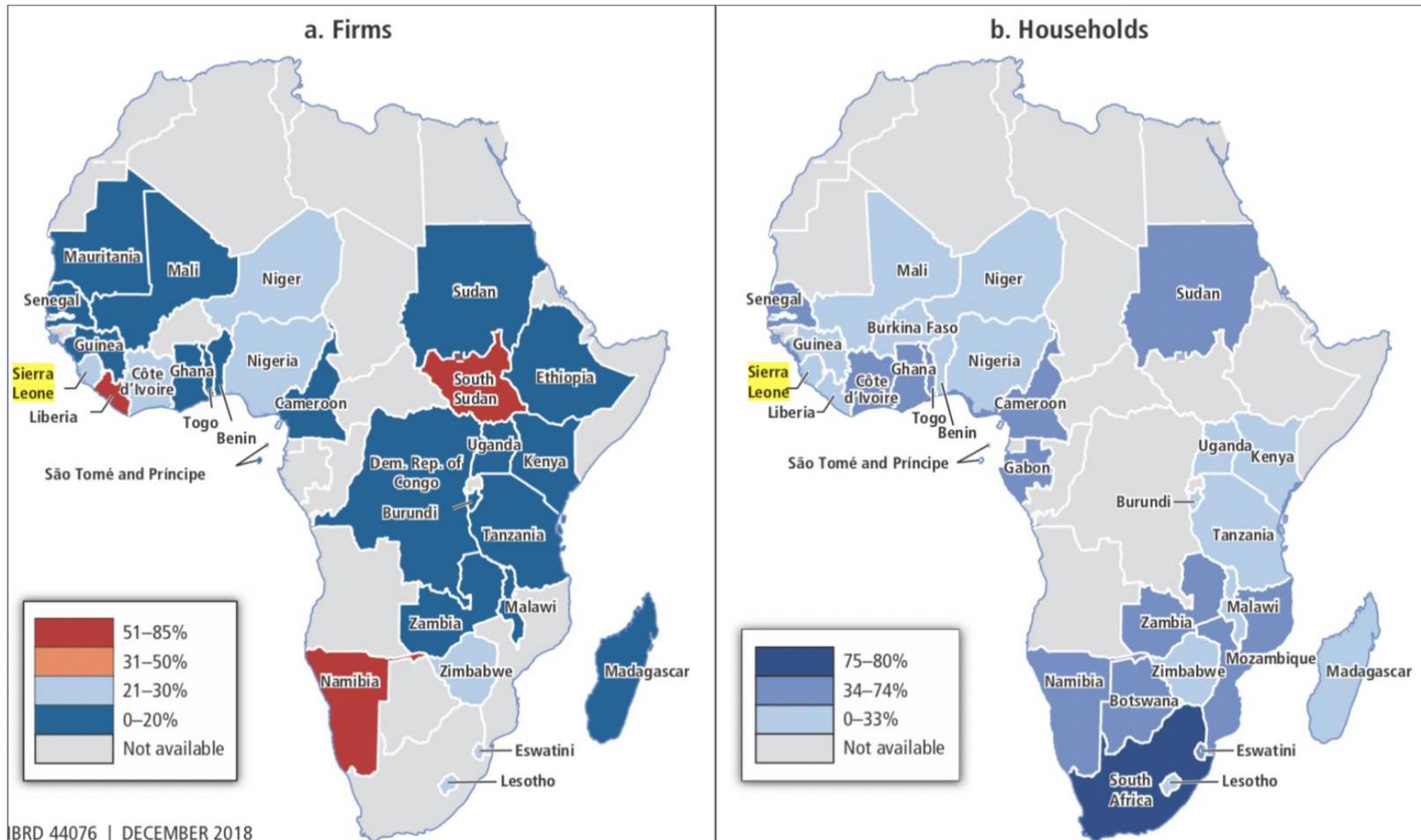
Figure 2: Electricity Transmission and Distribution Network<sup>53</sup>



Source: Energo Verda Africa GIS analysis

<sup>53</sup> See Annex 1 for more details, including data sources.

Figure 3: Access to Reliable Electricity by Firms and Households in Africa<sup>54</sup>

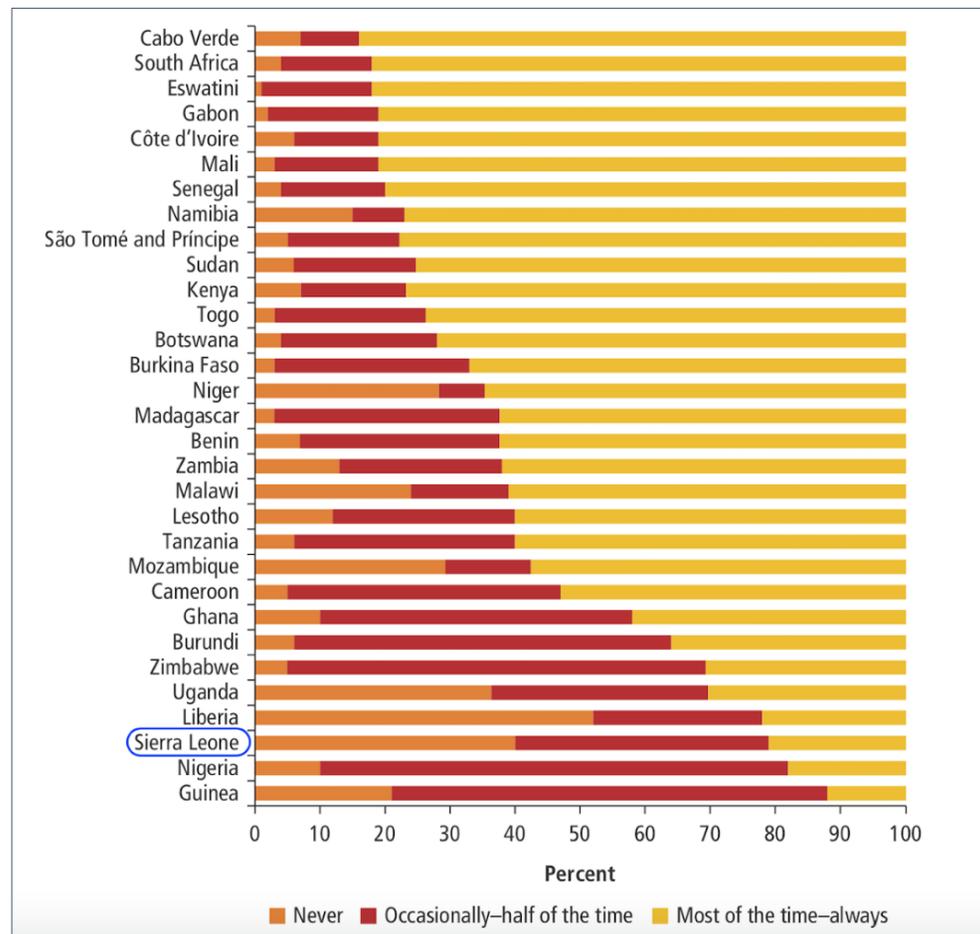


Source: World Bank Enterprise Surveys, 2013-2017 and Afrobarometer Household Surveys, 2014-2015

The maps in **Figure 3** illustrate the share of firms (Panel a) and households (Panel b) reporting access to a reliable supply of electricity across Africa. In Sierra Leone, fewer than one-third of surveyed firms and households reported having reliable access to electricity.

<sup>54</sup> Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact," AFD and World Bank, Africa Development Forum, (2019): <https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y>

Figure 4: Reliability of Grid Electricity in Connected Households in Africa<sup>55</sup>



Source: Afrobarometer Household Surveys, 2014-2015

Figure 4 shows the variation in the reliability of grid electricity for connected households across Africa. In Sierra Leone, fewer than 20% of households reported receiving electricity supply at least most of the time, while about one-third of surveyed households indicated having electricity only occasionally.

<sup>55</sup> Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact," AFD and World Bank, Africa Development Forum, (2019): <https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y>

#### 1.2.2.4 Least-Cost Electrification Analysis

A least-cost electrification analysis has been performed to assess the potential development of electricity access in Sierra Leone through 2023 and through 2030 (“Scenario 2023” and “Scenario 2030”).<sup>56</sup> The analysis identifies the scale of market opportunities for off-grid stand-alone solar electrification. A brief summary of the approach and methods used, main assumptions and key results of the analysis in Sierra Leone are outlined below. Additional geographic information system (GIS) information, including categorizations, key definitions, and datasets are included in **Annex 1**.

##### ➤ Methodology

This analysis used geospatial techniques to determine the least-cost electrification options for settlements across Sierra Leone based on their proximity to electrical infrastructure, population density or nodes of economic growth.

For the scenario 2023 analysis, it is assumed that widespread densification of the existing electrical grid will enable settlements within 5 km of existing grid lines to connect to the grid (according to WAPP densification plans).<sup>57</sup> Beyond this area, the likely candidates for electrification by mini-grid systems are settlements that are relatively dense (above 350 people/km<sup>2</sup>) and have active local economies, evidenced by the presence of social facilities and by their proximity to other settlements already with electricity access (i.e. within 15 km of night-lights areas). All remaining settlements – those in areas of lower population density (below 350 people/km<sup>2</sup>) or far from the national grid – are considered candidates for off-grid stand-alone systems.

For the scenario 2030 analysis, it is assumed that the grid and the reach of grid densification efforts will extend far beyond the existing network. Hence, settlements that are within 15 km of current lines (average densification distance announced by utilities across West Africa in a 10-year timeline in personal interviews) and 5 km of future planned line extensions are assumed to be connected. For mini-grids, future economic development – which will allow new settlements to grow sufficiently to become candidates for mini-grids – is assumed to occur in settlements within 1 km of mini-grid settlements (average distance of mini-grid coverage of different developers) identified in the scenario 2023 analysis, as well as within 15 km of economic growth centers – airports, mines and urban areas. All other settlements are considered candidates for off-grid stand-alone systems.

Given the lack of low voltage distribution line data, it is necessary to approximate areas where un-electrified settlements in close proximity to the grid exist. The analysis therefore focuses on settlements that are within 5 km of the high and medium voltage network, but that are located beyond 15 km of areas with night-time light emissions (indicative of electrification). Settlements in areas of low population density (below 350 people per km<sup>2</sup>) that met the above criteria are identified as both being currently un-electrified and unlikely to be electrified within scenario 2023.<sup>58</sup> Additional analysis was undertaken to estimate the population within each settlement. The current annual national population growth rate of 2.2%<sup>59</sup> was applied to the geospatial analysis to project population figures for the scenario 2023 and 2030 analyses.<sup>60</sup> **Figure 5** shows population density across the country, which served as the basis for this analysis.

<sup>56</sup> NOTE: Rather than presenting a 10-year projection through 2028, the analysis conforms to GoSL electrification targets for 2030

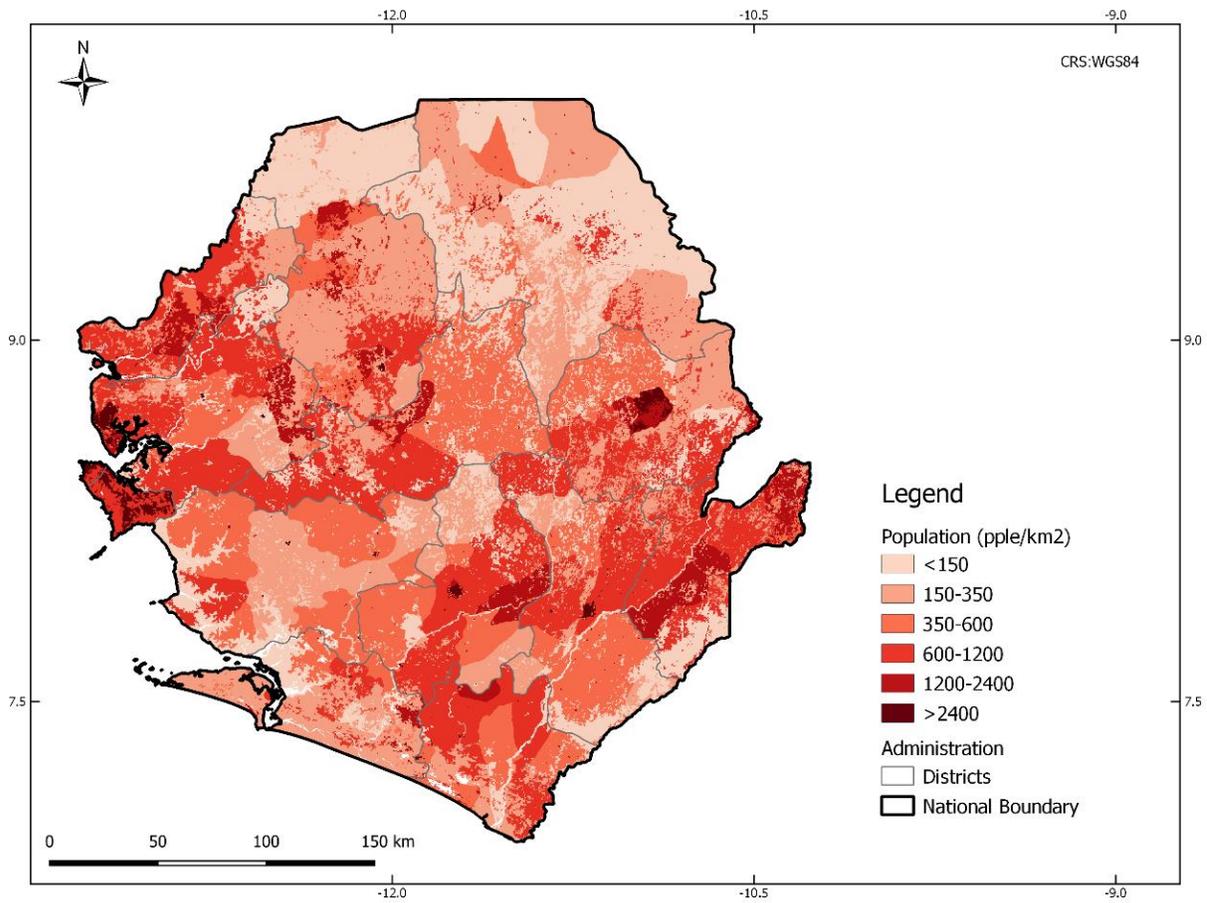
<sup>57</sup> NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)

<sup>58</sup> NOTE: This analysis was performed for scenario 2023 but not for the scenario 2030 due to uncertainties regarding population densities being too high over such a long timeframe

<sup>59</sup> <https://data.worldbank.org/indicator/SP.POP.GROW?locations=SL>

<sup>60</sup> See **Annex 1** for more details on the approach and methods used

Figure 5: Population Density, 2014<sup>61</sup>



Source: Energio Verda Africa GIS analysis

<sup>61</sup> See Annex 1 for more details, including data sources.

➤ **Results**

**Table 5** summarizes the results of the least cost electrification analysis. **Figure 6** and **Figure 7** illustrate the distribution of settlements according to least-cost electrification options under scenarios 2023 and 2030, respectively. The number of households was estimated by using the average household size for the country (5.6 persons/household).<sup>62</sup>

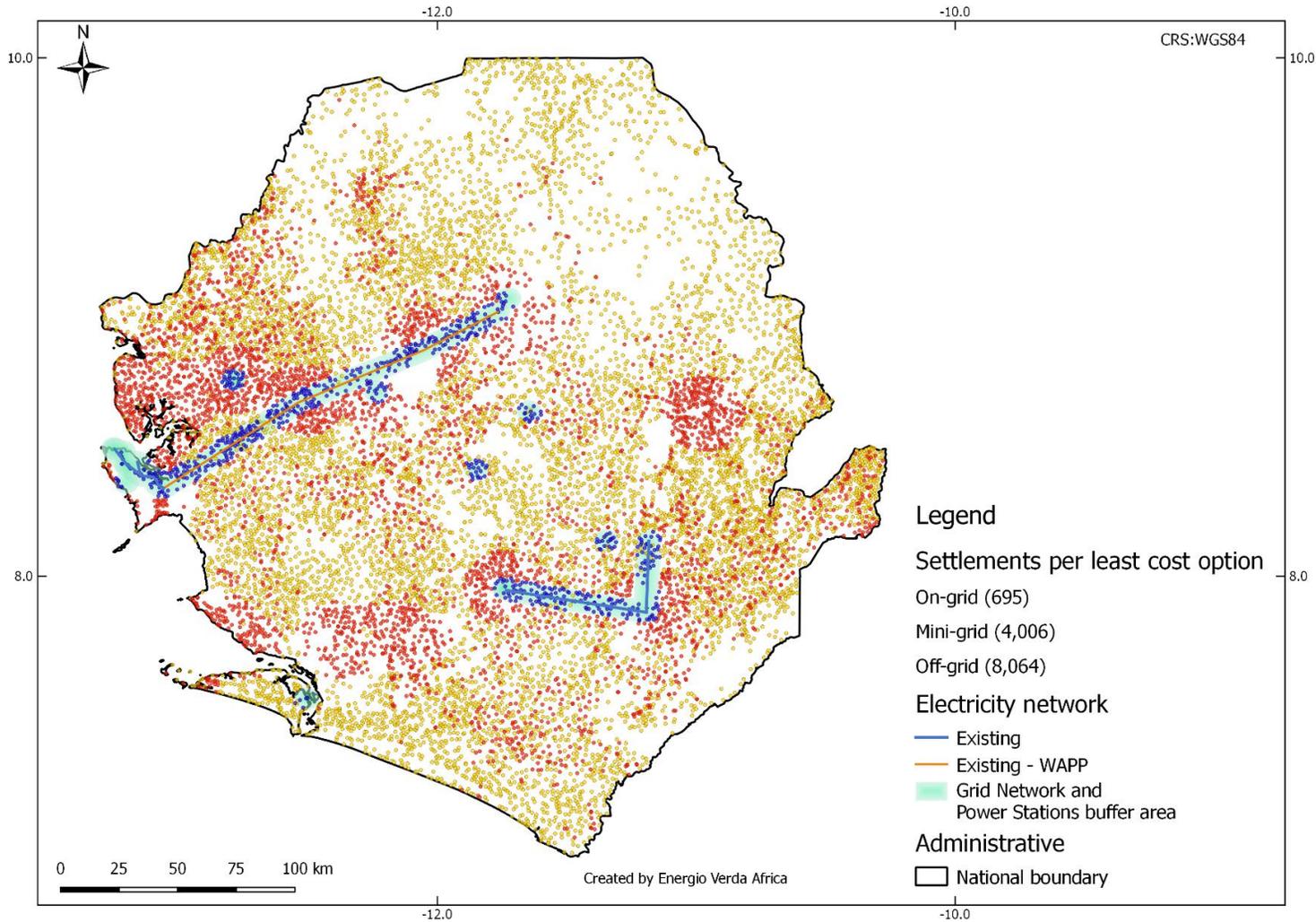
Table 5: Results of Least-Cost Electrification Analysis

Scenario	Indicator	Least-Cost Electrification Option			Grid Vicinity		
		Grid extension	Mini-grid	Off-grid stand-alone systems	Under-grid un-served	Total under-grid	Total outside grid vicinity
<b>Scenario 2023</b>	Number of settlements	695	4,006	8,064	56	751	12,014
	% of settlements	5.4%	31.4%	63.2%	7.5%	5.9%	94.1%
	Total population	2,091,578	2,416,651	3,281,083	13,998	2,105,577	5,683,737
	% of population	26.9%	31.0%	42.1%	0.7%	27.0%	73.0%
	Number of households	373,496	431,545	585,908	2,500	375,996	1,014,953
<b>Scenario 2030</b>	Number of settlements	5,461	4,365	2,939	Not calculated	5,461	7,304
	% of settlements	42.8%	34.2%	23.0%	Not calculated	42.8%	57.2%
	Total population	5,775,226	2,334,385	1,212,853	Not calculated	5,775,226	3,547,237
	% of population	61.9%	25.0%	13.0%	Not calculated	61.9%	38.1%
	Number of households	1,031,290	416,854	216,581	Not calculated	1,031,290	633,435

Source: Energo Verda Africa GIS analysis

<sup>62</sup> "Household Size and Composition Around the World," United Nations, (2017): [http://www.un.org/en/development/desa/population/publications/pdf/ageing/household\\_size\\_and\\_composition\\_around\\_the\\_world\\_2017\\_data\\_booklet.pdf](http://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf)

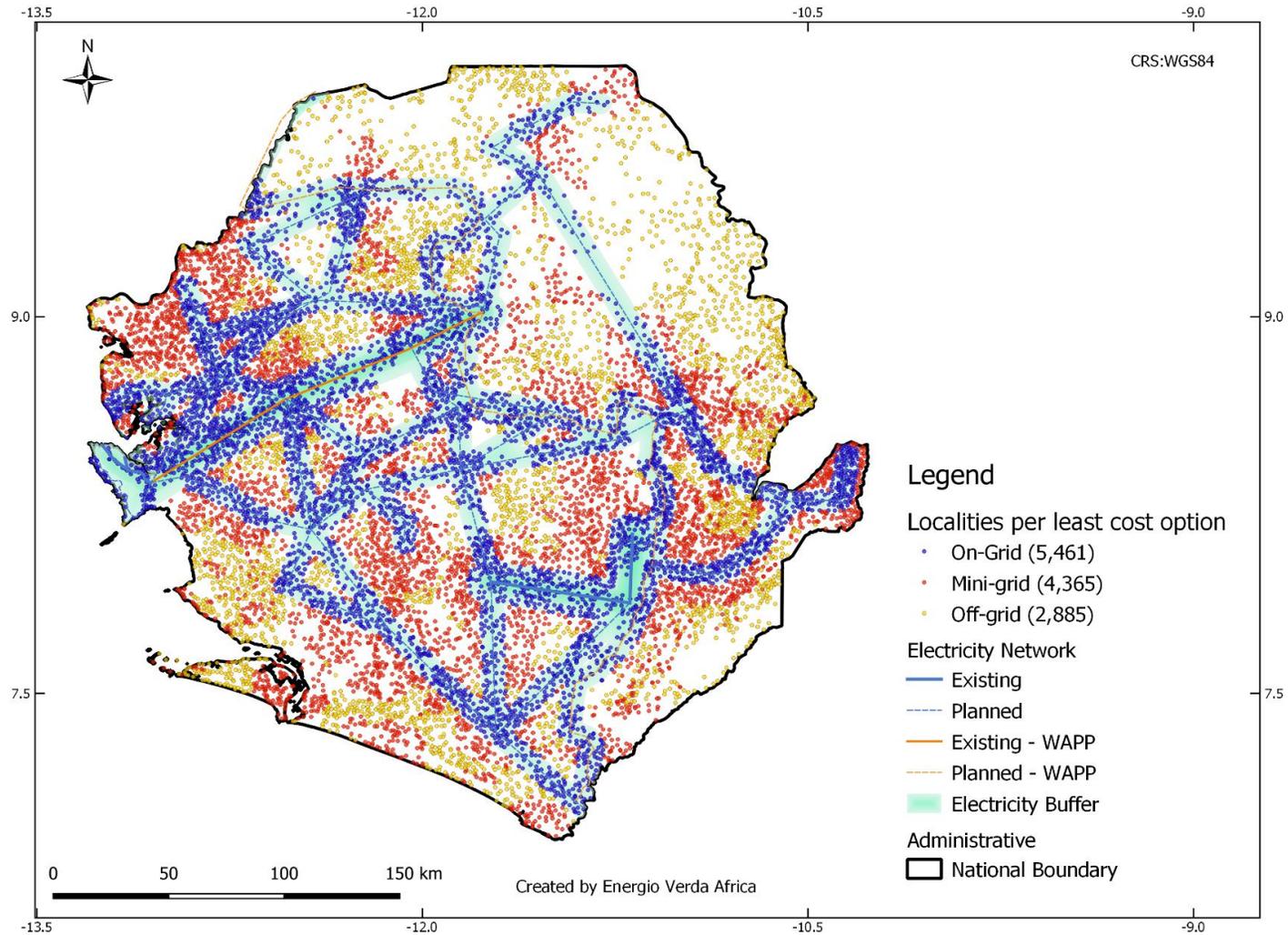
Figure 6: Distribution of Settlements by Least-Cost Electrification Option, 2023<sup>63</sup>



Source: Energio Verda Africa GIS analysis

<sup>63</sup> Displaying identified settlements with known location (given coordinates) only; see **Annex 1** for more details, including data sources.

Figure 7: Distribution of Settlements by Least-Cost Electrification Option, 2030<sup>64</sup>



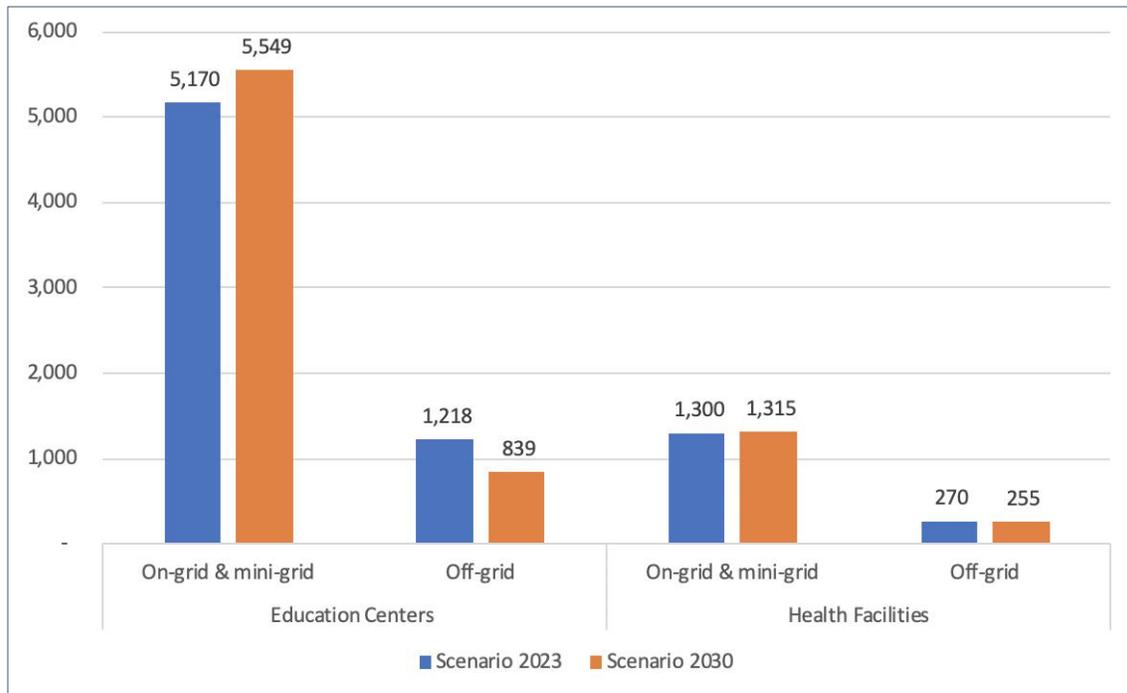
Source: Energio Verda Africa GIS analysis

<sup>64</sup> Displaying identified settlements with known location (given coordinates) only; see **Annex 1** for more details, including data sources.

The analysis also covered the education centers and health facilities that will remain off-grid during the analyzed timeframes. The number of education centers and health facilities cannot be seen as comprehensive as not all were available for the geospatial analysis (institutions with known coordinates); a total of 6,388 education centers and 1,570 health facilities were analyzed.

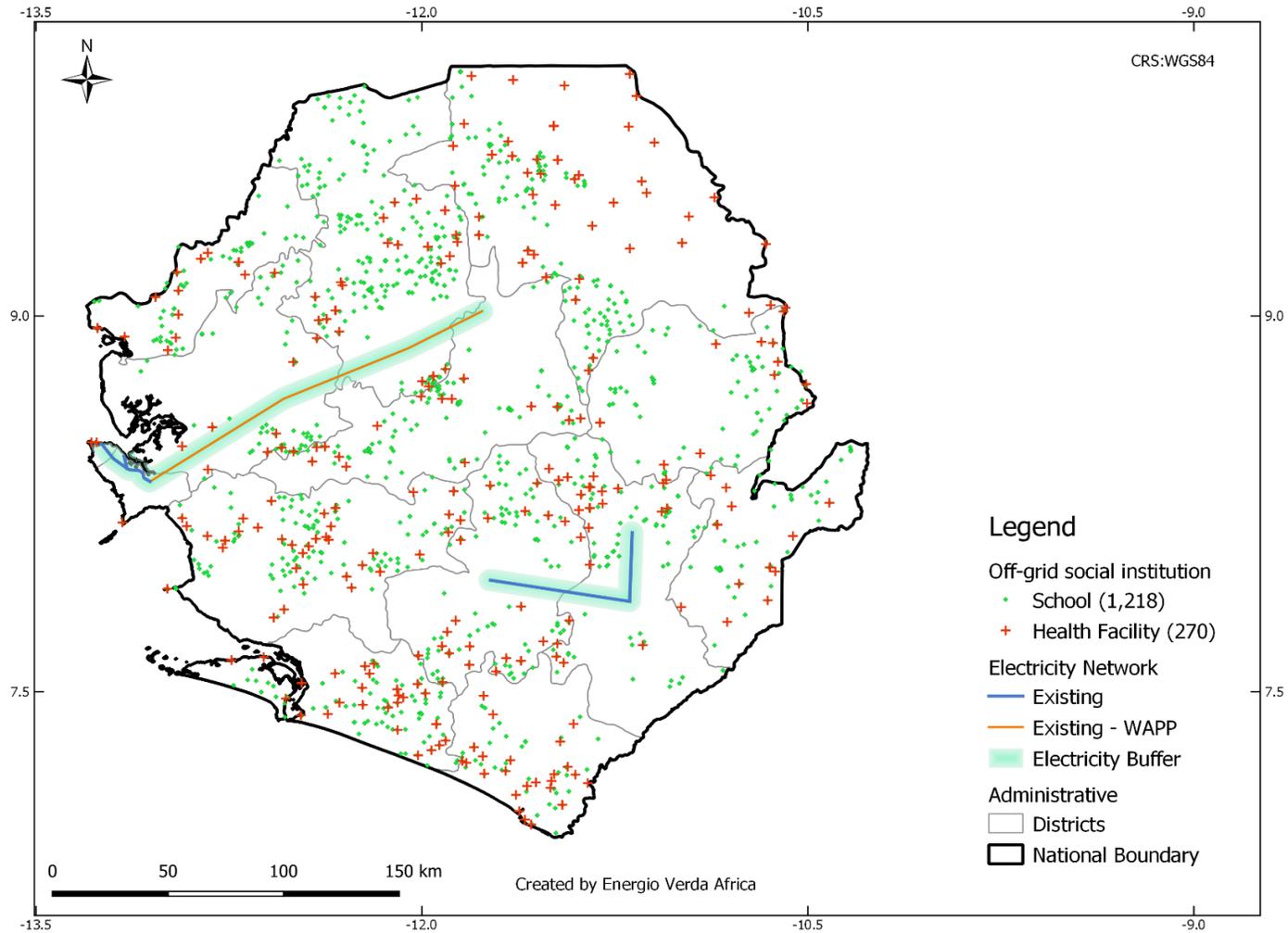
**Figure 8** summarizes the number of education centers and health facilities that may be electrified via on-grid or mini-grid solutions or that are suitable for off-grid solutions in scenarios 2023 and 2030. **Figure 9** and **Figure 10** illustrate the distribution of potential off-grid facilities across the country under the two scenarios.

Figure 8: Identified Social Facilities for On-Grid, Mini-Grid and Stand-alone Solutions, 2023 and 2030



Source: Energio Verda Africa GIS analysis

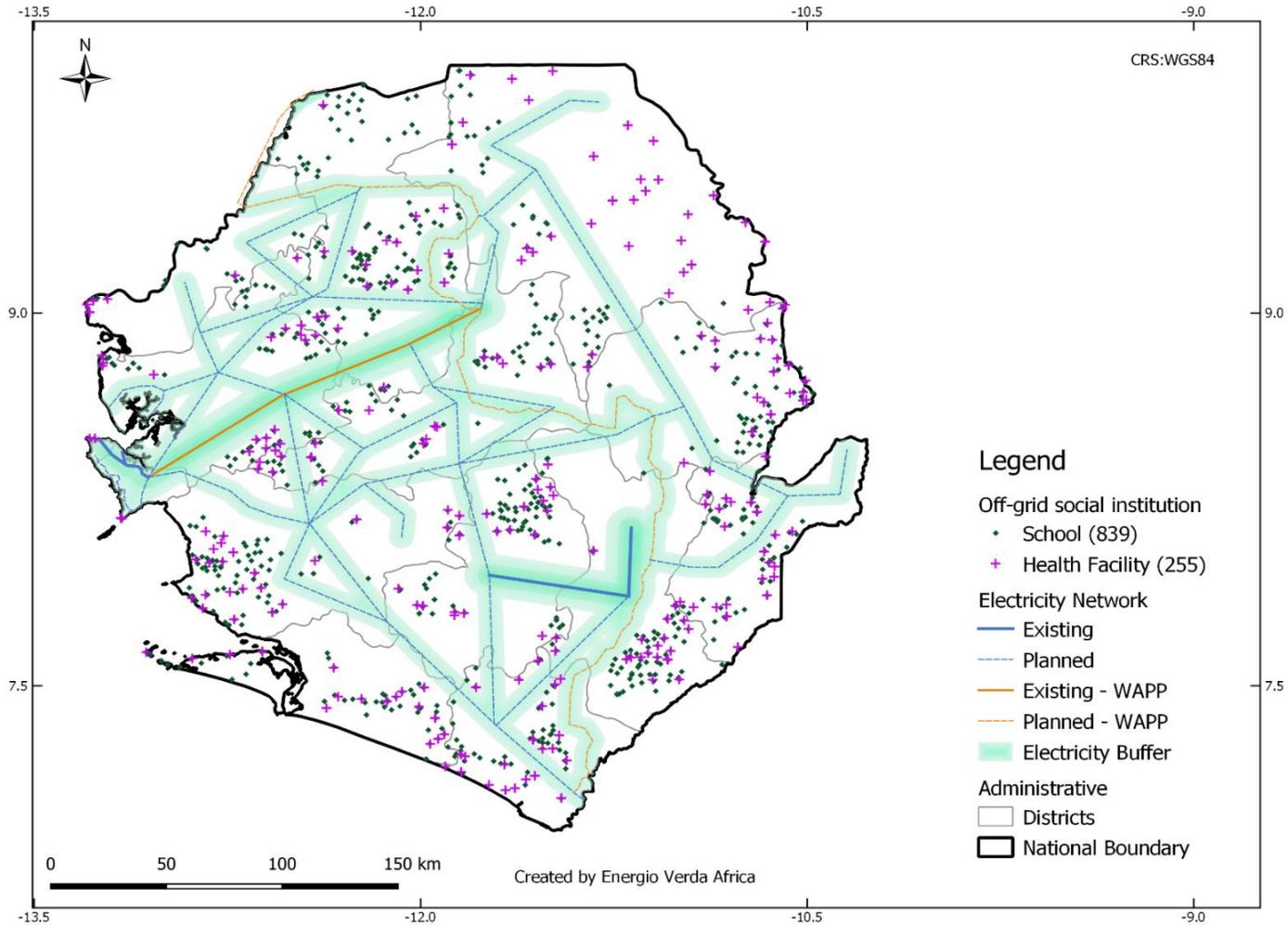
Figure 9: Distribution of Potential Off-Grid Social Facilities, 2023<sup>65</sup>



Source: Energo Verda Africa GIS analysis

<sup>65</sup> Displaying identified facilities with known location (given coordinates) only; see **Annex 1** for more details, including data sources.

Figure 10: Distribution of Social Facilities in Off-Grid Areas, 2030<sup>66</sup>



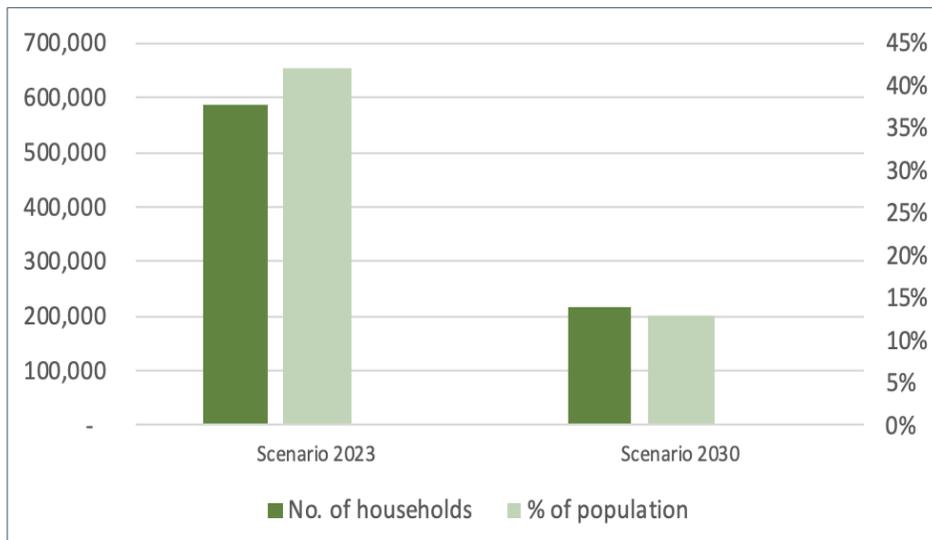
Source: Energio Verda Africa GIS analysis

<sup>66</sup> Displaying identified facilities with known location (given coordinates) only; see Annex 1 for more details, including data sources.

According to the geospatial analysis (**Table 5**), by 2023, 695 settlements across Sierra Leone (373,496 households) will be connected to the main grid, representing 26.9% of the population. By 2030, this figure will increase to 5,461 settlements (1,031,290 households), equivalent to 61.9% of the population. These estimates are based on the assumption that all planned grid extensions will be completed by 2030. Not all settlements in close proximity to electricity lines will connect to the main grid, largely due to the low density of these areas (dispersed settlements with a density below 350 people/km<sup>2</sup>). By 2023, an estimated 56 settlements located under the grid will meet these criteria (or 7.5% of the settlements located within 5 km of the grid).

Outside of the main grid areas, settlements with higher economic growth potential and higher population density can optimally be electrified by mini-grids. By 2023, this represents an estimated 4,006 settlements (431,545 households), or 31.0% of the population, increasing to 4,365 settlements by 2030. The remaining more dispersed settlements (further from centers of economic activity) can optimally be served by off-grid stand-alone systems. This comprises 8,064 settlements (585,908 households) and 42.1% of the population in 2023, decreasing to 2,939 settlements (216,581 households) and 13% of the population in 2030 (**Figure 11**).

Figure 11: Estimated Number of Households and Share of Population Suitable for OGS Systems, 2023 and 2030



Source: Energo Verda Africa GIS analysis

Mini-grid and off-grid stand-alone markets in Sierra Leone have the potential to grow significantly. More than 2,700 settlements have the potential for mini-grid solutions; to date, 57 mini-grid locations have been developed, with 40 more sites targeted by the RREP project. The off-grid stand-alone market has even greater potential. According to figures published by the Global Off-Grid Lighting Association (GOGLA), an estimated 57,711 off-grid solar PV products (pico solar and SHS) worth USD 811,740 in sales revenue have been sold in Sierra Leone through 2017 (see **Table 41** in **Section 2.4.3**).<sup>67</sup> The least-cost analysis

<sup>67</sup> “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (July – December 2017): [https://www.gogla.org/sites/default/files/resource\\_docs/gogla\\_sales-and-impact-reporth2-2017\\_def20180424\\_web\\_opt.pdf](https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf); and

“Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (January – June 2017): [https://www.gogla.org/sites/default/files/resource\\_docs/gogla\\_sales-and-impact-reporth12017\\_def.pdf](https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth12017_def.pdf); and

indicates that potentially 640,000 households in 2023 are suitable for these off-grid solutions to meet electrification needs.

Under its SEforALL Country Action Agenda, the GoSL envisions a relatively limited but gradually increasing share of the population will gain electricity access through off-grid stand-alone systems (**Table 6**). The findings of the least-cost analysis suggest that the Government may need to consider increasing the utilization of stand-alone solutions in its electrification planning in order to achieve its energy access targets, particularly in the near-term until planned grid extensions are realized.

**Table 6: Estimated Share of Population Served by Off-Grid Systems<sup>68</sup>**

Share of population with access to off-grid systems powered by renewable energy (%) <sup>*</sup>	2020 (target)	2030 (target)
	3%	10%

<sup>\*</sup> Estimate only for stand-alone systems – does not include mini-grids

Source: SEforALL Country Action Agenda

### 1.2.2.5 Inclusive Participation<sup>69</sup>

Inclusive participation in Sierra Leone remains an ongoing challenge. Gender inequality persists, as women are under-educated and generally have a lower socio-economic status, with inadequate access to basic social services and reduced economic opportunities compared to men. Sierra Leone performs poorly in the United Nations Development Programme (UNDP) Gender Inequality Index, which measures several indicators to assess levels of gender inequality in the areas of health, access to education, economic status and empowerment.<sup>70</sup> While gender discrimination is widespread, these issues tend to be more pronounced in rural areas of the country.

The GoSL has adopted several policies and action plans to promote gender equality and has signed on to key international and regional framework agreements protecting women’s rights. At the international level, Sierra Leone has ratified the Convention on the Elimination of All Forms of Discrimination Against Women and is also signatory to the Protocol to the African Charter on Human and People’s Rights on the Rights of Women in Africa, the Solemn Declaration on Gender Equality in Africa and the Beijing Platform for Action, among others.

The country’s Constitution includes a Bill of Rights guaranteeing the human rights of all Sierra Leoneans irrespective of their sex. To date, the Government has enacted a number of laws to ensure the protection and promotion of the rights of women and children and to create an enabling environment to ensure inclusive participation in the country’s development. These include the National Policy on the Advancement of Women, and the National Policy on Gender Mainstreaming, which were implemented under the National Gender Strategic Plan (2009-2012), 2007 Domestic Violence Act and Sexual Offences Act, the Registration of Customary Marriage/Divorce Act and the Devolution of Estates Act. The Ministry of Social Welfare Gender and Children’s Affairs is another agency mandated to formulate gender-responsive policies and to coordinate and monitor their implementation within different sectors of the society.

<sup>68</sup> “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (July – December 2016): [https://www.gogla.org/sites/default/files/recource\\_docs/final\\_sales-and-impact-report\\_h22016\\_full\\_public.pdf](https://www.gogla.org/sites/default/files/recource_docs/final_sales-and-impact-report_h22016_full_public.pdf); and “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (January – June 2016): [https://www.gogla.org/sites/default/files/recource\\_docs/global\\_off-grid\\_solar\\_market\\_report\\_jan-june\\_2016\\_public.pdf](https://www.gogla.org/sites/default/files/recource_docs/global_off-grid_solar_market_report_jan-june_2016_public.pdf)

<sup>69</sup> “Sierra Leone Country Action Agenda,” SEforALL / ECREEE, (July 2015): [https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country\\_AAs/Sierra\\_Leone\\_Sustainable\\_Energy\\_For\\_All\\_Action\\_Agenda.pdf](https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_AAs/Sierra_Leone_Sustainable_Energy_For_All_Action_Agenda.pdf)

<sup>69</sup> See **Annex 4** for more details

<sup>70</sup> “Gender Inequality Index,” UNDP, (2015): <http://hdr.undp.org/en/composite/GII>

In the energy sector, efforts have been made to implement measures under the regional framework, ECOWAS Policy for Gender Mainstreaming in Energy Access, as well as of the national level. Gender mainstreaming in the country’s energy policy requires capacity building of staff and the implementation of gender management systems at the institutional level to provide guidance on gender responsive leadership and decision making. As part of this process, the Government has established a gender focal point at the MoE to promote inclusive participation for women in the energy sector.

### 1.2.3 Key Challenges

Some of the key energy sector challenges facing Sierra Leone include (but are not limited to) the following:

- **Investment in Grid Extension and Maintenance:** Increasing electricity demand is putting pressure on power supply – a mismatch that will continue to burden the electricity transmission and distribution network that needs maintenance and investment to reduce losses and expand access.
- **Electricity Tariffs:** Average electricity tariffs in Sierra Leone (\$0.28/kWh) remain significantly higher than other countries in the region (**Figure 12**).<sup>71</sup> Sierra Leone subsidizes electricity tariffs for low-income consumers, providing electricity to poorer households below the cost of supply with funds from the GoSL and the utility (EDSA) through a range of residential and commercial consumers who pay higher electricity rates. Despite this cross-subsidization scheme, electricity remains largely unaffordable for most of the population. Average households in the country spend about 25% of their income on electricity compared to an average of 17% across the ECOWAS region (**Figure 13**), while electricity expenditures for low-income consumers remain nearly twice the ECOWAS average (3.2% in Sierra Leone compared to an average of 1.74% in the ECOWAS region).<sup>72</sup> High power costs serve as a significant deterrent to private business and investment and hinder economic growth.
- **Utility Financial Performance:** Without cost-reflective tariffs in place, EDSA and EGTC are not financially viable. As a result, Sierra Leone’s power sector remains largely dependent upon foreign assistance, while the overall quality of electricity service remains inadequate (**Figure 3**). A related issue is the relatively weak state of the local currency and the associated currency risk (Power Purchase Agreements are paid in USD, while electricity is sold at fixed rates in Leone). These challenges, among others, have limited the utility’s revenue, hampering its ability to invest in the country’s power infrastructure.
- **Imbalanced Energy Mix:** The country’s power supply mix is overly reliant upon liquid fuels (diesel and heavy fuel oil) and large hydropower, which are susceptible to price volatility and climatic conditions, respectively. While power sector planning (**Table 4**) continues to support hydropower technologies through 2030, there is comparatively little investment in non-hydro renewable energy, which cannot compete with cheaper baseload power in the country’s existing regulatory environment.
- **Rural Electrification:** Energy access, especially in rural areas, is a huge challenge for Sierra Leone, as only 6% of the rural population had access to electricity in 2016. The Government has developed a comprehensive plan – the Electricity Sector Reform Road Map (2017-2030) – to address the policy, regulatory, financial, and technical, issues associated with this challenge.

<sup>71</sup> “Electricity Tariffs in ECOWAS Region,” African Development Bank Group, Energy Policy, Regulation and Statistics Division, (September 2018): [http://www.ecowrex.org/sites/default/files/pesr1\\_-\\_energy\\_statistics\\_bulletin\\_september\\_2018.pdf](http://www.ecowrex.org/sites/default/files/pesr1_-_energy_statistics_bulletin_september_2018.pdf)

<sup>72</sup> Ibid.

Figure 12: Average End-User Tariffs in ECOWAS Countries, 2018

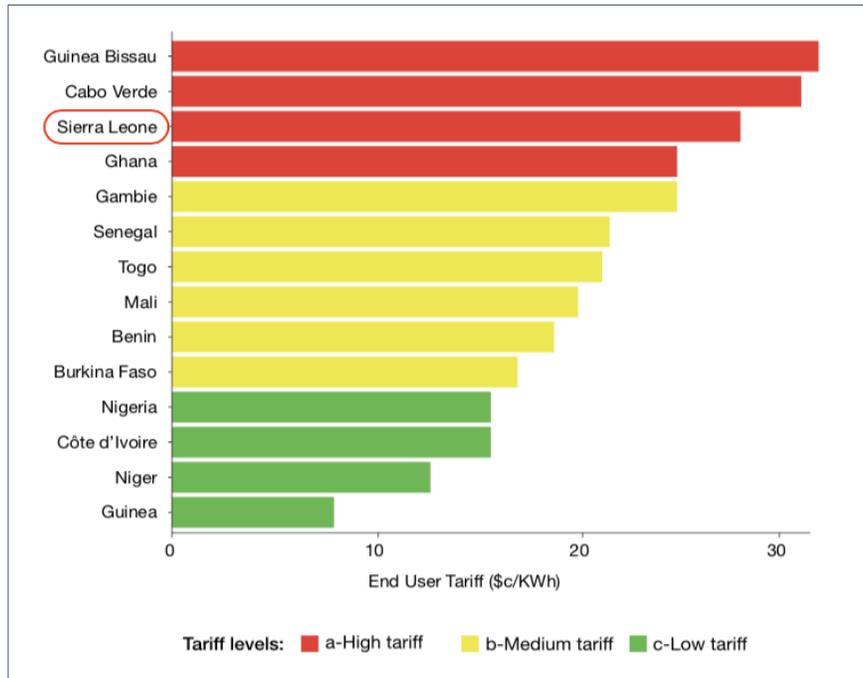
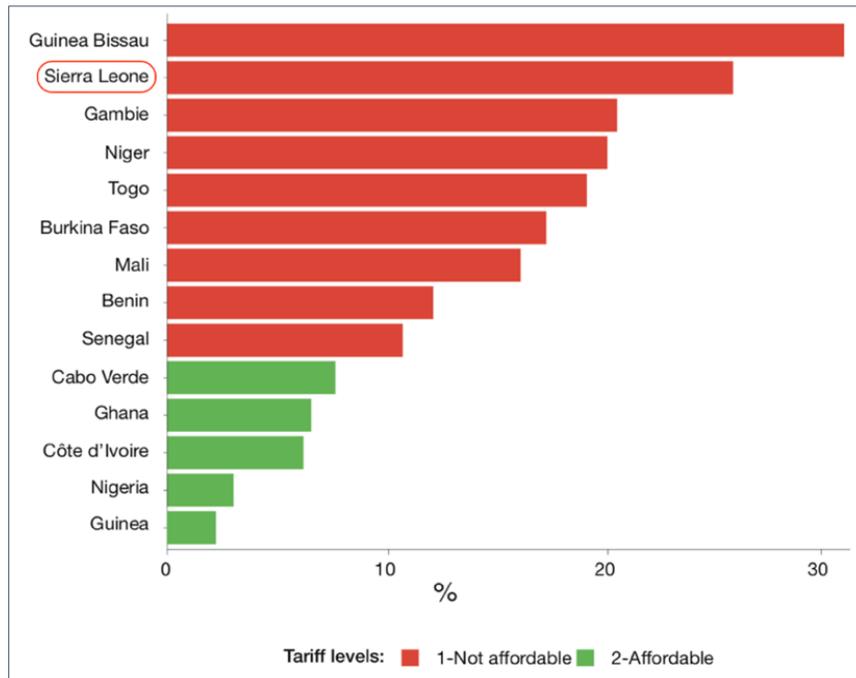


Figure 13: Share of Income Spent on Household Electricity in ECOWAS Countries, 2018



NOTE: Liberia is excluded from the analysis; the threshold for what is considered an affordable tariff is 10% of income spent on electricity – a household is considered energy poor if more than 10% of income is spent on energy/fuel to maintain adequate level of comfort; On average, households in the ECOWAS region spend 17% of their income on electricity.

Source (Figures 12-13): ECOWAS Regional Electricity Regulatory Authority

- Local Financial Institutions:**<sup>73</sup> Local financial institutions (FIs) and microfinance institutions (MFIs) lack sufficient internal capacity, credit appetite and capital base to invest in the renewable energy/off-grid sectors. This challenge is complicated as it arises mainly from risk perceptions of FIs, which influence whether efforts should be made to develop strategies and customize financial products to target a nascent market, where there is often limited knowledge of technologies, market characteristics and historical data on portfolio credit performance. There are also likely misperceptions about the potential size of these markets as well as doubts about the profitability of offering financial products in rural off-grid areas, where the creditworthiness of potential clients may be an issue. The off-grid space is particularly complicated given relatively high transaction costs and a comparatively unfavorable regulatory environment that exists in the country.<sup>74</sup>
- Other Challenges:** Successful development of the off-grid sector will require more than just a financial support mechanism – the Government and its supporting agencies will also need to develop and implement a range of measures to expedite growth of the market, including a robust technical assistance (TA) platform to supplement ROGEP’s objectives. This platform should address *inter alia* (i) awareness raising, education and training for consumers, including organization of appropriate community management structures; (ii) solar PV system supply chain and operations and maintenance (O&M) services, including training of local technicians to ensure that the cost of maintenance is affordable and sustainable; and (iii) standards for equipment and service providers (i.e. installers, technicians) to guide customers to companies providing the best value for their money. These measures should be part of a national rural electrification sector strategy to inform decision-making of key stakeholders surrounding development and regulation of the country’s stand-alone solar PV market.

<sup>73</sup> The role of FIs is examined in further detail in **Section 3**.

<sup>74</sup> One notable exception to this is the commercial and industrial (C&I) market segment, where systems are larger and off-takers are often companies with large enough balance sheets to borrow. This has been one of the stand-alone market segments where there has been some lending to date in Africa (e.g. AFD’s Sunref program)

## 1.3 National Policy and Regulation

### 1.3.1 National Electricity/Electrification Policy

The GoSL has pursued a number of policies and reforms to create an enabling regulatory framework for off-grid sector development. Both the 2009 Energy Policy and its corresponding 2016 Policy Letter seek to implement a number of measures to improve the performance of the power sector, including:

- Attract and ensure the sustainability of private sector investment in the electricity sector, including the prioritized Western Area Power Generation Project
- Ensure that the electricity distribution and supply authority, EDSA, becomes a financially independent and commercially viable distribution entity with a credible track record of making punctual payments to its power producers and fuel suppliers
- Improve transparency and predictability of cash flows in the electricity sector
- Reduce the burden of the electricity of the fiscal budget of Sierra Leone

To date, the Government has adopted the Renewable Energy Policy of Sierra Leone, which aims to ensure the provision of electricity to all remote and off-grid areas of the country by utilizing off-grid solar technologies.<sup>75</sup> This policy emphasizes the importance of stand-alone solar products and services to meet the needs of the off-grid sector. The GoSL has also embarked on the review of the 2009 National Energy Policy with funding from UNDP. A key priority for the Government is improved coordination of donor activities as well as the inter-ministerial level (e.g. roles to be played by the Ministries of Water, Health, and Education in rural electrification) to create a clear framework for the country's electrification plans.

At a regional level, the GoSL is committed to the ECOWAS Regional Renewable Energy Policy for the period of 2015-2030, which seeks to (i) set national renewable energy targets, (ii) create a harmonized regulatory framework with common tax policies and standards, (iii) develop technology knowledge and capacity building, and (iv) promote a regional energy market. For the electricity sector, the objective is to increase the share of RE generation in the power mix by 2030 as well as the share of the off-grid population served by mini-grid and stand-alone systems.<sup>76</sup> The Government intends to achieve these objectives through its NREAP.<sup>77</sup>

### 1.3.2 Integrated National Electrification Plan

The GoSL has not yet adopted a fully integrated national electrification plan and there is a lack of coherence among all of Government's energy and electrification plans. In 2017, with funding from Millennium Challenge Corporation (MCC), the GoSL published the Electricity Sector Reform Roadmap (2017-2030).<sup>78</sup> The Roadmap, which includes provisions for developing an "Off-grid Rural Electrification Master Plan" by 2018-2019,<sup>79</sup> is a detailed plan for grid rehabilitation and expansion as well as for development of an institutional framework to support the supply off-grid electricity services. The key measures of the Roadmap include:

<sup>75</sup> "Renewable Energy Policy of Sierra Leone," (May, 2016):

[http://www.energy.gov.sl/PR\\_Renewable%20Energy%20policy%20of%20SL\\_FINAL%20for%20Print.pdf](http://www.energy.gov.sl/PR_Renewable%20Energy%20policy%20of%20SL_FINAL%20for%20Print.pdf)

<sup>76</sup> "ECOWAS Renewable Energy Policy," ECOWAS, (2015):

[http://www.ecreee.org/sites/default/files/documents/ecowas\\_renewable\\_energy\\_policy.pdf](http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf)

<sup>77</sup> "Sierra Leone National Renewable Energy Action Plan," ECREEE / SEforALL, (2015): [https://www.se4all-](https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_PANER/Sierra_Leone_National_Renewable_Energy_Action_Plans.pdf)

[africa.org/fileadmin/uploads/se4all/Documents/Country\\_PANER/Sierra\\_Leone\\_National\\_Renewable\\_Energy\\_Action\\_Plans.pdf](https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_PANER/Sierra_Leone_National_Renewable_Energy_Action_Plans.pdf)

<sup>78</sup> "Electricity Sector Reform Roadmap (2017-2030)," Millennium Challenge Corporation, (2017): [http://www.mccu-](http://www.mccu-sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf)

[sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf](http://www.mccu-sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf)

<sup>79</sup> Electricity Sector Reform Roadmap, 2017-2030.

- The development of procurement contract/concession for power generation including (i) a single concession agreement with off-grid concessionaire for towns over 20,000 inhabitants (with transfer of public assets owned by public utilities), (ii) a single PPP contractor for towns below 20,000 inhabitants, (iii) the outsourcing from EDSA to private operators for the cities of Freetown and Lungi
- The development of feed-in-tariffs for new generation projects below 3.5 MW
- The division of the electricity supply market into (i) an on-grid centralized market and (ii) a decentralized off-grid market, allowing the distribution of licenses for the isolated mini-grid and off-grid market
- The implementation of an IPP procurement process/procedure for the timely planning of additional power generation capacity by implementing
- The implementation of a policy to develop low cost RE capacity by private investments, which seeks to update existing RE-related policies and regulation, namely the Energy Policy of 2009, the Policy letter of 2016, the Renewable Energy Policy of 2015
- The goal to reach financial viability by (i) creating a single EDSA collection account (financed by tax/levy from tariffs and providing subsidy), (ii) commissioning of new generation and distribution capacity, (iii) introducing short-term fuel tax exemption for thermal generation and (iv) long-term tariff restructuring measures

### 1.3.3 Energy and Electricity Law

Sierra Leone's electricity sector is governed by the 2011 National Electricity Act (enacted in 2015). According to recommendations provided in the Electricity Sector Reform Roadmap, the GoSL will implement a variety of additional legal reforms, including eventual privatization of the electricity market (EGTC, EDSA) and a repeal of the single buyer market arrangement and establishment of a decentralized market.

### 1.3.4 Framework for Stand-alone Systems

**Figure 14** is an overview of the key national policies, programs, laws, and regulations pertaining to Sierra Leone's framework for stand-alone systems. The gaps in this framework are addressed in **Section 1.3.5**.

To date, the Government's efforts to establish a supportive policy and regulatory framework for the off-grid sector are progressing well, as Sierra Leone more than doubled its World Bank Regulatory Indicators for Sustainable Energy (RISE) energy access score between 2015 and 2017. In the 2017 RISE evaluation, Sierra Leone ranked 11<sup>th</sup> among countries in West Africa and the Sahel (**Figure 15**).

Figure 14: Policy and Regulatory Framework for Stand-alone Systems

SIERRA LEONE		
	World Bank RISE 2017 Energy Access Score: 36 World Bank RISE 2015 Energy Access Score: 17	2017 ranking among West Africa and the Sahel (ROGEP) countries: 11 <sup>th</sup> (out of 16)
Policy/Regulatory Support and Financial Incentives	<b>Specific national policies, laws and programs<sup>80</sup></b>	
	National electrification policy with off-grid provisions	√ Renewable Energy Policy of Sierra Leone (2016)
	Integrated national electrification plan	□ Electricity Sector Reform Roadmap
	Energy/electricity law with off-grid provisions	x
	National programs promoting off-grid market development	√ Power for All; RREP; PRESSD
	Specific target for rural electrification	√ Universal access by 2025
	<b>Financial incentives</b>	
	Subsidies, tax exemptions or related incentives for solar equipment/stand-alone systems	√ Tax exemptions for IEC-compliant solar products
	<b>Standards and quality</b>	
	Government-adopted international quality standards for stand-alone systems	□ Electricity Sector Reform Roadmap
	Government-certified program for solar equipment installers	x
	Consumer awareness/education programs	x
	<b>Concession Contracts and Schemes</b>	□ Electricity Sector Reform Roadmap
	<b>Business Model Regulation</b>	x

√ = existing/implemented provisions in the current regulatory framework

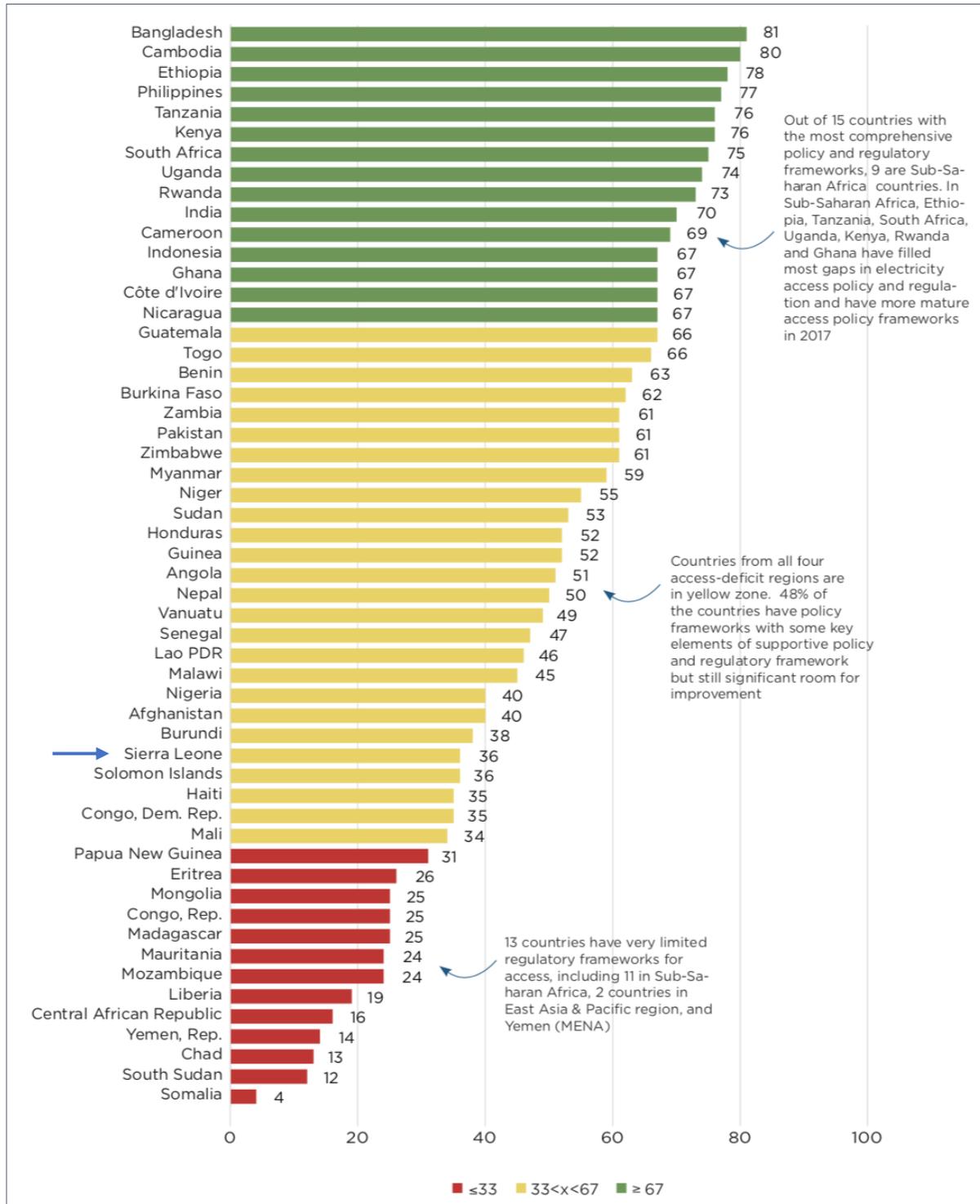
x = no existing provisions

□ = planned/under development

Source: World Bank RISE, Stakeholder interviews and GreenMax Capital Advisors analysis

<sup>80</sup> The Electricity Sector Reform Roadmap (2017-2030), which includes plans/provisions to address many of the existing gaps in the policy and regulatory framework, was still under development as of early 2019.

Figure 15: Distribution of RISE Electricity Access Scores in Access-Deficit Countries, 2017<sup>81</sup>



Source: World Bank Regulatory Indicators for Sustainable Energy

<sup>81</sup> "Policy Matters: Regulatory Indicators for Sustainable Energy," World Bank ESMAP, (2018): <http://documents.worldbank.org/curated/en/553071544206394642/pdf/132782-replacement-PUBLIC-RiseReport-HighRes.pdf>

#### 1.3.4.1 Existence of Specific National Programs

Among all of the donor-funded programs in Sierra Leone (**Table 7**), the most significant policy-related national initiative was the 2015 Power for All Energy Access Campaign.<sup>82</sup> The program established a task force comprised of government, donor, and private sector/industry stakeholders, and local FIs to collaborate on policy reform and accelerate off-grid solar market growth. The task force successfully implemented VAT/tariff exemptions for solar equipment, delivered a national awareness-raising campaign, and supported development of an MFI association to unlock local finance.<sup>83</sup>

To supplement existing donor-funded initiatives, the GoSL through the SLEWRC, intends to implement more rigorous off-grid regulation in the coming years (2018-2019) covering individual off-grid electricity supply services and isolated mini-grids. SLEWRC has already passed a series of mini-grid regulations in 2017, and the MoE plans to specify conditions for transferring to local authorities the power for organizing off-grid electricity supply services. The GoSL also intends to split the market into two sectors including both on-grid and off-grid market segments to better supply off-grid services.<sup>84</sup>

#### 1.3.4.2 Financial Incentives

In 2016 and 2017, guided by the Power for All campaign, the GoSL implemented duty and VAT exemptions on imported quality certified (IEC-compliant) solar products. Additionally, the Electricity Sector Reform Roadmap outlines several future financial incentives to be implemented including an “Energy Management Fund” that will channel finance from the GoSL and donors to project developers and consumers through local FIs to support electricity access, as well a tariff scheme to off-set costs for developers. The GoSL is also planning a levy to finance the rural electrification fund, that may be considered after its implementation.

#### 1.3.4.3 Standards and Quality

While there are no standards currently in place, there are provisions in the Electricity Sector Reform Roadmap to establish a set of technical criteria and required standards of performance for the off-grid sector. These standards will encompass licenses for generation, transmission, dispatch, import, export, distribution, on-grid sale of electricity, off-grid sale of electricity and the provision of related services. These technical criteria will be the basis of an interim grid code.<sup>85</sup>

#### 1.3.4.4 Concession Contracts and Schemes

Although concession contracts and schemes in Sierra Leone do not focus specifically on enhancing off-grid solar or stand-alone systems, under the Electricity Sector Reform Roadmap, the GoSL is considering selection of a single off-grid private sector operator to develop a cluster of off-grid villages (concession area) and adapt a uniform electricity supply tariff within the cluster under the authority of SLEWRC.<sup>86</sup>

<sup>82</sup> “Decentralized Renewables: From Promise to Progress,” Power for All, (March 2017): <https://static1.squarespace.com/static/532f79fae4b07e365baf1c64/t/58e3f73ce4fcb5a3a0989855/1491334979777/Decentralized-Renewables-From-Promise-to-Progress-March-2017.pdf>

<sup>83</sup> Ibid.

<sup>84</sup> “Electricity Sector Reform Roadmap (2017-2030),” Millennium Challenge Corporation, (2017): <http://www.mccu-sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf>

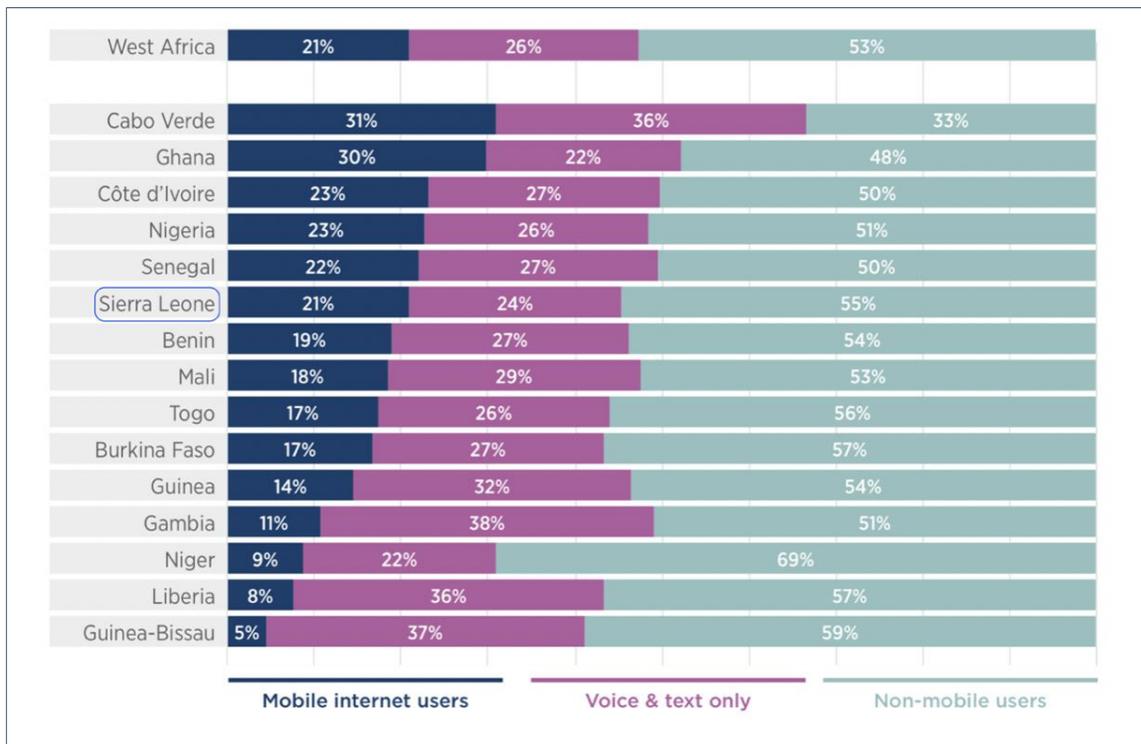
<sup>85</sup> “Electricity Sector Reform Roadmap (2017-2030),” Millennium Challenge Corporation, (2017): <http://www.mccu-sl.gov.sl/documents/Sierra%20Leone%20Power%20Sector%20Roadmap.pdf>

<sup>86</sup> Ibid.

1.3.4.5 Specific Business Model Regulation

No specific business model regulations exist for the off-grid sector in Sierra Leone, although the Government can take measures to support PAYG business models that have already been deployed by private solar companies engaged in the market. As was demonstrated in East Africa in recent years, the proliferation of mobile money platforms can rapidly facilitate energy access. Recent data suggests that there is an opportunity for the GoSL to bring together key stakeholders in the off-grid sector (solar providers, telecommunications companies etc.) to take advantage of the country’s rapidly growing mobile internet usage (**Figure 16**) and high rates of mobile phone ownership in rural areas (**Figure 17**). Moreover, a transition to mobile broadband networks is gaining rapid momentum, with Sierratel launching its LTE service in January 2018.<sup>87</sup>

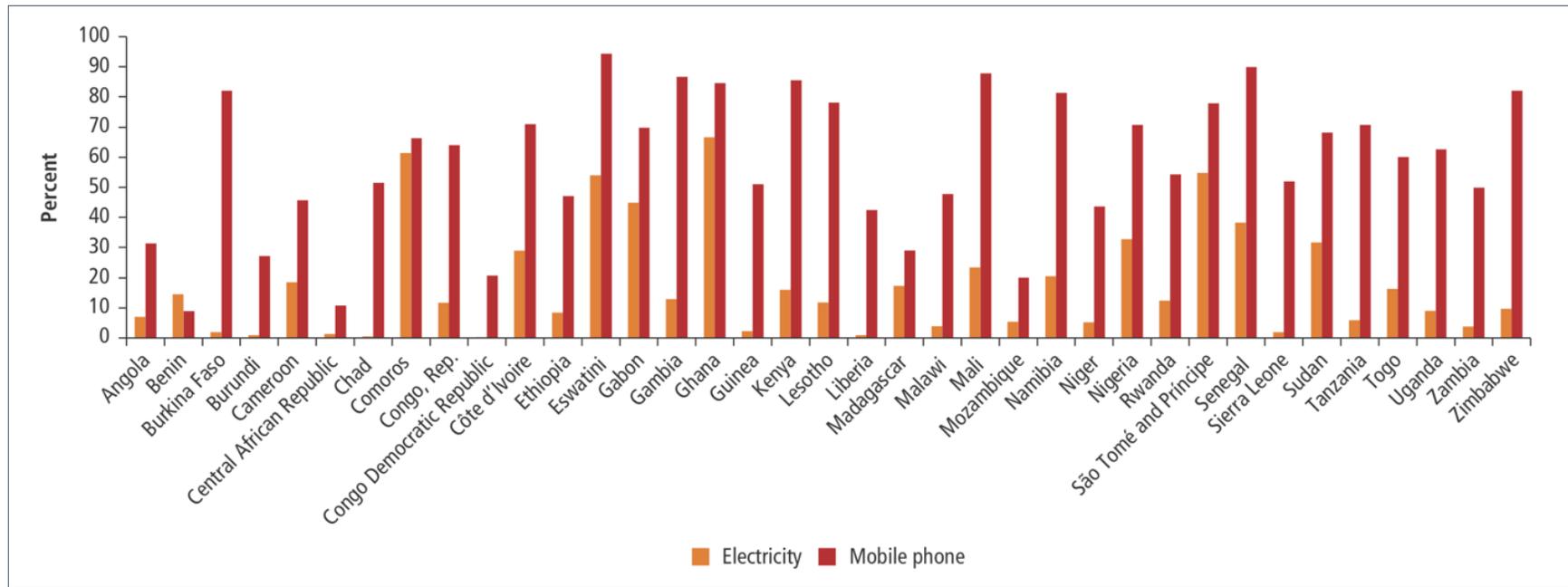
Figure 16: West Africa Mobile Internet Penetration Rates, 2017



Source: GSMA Intelligence

<sup>87</sup> “The Mobile Economy: West Africa 2018,” GSMA Intelligence, (2018): <https://www.gsmaintelligence.com/research/?file=e568fe9e710ec776d82c04e9f6760adb&download>

Figure 17: Electricity Access and Mobile Phone Ownership in Sub-Saharan Africa, 2016 (% of rural households)<sup>88</sup>



Source: World Bank

<sup>88</sup> Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake Reliability and Complementary Factors for Economic Impact," AFD and World Bank, (2019): <https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y>

### 1.3.5 Capacity Building and Technical Assistance

To overcome the challenges surrounding rural electrification, a range of technical and financial resources from both the public and private sector must come together. At the institutional level, the MoE and the electricity market regulator, SLEWRC, among others, will play key roles in establishing a supportive policy and regulatory framework. Additional reforms to the power sector may be required to provide the incentives necessary to increase private sector participation. Local FIs and MFIs will need incentives and support to develop and implement new financial products and administrative procedures to lend to the off-grid sector. International and local solar companies will need policy and financial support. Local technical capacity of the solar sector will need to be developed to ensure long-term O&M services are available and sustainable. Above all, financing and TA will be critical for all market actors – government, FIs, end-users, suppliers and service providers – in order to accelerate growth.

**Table 7** identifies some of the policy/regulatory challenges facing off-grid market development in Sierra Leone and the proposed mitigation measures and Technical Assistance interventions to overcome these gaps.

Table 7: Gaps in the Off-Grid Policy and Regulatory Framework<sup>89</sup>

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
1. Specific National Policies, Laws and Programs	<b>A. Lack of National Electricity / Electrification Policy</b>	
	a. No policy exists for rural electrification	a. Help Government establish a clear Rural Electrification Policy that encourages least cost, integrated planning for all options (grid, mini-grid and off-grid)
	b. Government is subsidizing fossil fuel electricity production	b. Help Government analyze where fossil fuel subsidies serve as an impediment to development of safe, clean energy access alternatives
	<b>B. Lack of Integrated National Electrification Plan</b>	
	a. No integrated plan exists	a. Help Government develop a comprehensive, least cost, integrated plan for all rural electrification options (grid, mini-grid and off-grid) with clear and consistent targets and policies <sup>90</sup>
	b. Insufficient focus on or understanding of framework to support private sector participation	b. Help Government improve the planning framework to encourage private participation in mini-grid and stand-alone solar system options, including <i>inter alia</i> preparation of guidelines to enhance collaboration between Government and private companies, industry associations, and other relevant stakeholders to coordinate development of effective policy that is flexible and responsive to the needs of the market <sup>91</sup>

<sup>89</sup> “Government” as it is used throughout this table refers to the main public institutions, officials and policymakers responsible for planning, management and regulation of the energy sector in Sierra Leone (**Table 2**), including the Ministry of Energy (MoE), the National Power Authority (NPA), the Sierra Leone Electricity and Water Regulatory Commission (SLEWRC), the PPP Unit of the Office of the President, the REASL and the national utility, EDSA, among other national and local authorities

<sup>90</sup> The Electricity Sector Reform Roadmap (2017-2030) is still under development / has not been implemented as of mid-2018

<sup>91</sup> This should build upon the successful policy efforts of the Power for All Energy Access Campaign

	<p><b>C. Lack of Energy and Electricity Law</b></p> <p>a. No specific Energy or Electricity Law with off-grid provisions exists</p>	<p>a. Help Government develop new legal framework that is flexible and helps create appropriate incentives for private sector participation in off-grid market development (e.g. to facilitate process of unbundling / electricity market liberalization)</p>
	<p><b>D. Insufficient national policies, laws, programs and/or action plans targeting off-grid market development</b></p> <p>a. Lack of specific Off-Grid Policy, Law, or Action Plan in place</p> <p>b. No Lead Agency</p> <p>c. Insufficient focus on or understanding of framework to support private sector participation</p>	<p>a. Help Government establish a medium-long term rural electrification strategy in the country through development and implementation of a Rural Electrification Master Plan</p> <p>b. Help Government establish a lead entity / Rural Electrification Agency (or assign an existing agency, e.g. PPP unit within the Presidency) that has a clear mandate to coordinate activities with the private sector, donor community and at national and local level in order to understand challenges and develop appropriate solutions to accelerate market growth and achieve energy access objectives</p> <p>c. Help Government improve policy and regulatory framework to create appropriate incentives for private sector participation to expedite off-grid solar market growth, including <i>inter alia</i> preparation of procurement schemes and financing mechanisms designed to encourage PPP engagement in the off-grid sector</p>
<p><b>2. Financial Incentives (import duties, taxes, etc.)</b></p>	<p><b>A. Insufficiently supportive financial incentives / tax regime</b></p>	<p>a. Help Government develop appropriate policies to reduce import duties and tariffs on the entire off-grid / stand-alone solar product supply chain (including batteries, inverters or other system components) that would provide necessary support to the industry<sup>92</sup></p> <p>b. Help Government establish a Special Task Force to (i) mitigate potential difficulties in customs clearance and import logistics, and (ii) oversee implementation of tax exemptions by coordinating with all agencies and regulatory bodies involved – Customs Authorities, the National Revenue Authority, National Standards Bureau etc.<sup>93</sup></p> <p>c. Help Government introduce appropriate grant and subsidy schemes which require private funding matches and are predictable and not overly bureaucratic</p> <p>d. Help Government create PPP schemes (through the PPP Unit) to share high project development and market entry costs particularly with developers in remote areas</p>

<sup>92</sup> There are currently tax exemptions in place for IEC-compliant solar products

<sup>93</sup> Stakeholder interviews in Sierra Leone revealed that despite government policy, tax exemptions have not been offered consistently in practice (duties as high as 40% were reported), resulting in increased costs for retailers and hindering overall market growth

		e. Help Government analyze where subsidies or exemptions for non-renewable energy sources provide unfair advantage for fossil-fuels and impede development of clean energy solutions
3. Standards and Quality	A. Insufficient Market Data	a. Help Government establish a Special Task Force (within REA, REASL etc.) responsible for collaborating with the private sector to compile and regularly update a database of critical off-grid market data (solar product imports, costs, sales volumes, resource potential etc., GIS data and other key indicators) that can be (i) utilized by policymakers to make informed electrification planning decisions based on accurate market information, and (ii) made easily accessible to interested off-grid developers, investors and other key industry stakeholders
	B. Unclear / lack of quality standards <sup>94</sup>	<p>a. Help Government establish international quality standards for off-grid stand-alone solar products, including minimum technical standards (IEC Technical Specifications), warranties, required availability of and cost guidelines for post-sale services/O&amp;M, and harmonization of equipment to expedite replacement of spare parts<sup>95</sup></p> <p>b. Help Government integrate standards with appropriate oversight agencies to ensure quality-verification procedures are in place to safeguard the reputation of licensed products and to in turn mitigate the detrimental impact of the counterfeit / inferior product market<sup>96</sup></p> <p>c. Help Government implement a legal framework that provides protections for consumers and suppliers, including <i>inter alia</i> regulations that (i) require licensing for the sale and installation of solar equipment; (ii) prohibit the sale of certain brands or models; and (iii) enable companies or public authorities to prosecute those caught distributing counterfeit / inferior products that are not up to promulgated standards</p>
	C. Lack of capacity of local technical sector (solar PV technicians, installers, services providers etc.)	<p>a. Support establishment of technical certification and vocational training programs through government, private sector, and/or academia for installation and maintenance of stand-alone solar system<sup>97</sup></p> <p>b. Support development of database of best practices / information sharing services to ensure skills transfer from international, local and regional initiatives (e.g. through REASL)</p>

<sup>94</sup> This was an area identified as a significant barrier to market growth during stakeholder interviews and focus group meetings. More specifically, the lack of a consumer protection framework / absence of elaborate licensing or standards framework to preclude any brand or model from the solar market; the sale and installation of solar equipment does not require any particular licensing either.

<sup>95</sup> The proposed Electricity Sector Reform Roadmap includes a range of provisions for standards and quality

<sup>96</sup> The presence of poor quality, sub-standard products has resulted in reduced profit margin for the genuine licensed players in the industry (see **Section 2.4** for more details)

<sup>97</sup> The Barefoot Women Solar Engineer Association of Sierra Leone conducts training and carries out rural development initiatives

	<p><b>D. Insufficient attention of private companies to environmental/social standards and community engagement</b></p>	<p>a. Assist private sector and/or civil society organizations to ensure environmental/social standards are in place</p> <p>b. Assist in development of strategies encouraging inclusive gender participation</p> <p>c. Support with the implementation of a repair and recycling framework for off-grid solar systems and equipment</p>
	<p><b>E. Insufficient public awareness</b></p>	<p>a. Support Government, trade associations and civic society organizations to develop and implement consumer awareness/marketing/education programs on the benefits of off-grid solar products and the existence of related national programs<sup>98</sup></p> <p>b. Support development and implementation of programs to educate consumers, retailers and distributors on the benefits of quality certified solar products vs. counterfeit low-quality products</p>
<p><b>4. Concession Contracts and Schemes</b></p>	<p><b>A. Lack of clear and transparent licensing and permitting procedures</b></p> <p>a. Unclear procedures</p> <p>b. Insufficient communication and streamlining</p>	<p>a. Help Government develop clear licensing and permitting procedures</p> <p>b. Help Government develop improved systems for sharing and disseminating information to project developers and key stakeholders, including establishment of a “one-stop-shop” for national level permits and approvals and expediting of local permits</p>
	<p><b>B. Lack of understanding of emerging concession and energy services schemes for off-grid providers</b></p> <p>a. Need for understanding of different SHS concession schemes</p> <p>b. Need for understanding of emerging models for ‘Integrated Private Utilities’ or ‘Energy Companies of the Future’</p> <p>c. Public procurement or public finance/budget laws that hamper deployment of energy services models for public facilities</p>	<p>a. Help Government understand all options and models for possibilities of granting geographic concessions to private operators of SHS<sup>99</sup></p> <p>b. Help Government to understand and develop approaches to facilitate pilots of ‘Integrated Private Utility’ or ‘Energy Company of the Future’ schemes.<sup>100</sup></p> <p>c. Help Government develop procurement and public finance laws that will facilitate stand-alone solar system investment for public facilities (schools, health care facilities, etc.)</p>

<sup>98</sup> This should build upon the successful policy efforts of the Power for All Energy Access Campaign

<sup>99</sup> Different models used to grant geographic concessions to SHS providers can yield wide-ranging results; while some observers have lauded the approaches being used in Rwanda, Nigeria, Togo and DRC as highly successful, there has been criticism of the approach deployed in Senegal

<sup>100</sup> Innovative models are emerging for entire geographic areas to be concessioned to integrated private energy services operators who may offer an appropriate mix of solutions within their franchised area (i.e. a mix of SHS, rooftop solar, specialized systems for productive use, mini-grids and micro-grids). This is being piloted by the Shell Foundation in several countries.

	<ul style="list-style-type: none"> <li>d. Lack of standardized contracts for energy services provided by private system operators to public facilities</li> <li>e. Insufficient protection for stranded investments</li> </ul>	<ul style="list-style-type: none"> <li>d. Help Government, trade associations or civic society organizations develop model bilateral PPA and Energy Services Contracts for small-scale IPPs and ESCOs to sell power or deliver energy services to public facilities (i.e. schools, healthcare facilities) or deliver solar street lighting services to municipalities</li> <li>e. Help Government develop proper procedures and guidelines to protect against stranded investments from competition among all on-grid and off-grid rural electrification approaches<sup>101</sup></li> </ul>
<p><b>5. Business Model Regulation</b></p>	<p><b>A. Lack of understanding about different pricing schemes and business models offered by stand-alone solar system developers</b></p>	<ul style="list-style-type: none"> <li>a. Support capacity building of regulators, Government, and non-Government stakeholders about different pricing schemes offered by stand-alone solar system providers to improve understanding and help avoid unnecessary interventions to regulate<sup>102</sup></li> <li>b. Support regulators and off-grid enterprises to collaborate specifically on developing pricing schemes for productive use market segment<sup>103</sup></li> <li>c. Support off-grid entrepreneurs and telecommunications companies in building the capacity of and fostering linkages between telecommunications companies / mobile money providers and off-grid solar companies to help roll out technology platforms and PAYG business models</li> </ul>

Source: Focus Group Discussions; Stakeholder interviews; GreenMax Capital Advisors analysis

<sup>101</sup> As the off-grid sector becomes populated by a variety of different approaches, all private operators are subject to potential stranded investments “when the grid arrives” and even SHS providers can have their assets and revenues threatened when the mini-grid arrives

<sup>102</sup> The term “pricing schemes” used in this context refers to pricing options offered by standalone solar system providers for SHS, productive use, rooftop solar for public facilities, solar street lighting, etc. that are new, innovative and may be difficult for stakeholders to initially well understand. Whether these are PAYG, Lease to Own, electricity sales, commodity-based pricing, time of use or block pricing, the lack of understanding can often cause stakeholders to ask Government to intervene to “protect consumers” where such regulation of the market could in fact be misguided and unwarranted.

<sup>103</sup> The productive use segment is brand new with SHS providers, mini-grid operators and vendors specialized on a single type of SME or agricultural productive use (i.e. grain mills, water pumps, cocoa processing etc.) all grappling to arrive at attractive approaches to billing for energy services. This is a particular area where TA support is much needed to help all stakeholders sort out practical approaches.

## 1.4 Development Initiatives

### 1.4.1 National Government Initiatives

The GoSL has led several initiatives to address the country’s rural electrification challenges. The Electricity Sector Reform Roadmap includes plans to develop and implement a Rural Electrification Master Plan in 2018-2019 along with an Energy Management Fund. The National Renewable Energy Policy stresses the importance in implementing off-grid solar solutions as a key element to meet rural electrification objectives, and the Energy Sector Strategy and Action Plan (2014-2017) includes an allocation for the development of off-grid systems in the country. The GoSL has also sponsored BWSEASL, which has helped install more than 7,000 solar home systems in rural Sierra Leone.<sup>104</sup> Previously, in 2014, The GoSL has also undertaken various public street lighting initiatives, including in Freetown, Makeni, Kambia, Port Loko, Kono, Kenema, Kailahun and Bonthe.

### 1.4.2 DFI and Donor Programs

In addition to Government-led initiatives, there are a number of related Development Finance Institution (DFI) and donor-funded programs also supporting development of the off-grid sector in Sierra Leone, led by the EU and ECREEE among others, while UK DFID and AFD have been engaged on a bilateral basis (Table 8).

Table 8: DFI and Donor Funded Off-Grid Development Programs

Project/Program	Funding Source(s)	Timeline	Market Segment(s)	Description
Rural Renewable Energy Programme (RREP)	DFID	2017 - 2019	Stand-alone systems, mini-grids	<ul style="list-style-type: none"> <li>The RREP program funded by DFID and implemented by UNOPS aims to increase electricity access in rural Sierra Leone over a 3-year period</li> <li>The first phase of the project (2017-2018) already supplied solar PV electricity (6 kW systems) to 54 rural community health centers</li> <li>The second phase of the project (2018-2019) will also provide 40 micro-grids between 40 and 200 kW to additional health centers and markets</li> <li>The first 54 sites which are included as part of the first phase of the project are financed solely by grants</li> </ul>
Promoting Renewable Energy Services for Social Development project (PRESSD)	EU	Ongoing	Stand-alone systems, pico solar	<ul style="list-style-type: none"> <li>Provides an innovative, decentralized approach to supplying households and businesses with power in rural Sierra Leone</li> <li>Present in six districts of Sierra Leone including Bombali, Kambia and Portloko, in the North, and in Kenema, Kono and Kailahun in the East</li> <li>Distributing:                             <ul style="list-style-type: none"> <li>100 charging stations of approx. 570 W each.</li> <li>22 Energy hubs of average 3 kW each (in agricultural business processing centers)</li> <li>3 mini-grids (Gbinti - 79 kW; Panguma – 64 kW; Segbwema – 127 kW)</li> </ul> </li> </ul>

<sup>104</sup> “Introduction: Energy Sector in Sierra Leone,” Ministry of Energy (MOE), Government of Sierra Leone, (2014): <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwi8jrj98bncAhUwMwKHZgFBsgQFjABegQICBAC&url=https%3A%2F%2Feuropa.eu%2Fcapacity4dev%2Ffile%2F27783%2Fdownload%3Ftoken%3DRKyc-BuE&usg=AOvVaw0u-ixlWp72e2Ami0efrH8g>

				<ul style="list-style-type: none"> <li>- 12 schools (average 4.3kW), 3 hospitals (20.6 kW), 7 large clinics (3.8 kW), 2 small clinics (1.5 kW)</li> <li>- 3 solar PV laboratories (3.6 kW) in technical institutes including Government Technical Institute (GTI) Kissy, Government Technical Institute (GTI) Magburaka and Eastern Polytechnic (EP) of Kenema</li> <li>- 10,558 pico-PV products (D-Light home lighting systems) for sale through a retailing network<sup>105</sup></li> </ul>
Power for All - Energy Access Campaign	DFID, Climate Works, UN Environment, others	2015 - Present	Pico solar	<ul style="list-style-type: none"> <li>• Seeks to improve market conditions and increase investment in off-grid solar in Sierra Leone</li> <li>• Sierra Leone was the first country to participate in the Energy Africa Campaign, and has since received policy support and technical assistance from the UK government.</li> <li>• As part of the Energy Africa Campaign compact between the GoSL and the UK Government, Sierra Leone announced the removal of import taxes on solar equipment.</li> </ul>
EU Africa Infrastructure Trust Fund	EU, AfDB, KfW		Grid maintenance	<ul style="list-style-type: none"> <li>• Includes a EUR 10 million direct grant for rural electrification</li> <li>• The grant will finance activities for development of five off-grid substations in Sierra Leone</li> </ul>
Rural Finance and Community Improvement Programme – Phase II (RFCIP2)	IFAD	2013 - 2022	MFIs, Community Banking, SHS	<ul style="list-style-type: none"> <li>• Strengthening capacity of the finance service providers in rural areas, to increase their outreach and provide demand-driven services to rural communities, including, among others: <ul style="list-style-type: none"> <li>- 285,000 rural households having access to at least one financial product;</li> <li>- 175,000 rural loans extended nationwide;</li> <li>- USD 72 million in incremental lending to the rural sector;</li> </ul> </li> <li>• Provision of SHS for 64 Financial Service Associations and approx. 18 Community Banks</li> </ul>
Advancing Partners and Communities	USAID, JICA, JSI, ACF	2016	SHS	<ul style="list-style-type: none"> <li>• Installation of solar systems for health facilities</li> </ul>
Energizing Development Project (EnDev)		2017	SHS, Pico Solar	<ul style="list-style-type: none"> <li>• Distribution of SHS for health facilities and schools in Kono and Kailahun</li> <li>• Development of solar stakeholders and interventions coordination platform: <a href="http://www.renewables-salome.info">www.renewables-salome.info</a></li> </ul>

<sup>105</sup> “Electricity Sector Reform Roadmap,” Ministry of Energy, Government of Sierra Leone, (2017).

### 1.4.3 Other Initiatives

Outside of the Government and donor initiatives mentioned above, there are also several non-governmental organization (NGO) programs and other related initiatives in Sierra Leone’s off-grid sector:

- **Acumen Fund** : In early 2018, the nonprofit global venture fund, Acumen, invested in Easy Solar to support the company in its efforts to provide off-grid solar services in the country. This investment was made under Acumen’s Pioneer Energy Investment Initiative, an effort to bridge the funding gap in off-grid energy and accelerate access across the developing world.<sup>106</sup>
- **Akon Lighting Africa**: In 2018, Senegalese rapper, Akon, through his organization, Akon Lighting Africa, committed to provide 5,000 street lamps and 2,500 solar-powered traffic lights for several cities in the country.<sup>107</sup>
- **Cordaid Investments** – the asset management branch of Cordaid Foundation – rolled out its Stability Impact Fund Africa (SIFA) activities in Sierra Leone in 2015: it has provided important working capital investments into BBOXX SL and Easy Solar, solar companies that are among the largest in Sierra Leone.<sup>108</sup>
- **Barefoot Women**: BWSEASL is supported by the Government and trains women in solar technology. This is a branch of the larger Barefoot College Initiative, which is based in India. Hundreds of female technicians have received scholarships for training through this program. The initiative has led to tangible results by installing more than 7,000 solar home systems in rural Sierra Leone.<sup>109</sup>

<sup>106</sup> “Acumen Makes First Investment in Sierra Leone,” Acumen, (2018): <https://acumen.org/blog/press-releases/acumen-makes-first-investment-in-sierra-leone/>

<sup>107</sup> Takouleu, J., “Sierra Leone: Senegalese rapper Akon aims to light streets with solar energy,” Afrik21, (October 7, 2017): <https://www.afrik21.africa/en/sierra-leone-senegalese-rapper-akon-aims-to-light-streets-with-solar-energy/>

<sup>108</sup> “Stability Impact Fund Africa: Succeeding in A Fragile Economy,” Cordaid, (2017): <https://www.cordaid.org/en/news/stability-impact-fund-africa-succeeding-fragile-economy/>

<sup>109</sup> “Introduction: Energy Sector in Sierra Leone,” Ministry of Energy (MOE), Government of Sierra Leone, (2014).

## II. OFF-GRID SOLAR PV MARKET ASSESSMENT

This section presents the overall market assessment for stand-alone OGS energy systems in Sierra Leone. **Section 2.1** provides an overview of the current household off-grid energy situation and estimates potential household market demand for solar energy systems. **Section 2.2** introduces institutional off-grid energy demand and the potential of solar to supply this market. **Section 2.3** evaluates the demand for off-grid solar to serve productive use applications. **Section 2.4** examines the existing off-grid solar product supply chain in the country. **Table 9** summarizes the overall total cash market potential for OGS systems from each of the analyzed market segments. **Annex 2** provides an overview of the Task 2 methodology.

It should be noted that the Task 2 market sizing assesses the total *potential* demand for off-grid solar, as well as variables that affect demand, such as changes in population density, household income, expansion of national grids and access to finance, among other factors. This data will support policymakers and practitioners as they assess market potential over time. However, the quantitative demand estimate has not been revised to reflect *realistic* market potential. Many other factors and market failures will prevent the full realization of this total market potential, and these will vary by market segment.

For household demand, the off-grid solar market is already tangible. Still, many factors will affect household demand for solar products, such as distribution realities, consumer education, competing economic priorities for households, financial shocks, etc. The institutional market will be affected largely by government and donor budget allocations along with the potential for community-based finance. The productive use market is perhaps the least concrete. Considered a relatively new market segment for the off-grid solar industry, productive use market dynamics are not yet well understood. The ability to realize potential productive use market demand will also be affected by many of the factors that commonly determine enterprise prospects in the country, including infrastructure, rural distribution, marketing, access to finance, insecurity, regulation, etc. The data presented in this report is intended to provide a baseline for future research.

Table 9: Indicative Total Cash Market Potential for Off-Grid Solar PV Products in Sierra Leone, 2018

Off-Grid Market Segment	Annualized Cash Demand (Units)	Annualized Cash Demand (kW)	Annualized Cash Market Value (USD)	Financed Market Value (USD)
<b>Household</b>				
Pico solar	249,658	749	\$11,234,605	\$0.00
Plug and play	62,977	630	\$7,872,096	\$11,245,851
Small SHS	0	0	\$0.00	\$38,460,811
Medium and Large SHS	0	0	\$0.00	\$23,616,287
<b>Household Subtotal</b>	<b>312,635</b>	<b>1,379</b>	<b>\$19,106,701</b>	<b>\$73,322,949</b>
<b>Institutional</b>				
Water supply	257	897	\$2,240,188	-
Healthcare facilities	185	142	\$356,350	-
Primary and secondary schools	319	192	\$552,525	-
Public lighting	37	18	\$55,350	-
<b>Institutional Subtotal</b>	<b>798</b>	<b>1,249</b>	<b>\$3,204,413</b>	<b>-</b>
<b>Productive Use</b>				
SME applications for microenterprises	581	145	\$363,125	-
Value-added applications	112,343	15,102	\$76,983,157	-
Connectivity / ICT (phone charging)	3,336	1,334	\$2,875,776	-
<b>Productive Use Subtotal</b>	<b>116,260</b>	<b>16,581</b>	<b>\$80,222,058</b>	<b>-</b>
<b>TOTAL</b>	<b>429,693</b>	<b>19,209</b>	<b>\$102,533,172</b>	

Source: African Solar Designs analysis

## 2.1 Demand – Households

This section analyzes the main characteristics of the household (HH) OGS demand in Sierra Leone. Section 2.1.1 provides an overview of the household market segment, including its geographic components. Section 2.1.2 analyzes current household ability and willingness to pay for electricity services to estimate the total potential household sector demand. From this data, the potential household market for off-grid solar products is then calculated for both cash purchases (Section 2.1.3) and financed (2.1.4) purchases. Section 2.1.5 assesses consumer perceptions, interest, and awareness on OGS

### 2.1.1 Overview of Household Market Segment

Sierra Leone has a relatively small household solar PV market that is still largely undeveloped. Rapid uptake of household lighting and communication technology are driving demand for new electricity sources. However, despite recent entrance of PAYG and finance players into the household market segment, the country’s household solar market is still in early stages and dominated by the informal sector. Section 2.4 discusses how existing sections of the market have purchased and procured their solar systems equipment.

The observation below from a 2015 survey of 4,500 sites provides key insights into the electricity needs and expenditures of a typical Sierra Leone household:

*“The main source of lighting for the house is battery powered torches. The house owns around five of these and spends about 10-15% of its income buying batteries for the torches. A decade earlier, however, the main source of lighting in the house would have been kerosene lamps. The house also owns about three mobile phones, equating to approximately one mobile phone for every two adults, and spends roughly 7-10% of its income paying for the phones to be recharged at the local charging station. The only other (operating) electrical item in the household is a radio. No one in the household has ever used a computer or accessed the internet.”<sup>110</sup>*

It can be seen from the above that about 20-25% of monthly household income is spent on very small amounts of household electricity. When households lack income, they do without both electricity and communication services. These two points provide strong evidence of the major transition in household energy expenditure that small-scale solar systems can trigger.

### ➤ Demographic and Socio-Economic Segmentation of Household Market

According to the International Energy Agency (IEA), in 2016 there were about 1.2 million households (6 million people) in Sierra Leone without access to electricity.<sup>111</sup> In that year, an estimated 9% of the population had access to electricity, with the rate of access at 12% in urban areas and 6% in rural areas. Despite the country’s extremely low electrification rate, it is still a relatively small market for OGS from the perspective of a global off-grid investor.

The 2015 Census characterizes the population’s occupations as follows: 8.6% are unemployed, while 91.4% are employed, of which 83.9% are self-employed, 6.2% are employed by the Government, and 4% by the private sector. Agriculture is by far the largest sector of employment, employing 59.2% followed by services (31.1%).<sup>112</sup> Off-grid household income is highly seasonal and depends on crop cycles. Potential

<sup>110</sup> Lai, K., Munro, P., Kebbay, M., and Thoronko, A., “Promoting Renewable Energy Services for Social Development in Sierra Leone: Baseline Data and Energy Sector Research, Final Report,” European Union, (July 2015): <https://pressd-sl.org>

<sup>111</sup> See **Annex 2** for more details.

<sup>112</sup> “2015 Population and Housing Census: Summary of Final Results,” Statistics Sierra Leone, (2016): [https://www.statistics.sl/images/StatisticsSL/Documents/final-results\\_-2015\\_population\\_and\\_housing\\_census.pdf](https://www.statistics.sl/images/StatisticsSL/Documents/final-results_-2015_population_and_housing_census.pdf)

financing mechanisms for financing solar equipment must be based on this seasonality (many solar industry players already consider seasonality aspects when planning sales cycles).

➤ **Ability to Pay**

Even with the high demand for electricity, ability to pay for electricity is extremely constrained due to the high incidence of poverty in the country. As indicated in **Table 10**, over 52% of the population lived on below USD 1.90/day in 2011 and 94.7% lived below USD 5.50/day.

**Table 10: Poverty Headcount in Sierra Leone, 2011**

Poverty headcount ratio	% of population
Lives at or below \$1.90 a day*	52.2%
Lives at or below \$3.20 a day*	81.3%
Lives at or below \$5.50 a day*	94.7%

\* 2011 PPP

Source: World Bank

Rural households prioritize electricity services and have an ability to pay for electricity albeit in small amounts. Focus Group Discussion (FGD) participants indicated that average households spend between USD 12-19 per month on energy needs. A recent study estimated a monthly ability to pay ranging between USD 1.70/month for Tier 1 households and USD 21.00/month for Tier 3/4 households. Another study found that the “cost of lighting, on average, occupied between 10-15% of household incomes. Households using generators were found to spend a greater proportion of their income (upward of 20%) on lighting.”<sup>113</sup>

Based on this demographic and income data,<sup>114</sup> the household solar market in Sierra Leone can be divided into four distinct segments, which each require a different business and financing approach. Each segment fits into a distinct tier group as indicated by the Multi-Tier Framework<sup>115</sup> (note that Tier 5 is not included in this analysis. Off-grid solar systems that can provide a Tier 5 level of service are beyond the reach of 99.9% of Sierra Leoneans). As will be elaborated upon in Section 2.4 (Solar Supply), suppliers have already developed business models to approach market groups with growing sophistication.

<sup>113</sup> Lai et. al., 2015.

<sup>114</sup> “2015 Population and Housing Census: Summary of Final Results,” Statistics Sierra Leone, (2016): [https://www.statistics.sl/images/StatisticsSL/Documents/final-results\\_-2015\\_population\\_and\\_housing\\_census.pdf](https://www.statistics.sl/images/StatisticsSL/Documents/final-results_-2015_population_and_housing_census.pdf); and “National Strategy for Financial Inclusion, 2017-2020,” Bank of Sierra Leone, (2017): <https://www.bsl.gov.sl/SL%20FI%20Strategy%202017%20-%202020.pdf>

<sup>115</sup> “Multi-tier framework for measuring energy access,” ESMAP: <https://www.esmap.org/node/55526>

Table 11: Household Consumer Market Segments<sup>116</sup>

Income Quintile	% w/o Access	# HH w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# HH w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# HH w/o Access	Avg. GDP per HH per year	Energy Tier	Geographic segments	Description
Highest 20%	70%	188,93	\$5,271	Tier 3	1%	2,782	\$7,429	Tier 3	1%	3,329	\$9,150	Tier 3	High income rural	<ul style="list-style-type: none"> <li>• Small portion of rural households using a petrol generator set</li> <li>• Has a demonstrated ability to pay for solar off-grid systems</li> </ul>
													Mid to high income urban	<ul style="list-style-type: none"> <li>• Professionals, business owners and salaried people are likely to be connected to the grid.</li> <li>• Desires solution as a back-up or replacement to grid or generator power<sup>117</sup></li> </ul>
Fourth 20%	90%	242,910	\$2,723	Tier 2	2%	5,564	\$3,837	Tier 3	2%	6,659	\$4,726	Tier 2	Low income peri-urban / urban "under-grid"	<ul style="list-style-type: none"> <li>• Low income urban population engaged in SME work or casual labor</li> <li>• Lives near grid but cannot afford or does not have access to connection</li> </ul>
Third 20%	95%	256,405	\$1,964	Tier 2	9%	23,964	\$2,768	Tier 2	3%	9,988	\$3,410	Tier 2		
Second 20%	100%	269,900	\$1,479	Tier 2	99%	275,408	\$2,085	Tier 2	4%	13,318	\$2,568	Tier 1.5	Low income rural	<ul style="list-style-type: none"> <li>• Engaged in farming, SME or mining support activities</li> <li>• Lives more than 15km from the nearest grid connection.</li> </ul>
Lowest 20%	100%	269,900	\$982	Tiers 1, 1.5	100%	278,190	\$1,384	Tiers 1, 1.5	55%	183,286	\$1,705	Tier 1		
<b>Total Households without Access to Electricity</b>		<b>1,228,047</b>			<b>Total</b>	<b>585,908</b>			<b>Total</b>	<b>216,581</b>				

Source: IEA and World Bank; African Solar Designs analysis

<sup>116</sup> See Annex 1 and Annex 2 for more details

<sup>117</sup> This model does not consider connected on-grid households that would purchase OGS systems as a back-up power system due to poor grid quality and reliability. The "households without electricity access" estimates shown here include households without electricity connections, either from a grid connection or from a renewable energy-based off-grid source. This does include "under-grid" households, largely in the lower income quintiles, that live within grid vicinity but are currently not connected. 2023 and 2030 projections assume that under-grid households will become connected in those years.

➤ **Geographic Components of the Solar Market**

As will be elaborated in section 2.1.3, household poverty holds back geographic expansion of solar products and “pure” rural markets are largely untapped because of lack of ability to pay and lack of ability of companies to reach consumers. Four market segments – high and low-income rural, peri-urban and urban – were listed as the most important for those selling household equipment. Note also that small-scale productive use equipment is closely associated with household OGS systems (and dealers do not distinguish between the two markets).

The following information provided during the FGDs is also helpful in understanding market segments:

- Farmers and business women are key target groups. Traders focus on areas where cash crops such as rice, coffee, cocoa, livestock and fishing are concentrated. Some solar traders provide solar equipment during periods when harvests are underway / consumers are cash-rich and can afford to make purchases.
- A number of off-grid “mining enclaves” have potential for sales of OGS products. These areas include locations where iron, ore, diamonds and rutile (titanium dioxide) are produced. Workers in mines have cash for their own homes or for their remote families.
- For some solar traders, urban areas are not considered very good market locations, due to the availability of grid-power. However, other traders consider that the urban and peri-urban demand is viable because of the lack of low-cost quality electricity. In particular, they are interested in demand from consumers of high-end solar systems and from peri-urban poor without access to grid connections. Both of these groups are said to be more “cash rich” than rural areas that are focused on subsistence agriculture.

In rural areas, demand for household systems is concentrated in areas where there are high populations and high productivity. However, demand is spread over a large area given the large portion of the country that is un-electrified and distant from the grid. **Table 12** provides the approximate number of off-grid rural households by region and includes an overview of the potential market for off-grid solar systems in the entire country. According to the 2015 Census report, Sierra Leone had approximately 1.26 million households out of which 44.87% were in urban areas. Almost all households in the Western Region (97.2%) were enumerated in urban areas, compared to only 19.9% in the Southern Region. For this study, it is assumed that both rural and urban households are potential market for the off-grid systems.

Table 12: Estimated Number of Households by Region, 2015

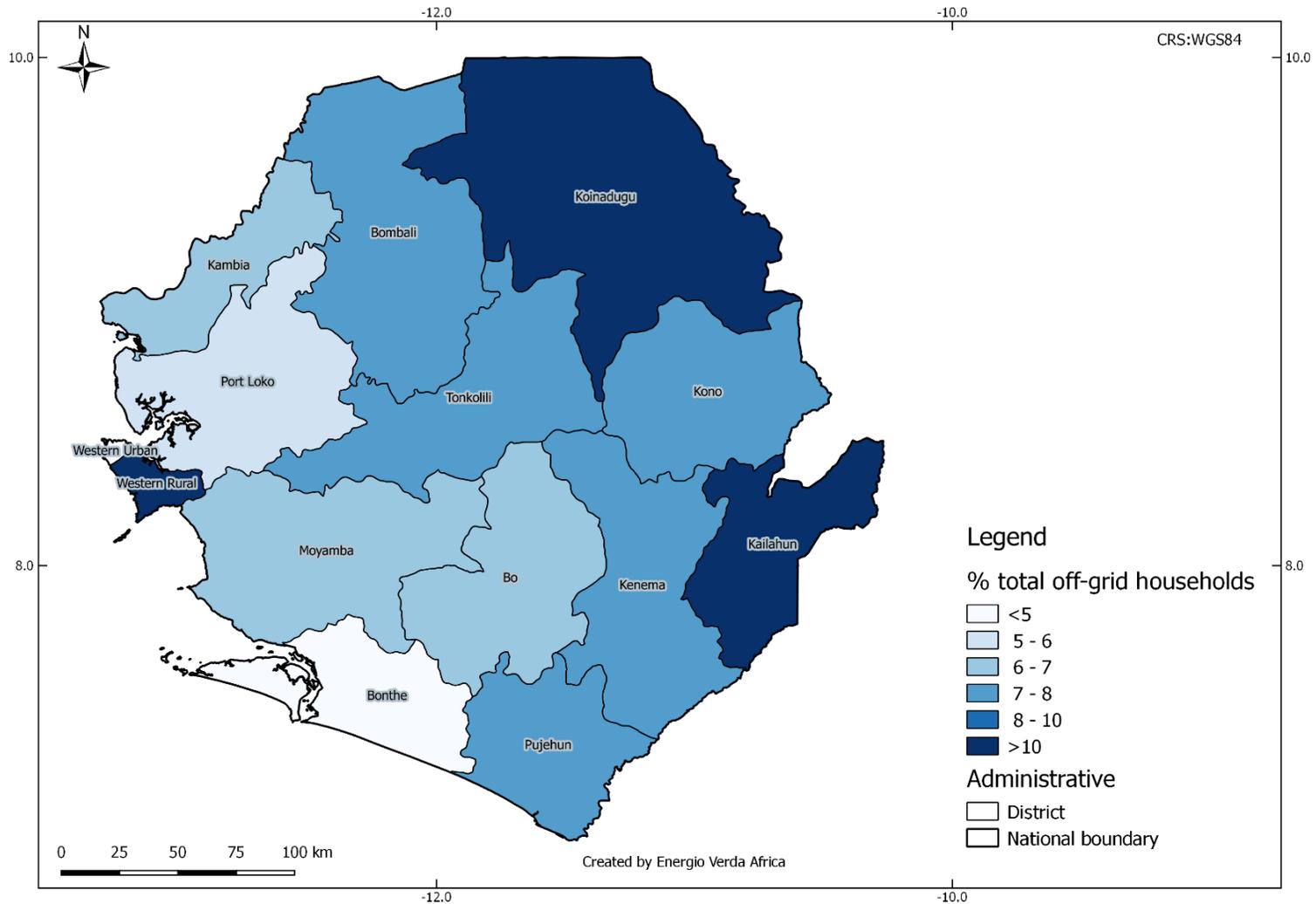
Region	Total Number of Households by region	Off-grid Rural	Urban
Eastern	281,201	182,498 (64.9%)	98,701 (35.1%)
Northern	414,377	307,053 (74.1%)	107,324 (25.9%)
Southern	248,655	199,172 (80.1%)	49,483 (19.9%)
Western	321,284	8,996 (2.8%)	312,288 (97.2%)
<b>Total</b>	<b>1,265,517</b>	<b>697,719 (55.13%)</b>	<b>567,798 (44.87%)</b>

Source: Statistics Sierra Leone

The total number of off-grid households and their geographic distribution will also change significantly over time. To analyze the potential OGS market over time, GIS maps were prepared from demographic information to present potential market areas for OGS. GIS calculations consider drivers of off-grid household market change including grid extension around current urban and peri-urban centers, mini-grid development for more densely populated rural areas, and population growth. Sources of information for the maps presented below (**Figures 18-21**) can be found in **Annex 1**.

As shown in the maps and chart summaries below, the total size of the OGS market will decrease over time, while also becoming more concentrated in more remote regions in the northeast of the country. This has implications for solar product market long-term business models, which will need to consider broader distribution areas as the total number of off-grid households declines. Lessons learned in central districts will be valuable in extending market reach to more remote areas, as will new and more innovative business model approaches.

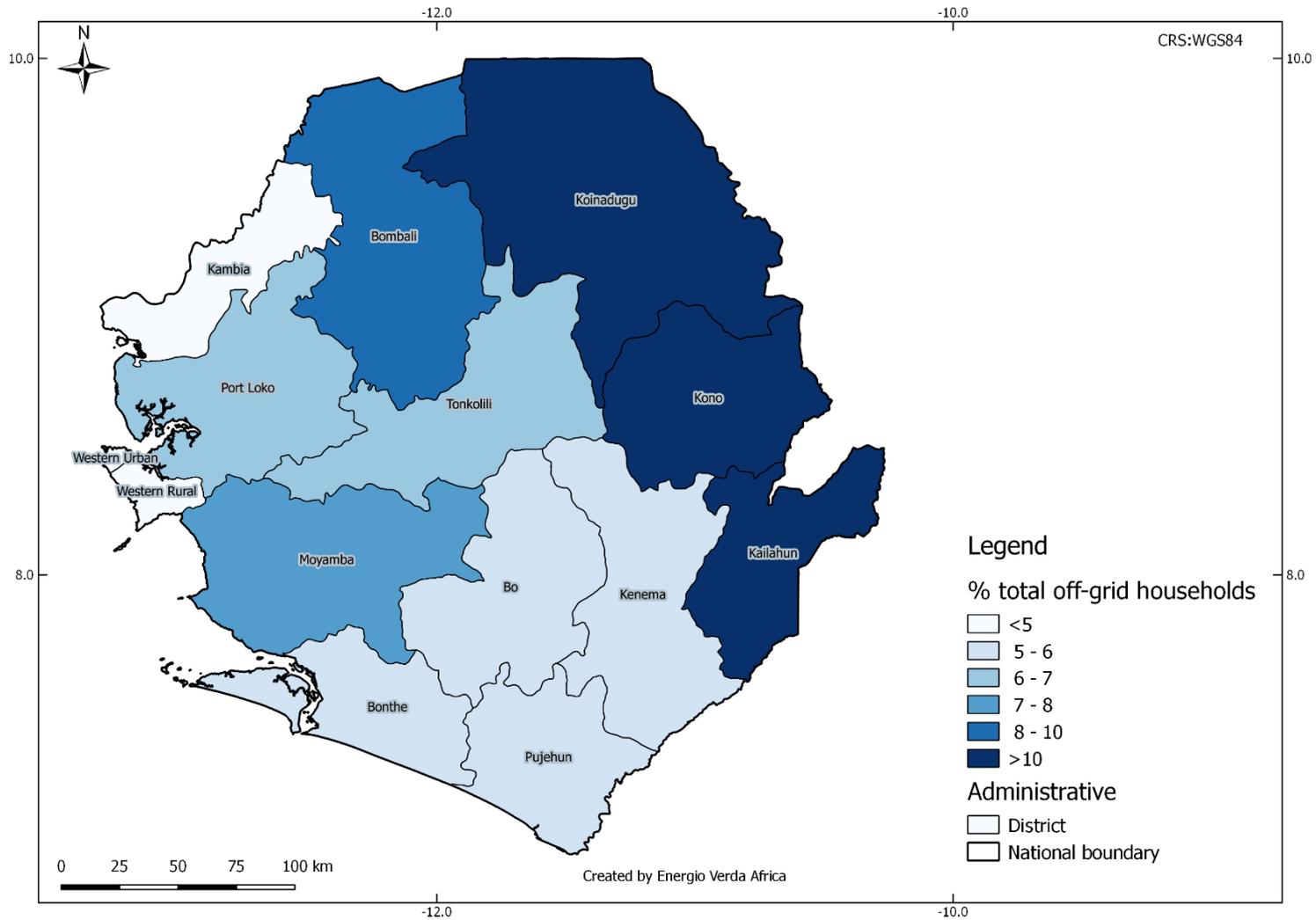
Figure 18: Distribution of Potential Off-Grid Households by Region, 2023<sup>118</sup>



Source: Energio Verda Africa GIS analysis

<sup>118</sup> See Annex 1 for more details, including data sources.

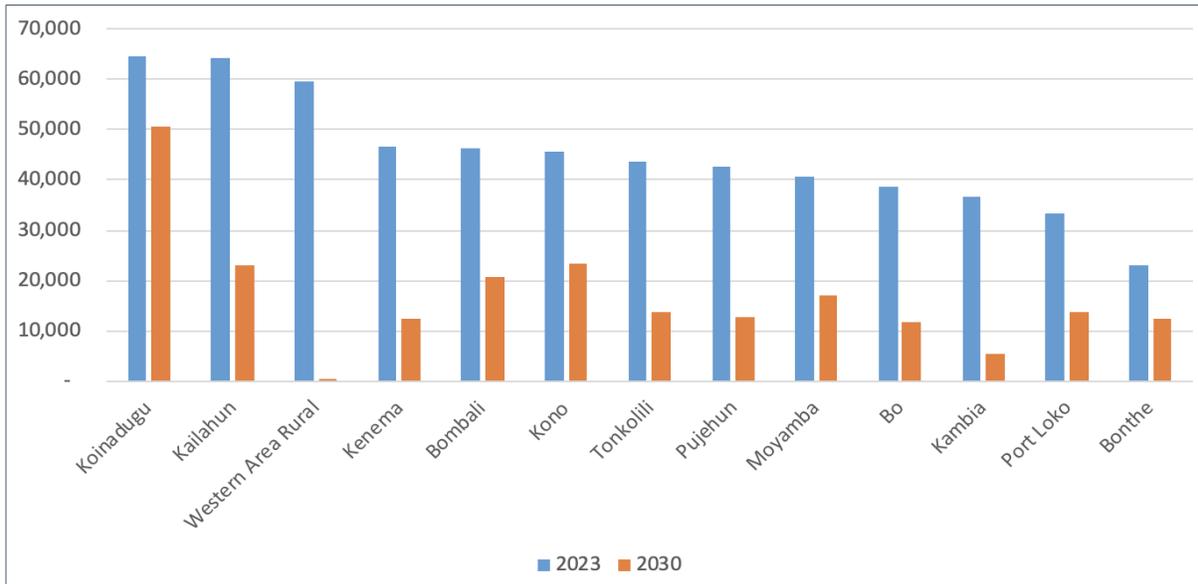
Figure 19: Distribution of Potential Off-Grid Households by Region, 2030<sup>119</sup>



Source: Energio Verda Africa GIS analysis

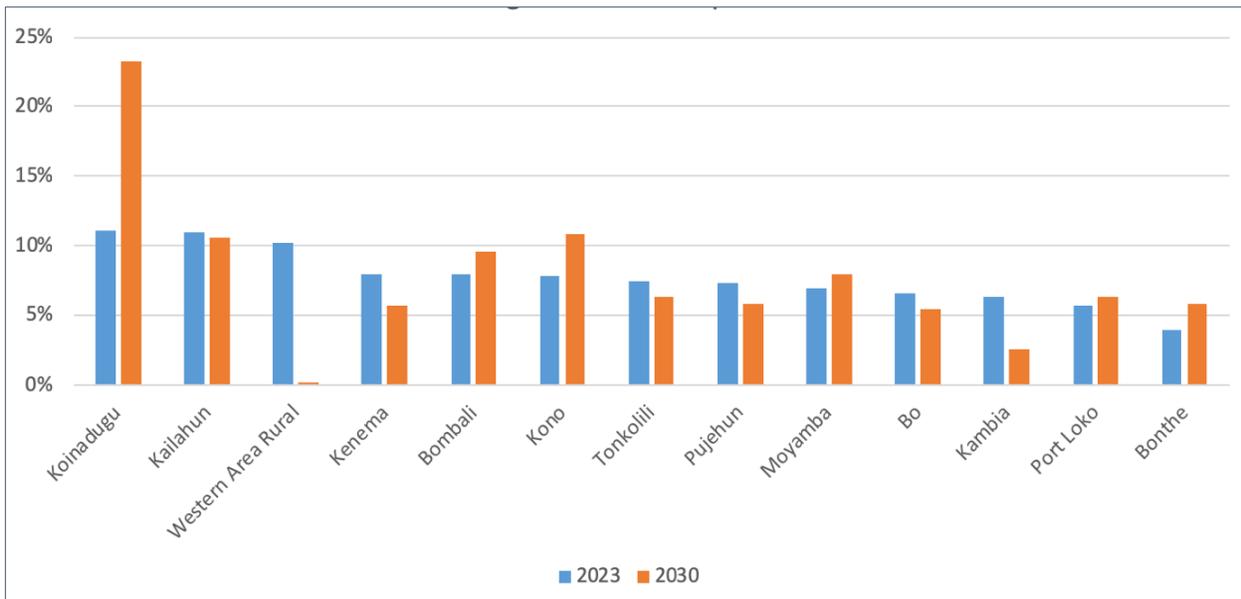
<sup>119</sup> See Annex 1 for more details, including data sources.

Figure 20: Estimated Number of Off-Grid Households by Region, 2023 and 2030



Source: Energio Verda Africa GIS analysis

Figure 21: Estimated Percentage of Off-Grid Households by Region, 2023 and 2030



Source: Energio Verda Africa GIS analysis

### 2.1.2 Analysis of Household Market Segment Demand

In order to calculate total potential household demand for off-grid solar products for the national market, this section examines several indicators:

- Household usage and costs of typical rural energy fuels and devices (non-solar)
- How these rural energy technologies align with typical access to “energy tiers”
- Cost of off-grid solar products alternatives, by energy tier
- Household uptake of solar products thus far
- Potential household demand based on household income quintiles

From this data, the potential household market for off-grid solar products is then calculated for both cash purchases and financed purchases.

#### ➤ Consumption and expenditures on existing non-solar household fuels and devices

The 2015 National Census indicates that 76.4% of households use battery/rechargeable light as the main source of lighting, with utility connections (NPA/BKPS)<sup>120</sup> reaching 17.8 % of the population. Other sources consider the use of battery power torches to be even more prevalent. Key household electricity use findings include the following:

- An estimated 35,000 generators are being used in households, SME’s and industries across the country providing an installed capacity of 180 MW. Monthly expenditures are totally dependent on the availability of funds and the size of the generator.
- About 97% of households use dry cell-powered over-the-counter electric lamps. These are low-cost, often low-quality lighting alternatives. Nearly every remote village has dry cells for sale for ‘torchlights’ – making them easily available for nearby households. In the period after 2008, most kerosene lamps in the country were replaced by these low-cost electric lamps. With the introduction of the electric lamps, use of kerosene fuel for lighting fell rapidly.
- Few rural shops have basic solar items (solar torch lights, solar chargers, solar lamps) available.

Table 13: Baseline Household Lighting, 2015

Device	Estimated % of Off-grid HH that Use
Battery powered light	96.8%
Kerosene	1.6%
Petrol/diesel generator and electric lights	1.5%
Solar PV	0.1%
Candles	0.0%

Source: EU - Promoting Renewable Energy Services for Social Development in Sierra Leone

The figures in **Table 13**, are based on a 2015 EU baseline analysis.<sup>121</sup> However, based on FGD discussions undertaken with key stakeholders in the country, generator usage in households may be higher (5-12% were quoted by participants). In addition, the use of solar PV systems is growing rapidly and is likely to have reached 3 to 5% of the population in some districts as solar gradually replaces battery powered lights. Note also that neither the census nor the EU baseline analysis separated household and productive use, so there

<sup>120</sup> National Power Authority / Bo-Kenema Power System

<sup>121</sup> Lai et. al., 2015.

is overlap in their counts. Focus group participants estimated common energy sources and their associated costs as shown in **Table 14**.<sup>122</sup>

➤ **Current usage and procurement process for household solar products**

According to feedback from focus group discussion (FGD) participants, household usage of solar products is expanding in Sierra Leone. However, household knowledge about how to procure products and the ability to do so remains limited. This was apparent during the focus group discussions.

Many Sierra Leoneans have heard about the solar initiatives in 2016 and 2017. Advertisement campaigns have created demand, but not followed through with adequate distribution. The general messages being communicated about solar also need to be translated into more specific understanding of what products are better than others, what are the choice options, where to buy solar, what is a better way to pay for solar – PAYG or upfront, what suppliers are more reliable, where to fix solar, etc.

One comment made in the FGD was that “people buy solar, they dump it on people on the ground and go; when there is a problem people get frustrated because there is nobody to reach.” Some solar products have been given away for free by donors, which FGD participants raised as potentially distorting the market. One important observation on procurement from the FGD was that nearly every remote village will have constantly accessible torch light batteries for sale. In contrast, solar products are only available when an agent visits the village once in a while and makes some presentations, markets the products and then returns in a few weeks or months’ time to actually sell the solar products. There are only few shops that have basic solar items (solar torch lights, solar chargers, solar lamps) available in the shops/kiosks.

Local suppliers all claim that have good ability to sell and install local systems. This is discussed in detail in the Supply section of this document. Most solar suppliers are based in Freetown and serve the country from there. Some companies have their offices and distributions networks close to the 2nd and 3rd largest cities of Sierra Leone – Kenema (approx. 200,000 pop.) and Bo (approx. 175,000 pop.).

Access to finance is also a limiting factor for household procurement of solar products. PAYG is an important distribution model for companies in Sierra Leone because household income remains low. However, PAYG sales are often limited by the lack of the mobile networks or physical distribution networks of cash. Other sources of financing are equally constrained. FGD comments were made by experienced local distributor: “I have not seen a customer to take a microfinance to buy solar”. Another comment added that: “It is hard to lend for the non-productive use”.

Even where solar products can be bought, remote areas suffer from lack of technical support and technicians’ visits typically have to be arranged from Freetown or Bo for more significant technical problems. In general, the network of suppliers and installers is very initial stage of development in Sierra Leone, therefore most projects and installations are being done on a case-by-case basis, depending on the project size and commercial opportunity.

On the very small/pico level, households (Tier 1-3) believe that their electricity needs can be met by the equipment in the market – if only they can afford them. While the clients from the larger-home systems (Tier 4) are more aware of global prices and sometimes complain not even about the costs of the systems compared to the prices they can find on the internet in other countries and more developed markets. Households at this level often assess the possibility of importing the system by themselves individually. This indicates that the solar market is in a very early stage of development, when a single user can still theoretically compete with the established market players.

<sup>122</sup> These figures are close to the willingness to pay study results. 7900 Le = 1 USD

Table 14: Rural Energy Technology and Costs<sup>123</sup>

Technology	Description	Average Life (Years)	Unit Capital Cost (USD)	# of Units/ Month	Unit Operating Cost (USD)	Typical Monthly Cost (USD)	Unit Capital Cost (USD)	# of Units/ Month	Unit Operating Cost (USD)	Typical Monthly Cost (USD)	Unit Capital Cost (USD)	# of Units/ Month	Unit Operating Cost (USD)	Typical Monthly Cost (USD)
			2018 Scenario				2023 Scenario				2030 Scenario			
Torch lights/Electric Lanterns	Torch lights/electric lanterns powered by D-type, AA-type or AAA-type batteries	0.5	\$2.00	16	\$0.16	\$2.56	\$2.46	16	\$0.16	\$3.15	\$4.00	16	\$0.16	\$5.13
Cell Phone Charging	Done at a charging station	-	\$0.00	8	\$0.13	\$1.04	\$0.00	8	\$0.13	\$1.28	\$0.00	8	\$0.13	\$2.08
Smart Phone Charging	Done at a charging station	-	\$0.00	16	\$0.13	\$2.08	\$0.00	16	\$0.13	\$2.56	\$0.00	16	\$0.13	\$4.17
Battery-powered DC Radio	Radio powered by dry cells replaced two times per month	-	\$0.00	8	\$0.16	\$1.28	\$0.00	8	\$0.16	\$1.58	\$0.00	8	\$0.16	\$2.57
Small Petrol Generator	The most popular rural generator for basic use is 0.9kW generator (for phone charging, lighting, TV, fan and music system)	2	\$100.00	23	\$0.95	\$22.23	\$123	23	\$0.95	\$27.39	\$200.00	23	\$0.95	\$44.55

Source: African Solar Designs analysis

**Table 14** shows the typical monthly cost of using common rural energy technologies. Household use of different types and amounts of energy technologies is associated with different energy access tiers, as defined in the Multi-Tier Energy Access Framework. For example, a household using one battery powered lantern and one charged cell phone would fall under the Tier 1 level of energy access. A household using two lanterns, one cell phone and a radio would be in Tier 1.5. These tiers are defined in **Table 15**. Establishing an average monthly household expenditure for each energy tier using common rural technologies shows how household income level aligns with energy tiers. Secondly, it provides a basis to compare these costs to solar products that can offer an equivalent level of service by energy tier. This in turn reveals potential household savings by switching to solar products, as shown in **Figure 22** and **Table 16**.

It should be emphasized that even where households can be categorized into energy tiers by their income, few households actually pay full typical monthly costs because they do not have the available income. In reality, household income is highly variable throughout the year, and they simply do without service for portions of the month and year when cash is not available. This accounts for the difference between “typical monthly costs” (which are real) and “equivalent service costs” (which would be required to maintain the tier-level service). For example, very few households could actually run generators for the number of hours that would enable full tier 3 level services.

<sup>123</sup> Data from FGDs, field surveys and various published data sources

Table 15: Typical Tier-Based Energy Costs

Device category and indicative energy supplied	Appliances and level of service	Non-solar devices used to power tier requirement	Typical Monthly Cost (USD) 2018	Typical Monthly Cost (USD) 2023	Typical Monthly Cost (USD) 2030
<b>Tier 0</b> No electricity	<ul style="list-style-type: none"> <li>Characterized by complete lack of electricity services</li> <li>Many cash-poor consumers are in this situation part of each month when they don't have money to buy dry cells or charge phones</li> </ul>	<ul style="list-style-type: none"> <li>Rely solely on kerosene, wood and other fuel sources for cooking and lighting</li> </ul>	<ul style="list-style-type: none"> <li>Subsistence level of energy</li> <li>Absolute energy poverty</li> </ul>	<ul style="list-style-type: none"> <li>Subsistence level of energy</li> <li>Absolute energy poverty</li> </ul>	<ul style="list-style-type: none"> <li>Subsistence level of energy</li> <li>Absolute energy poverty</li> </ul>
<b>Tier 1</b> Range: 1 to 20 Wh/day	<ul style="list-style-type: none"> <li>Access to one torch powered by dry cell batteries</li> <li>One cell phone powered by charging service</li> </ul>	<ul style="list-style-type: none"> <li>One battery-powered light requires dry cell replacement on weekly basis</li> <li>One cell phone charged 8 times per month</li> </ul>	\$3.60	\$4.43	\$7.22
<b>Tier 1.5</b> Range: 20 to 100 Wh/day	<ul style="list-style-type: none"> <li>Access to one torch and one lantern each powered by dry cells</li> <li>One cell phone powered by charging service</li> <li>Radio powered by dry cells</li> </ul>	<ul style="list-style-type: none"> <li>Two battery-powered light points require dry cell replacement on weekly basis</li> <li>One cell phone charged 8 times per month</li> <li>Radio dry cells replaced two times per month</li> </ul>	\$7.44	\$9.17	\$14.91
<b>Tier 2</b> Range: 55 to 500 Wh/day	<ul style="list-style-type: none"> <li>One torch and two lanterns powered by dry cells</li> <li>One cell phone and one smart phone powered by charge service</li> <li>Radio</li> <li>DC TV</li> </ul>	<ul style="list-style-type: none"> <li>Three battery light points require dry cell replacement on weekly basis</li> <li>One cell phone charged 8 times per month and one smart phone charged 16 times per month</li> <li>TV/Radio powered by lead acid battery recharged once per week</li> </ul>	\$13.36	\$16.46	\$26.78
<b>Tier 3</b> Range: 500 to 2500 Wh/day	<ul style="list-style-type: none"> <li>Five lighting points</li> <li>Multiple cell/smart phones</li> <li>AC radio and music system</li> <li>AC TV</li> </ul>	<ul style="list-style-type: none"> <li>Generator powers a set of appliances</li> </ul>	\$22.23	\$27.39	\$44.55

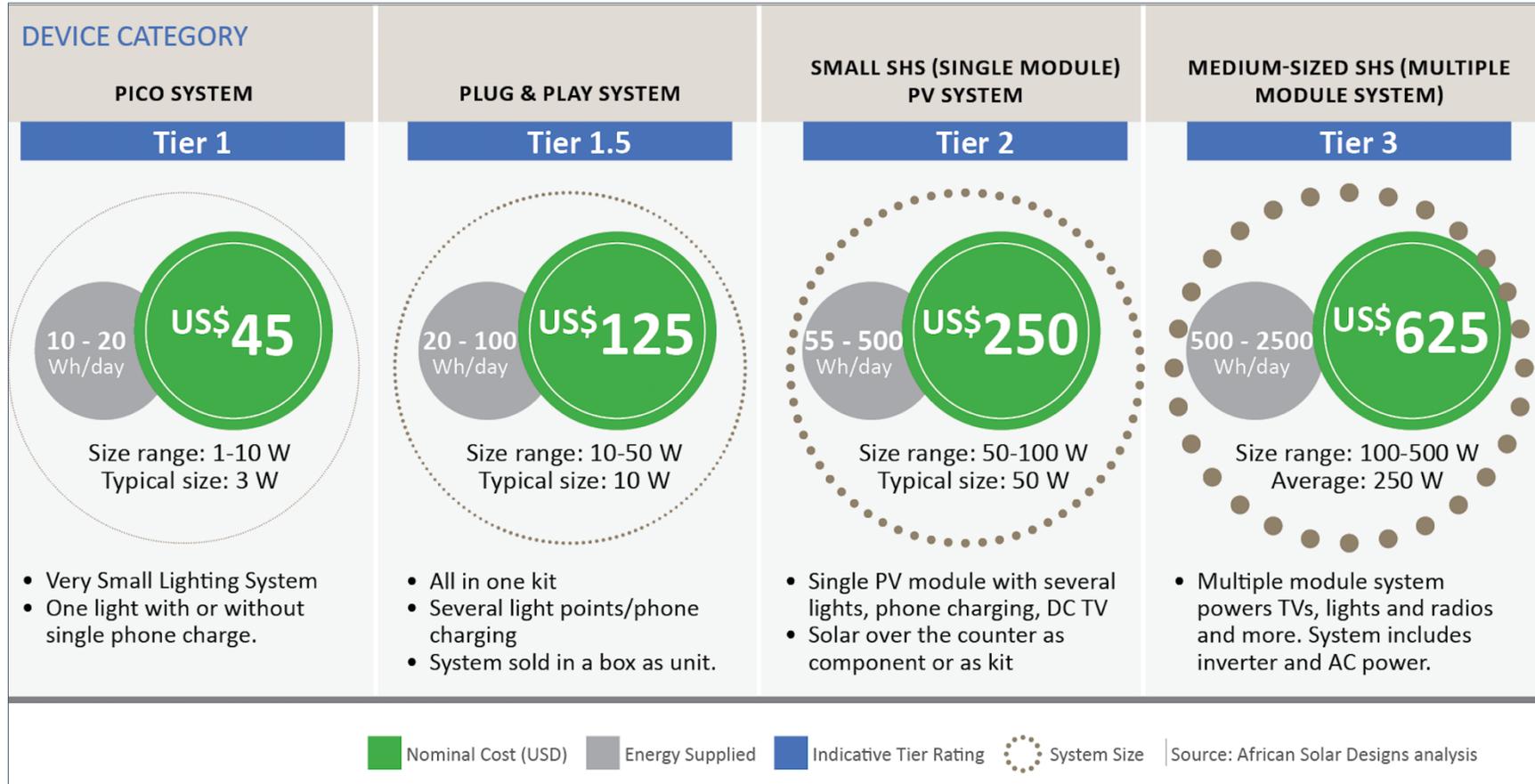
Source: African Solar Designs analysis

Per **Table 15**, it can be seen that, given the purchase price of dry cells and the cost of phone charging, the “ideal” electricity availability is extremely difficult to sustain. This is especially true with the high incidence of poverty in rural areas and lack of regular incomes. In reality, households often must reduce their energy consumption when cash is not available. This means that even a Tier 2 level family might drop to Tier 1 for a week each month when cash is not available to pay for phone charging or dry cell purchase.

➤ **Household Solar PV System Types**

Solar PV systems can provide lower cost and higher levels of service than existing dry cell, phone charging and generator options. In order to model how solar systems can meet existing energy use categories, levels of service and ability to pay, four types of household solar systems are configured to match the tier-based demands of Sierra Leone off-grid communities. The system descriptions, energy outputs, prices, tier ratings and target consumer groups are listed in **Figure 22**. Note that the “indicated” prices are less than current prices in Sierra Leone and are based on the expectation that prices will reduce significantly as the market matures and competition forces down prices.

Figure 22: Household PV System Descriptions and Market Segments



Source: African Solar Designs analysis

➤ **Potential household demand for off-grid solar products**

Looking beyond current use of off-grid solar products by households, this study analyzes potential for OGS market development by estimating potential household demand based on household income. Household income shown in **Table 16** is sourced from World Bank demographic data based on household surveys, which reports income by population quintiles. From household income, potential for energy spending is estimated as 10% of monthly income.<sup>124</sup> Future scenarios project higher energy budgets as household incomes rise with economic development over time. In all scenarios, the large majority of off-grid households will fall under the lowest income quintile.

Table 16: Energy Expenditure of Different Income Groups

Population Income Quintiles	Per Capita Income (USD per month)	Household Income (USD per month)	Energy as % of Income	Monthly Energy Budget (USD)
<b>2018 Scenario</b>				
Lowest Quintile of Population	\$14.61	\$81.84	10%	\$8.18
2nd Quintile of Population	\$22.01	\$123.28	10%	\$12.33
3rd Quintile of Population	\$29.23	\$163.69	10%	\$16.37
4th Quintile of Population	\$40.51	\$226.88	10%	\$22.69
Highest Quintile of Population	\$78.44	\$439.26	10%	\$43.93
<b>2023 Scenario</b>				
Lowest Quintile of Population	\$20.60	\$115.34	10%	\$11.53
2nd Quintile of Population	\$31.03	\$173.74	10%	\$17.37
3rd Quintile of Population	\$41.19	\$230.68	10%	\$23.07
4th Quintile of Population	\$57.10	\$319.75	10%	\$31.97
Highest Quintile of Population	\$110.54	\$619.05	10%	\$61.91
<b>2030 Scenario</b>				
Lowest Quintile of Population	\$25.37	\$142.06	10%	\$14.21
2nd Quintile of Population	\$38.21	\$213.99	10%	\$21.40
3rd Quintile of Population	\$50.74	\$284.13	10%	\$28.41
4th Quintile of Population	\$70.33	\$393.82	10%	\$39.38
Highest Quintile of Population	\$136.15	\$762.47	10%	\$76.25

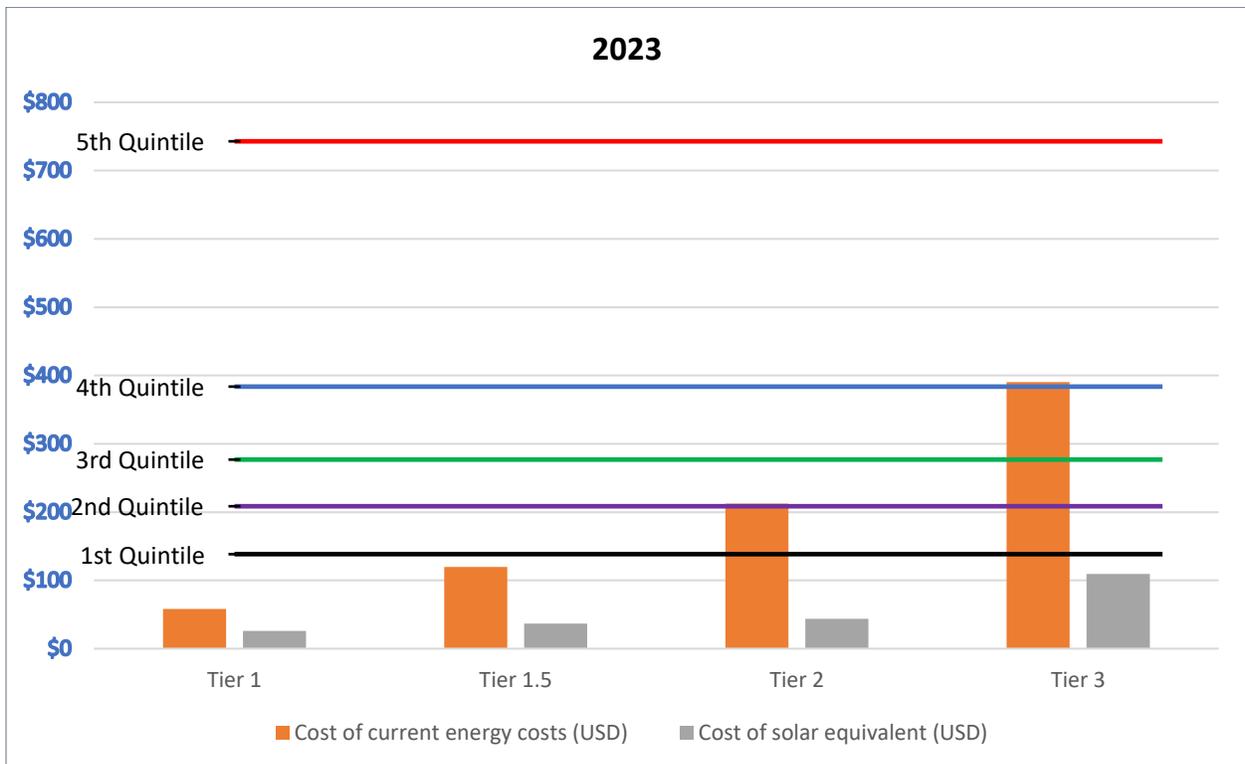
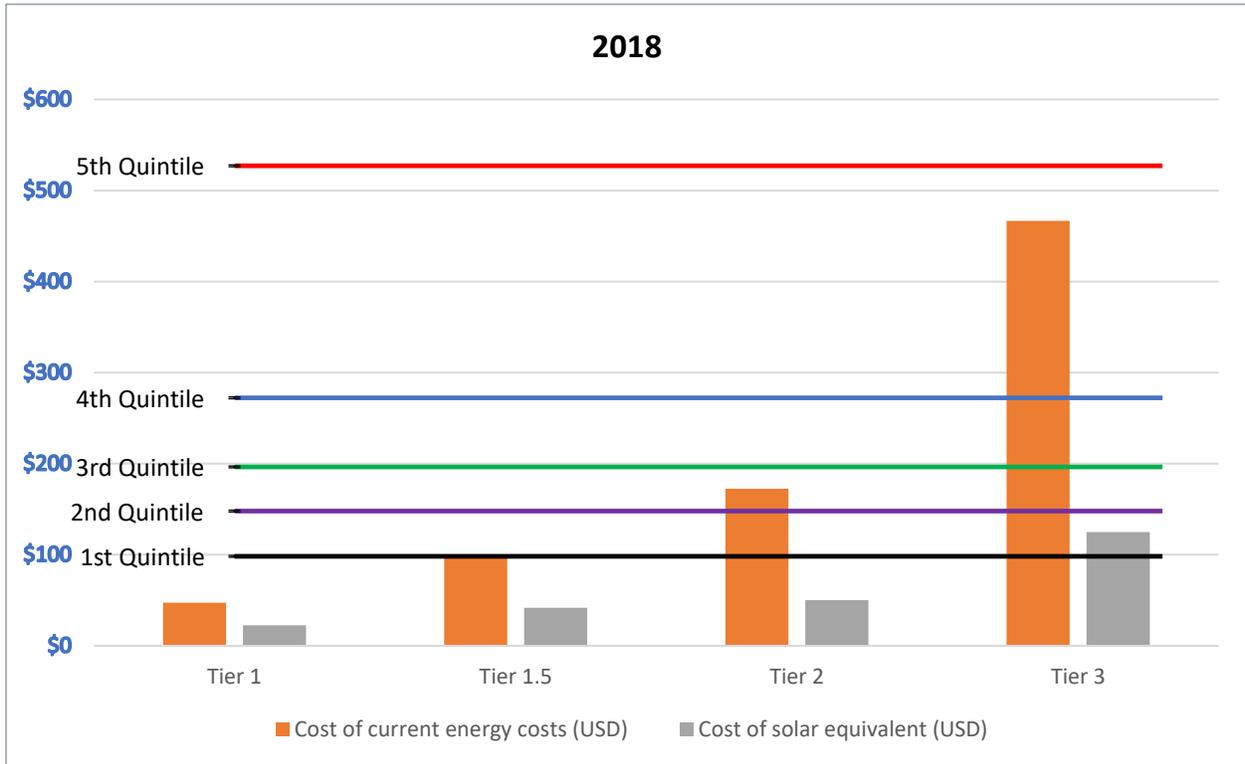
Source: African Solar Designs analysis

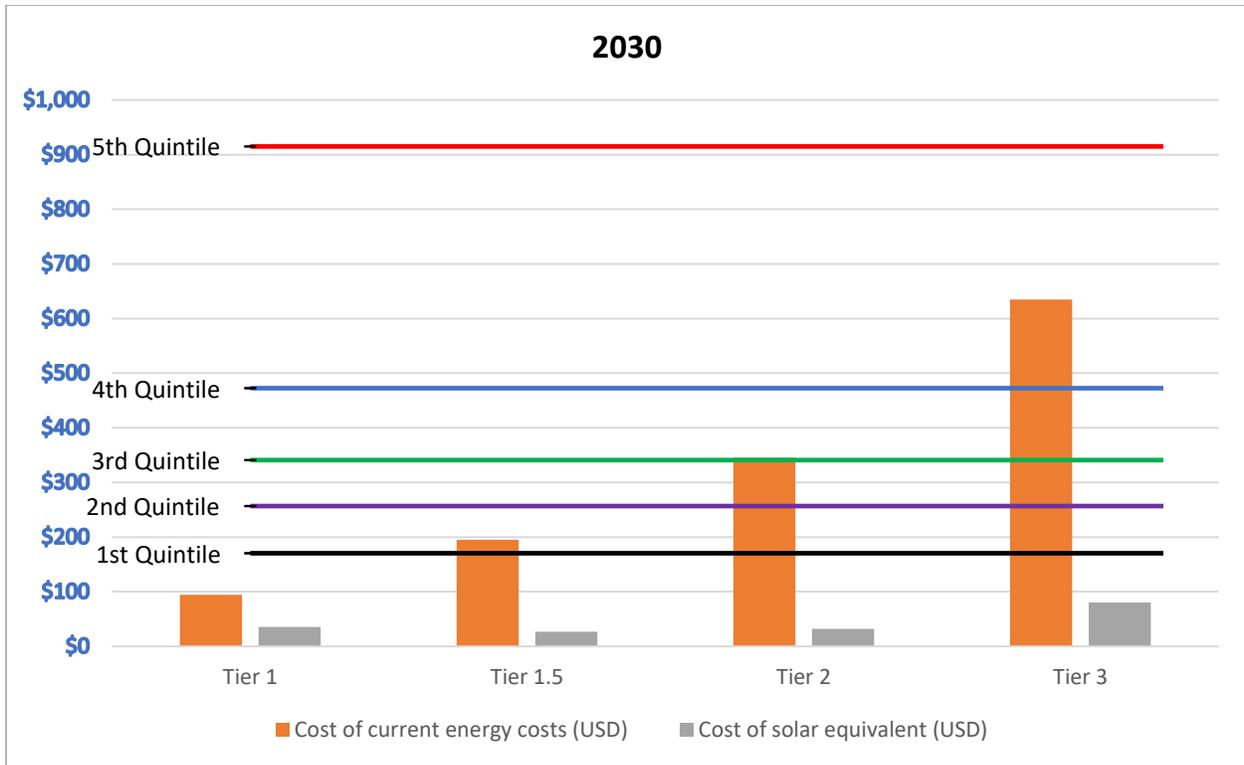
**Figure 23** summarizes the preceding data in this section by comparing household energy spending with typical rural energy costs and their solar equivalents. This analysis presents annualized costs (not including financing cost) of current energy technologies for each energy tier, compared with the annual cost of an equivalent solar product. Both the annual costs of current energy technologies and equivalent solar solutions consider the capital costs of the units, and the operating costs considered over the average unit life times.

Household energy spending is estimated as 10% of the average household income for each quintile. The data clearly shows strong potential savings for households to switch to solar products. Affordability also increases over time, as the cost of solar technology reduces, while the cost of traditional energy sources increases with inflation, and household income increases. Affordability here is shown by comparing annual income and energy costs over the life of a product. This may indicate the need for short term financing, as many households still struggle to pay up front unit capital costs to achieve subsequent savings.

<sup>124</sup> See **Annex 2** for more details.

Figure 23: Annual HH Energy Budget by Quintile, Annual Energy Costs and Costs of Solar Equivalents





Source: African Solar Designs analysis

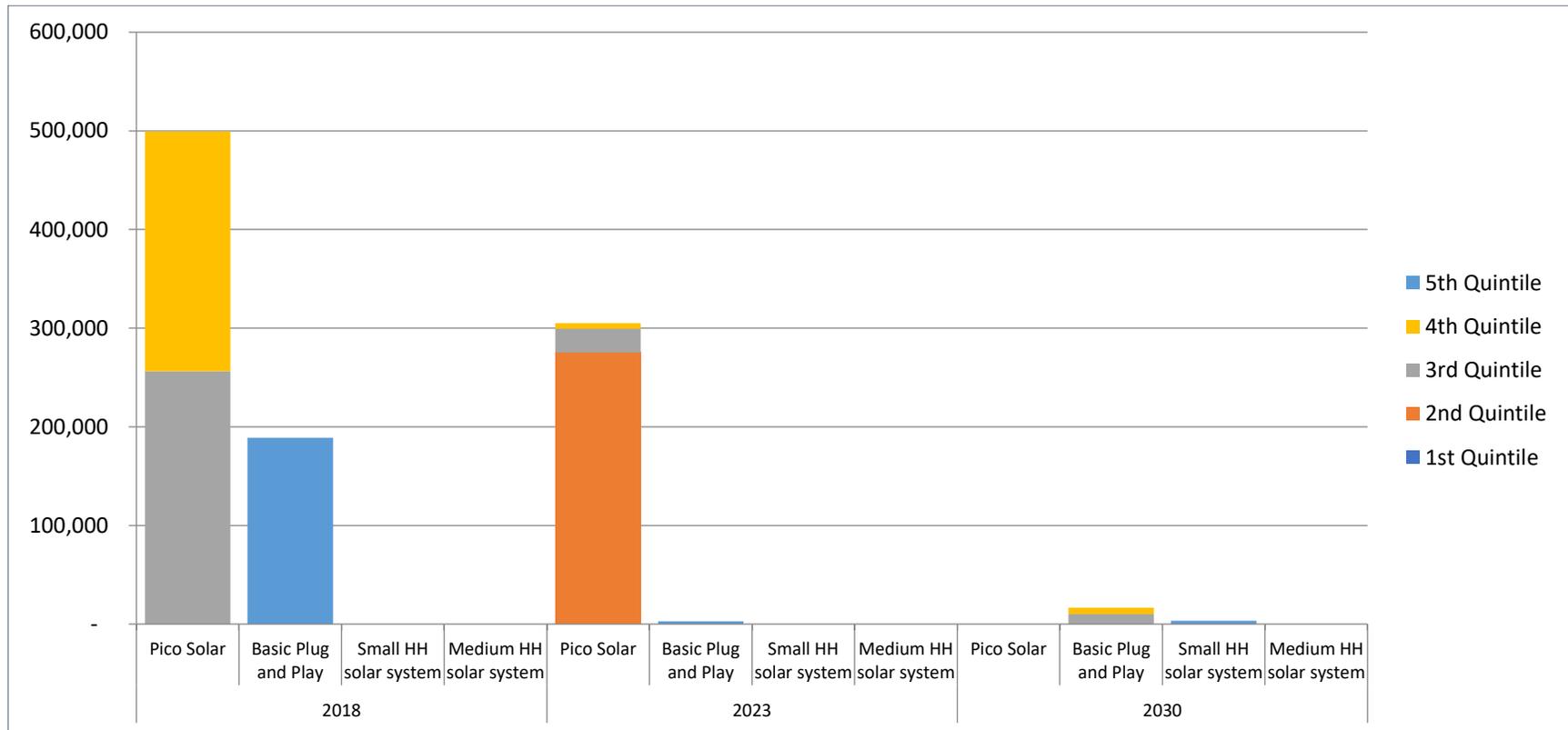
### 2.1.3 The Market for Household Devices without Consumer Finance

This section analyzes the cash market for various income levels and the corresponding energy services powered by OGS systems they can afford. Modelling of the viable market was based on income quintiles associated with data from the World Bank. The calculations and assumptions made are presented in **Table 17**. It was assumed that for a cash purchase a household is willing to save three months of their current energy expenditure to purchase the OGS system.

Based on these income quintiles and corresponding estimated current energy expenditure, only off-grid households in the higher income quintiles – 3, 4 and 5 – can afford an OGS system unfinanced. Even then, these households can only afford to purchase pico solar and basic plug and play systems. The two lowest quintiles would either have to continue using their current energy systems or save for a longer period to afford an OGS system. Based on the assumption that 30% of the households in the highest quintile are connected to the grid, the annualized off-grid cash market for basic plug and play systems is limited to 62,977 units in 2018. This market size would decrease further in 2023 and 2030, as shown below.

The model assumes that each household purchases only one system. It also does not consider on-grid households that would purchase OGS systems as a back-up power system due to poor grid quality and reliability. This market has become a key segment of the more mature OGS markets (e.g. in East Africa), but is not the focus of this study, which is based on sizing the current markets in West Africa, alongside a least cost analysis for future access to energy that prioritizes reliable grid connections where possible.

Figure 24: Estimated Number of Households Able to Afford Cash Purchase of OGS Systems by Income Group



Source: African Solar Designs analysis

**Table 17** presents the estimated annualized cash market potential for off-grid solar product sales in the country’s household sector.

**Table 17: Estimated Cash Market Potential for Household Sector**

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
<b>2018 Scenario</b>			
Pico Solar	249,658	749	\$11,234,605
Basic Plug and Play	62,977	630	\$7,872,096
Small HH solar system	0	0	\$0.00
Medium HH solar system	0	0	\$0.00
<b>Total</b>	<b>312,635</b>	<b>1,379</b>	<b>\$19,106,701</b>
<b>2023 Scenario</b>			
Pico Solar	152,468	457	\$7,867,902
Basic Plug and Play	927	9	\$101,483
Small HH solar system	0	0	\$0.00
Medium HH solar system	0	0	\$0.00
<b>Total</b>	<b>153,395</b>	<b>466</b>	<b>\$7,969,385</b>
<b>2030 Scenario</b>			
Pico Solar	0	0	\$0.00
Basic Plug and Play	5,549	55	\$445,323
Small HH solar system	666	33	\$106,877
Medium HH solar system	0	0	\$0.00
<b>Total</b>	<b>6,215</b>	<b>88</b>	<b>\$552,200</b>

Source: African Solar Designs analysis

The following observations and conclusions can be made based on this analysis:

- In the extremely low income off-grid environment, many consumers will not be able to afford even the smallest systems. As can be seen, the absolute poverty of rural areas means that a large number of the lowest two quintiles by income cannot afford any system.
- The most common type of systems which the market can afford on a cash basis are pico and small plug and play systems. Based on available income figures Tier 2 and Tier 3 solutions are less viable for the vast majority of the population.
- The model does not adequately address highest quintile and actual sales in the market. Note that the analysis does not predict purchases of Tier 3 equipment and it does not reflect what is happening at the extreme high end of the market. Because the analysis divides the population into relatively wide quintiles, it does not adequately address the very small portion of apex rural (and peri-urban) customers that now use generators.
- There is reason to be optimistic about solar product market growth. In fact, evidence presented in **Section 2.4** shows that there is significantly more market activity in the solar market than predicted by this income-driven analysis. Uptake of cash purchases of electric lamps, mobile phones and other consumer goods signify changes in consumer expenditures – especially among the rural population – that are not captured in income figures and economic analysis. This could be driven by a number of complex financial dynamics not represented well by aggregated household survey data. For example, some rural households benefit from remittances sent by family members. Other fluctuations in seasonal rural income could also be driving rural uptake. A significant portion of Tier 1 customers may be likely to move to Tier 1.5. There are also indications that purchasers of generator sets will begin to move to Tier 3 solar systems as consumer awareness and willingness to pay change.

#### 2.1.4 The Financed Market for Off-Grid Solutions

PAYG schemes have helped rural households obtain financing. By beginning with the purchase of small products with a down payment, customers can establish a repayment track record that is then used to finance progressively larger products.<sup>125</sup> However, similar to microfinance institutions, PAYG companies have also found it challenging to reach customers in the remote rural areas and in the lowest income demographics.

Existing consumers therefore continue to make many purchases for small OGS products in cash. Of the five quintiles discussed above, less than 20% would be likely candidates for conventional microfinance loans due to their lack of a steady income. The extreme incidence of poverty already described creates a major challenge for financial services in rural and peri-urban areas. Still, given the relatively low incomes of households and the comparative high cost of OGS, long-term consumer finance obviously is required to grow solar sales. To date, consumer finance options have had limited availability and reach, especially in rural areas. For the vast majority, there are little to no financing mechanisms available. Peri-urban low-income groups tend to have more stable income than the rural population and make up an important part of solar demand, especially for pico solar equipment, but they have also yet to use bank finance. Urban middle- and upper-class groups have better access to formal finance and may be attractive options for financiers.

##### ➤ **Microfinance**

MFIs may be positioned to meet consumer financing requirements in the future. However, currently they are not yet contributing significantly to the financing of solar products, for a variety of reasons.

- MFIs in Sierra Leone are largely unaware of how solar can be used to empower rural people and save them money on recurrent energy expenditures
- MFI terms in Sierra Leone are an ill-fit for solar products. Solar products are perceived as high risk by Sierra Leone MFIs because they do not have adequate understanding of the equipment or suppliers
- Microfinance groups in Sierra Leone lack the distribution networks to reach rural areas where there is high demand for solar products
- Some MFIs only focus on productive use applications of loans and avoid household loans
- Rural customers that do qualify for loans are often financially over-extended, especially before the harvest, and this affects both consumer appetite to take on more loans and bank appetite to extend loans
- High interest rates are an issue for consumers (above 15% p.a.). However, the customer can more easily absorb or agree to the high interest rate when it is built-into the cost of the product.

Certain micro-financing institutions and community banks have indicated willingness to start financing solar installations. For example, the Sierra Leone Microfinance Association was involved in an initiative with REASL to explore building a loan portfolio. However, no information is available as to whether they continued with the initiative further.<sup>126</sup>

##### ➤ **Pay-As-You-Go (PAYG)**

Solar PAYG products have been introduced and have been sold to over 50,000 consumers in Sierra Leone. They are increasingly popular (but still at relatively low level), especially in areas with mobile phone coverage. Though markets are developing rapidly, and though they are considered ‘best practice’ and applied by the local companies, PAYG applications are limited by the availability of the mobile network coverage – and more specifically mobile money – which is not available in most remote off-grid areas. PAYG also poses difficulties with cash collection, accounting and other cash management issues (trust,

<sup>125</sup> EasySolar operates with this business model in Sierra Leone.

<sup>126</sup> “First of kind Solar Pilot in Sierra Leone,” Power for All, (2016): <http://www.powerforall.org/blog/2016/12/1/news-release-first-of-kind-solar-pilot-in-sierra-leone>

theft, misappropriation of money, etc.); these issues are especially relevant where PAYG models must operate in regions without mobile money access.

Due to the rapid depreciation of the Le against USD (two years ago the exchange rate was around 6,000 SLL/USD and now it is 7,900 SLL/USD), PAYG models have had to be redesigned to maintain their affordability for rural populations. Fixed commitments for PAYG schemes are also affected by “willingness to pay” issues with conservative rural consumers. The long commitment periods (i.e. \$1.30/week for 18 months) worry customers that are uncertain about income even in the immediate future. With diesel or batteries, if they don’t have the funds at a given time, they can simply ‘wait it out’ without electricity or manage it at bare minimum amounts until the situation improves. PAYG solutions need to include such management/flexibility of payments for solar products and their financing to be more positively considered by the bottom of pyramid consumers of rural Sierra Leone.

➤ **Sellers’ credit vs. PAYG**

A small-scale informal seller’s credit system has been put in place by some actors that has attributes of the PAYG system. The main supplier finds trusted distributors around the country and gives them solar systems on credit (the amount and scope depend on the level of trust and experience). The distributor (who may be a student having a side-job, or a trusted shop or kiosk keeper) in turn sells the systems within its own network of contacts either against cash, or PAYG method. In turn, the distributor pays for the goods sold at the end of the month/week to the main supplier. This informal system is used by many traders in agricultural areas where consumers go for long periods without cash.

➤ **Osusu Community Savings**

Another system in common rural usage (though not yet for solar) is the community savings scheme called “Osusu.” With this system a closed circle of trusted members each contribute monthly/weekly payments to the designated community cashier and then each member in turn receives all the contributions from all the community members for that month. This type of savings is quite widely used in the provinces (i.e. for 20-25% of regions). The money from such contributions are significant and are typically used to purchase larger items like freezers, TVs, generators, changing the roof, etc.

➤ **Employer Loan Schemes**

There have been discussions about larger institutions (like banks or security firms) providing credit to their employees for home solar installations and withholding monthly payments from their salaries as the payment for the credit. Given that most of the population is self-employed, and because this financing approach is mainly applicable in urban areas, this would have limited impact.

➤ **Financial Model**

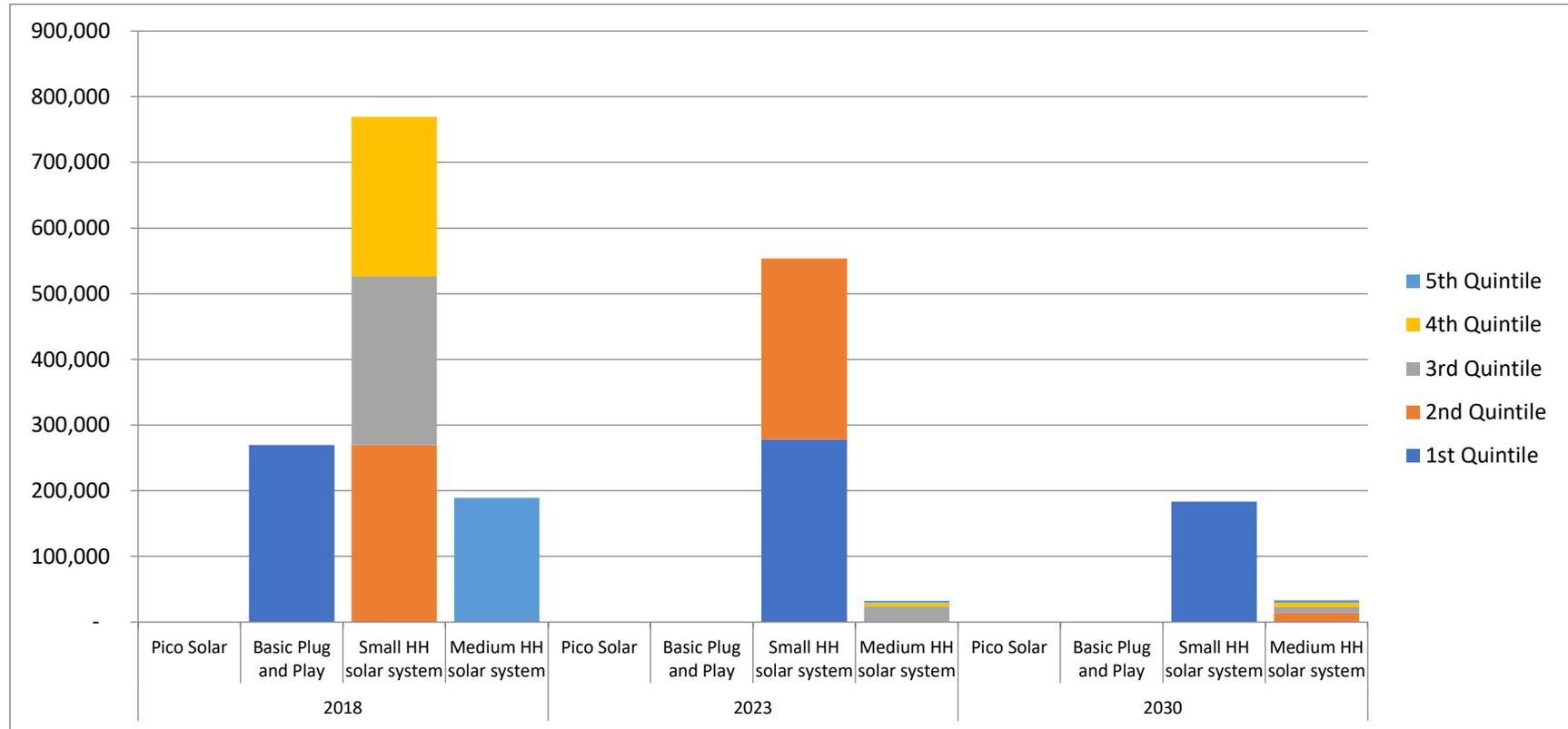
In order to portray the effects of finance, a simple model was prepared that provides OGS system finance with a 30% p.a. interest rate and a 24-month term.<sup>127</sup> This model is designed to include various financing schemes, including PAYG and MFI finance. The financial model assumes that the households would be willing to save for three months of their current energy expenditure to cover a small deposit of 10% of the system and their current energy expenditure would be used to pay the monthly installments. This reflects the common practice of both PAYGs and MFIs.<sup>128</sup>

<sup>127</sup> These terms are provided by the Sierra Leone Association of Microfinance Institutions: <http://slamfi.sl/activities-services/> They provide a maximum lending rate of 36% and a minimum of 25%; an average of the two is used in this analysis.

<sup>128</sup> See **Section 3** for more details.

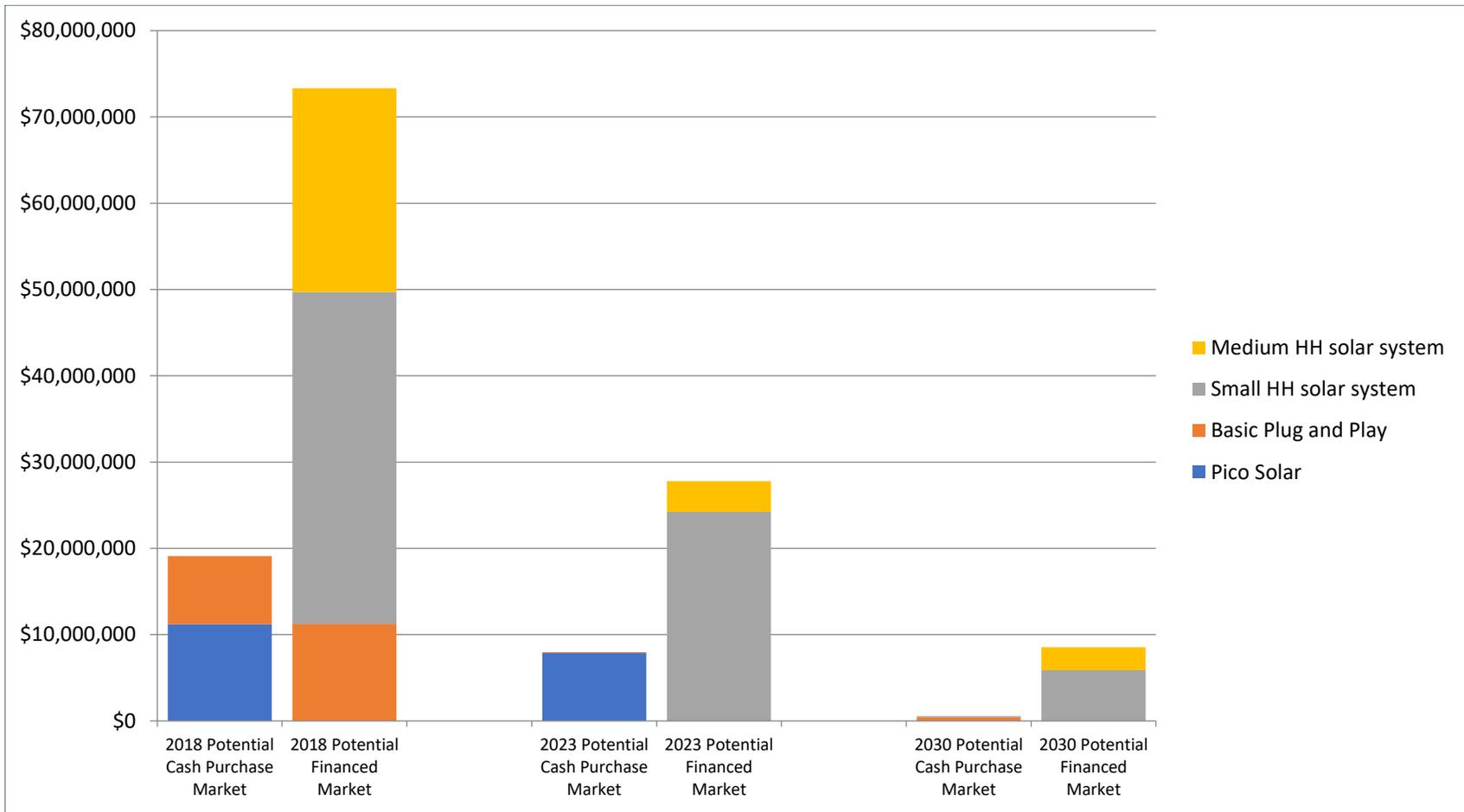
This model assumes that each household will purchase the system that offers the highest energy service level they can afford. As with the cash market model, it assumes that each household purchases one unit each. With this simple analysis, it can be seen that financing the systems unlocks potential market at the lower quintiles as the 1<sup>st</sup> and 2<sup>nd</sup> quintile households can now afford OGS systems (**Figure 25**). It also moves the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> quintiles into higher energy service levels.

Figure 25: Estimated Number of Households Able to Afford Financed OGS Systems by Income Group



Source: African Solar Designs analysis

Figure 26: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type



Source: African Solar Designs analysis

In 2018, without financing, 688,246 households (56.0% of households without access) in the country could afford an OGS system. However, with financing, 1,228,047 households (100% of households without access) could afford an OGS system as the 539,801 of households without access in the two lowest income quintiles are enabled to acquire at least one OGS system. Consequently, the annualized potential market size increases from USD 19.1 million to USD 73.3 million mainly due to the fact that the households are enabled to purchase larger systems (**Figure 26**).

The least-cost electrification 2023 scenario calculates that 585,908 households could be electrified by stand-alone systems. Under this scenario, with financing, the number of households with the ability to acquire at least one OGS system increases from 307,718 (52.5% of off-grid households) to 585,908 (100% of all off-grid households) as the 278,190 households without access in the lowest income quintile are enabled to acquire at least one OGS system. The annualized potential market size increases from USD 7.97 million to USD 27.77 million (**Figure 26**).

The least-cost electrification 2030 scenario calculates that the total number of households that could be electrified by stand-alone systems would drop further to 216,581 (according to GIS data). Under this scenario, with financing, the number of households with the ability to acquire at least one OGS system increases from 19,977 (9.2% of households without access) to 216,581 (100% of all households without access) as the 196,604 off-grid HH in the two lowest income quintiles are enabled to acquire at least one OGS system. The annualized potential market size increases from USD 552,200 to USD 8.6 million (**Figure 26**).

**Table 18** presents the estimated annualized financed market potential for off-grid solar product sales in the country’s household sector.

Table 18: Estimated Financed Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
<b>2018 Scenario</b>			
Pico Solar	0	0	\$0.00
Basic Plug and Play	89,967	900	\$11,245,851
Small HH solar system	153,843	7,692	\$38,460,811
Medium HH solar system	37,786	9,447	\$23,616,287
<b>Total</b>	<b>281,596</b>	<b>18,039</b>	<b>\$73,322,949</b>
<b>2023 Scenario</b>			
Pico Solar	0	0	\$0.00
Basic Plug and Play	0	0	\$0.00
Small HH solar system	110,720	5,536	\$24,234,120
Medium HH solar system	6,462	1,616	\$3,535,989
<b>Total</b>	<b>117,182</b>	<b>7,152</b>	<b>\$27,770,109</b>
<b>2030 Scenario</b>			
Pico Solar	0	0	\$0.00
Basic Plug and Play	0	0	\$0.00
Small HH solar system	36,657	1,833	\$5,883,610
Medium HH solar system	6,659	1,665	\$2,671,936
<b>Total</b>	<b>43,316</b>	<b>3,498</b>	<b>\$8,555,546</b>

Source: African Solar Designs analysis

### 2.1.5 Consumer Perceptions, Interest and Awareness

A relatively small number of consumers have purchased OGS. However, the number of sales has been increasing exponentially and a large portion of purchases are recent (see **Section 2.4.3**).

- **Purchasers of solar are “early adopters” who tend to buy from system integrators as well as hardware traders**
  - **Retail purchasers:** Most purchases are made over-the-counter sales in capital and major cities as cash purchases. As with the consumer migration from kerosene to electric lights, there is a gradual migration from low cost dry-cell electric lamps to solar PV systems. Consumers make purchases in the same shops, and sellers are adapting to changes in demand by offering solar equipment.
  - **High-end consumers:** As elaborated in Section 2.4, a small number of early adopting consumers buy from specialized solar integrators who offer quality services and components. A large portion of buyers in this segment opt for systems above 200Wp for residential and small business demand.
  - **PAYG:** As the PAYG market segment is still in its nascent stages, detailed data of PAYG customers is still largely unavailable, although recent experience from East Africa suggests that these customers include both rural and peri-urban inhabitants. The PAYG business model / method is still not widely understood; moreover, there are still questions about how to account for the seasonality of incomes as opposed to regular monthly payment plans. Yet, there are well over 50,000 customers in the country and strong experiences are being built by first entrants like Easy Solar.
  
- **Consumers have a general awareness that solar can economically replace generators and batteries, but they are still largely uninformed about solar electric specifics**
  - While knowledge is gradually improving (particularly for small/pico solar lighting systems) most consumers are not yet educated enough to make informed decisions about solar systems.
  - There are often geographic disparities in awareness levels of OGS products, as households in urban or peri-urban areas tend to have better understanding of solar vis-à-vis rural villages.
  - Consumers are hearing “general messages” (i.e. “solar is good,” “solar can be cheap,” “solar can be more economical”). These messages need to be translated into more specific understanding of the technology (i.e. what are the options, what products are better than others, where to buy solar, what is a best way to pay for solar, what suppliers are more reliable, how to manage O&M, etc.).
  - Consumers often do not get fair information on the product they are buying. Marketing messages are quite mixed and much ‘overpromising’ occurs for systems. Consumers are largely unaware of standards and quality assurance for solar.
  
- **Perceptions of households vary according to experience they have had with solar**
  - Although many households recognize the benefits of solar, there is a general perception that solar equipment is very expensive and that products are considered largely un-affordable.
  - Many customers are disappointed with solar technology or mistrust it because:
    - They have bought a substandard/not certified product that broke down quickly;
    - There was no adequate maintenance, aftersales service when the system broke down;
    - There was lack of understanding/experience on how to use the system and it broke down due to over usage or incorrect usage.
    - There is no warranty or fault management system (long-term O&M)
  - Households that have a fuel-powered generator, consider them as a ‘sunk cost’ and treat solar only as an addition to that cost.
  - Solar is seen as risky by many. Since there are so many options and little information as to what

the best solution is, many people think that it is easy to make a costly mistake in choosing what is best for them. Generators are much better understood.

- Some consumers have ‘investment fatigue’ from buying multiple solar products of low or unknown quality and are unwilling to make further investments.

➤ **Willingness to Pay is strongly associated with consumer understanding and perceptions of OGS**

Although there is demonstrated ability to pay for households in higher income demographics on cash purchase, and for many households through a financed scenario, willingness to pay is strongly associated with consumer understanding and perceptions of OGS. Component-based Plug-and-Play SHS are much more expensive than battery-powered alternatives and are more than what households expect to pay for access to lighting. Consumers who purchase low-priced inferior lighting products for which they have low expectations are less likely to be willing to purchase a relatively high priced OGS system without fully understanding the difference between the products.

Since most of the retail-shop dry-cell battery-powered lighting products are extremely low cost (and short-lived), conservative rural consumers are wary of expensive new products if they are unable to assess product quality and durability. For this reason, willingness to pay presents a much larger barrier for the development of sales than actual *ability* to pay. East African experience with Global Lighting-certified products has demonstrated that consumer awareness campaigns can grow the demand for quality products.

## 2.2 Demand – Institutional

### 2.2.1 Overview of Institutional Market Segment

This section estimates the market potential for off-grid solar products for institutional users in Sierra Leone. This market includes the following segments: (i) rural water supply, (ii) healthcare facilities, (iii) primary and secondary schools, and (iv) public town center lighting. The following sub-sections provide an overview of the assumptions used for each market segment along with corresponding analysis. The section concludes with an assessment of institutional ability to pay, looking at funding sources and highest potential market segments. **Annex 2** provides an overview of the methodology, including all calculations.

### 2.2.2 Analysis of Institutional Market Segment Demand

**Table 19** shows the estimated annualized cash market potential for institutional users in Sierra Leone. This estimation is calculated using available GIS data, secondary research, and primary source field data. The analysis is based on available information from planned expansion of the sectors and typical usage patterns and costs of existing systems in the country.

Table 19: Indicative Total Cash Market Potential for Institutional Sector<sup>129</sup>

Institutional Sector		Units	kW Equivalent	Cash Value (USD)
Water supply	Low power pumping system	115	172	\$429,938
	Medium power pumping system	115	459	\$1,146,500
	High power pumping system	27	266	\$663,750
	Subtotal	257	897	\$2,240,188
Healthcare	Health post (HC1)	141	35	\$88,375
	Basic healthcare facility (HC2)	28	41	\$103,125
	Enhanced healthcare facility (HC3)	16	66	\$164,850
	Subtotal	185	142	\$356,350
Education	Primary schools	297	149	\$445,725
	Secondary schools	22	43	\$106,800
	Subtotal	319	192	\$552,525
Public lighting	Public lighting (excluding street lighting)	37	18	\$55,350
<b>TOTAL</b>		<b>798</b>	<b>1,249</b>	<b>\$3,204,413</b>

Source: African Solar Designs analysis

<sup>129</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

➤ **Water Supply**

Table 20: Key Assumptions for Water Supply Sector Analysis

Sector	System Sizes	Key Assumptions
Water supply	<ul style="list-style-type: none"> <li>• Low Power (1,500 W)</li> <li>• Medium Power (4,000 W)</li> <li>• High Power (10,000 W)</li> </ul>	<p>The type of pump selected is dependent on depth, yield, community need and other factors. System sizes depend on the common pump sizes used for rural applications:</p> <ul style="list-style-type: none"> <li>• Low power pumps are used for low/medium head applications. They replace hand pumps for shallow wells</li> <li>• Medium power pumps have high volume low head and medium volume medium head applications</li> <li>• High power pumps are used for high volume or high head applications such as deep wells and boreholes</li> </ul>

The water supply sector analysis considered the electricity needs for water supply for communities in off-grid areas. Energy is only one component of this sector – a variety of factors (water quality, number of users, yields of well, delivery system etc.) need to be considered when planning for off-grid water supply. The supply of solar powered pumping systems for village water supply requires additional planning and study to identify the most viable sites (**Table 20**).

Data obtained from a survey conducted for the Sierra Leone Wash Data Portal<sup>130</sup> identified off-grid water points such as boreholes and wells that could be electrified by stand-alone systems. Based on the analysis, the estimated annualized cash market potential for the water supply sector is presented in **Table 21**.<sup>131</sup> The distribution of potential off-grid water points is illustrated in **Figure 27**.

Table 21: Estimated Cash Market Potential for Water Supply<sup>132</sup>

Pump Type	Units	Size (kW)	Cash Value (USD)
Low power	115	172	\$429,938
Medium power	115	459	\$1,146,500
High power	27	266	\$663,750
<b>Total</b>	<b>257</b>	<b>897</b>	<b>\$2,240,188</b>

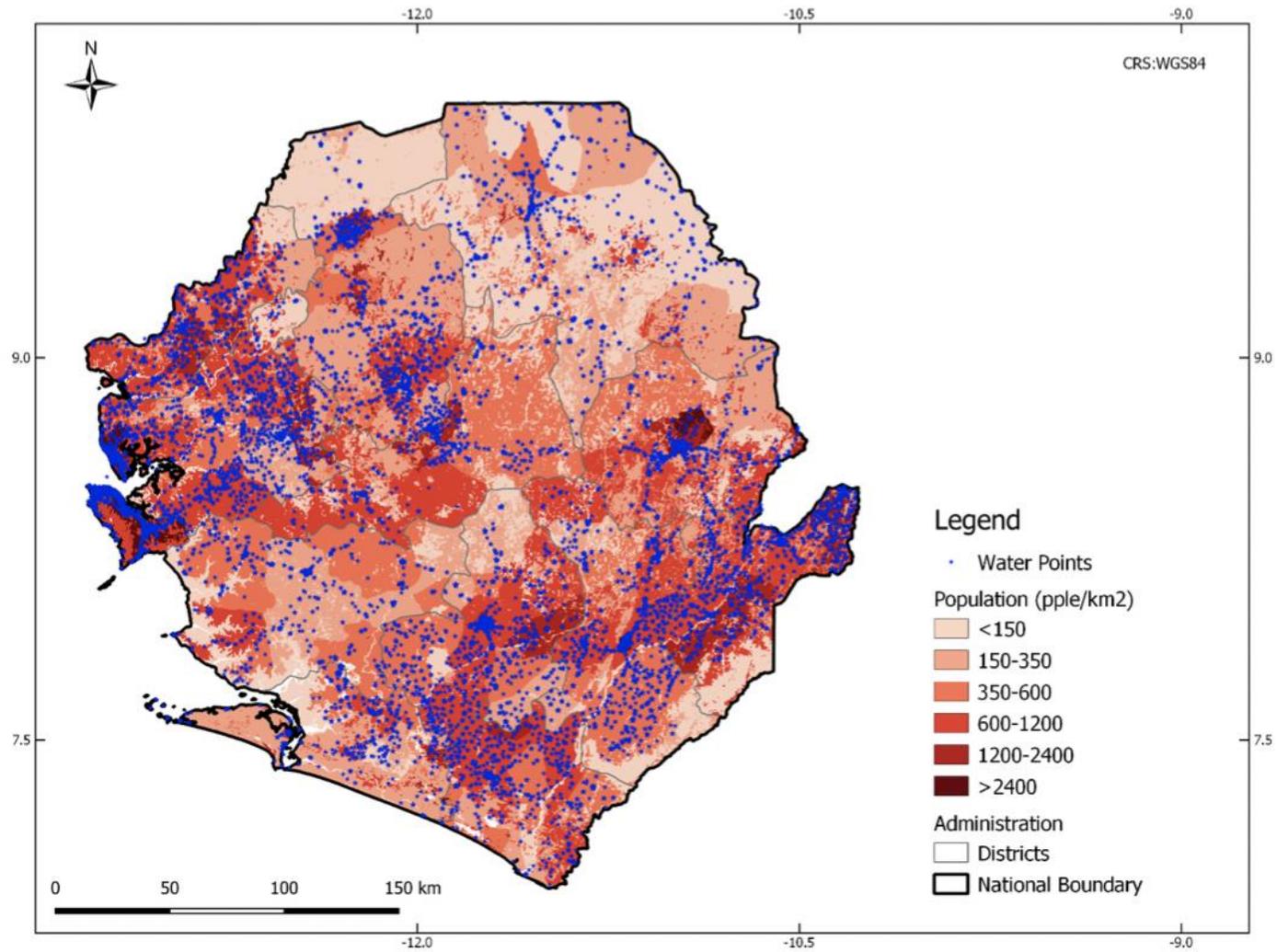
Source: African Solar Designs analysis

<sup>130</sup> Sierra Leone WASH data portal: <https://washdata-sl.org/>

<sup>131</sup> See **Annex 2** for more details.

<sup>132</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

Figure 27: Distribution of Off-Grid Water Points and Population Density<sup>133</sup>



Source: Energo Verda Africa GIS analysis; Sierra Leone Wash Data Portal<sup>134</sup>

<sup>133</sup> Displaying identified water points with known location (given coordinates) only; see **Annex 1** for more details.

<sup>134</sup> Sierra Leone WASH data portal: <https://washdata-sl.org/>

➤ **Healthcare**

Focus group discussion participants indicated that a significant number of health clinics have solar PV systems, especially for vaccine refrigerators, with many systems not working due to battery failure. The EU Promotion of Renewable Energy Services for Social Development-Sierra Leone (PRESSD-SL) report summarizes information from surveys of over 60 health centers:

*“Most health clinics rely on multiple sources for their energy, usually in the form of a combination of solar power and torches; solar power and generators; or generators and torches. The health sector had the highest use of solar out of all the sectors due to the high prevalence of solar vaccine fridges (at 65% of the sites in the Northern Districts; and 67% of sites in the Eastern Districts) and the UNFPA solar suitcases (two lights and a battery system). The vast majority of the vaccine fridges were not functioning, while most clinics indicated that the solar suitcases were insufficient for their needs. Unfortunately, despite its high prominence, solar power has not been utilized effectively in the health sector. Generators, as in the private sector, presented major problems in terms of their running costs and maintenance. Many clinics owned generators that had broken down sometime in the last five years and had remained in a state of disrepair due to a lack of funds to pay for maintenance costs. Although there was great variance between the sites, on average SLL 53,000 (USD 6.50) was reportedly spent per site on lighting (i.e., batteries or fuel).”<sup>135</sup>*

Table 22: Energy Sources at Health Facilities in Six Districts<sup>136</sup>

Energy Source	Northern Districts	Eastern Districts
Battery Powered Torches	84%	91%
Solar Power	73%	69%
Grid Electricity	4%	4%
Generator	16%	34%
Candles	1%	1%

Source: EU - Promoting Renewable Energy Services for Social Development in Sierra Leone

Table 23: Key Assumptions for Healthcare Sector Analysis

Sector	System Sizes	Key Assumptions
Healthcare	<ul style="list-style-type: none"> <li>HC1: Dispensary health post (300 W)</li> <li>HC2: Basic health facility (1,500 W)</li> <li>HC3: Enhanced health facility (4,200 W)</li> </ul>	1,571 off-grid healthcare facilities were identified that could be electrified by stand-alone systems

The healthcare sector analysis considered the electricity needs for off-grid health facilities in the country. Off-grid clinics require power for lighting and various Information and Communications Technology (ICT) needs, including phone charging, maternity, medical examinations, vaccine refrigeration, laboratory, sterilization and staff housing. The size of a facility and number of patients served determines the amount of energy it requires.

Available GIS data identified off-grid health facilities categorized according to their size (HC1, HC2, and HC3) that could be electrified by stand-alone systems (Table 23).<sup>137</sup> To establish electricity demand, an assessment of equipment found within each category of healthcare facility was undertaken, with the daily demand of each used to calculate the system size required to cater to the load of the facility (Table 24). The assumptions of system size below are based on the services offered at each of these facilities.

<sup>135</sup> Lai et. al., 2015.

<sup>136</sup> The six districts are: Port Loko, Kambia, Bombalo, Kono, Kenema and Kailahun; data was only collected from rural areas

<sup>137</sup> NOTE: This represents a small subset of the overall health infrastructure in the country

Table 24: Healthcare Facility Categorization and Electricity Demand<sup>138</sup>

Type of Facility	Load Category	Wh/day	Total Load (Wh/day)	System Size (W)
Health post (HC1)	Lighting	240		
	Communication	160		
	ICT	800		
			<b>1,200</b>	<b>250</b>
Basic healthcare facility (HC2)	Lighting	1,600		
	Maternity	800		
	Vaccine refrigeration	800		
	Communication	400		
	Examination room	400		
	ICT	1,600		
	Staff housing	400		
			<b>6,000</b>	<b>1,500</b>
Enhanced healthcare facility (HC3)	Lighting	3,200		
	Communication	1,600		
	Examination room	1,200		
	ICT	2,400		
	Maternity	2,400		
	Laboratory	2,000		
	Sterilization	1,200		
	Vaccine refrigeration	1,200		
	Staff housing	1,600		
			<b>16,800</b>	<b>4,200</b>

Source: GIZ; African Solar Designs analysis

Based on these assumptions, the estimated annualized cash market potential for the healthcare sector is presented in **Table 25**. The distribution of potential off-grid health facilities is illustrated in **Figures 9-10** in **Section 1.2.2.4**.

Table 25: Estimated Cash Market Potential for Healthcare Facilities<sup>139</sup>

Type of Facility	Units	kW Equivalent	Cash value (USD)
HC1 Health post	141	35	\$88,375
HC2 Basic healthcare facility	28	41	\$103,125
HC3 Enhanced healthcare facility	16	66	\$164,850
<b>Total</b>	<b>185</b>	<b>142</b>	<b>\$356,350</b>

Source: African Solar Designs analysis

<sup>138</sup> "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): [https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ\\_2016\\_Catalogue\\_PV\\_Appliances\\_for\\_Micro\\_Enterprises\\_low.pdf](https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ_2016_Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf);

<sup>139</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

➤ **Education**

The EU PRESSD-SL report offers useful insight about energy use in the schools that were assessed:

*“Sixty schools were surveyed across Kono, Kenema and Kailahun Districts. Seven schools used battery power torches for night lighting, spending on average SLL 28,000 to pay for batteries; 20 schools owned generators, spending around SLL 100,000 per month to pay for operating costs. A small number of schools owned generators that needed repair. Two schools in Kenema Town were connected to the grid network and paid around SLL 38,000 in electricity bills per month. One school used solar power, while the remaining 36 schools had no lighting source. If night classes were available, students were required to bring their own lighting source. 15% of all schools surveyed opened for night classes; the majority of these did so during exam periods.”<sup>140</sup>*

Table 26: Key Assumptions for Education Sector Analysis<sup>141</sup>

Sector	System Sizes	Key Assumptions
Education	<ul style="list-style-type: none"> <li>Elementary schools (500 W)</li> <li>Secondary schools (1,920 W)</li> </ul>	5,943 off-grid primary schools and 445 off-grid secondary schools were identified that could be electrified by stand-alone systems

The education sector analysis considered the electricity needs of off-grid primary and secondary schools.<sup>142</sup> These include lighting, ICT (computers, tablets etc.), communication (phone charging), laboratories and staff housing. The size of a school and number of students determines the amount of energy it requires.

Available GIS data identified off-grid primary and secondary schools that could be electrified by stand-alone systems. To establish electricity demand, an assessment of equipment found within each type of school was undertaken, with the daily demand of each used to calculate the system size required to cater to the electric load of the school (**Table 27**).

Table 27: Education Center Categorization and Electricity Demand<sup>143</sup>

Type of Facility	Load Category	Wh/day	Total Load (Wh/day)	System Size (W)
Primary School	Communication	160		
	Lighting	640		
	ICT	800		
	Staff house	400		
			<b>2,000</b>	<b>500</b>
Secondary School	Communication	160		
	Lighting	1,920		
	ICT	3,200		
	Laboratory use	800		
	Staff house	1,600		
			<b>7,680</b>	<b>1,920</b>

Source: GIZ; African Solar Designs analysis

<sup>140</sup> Lai et. al., 2015.

<sup>141</sup> NOTE: While the GIS analysis in **Section 1.2.2.4** covers all education centers (including nursery, pre-primary, primary, secondary, technical-vocational, universities etc.), this analysis only examines primary and secondary schools (see **Annex 1** and **Annex 2**).

<sup>142</sup> Primary schools encompass both primary and nursery schools. Vocational schools and universities were not considered because they tend to be in cities, which are often grid electrified.

<sup>143</sup> “Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances,” GIZ, (2016): [https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ\\_\\_2016\\_\\_Catalogue\\_PV\\_Appliances\\_for\\_Micro\\_Enterprises\\_low.pdf](https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ__2016__Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf);

Based on these assumptions, the estimated annualized cash market potential for primary and secondary schools is presented in **Table 28**. The distribution of potential off-grid schools (not just primary and secondary schools, but all schools) is illustrated in **Figures 9-10** in **Section 1.2.2.4**.

Table 28: Estimated Cash Market Potential for Primary and Secondary Schools<sup>144</sup>

Type of Facility	Units	kW Equivalent	Cash value (USD)
Primary school	297	149	\$445,725
Secondary school	22	43	\$106,800
<b>Total</b>	<b>319</b>	<b>192</b>	<b>\$552,525</b>

Source: African Solar Designs analysis

➤ **Public Lighting**

Table 29: Key Assumptions for Public Lighting Sector Analysis

Sector	System Sizes	Key Assumptions
Public lighting	Standard system (200 W)	<ul style="list-style-type: none"> <li>District population figures were used to determine the number of market centers per district, assuming 5,000 people per market center</li> <li>Each market center was assumed to have two public lighting points</li> </ul>

Analysis of the public lighting sector considered the public lighting needs for off-grid villages and market centers. It did not assess public street lighting, which would generally be included in road infrastructure projects. Based on these assumptions, the estimated annualized cash market potential for the public lighting sector is presented in **Table 30**.

Table 30: Estimated Cash Market Potential for Public Lighting<sup>145</sup>

Public Lighting Network	Units	kW Equivalent	Cash value (USD)
Village lighting (excluding street lighting)	37	18	\$55,350

Source: African Solar Designs analysis

2.2.3 Ability to Pay and Access to Finance

Financing for institutional off-grid systems in Sierra Leone typically comes from budget allocations made directly by relevant ministries or, more commonly, by donor-funded projects. In recent years, virtually all institutional solar projects in the country have been financed with tender-based procurements and cash-based contracts. Government allocations are typically made ad-hoc, depending on the needs and priorities of the ministry, and whether funds are available. Operation, maintenance and replacement of parts in energy systems (e.g. solar system batteries and inverters) is typically the responsibility of the institution and community. Schools, clinics and other institutions with generators must buy fuel on a regular basis. With the development of the renewable energy sector, NGO/donor funds increasingly design projects that ensure that maintenance of the system is factored into its implementation. However, when there are no funds to maintain the system any further, usage is typically discontinued, and the system falls into disrepair.

Institutional users that rely on government or donor funds for the purchase and O&M of solar systems may be constrained by limited funds and/or competing budget priorities. Thus, local communities benefiting from solar electrification would also have to bear some long-term costs for the maintenance of systems and

<sup>144</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

<sup>145</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

replacement of parts. In the event that public or donor funding is made available to cover the initial capital expenditure, funds can be raised by local communities through a minimal tariff to customers of the health facilities, water pumping stations etc. for long-term O&M. A market standard of 5-10% of the capital expenditure is accepted as a rate for annual maintenance of systems.<sup>146</sup>

Given budgetary constraints, some institutional sectors may be prioritized for solar electrification over others. Advanced health centers for example, could be prioritized by governments and communities given that electricity is essential to run advanced healthcare equipment. It may be easier in this case to extract maintenance fees from community members receiving health services or budget allocations from local government. In contrast, off-grid schools can be run more easily without access to electricity and may therefore present a lower priority institutional market.

#### 2.2.4 Success and Failures of Solar Experiences for Community Projects

##### ➤ Water Supply

Solar water pumping is a relatively new sector in Sierra Leone. However, initial indications from experiences with pumps are encouraging. World Hope International (WHI) has used the local branch of Aptech Africa to install solar water well pumping solutions across the country with positive experiences and results. Though precise figures are not available, it is estimated that a few hundred solar water pumps have been installed, many of which continue to operate because of the simple design, international experience from the installing party, and simple maintenance protocols undertaken by the local community.

##### Lessons Learned / Recommendations

- Simple solar pumping systems without batteries have a strong future
- Solar pumping is a viable method to improve access to water for rural communities
- More community training and sensitization would be recommended for future projects

##### ➤ Healthcare

The “Rural Renewable Energy project” has electrified 54 Community Health Centers (CHC) and their surrounding communities with PV mini-grids ranging from 6 to 30 kWp. The project is being implemented by UNOPS with funding from DFID and will install 40 more PV mini-grids before 2020. The project is innovative as it is one of the first attempts to use public facilities as anchor loads for mini-grids that are a run as a service. Normally, institutional systems are installed as procurements that result in eventual failure when batteries or other components come to the end of their life. A mini-grid with sustainable income from a large base of clients, will enable a sustainable supply of power for a longer term with contract for an operator to ensure power is available.

The Government’s involvement in the project’s implementation is limited to a Memorandum of Understanding between three ministries – the Ministry of Energy, Health and Sanitation, and Local Governance. District Medical Officers (DMOs) operating in the district level have commented that they have little involvement in selecting the CHCs. The project will install 4 to 11 sites per district. By the end of 2020, the project will have installed 94 mini-grids across the country. A private partner will be responsible for management and operations of the mini-grids selling electricity to the community at a rate that can recover costs, fund the maintenance and operation, and cover the clinic electricity costs.

##### Lessons Learned / Recommendations

<sup>146</sup> Grundfos: <https://www.grundfos.com/service-support/encyclopedia-search/maintenance-and-repaircostscm.html>

- Good system design led to proper electricity access for the surrounding community and provided the private sector with maintenance responsibilities
- Lack of communication between the installing party and the DMOs led to disagreements on which sites to prioritize for electrification
- Local capacity to carry out installation work was not adequately utilized. High requirements for financial turnover and years of experience heavily favors foreign companies in internationally-funded tenders

➤ **Public Lighting**

The Government has implemented a solar street light electrification project for major towns since 2010. The initiative was funded by an Indian development loan with implementation support from an Indian company. However, due to lack of maintenance and vandalism, many of the installed solar street lights fell into disrepair. Overall, this experience was unsuccessful. During the first two years of operation the lights were under warranty and managed by the supplier. Afterwards, the responsibility of maintenance was handed over to the local district. With no funding or capacity for repairs, the street lights deteriorated and/or were subject to theft and vandalism.

**Lessons Learned / Recommendations**

- Increased safety of the environment and a reduction of accidents was noticed upon implementation
- The system designs were not theft proof and the maintenance scheme was not properly financed, which ultimately led to the project failing
- A comprehensive long term O&M plan should have been included in the procurement process

## 2.3 Demand – Productive Use

### 2.3.1 Overview of Productive Use Market Segment

The section provides an overview of the main characteristics of productive use of energy (PUE) and how off-grid solar applications have the potential to generate economic activity, increase productivity and transform rural livelihoods in Sierra Leone. Focus group participants noted that productive use applications in the agricultural, food processing and informal sectors already exist in the country, including solar powered lighting, mobile phone charging, refrigeration and chilling, water pumping, irrigation and agricultural processing. The PUE market sizing analyzed demand for SME applications for village microenterprises, value-added applications for solar powered irrigation, milling and refrigeration, and connectivity applications for mobile phone charging enterprises.

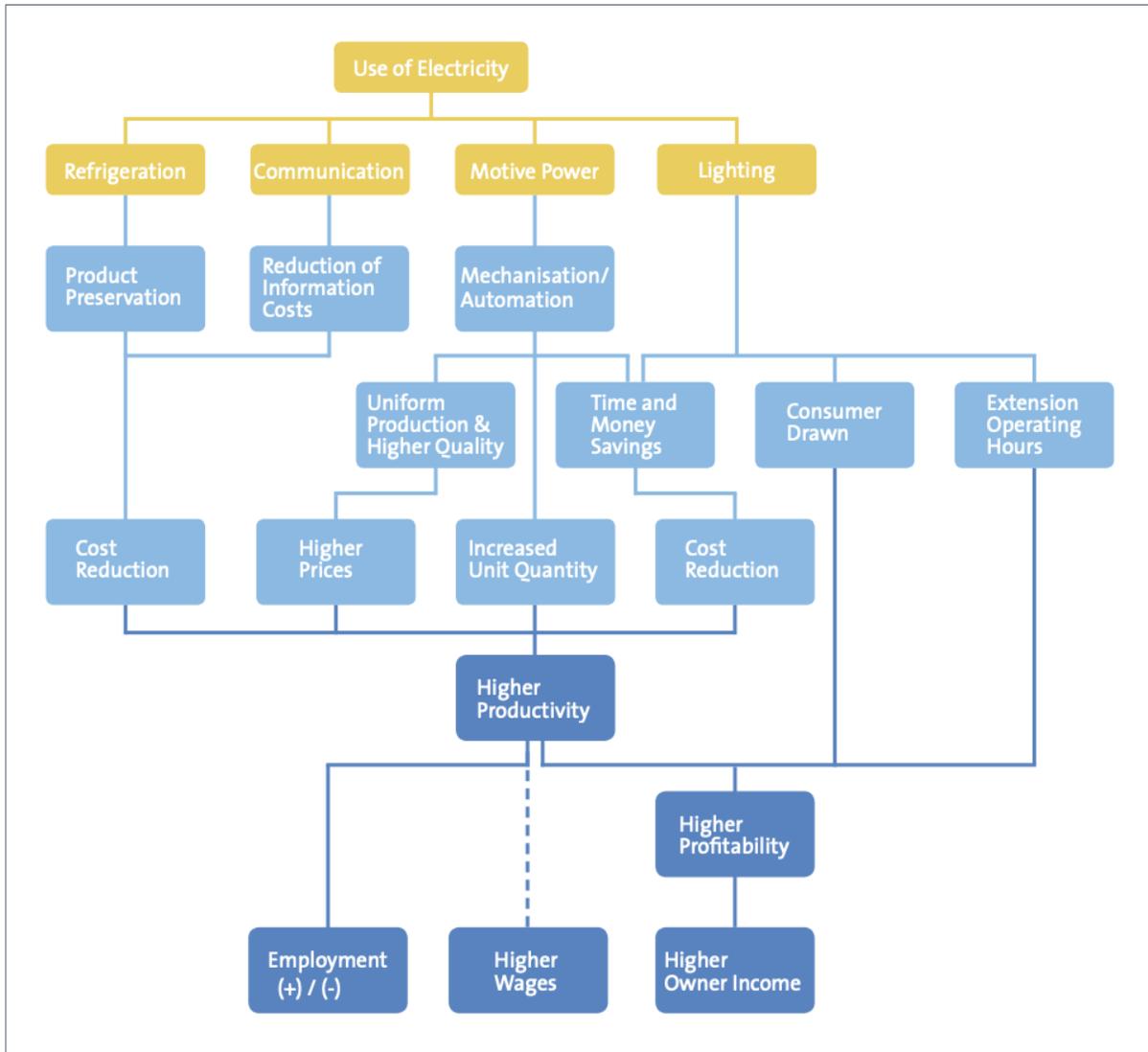
The calculation of the estimated off-grid solar market for SMEs focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit significantly from extended working hours and the use of modern appliances/machinery. The estimated demand for this market segment is therefore intended to provide a baseline for future research, as a more robust analysis would be necessary to assess realistic demand from all SMEs.

The value-added applications that were analyzed include solar pumping for smallholder agricultural irrigation, solar powered milling and solar refrigeration. Access to energy for agriculture is critical to economic development, particularly given the sector’s importance to GDP in the country.

Off-grid solar power supports a wide range of connectivity applications, including mobile phone charging, wi-fi servers, banks, mobile money kiosks, and telecommunications towers. Mobile phone and internet connectivity are also necessary precursors for mobile money and PAYG solutions in the off-grid solar sector. The market sizing examined rates of mobile phone ownership and mobile internet penetration to estimate the market potential for mobile phone charging enterprises (stations/kiosks) in the country.

A number of productive use applications have emerged in the country, most notably mobile phone charging in rural areas. The economic impacts of off-grid electrification, however, are highly market and sector specific. Further, the impact of electricity use on SMEs depends on a variety of external and internal factors such as access to markets, the location of the firm, supply of inputs and financial capability. Thus, the extent to which firms can afford to invest in off-grid solar solutions is determined largely by increases in productivity, profitability, and employment/wages from the investment in the off-grid appliance (**Figure 28**).

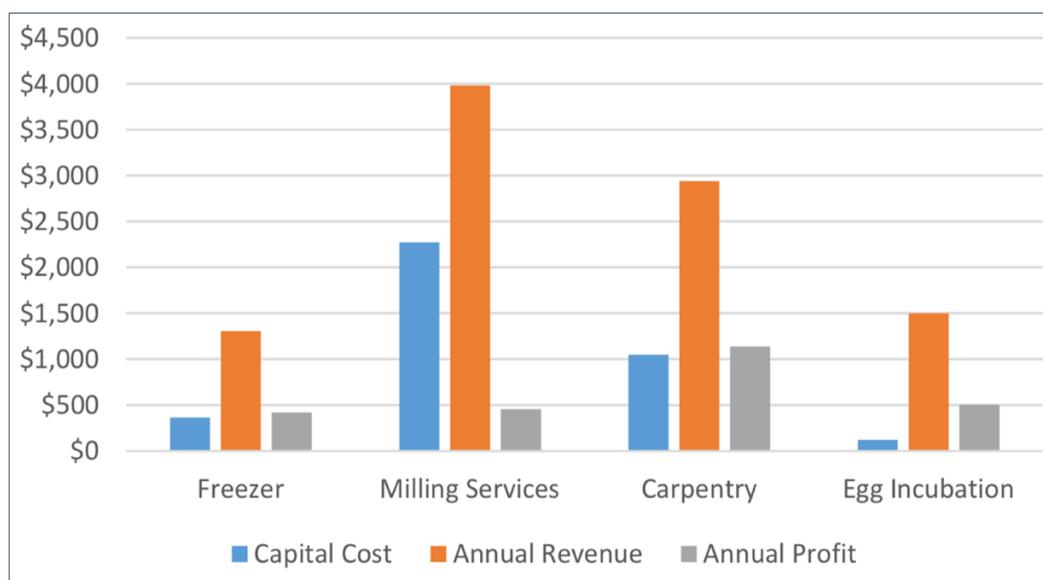
Figure 28: Pathways from Electricity to Income Generation<sup>147</sup>



Source: EUEI PDF and GIZ: Productive Use of Energy – A Manual for Electrification Practitioners

<sup>147</sup> “Productive Use of Energy – A Manual for Electrification Practitioners,” European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) and GIZ, (2011): <https://www.giz.de/fachexpertise/downloads/giz-eueipdf-en-productive-use-manual.pdf>

Figure 29: Analysis of Cost, Revenue, and Profit for Various Off-Grid Productive Use Applications<sup>148</sup>



NOTE: Annual profit does not include recovery of cost capital

Source: USAID-NREL and Energy 4 Impact: Productive Use of Energy in African Microgrids

In order to organize and simplify this analysis and to deliver meaningful insights on country level market sizing, productive solar applications have been divided into three main groups (Table 31).

Table 31: Overview of Productive Use Applications

Productive Use Application	Description
1) SME applications for village businesses	Barbers and tailors are the two microenterprises that were analyzed. While these businesses employ people and are critical for off-grid towns, they do not create additional income for towns and are not transformative in nature. SME businesses are therefore most at risk during economic downturns because they are at the mercy of the overall economic and political climate.
2) Value-added applications	Solar-powered irrigation, refrigeration/chilling and milling are the three value-added applications that were analyzed. Value-added productive use applications enable businesses to add value to products or services and to build new income streams. This can be done by creating a new product or service or by enhancing the value of an existing product (e.g. milling maize). Water pumping tools that support the agricultural, dairy or fishing value chains are included here (water pumps, refrigerators/chillers, and grain mills).
3) Connectivity / ICT applications	Mobile phone charging is the connectivity application that was analyzed. Connectivity applications enable consumers to communicate and access data from the internet. Following the advent of mobile phones and mobile money in East Africa, solar devices that support connectivity applications became the most important income earning applications in East Africa. Mobile phone charging is extremely important for the telecommunications sector. Other connectivity applications include wi-fi servers, mobile money kiosks, banks, and telecommunications towers.

Source: African Solar Designs

<sup>148</sup> "Productive Use of Energy in African Micro-Grids: Technical and Business Considerations," USAID-NREL and Energy 4 Impact, (August 2018): [https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive\\_use\\_of\\_energy\\_in\\_african\\_micro-grids.pdf](https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive_use_of_energy_in_african_micro-grids.pdf)

➤ **Geographic Locations**

Most solar powered productive use will take place in rural areas outside of Freetown, where electricity access is restricted and expensive. Other areas include larger towns without stable electricity (e.g. Kenema, Bo, Kono, and Kambia). Towns like Makeni and Port Loko have more stable power due to proximity to major power lines or local power dams (like Bankasoka dam near Port Loko).

2.3.2 Analysis of Productive Use Market Segment Demand

Data from the World Bank, Food and Agriculture Organization of the UN (FAO) and GSMA was used to conduct the PUE market study. In order to conduct the analysis, several key assumptions were made about PUE applications, which are presented in the sections below and in **Annex 2** in greater detail. **Table 32** presents the estimated annualized cash market potential for off-grid solar productive use applications.

Table 32: Indicative Total Cash Market Potential for Productive Use Sector<sup>149</sup>

Productive Use Sector		Units	kW Equivalent	Cash Value (USD)
SME Applications for Village Businesses	Microenterprises	581	145	\$363,125
	Value-added Applications			
	Irrigation	112,083	13,450	\$72,854,167
	Milling	223	1,449	\$3,621,615
	Refrigeration	37	203	\$507,375
	Subtotal	112,343	15,102	\$76,983,157
Connectivity Applications	Phone Charging	3,336	1,334	\$2,875,776
<b>TOTAL</b>		<b>116,260</b>	<b>16,581</b>	<b>\$80,222,058</b>

Source: Food and Agriculture Organization, GIZ and GSMA; African Solar Designs analysis

➤ **SME Applications for Village Businesses**

Access to solar powered appliances can have a wide-ranging impact on SMEs, many of which would otherwise rely on diesel generators to power their enterprises. An estimated 33% of SMEs in emerging markets use fossil fuel powered generators in order to address energy security.<sup>150</sup> For ECOWAS countries, independent power generation via fossil fuel powered generators is especially prevalent.<sup>151</sup>

While many rural microenterprises would benefit from access to solar power, it may not be a requirement for a commercial enterprise to have access to electrical appliances. Further, while petit trade is facilitated greatly by the availability of electricity (kiosks and retail shops can be open longer hours and sell more and fresher products), electricity is not essential for SMEs because even without lighting, small shops can still sell their merchandise. Additionally, unlike value-added applications, there is not as strong a correlation between the value of the electric appliance and the economic capability of the SME. For example, a refrigerator used to preserve perishable food and chill beverages, irrespective of the value of food and beverages, may be used by either a large hotel or a street side vendor.

With the exception of replacing diesel gensets, the estimation of the available market for off-grid solar appliances for SMEs is not as closely correlated with economic indicators. Nonetheless, some widely

<sup>149</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

<sup>150</sup> Foster, V., and Steinbuks, J., "Paying the Price for Unreliable Power Supplies: In-House Generation of Electricity by Firms in Africa," World Bank Policy Research Working Paper, (2009): <https://openknowledge.worldbank.org/handle/10986/4116>

<sup>151</sup> Ibid.

marketed solar powered appliances are more centrally related to the revenue generation of SMEs. Investments in such appliances in off-grid and low-income settings are more likely to be sustainable. This study analyzed barbering and tailoring appliances (i.e. hair clippers and sewing machines designed or marketed for off-grid solar powered settings) with respect to microenterprises that face difficulty in accessing outside capital, as the two appliances would provide an economic opportunity for such entrepreneurs that are demographically most likely to be in off-grid communities. A study undertaken in West Africa that found little correlation between electricity access and a firm’s profitability did, however, find that tailors do consistently benefit from electricity access.<sup>152</sup>

Focus group participants also highlighted the potential for solar power to support service-based industries, specifically those participating in retail sales of fish, meat, beverages, entertainment and phone charging. The calculation of the estimated OGS market focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit most from extended working hours and the use of modern appliances/machinery. The quantitative demand estimate for this market segment is therefore intended to provide a baseline for future research, as a more robust analysis would be necessary to assess OGS demand from all SMEs.

According to the analysis, estimated annualized off-grid solar cash market potential for barbers and tailors is USD 363K (Table 33).

Table 33: Estimated Cash Market Potential for SMEs – Barbers and Tailors<sup>153</sup>

No. of SMEs with Constrained Access to Finance <sup>154</sup>	Units	kW Equivalent	Cash Value (USD)
2,905	581	145	\$363,125

Source: World Bank; African Solar Design analysis

<sup>152</sup> Grimm, M., Harwig, R., Lay, J., “How much does Utility Access matter for the Performance of Micro and Small Enterprises?” World Bank (2012): [http://siteresources.worldbank.org/INTLM/Resources/390041-1212776476091/5078455-1398787692813/9552655-1398787856039/Grimm-Hartwig-Lay-How\\_Much\\_Does\\_Utility\\_Access\\_Matter\\_for\\_the\\_Performance\\_of\\_MSE.pdf](http://siteresources.worldbank.org/INTLM/Resources/390041-1212776476091/5078455-1398787692813/9552655-1398787856039/Grimm-Hartwig-Lay-How_Much_Does_Utility_Access_Matter_for_the_Performance_of_MSE.pdf)

<sup>153</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see Annex 2 for more details.

<sup>154</sup> “MSME Finance Gap,” SME Finance Forum: <https://www.smefinanceforum.org/data-sites/msme-finance-gap>

➤ **Value-Added Applications**

Agricultural practices, especially for smallholder farmers, can benefit from a wide range of off-grid solar technologies. Cold rooms and ice production are valuable investments for economies engaged in aquaculture. Solar refrigeration, cooling and processing equipment would enable traders and livestock farmers to sell dairy products. Solar drying of cocoa and palm oil processing are productive use applications that would greatly benefit rural farmers in countries where these products contribute to export revenues.

The three value-added applications that were analyzed include solar pumping for agricultural irrigation, solar milling and solar powered refrigeration.

Solar Powered Irrigation:

In most West African countries, the national government is typically responsible for carrying out irrigation initiatives, which vary by the scale of the project and often require the construction of civil works such as dams, canals, embankments, and piping. Donor agencies and development partners provide funding for such projects. This analysis focused instead on a small-scale private sector driven approach and estimated the market potential for off-grid solar pumping systems to support smallholder farmers.

Solar pumping systems vary in their wattage depending on the area of land irrigated, the depth of water abstracted and the quality of the soil and crops among other factors.<sup>155</sup> GIS analysis demonstrated that access to the water table and surface water is not a major determinant of the costing of applicable solar irrigation systems, as most farming settlements in Sierra Leone are within close proximity to either surface water or relatively easily extractable sources of water (**Figure 30**).

In analyzing the available market for solar-powered irrigation, this market scoping exercise focused exclusively on smallholder farmers and solar water pumping irrigation technologies to address their needs. In doing so, this analysis took into consideration the emerging experience with small-scale productive use pumping in East Africa. Small pumps of 80 Wp-150 Wp (e.g. Futurepump and SunCulture) make up the bulk of sales, while larger-sized pumps (e.g., Grundfos) are also frequently marketed to address differing water access and crop conditions.

**Table 34** presents the estimated annualized off-grid solar cash market potential for smallholder value-added solar irrigation applications in Sierra Leone, which has an estimated cash value of USD 72M (see **Annex 2** for more details).

Table 34: Estimated Cash Market Potential for Value-Added Applications – Irrigation<sup>156</sup>

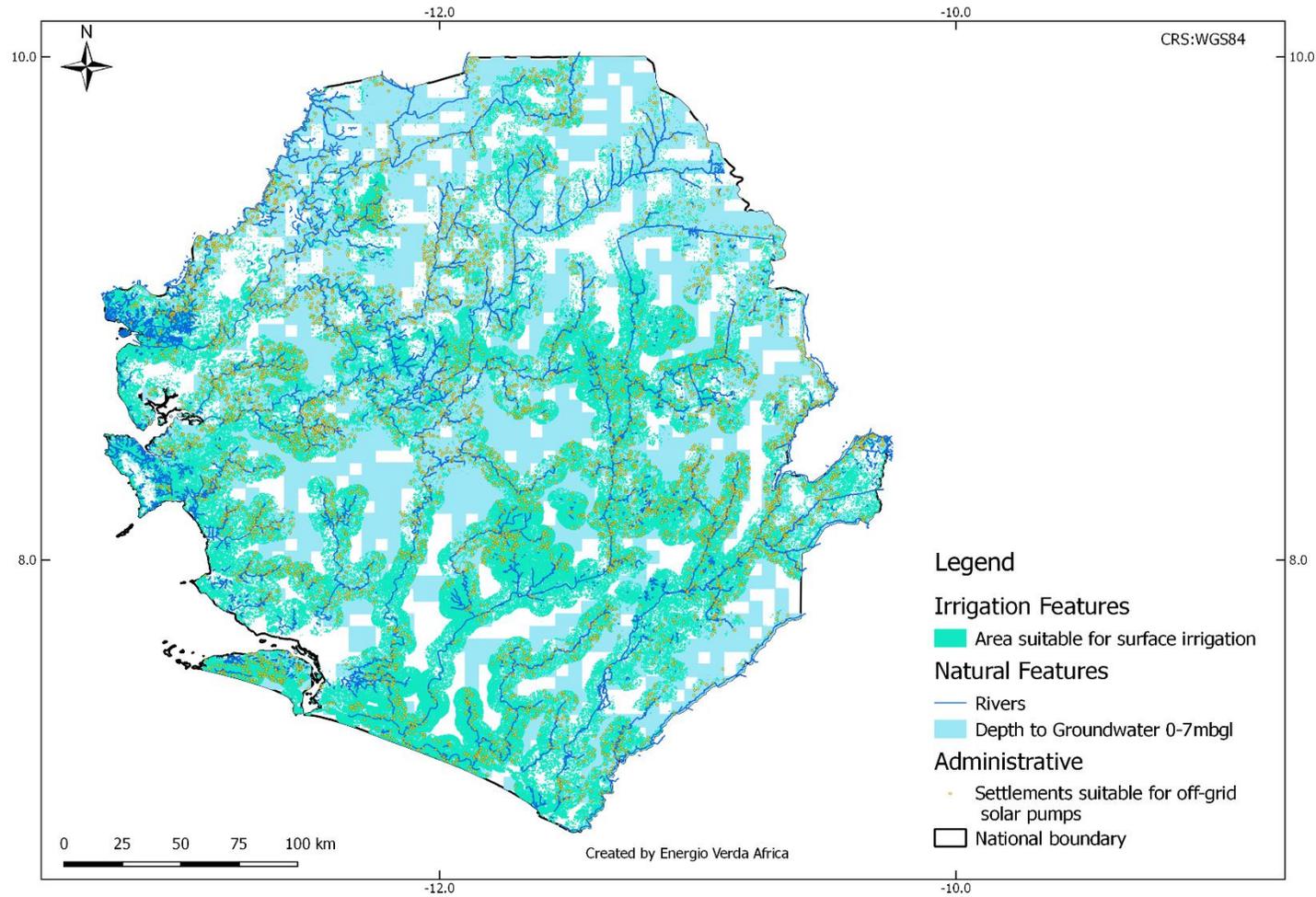
Estimated No. of Smallholder Farms Suitable for OGS Pumping for Irrigation	Units	kW Equivalent	Cash Value (USD)
672,500	112,083	13,450	\$72,854,167

Source: Food and Agriculture Organization; World Bank; African Solar Designs analysis

<sup>155</sup> See GIZ Powering Agriculture Toolbox on Solar Powered Irrigation Systems: [https://energypedia.info/wiki/Toolbox\\_on\\_SPIIS](https://energypedia.info/wiki/Toolbox_on_SPIIS)

<sup>156</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

Figure 30: Area Suitable for Surface Irrigation and Identified Settlements Suitable for Off-Grid Solar Pumps<sup>157</sup>



Source: Sierra Leone Wash Data Portal and British Geological Survey, Bureau of Statistics; and World Database on Protected Areas (WDPA);  
Energio Verda Africa GIS analysis

<sup>157</sup> NOTE: mbgl = meters below ground level

Sources: Sierra Leone WASH data portal: <https://washdata-sl.org/> and British Geological Survey © NERC 2012. All rights reserved.

Solar Powered Milling:

Cereal crops like maize, sorghum, millet, and rice provide an opportunity for value addition through hulling or milling. Off-grid communities use maize or rice milling equipment that is typically powered by diesel generators. Discussions with off-grid community groups revealed that although many are aware of the long-term cost savings associated with solar powered mills, the up-front cost of purchasing equipment was viewed as too high.

**Table 35** presents the estimated annualized off-grid solar market potential for smallholder value-added solar grain milling applications in Sierra Leone, which has an estimated cash value of USD 5 million (see **Annex 2** for more details).

**Table 35: Estimated Cash Market Potential for Value-Added Applications – Milling<sup>158</sup>**

Estimated No. of Solar Mills	Units	kW Equivalent	Cash Value (USD)
4,457	223	1,449	\$3,621,615

Source: Food and Agriculture Organization; African Solar Designs analysis

Solar Powered Cooling and Refrigeration:

Solar-powered refrigerators and freezers in rural areas serve multiple purposes, including to store milk, fish, meat and vegetables to extend the life of produce and reduce losses. In addition to storing produce, ice-makers can increase the income of rural SMEs by providing ice to businesses that require cold storage (stores, restaurants etc.).

**Table 36** presents the estimated annualized off-grid solar market potential for smallholder value-added solar refrigeration applications in Sierra Leone, which has an estimated cash value of USD 507,375 (see **Annex 2** for more details).

**Table 36: Estimated Cash Market Potential for Value-Added Applications – Refrigeration<sup>159</sup>**

Off-Grid Market Centers	Units	kW Equivalent	Cash Value (USD)
738	37	203	\$507,375

Source: Solar-Powered Cold Hubs, Nigeria; African Solar Designs analysis

Ultimately, the ability for an agricultural community to benefit from productive use applications has as much to do with access to markets and improved crop inputs, as it has to do with the pricing and availability of financing to purchase the equipment. Hence, the macroeconomic approach used to carry out this market sizing does not account for country-specific cost and supply chain constraints.

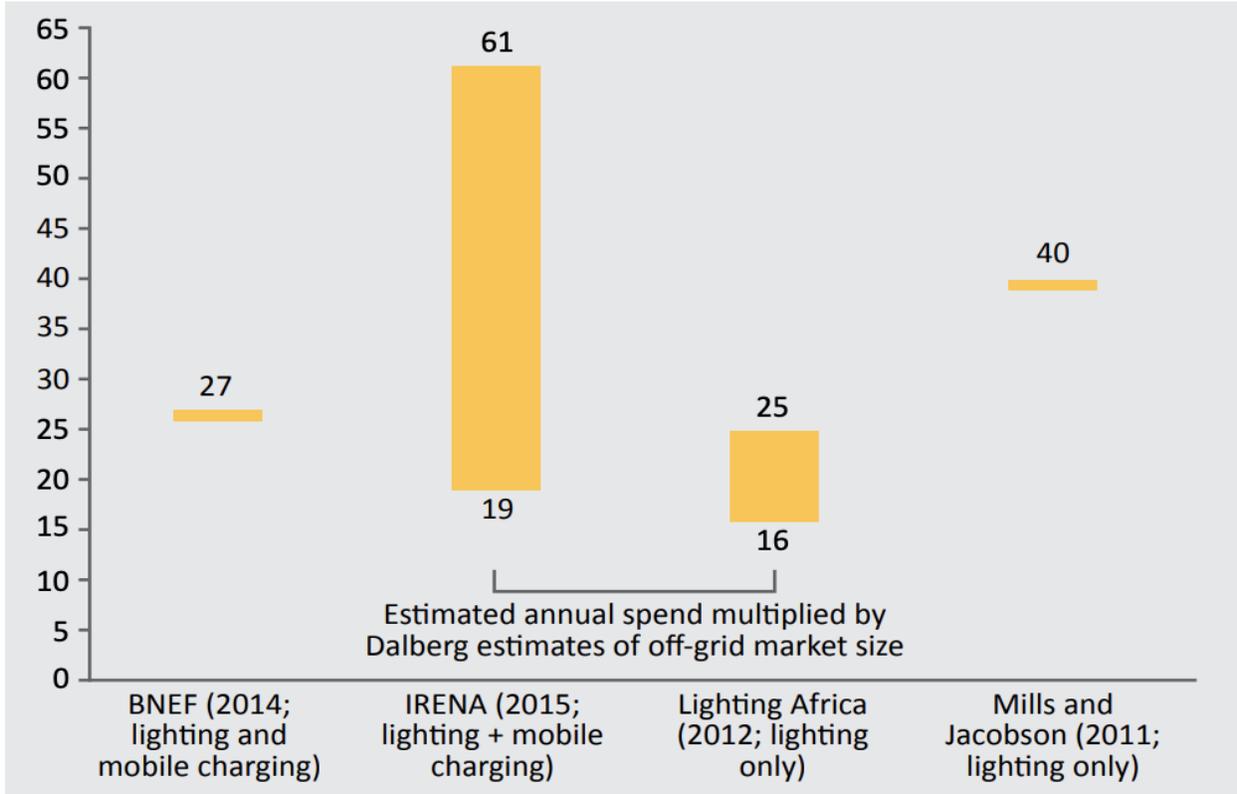
➤ **Connectivity Applications**

Mobile phone charging stations/kiosks make up a critical segment of off-grid solar demand, as the market for solar phone charging is expected to grow significantly in the near-term. Household rates of mobile phone ownership often greatly exceed rates of electricity access, while households spend a significant share of income on lighting and phone charging (**Figure 31**). Increasingly, off-grid solar devices, such as lighting devices, also include phone-charging capabilities that enable owners to engage in mobile-phone charging businesses.

<sup>158</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

<sup>159</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

Figure 31: Estimated Annual Off-Grid Household Expenditure on Lighting and Mobile Phone Charging<sup>160</sup>



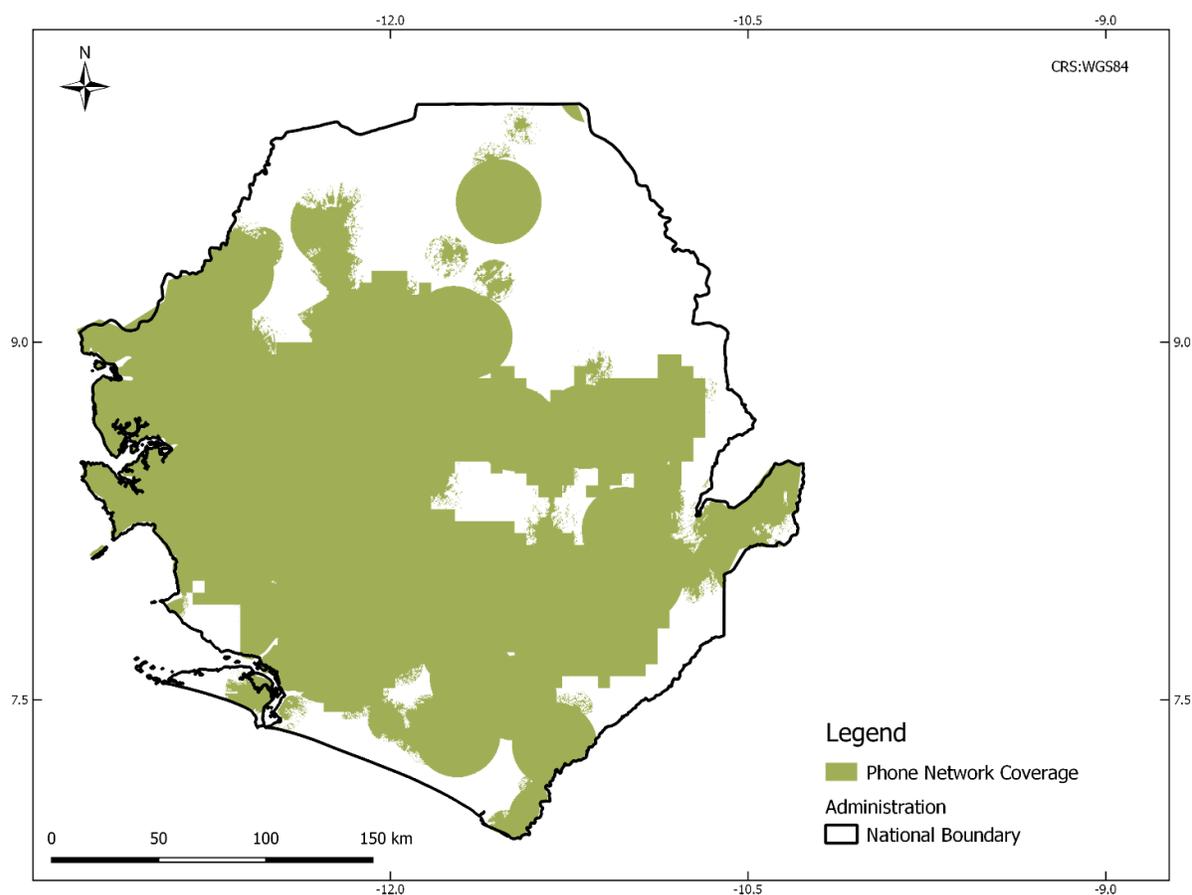
NOTE: Figures in Billion USD

Source: Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP

**Figure 32** shows the relatively broad geographic coverage of cellular signals across the region. Cellular connectivity is essential for solar PV markets. In many African countries, mobile phone charging provides a primary productive use application for off-grid solar. Mobile phone access – and more importantly connectivity – helps drive commerce and employment in rural areas. The penetration of mobile money services is also critical, as it drives greater financial inclusion, expands consumer financing options and further increases demand for phone charging enterprises. Above all, mobile phones and connectivity are a necessary precursor to PAYG solutions in the OGS sector. Countries with expanding mobile phone coverage and especially broadband internet users are more attractive to PAYG solar companies (**Figure 16**).

<sup>160</sup> “Off-Grid Solar Market Trends Report 2018,” Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018): [https://www.lightingafrica.org/wp-content/uploads/2018/02/2018\\_Off\\_Grid\\_Solar\\_Market\\_Trends\\_Report\\_Full.pdf](https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf)

Figure 32: Mobile Phone Network Geographic Coverage<sup>161</sup>



Source: GSMA

The analysis of the potential solar-powered phone charging market was based on the country’s mobile phone penetration rate, rural population rate, and the average costs of OGS phone charging appliances. **Table 37** presents the estimated annualized cash market potential for off-grid solar mobile phone charging enterprises in Sierra Leone, which has an estimated cash value of USD 2 million (see **Annex 2** for more details).

Table 37: Estimated Cash Market Potential for Mobile Phone Charging Enterprises<sup>162</sup>

Mobile Subscribers <sup>163</sup>	Rural Population (%) <sup>164</sup>	Units	kW Equivalent	Cash Value (USD)
2,800,000	59.6%	3,336	1,334	\$2,875,776

Source: GSMA; World Bank; African Solar Designs analysis

<sup>161</sup> See **Annex 2** for more details.

<sup>162</sup> Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

<sup>163</sup> “The Mobile Economy: Sub-Saharan Africa,” GSMA, (2017):

<https://www.gsmainelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download>

<sup>164</sup> World Bank: Rural Population (% of total population) <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS>

### 2.3.3 Ability to Pay and Access to Finance

The above analysis illustrates that there is a sizeable off-grid solar cash market for productive use applications in Sierra Leone. However, more research needs to be done in each segment to better understand affordability of OGS appliances and equipment based on ability and willingness to pay as well as other factors such as access to finance and ultimately whether the expenditure for the equipment is justifiable given increased revenue/productivity in the long-term.

The value-added market for water pumping for irrigation indicates that increased revenues from the use of solar appliances would justify the expenditure for the equipment – although as mentioned, agricultural productivity also depends on other environmental and market factors that are specific to each country. Solar powered irrigation systems may require a financed solution to be profitable investments for farmers, as their cost may exceed benefits depending on how the systems are designed and what components are used.

With regard to microenterprises, further study would be needed to determine the impact of off-grid solar on this sector, especially as it relates to income and affordability of the sectors analyzed (phone charging, barbers and tailoring). Providing solar-kits through subsidized micro-credit schemes can lead to productive uses and boost household income.

The focus group discussion yielded additional insights into the off-grid solar PUE sector from a consumer point of view:

- Many companies cannot afford the up-front cost of the solar solutions. A potential solution to this problem would be to implement a third-party ownership system and increased access to financing. The downside to this solution is that decommissioning products from the non-paying customers can be easy technically, but complicated legally, because the legal system in Sierra Leone is not very transparent and may not be ready for such system. Observers noted some solar companies are partly financing systems for productive use.<sup>165</sup> But they are very selective about such customers, so the market is not expanding fast. Suppliers commented that, “they don’t want to be the financier,” but just want to sell and install their products.
- Although there is developing experience working with SMEs, banks do not have loan products specifically for the solar solutions. Hence, banks do not have experience of calculating savings of the fuel against the solar and they don’t have capacity to assess the solar solutions (even though customers are fully aware of the benefits). The banks still require assets on which to base the loan – they are extremely risk averse.
- FGD participants indicated that a PAYG system for productive use might be the best option to develop finance for small business. Most companies/ individuals are quick to note that the high cost of the solar systems is prohibitive to them installing the systems. A PAYG system that is customized for this market is due.
- Productive use loan structures would have to be carefully developed, with tailored terms (attractive interest rates, currency hedging, guarantee instruments).

<sup>165</sup> I.e. 60% upfront payment and the rest is paid over the period of 1 year

## 2.4 Supply Chain

This section reviews the off-grid solar supply chain in Sierra Leone, including an overview of key actors, solar products and services, business models, and sales volumes. The section also analyzes the role of informal market players and the impact of uncertified products. The section concludes with an assessment of local capacity and the needs of the supplier market segment. The data presented in this section was obtained through desk research, interviews with local officials and industry stakeholders, focus group discussions and surveys of international and local solar companies (see **Annex 2** for more details). The tier system used to classify solar companies throughout this section is described in **Table 38**.

**Table 38: Solar Company Tier Classification**

Classification		Description
Tier 1	Startup companies	<ul style="list-style-type: none"> <li>Less than 3 full time employees</li> <li>Less than 300 SHS or Less than 1,500 lanterns sold</li> <li>Less than USD 100,000 annual revenues</li> <li>Does not have access to outside finance except personal loans and may have a business account</li> </ul>
Tier 2	Early stage companies	<ul style="list-style-type: none"> <li>3 to 25 full time employees</li> <li>300 to 30,000 solar home systems or 1,500 to 50,000 lanterns sold</li> </ul>
Tier 3	Growth/Mature	<ul style="list-style-type: none"> <li>More than 25 full time employees</li> <li>More than 30,000 solar home systems or 50,000 lanterns sold</li> <li>More than USD 3 million annual revenues</li> <li>Has a credit line at a bank and financial statements</li> <li>Raising equity or other outside financing</li> </ul>

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

### 2.4.1 Overview of Commercial Market for Solar PV Equipment

The off-grid solar supply chain in Sierra Leone is made up of a wide range of stakeholders – importers, distributors, wholesalers, retailers, NGOs, and end-users (**Figure 33**). Sierra Leone is a small but quickly growing solar market, as the country’s overall commercial environment and opportunity for solar companies is improving (**Figure 14**).

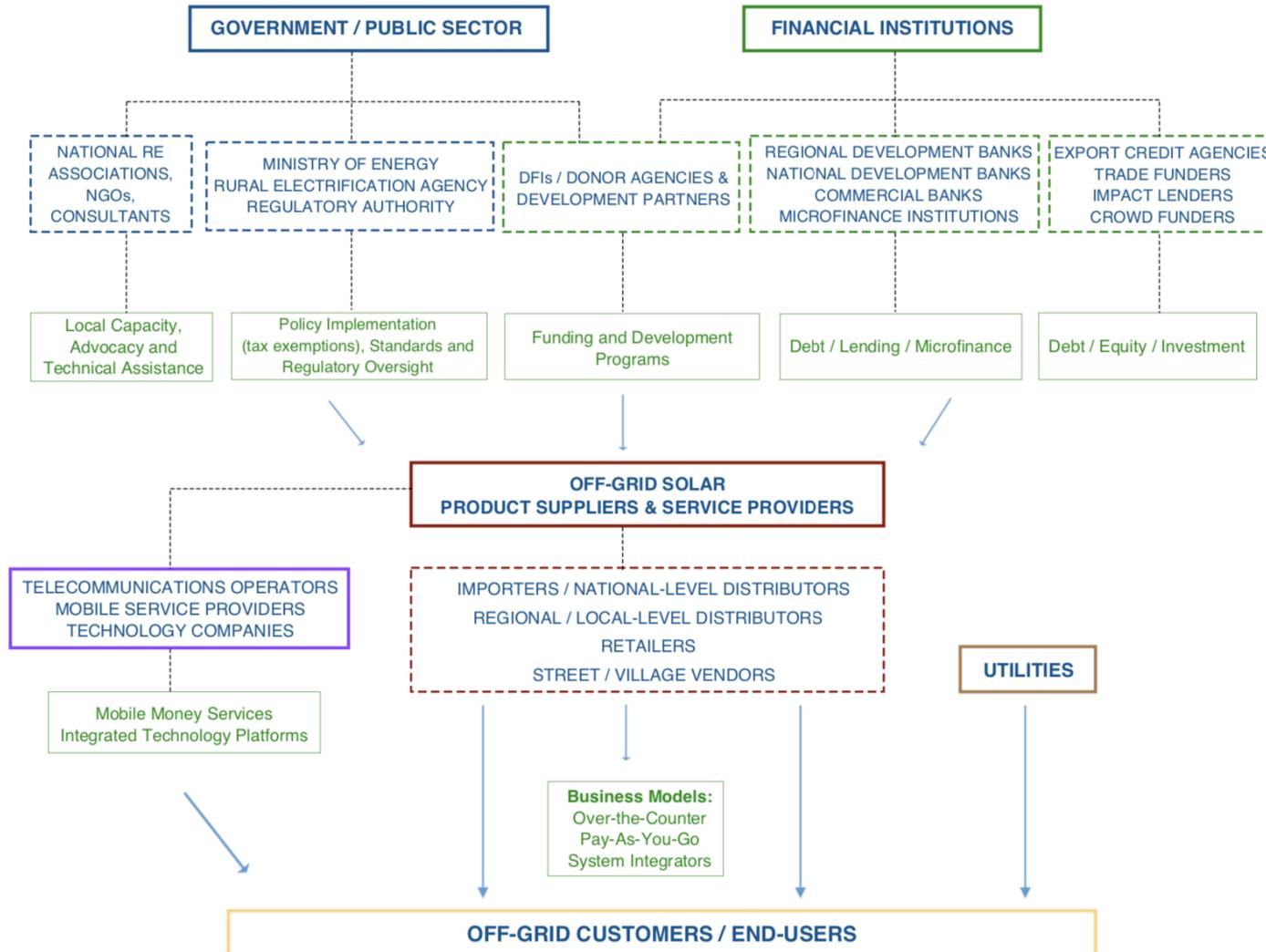
Rural households make up the main market for off-grid lighting products in the country, as the demand for lighting products and household electrical appliances is growing. Urban households, both electrified and non-electrified, are also a key consumer market, as they may have greater ability to afford OGS products and systems. Moreover, despite the high level of grid connectivity in urban areas, power supply is often not sufficient, continuous, or reliable (**Figure 3** and **Figure 4**), further supporting expanded use of solar PV equipment by this consumer segment.

There are a wide range of solar products and systems offered by companies in the market (by both the formal and informal sector) as well as a variety of business models being utilized. Most commercial transactions take place in capital cities and a few regional hubs (Bo, Kenema). Most solar distributors do not specialize; in order to take advantage of all opportunities, they sell systems over a wide size range. While large companies selling certified products play a central role in the market, the informal sector remains a key factor. Surveys of local industry stakeholders and focus group discussions noted that a regulatory framework was necessary to address the widespread sale of low-quality, uncertified products, which is hindering development of the country’s OGS market.

The key actors in Sierra Leone’s off-grid solar supply chain include:

- **Solar importers/distributors:** The solar supply chain includes firms that import, distribute and retail products around the country. Of the firms surveyed, all are engaged in importation and product distribution and most also manage retail outlets. Over half of the firms are engaged in direct distribution of solar devices to private household end-consumers and offer a range of solar lanterns. Private sector players are discussed in more detail in the next section.
- **Consumers/End Users:** Household, institutional and productive use consumers are fully described in the first three sections of this chapter.
- **Government of Sierra Leone and Regulatory Bodies:** The GoSL has committed to improved performance of the solar home system energy market and is spearheading reforms including duty waivers and adoption of universal standards. It also does some procurements of systems through national projects. However, due to a shortage of funds and multiple energy sector commitments, the Government is unable to directly stimulate OGS markets with central funding.
- **Renewable Energy Association of Sierra Leone (REASL):** REASL is a private sector trade and industry association formed in 2016 to address challenges hampering the RE and SHS / lantern market. Through its advocacy efforts REASL tries to resolve challenges faced by its members related to policy and regulation, port operation, registration, taxes, and standards. REASL has been engaged in a number of initiatives to have a central support/faults reporting system for solar lights.
- **Development and Donor Community:** Donor partners have made major investments in renewable energy either directly into programs (i.e. UNOPS, PRESSD, Energy Africa Compact) or through finance of systems in NGOs that they support. DFID and the EU are the most active donor supporters of renewable energy.
- **Non-Government Organizations:** NGOs are key drivers of the market for several reasons. They purchase and distribute large quantities of solar products to the local population as well as to institutions. NGOs are also involved in service provision to build the sector through training, capacity building, financing and private sector development.
- **Financial service providers:** Thus far, financial service providers have not played a strong direct role in either consumer or company finance for the solar sector. Commercial Banks/ MFIs are relatively risk averse and have seen solar lending as high risk. Because they are unfamiliar with the sector, banks are unable to assess risks associated with solar and they do not have the capacity required to manage small sized solar loan portfolios.
- **Telecommunications and mobile payment platforms:** Five main telecommunications operators in the country, with Africell and Airtel being the most dominant. Telecommunications coverage in the country is relatively wide and the availability of cell phones is a key driver of small-scale electricity demand and therefore of the off-grid solar market. Mobile money transfer schemes in Sierra Leone offer the potential for innovative consumer payment mechanisms, but they are not yet widely used (see Section 3.2).

Figure 33: Off-Grid Solar Market and Supply Chain Overview



Source: GreenMax Capital Advisors

#### 2.4.2 Overview of OGS Companies in Africa and Level of Interest in the Region

The African off-grid solar market has experienced rapid growth over the last five years. This growth can largely be attributed to the emergence of a progressively diverse, global pool of manufacturers and distributors, decreased system costs and an increase in three major product categories – Pico solar, Plug-and-Play SHS, and component based systems.<sup>166</sup> Leading solar companies such as Greenlight Planet, D.Light, Off-Grid Electric, M-KOPA Solar, Fenix International, and BBOXX represent the largest share of the African off-grid solar market and are now joining other major players in West Africa and the Sahel, including Lumos Global, PEG Africa, Barefoot Power, Yandalux, Schneider Electric, Azuri Technologies, Solarama, AD Solar, Enertec, SmarterGrid, GoSolar, Total, Oolu Solar, EnergenWao and SunTech Power to list a few.

Market entry into Africa began in East Africa for a majority of the leading companies, a trend that can be attributed to advancements in mobile money transfer systems such as M-Pesa that have facilitated the PAYG off-grid business model. As the East African market becomes more crowded and mobile money services spread across the Continent, many international off-grid solar companies have recently entered markets in West Africa and the Sahel. The regional market grew from being nearly non-existent in 2013 to accounting for 9% of worldwide sales (20% of SSA) with over 2 million systems sold in 2017.<sup>167</sup>

Over 500 solar companies have been identified operating across the region, many of which are small local players. These local distributors either operate independently or act as local affiliates of larger international companies operating in this space. The majority of companies in the region are primarily Tier 1 and Tier 2 companies, with relatively few Tier 3 companies. The highest concentration of Tier 3 companies was identified in Burkina Faso, Cameroon, Côte d’Ivoire, Ghana, Mali, Nigeria and Senegal.<sup>168</sup>

A survey of large international solar companies that assessed *inter alia* their level of interest in entering the off-grid markets in West Africa and the Sahel is presented in **Figure 34**. The survey found that among respondents, companies expressed the most interest in Nigeria, Sierra Leone, and Côte d’Ivoire, with at least half of respondents indicating a “very high level of interest” in these markets. There was also a relatively high level of interest in Liberia, Senegal, Burkina Faso, Mali and Togo, with at least half of respondents indicating a “very high” or “moderate” level of interest in these markets.

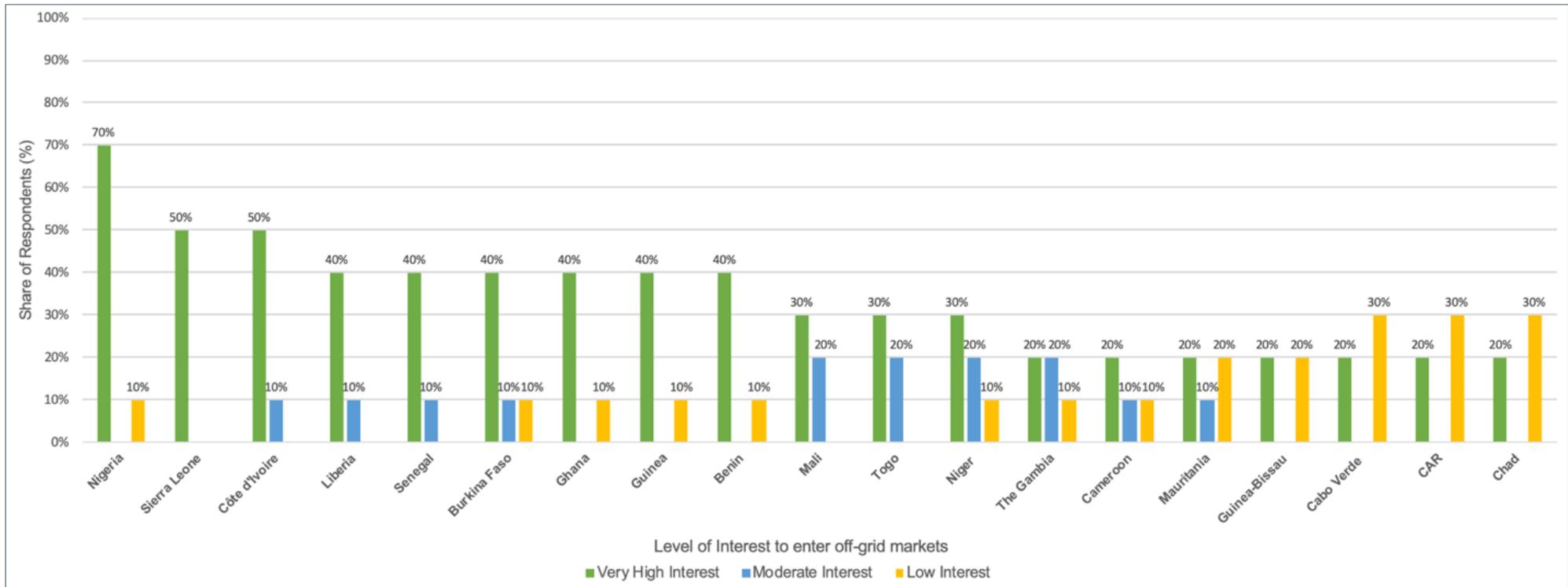
<sup>166</sup> “Off-Grid Solar Market Trends Report, 2018,” Dahlberg Advisors and Lighting Africa, (January 2018):

[https://www.lightingafrica.org/wp-content/uploads/2018/02/2018\\_Off\\_Grid\\_Solar\\_Market\\_Trends\\_Report\\_Full.pdf](https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf)

<sup>167</sup> Ibid.

<sup>168</sup> “Insights from Interviews with Off-Grid Energy Companies,” ECREEE, (June 2018).

Figure 34: Level of Interest in Off-Grid Markets in West Africa and the Sahel among Major Suppliers<sup>169</sup>



Source: Stakeholder interviews; GreenMax Capital Advisors analysis

<sup>169</sup> NOTE: This is not a representative sample of respondents (sample size = 10 respondents). The figure is meant to provide feedback from “major suppliers” of off-grid solar products and services and gauge their level of interest in entering specific ROGEP country off-grid markets. Respondents are all GOGLA members and are either already active in the West Africa and Sahel region or seeking to enter it. The figures presented are the share of respondents (%) who indicated their level of interest in a given country.

### 2.4.3 Solar Market, Products and Companies in Sierra Leone

This section characterizes the current formal market (local and international companies) including recent sales trends, the main solar products, brands and prices.

#### ➤ **The Formal Market – Local and International Companies**

Focus groups and stakeholder interviews identified over 20 companies operating in Sierra Leone’s solar sector, offering a wide range of products and services to consumers throughout the country (see **Annex 2** for a complete list of identified companies). In addition to local firms, the formal market includes international players that enter the market to install systems for donor-funded projects. Formal market players are largely Lighting Global and GOGLA affiliated companies, while most local solar companies are members of the REASL.

Major international Tier 3 suppliers of OGS products operate in the market through local distributors and often maintain exclusive relationships with their partners. Many local distributors collaborate with suppliers of Lighting Africa and IEC-standard products. All of surveyed solar firms have regional affiliations in other West African countries, either operating in other countries in the region or receiving inventory from them. Companies utilize a variety of methods to raise awareness about their products and services. Suppliers of larger systems typically build client bases with local businesses and donor partners. Solar home system and pico solar product suppliers use a variety of techniques to reach rural markets:

- PAYG providers use social media and/or rural promotion campaigns through local networks
- Some companies partner with aggregator traders who buy and sell goods in rural areas or work with a barter system
- Donors have also worked with REASL to promote solar products among various consumer groups
- Many players rely on reputation and word-of-mouth to market their products

#### ➤ **Sales Volumes**

Focus group participants indicated that it is challenging to assess the size of the current market due to a lack of standardization in pricing from one company to another and a shortage of sound statistical data. Moreover, during surveys and FGDs, companies were reluctant to share confidential data on sales volumes and market shares. Local industry stakeholders described the market as having significant volume of sales distributed between hundreds of larger installations (>1 kW) and tens of thousands of consumer product sales along with institutional system market activity.

Using reports published by GOGLA, some basic market information is presented in **Table 39**. It is important to note that this data only includes figures from GOGLA-affiliated companies and certified product sales and is therefore not fully representative of off-grid solar market activity in Sierra Leone.

Table 39: Total Sales Volume and Cash Revenue for Stand-alone Systems in Sierra Leone, 2016-17<sup>170</sup>

Sales Volume / Revenue	2016	2017	Total
<b>Total Volume of Products Sold (Units)</b>			
Total Volume of Products Sold	24,240	33,471	<b>57,711</b>
Pico Solar	22,786	28,450	<b>51,236</b>
SHS	1,454	5,021	<b>6,475</b>
<b>Total Cash Sales Revenue (USD)</b>			
Total Cash Sales Revenue	\$402,440	\$409,300	<b>\$811,740</b>
Pico Solar	\$346,098	\$392,928	<b>\$739,026</b>
SHS	\$56,342	\$16,372	<b>\$72,714</b>

Pico solar products categorized as 0-10W

SHS products categorized as >10W

In 2016-2017, about 90% of the overall share of OGS products sold and 92% of total sales revenue in West Africa were pico solar products compared to 10% of products sold and 8% of sales revenue were SHS.

Source: GOGLA, Lighting Global and World Bank; GreenMax Capital Advisors analysis

- **Sales:** Based on GOGLA Sales Reports, in 2016-2017, a total of 57,711 off-grid solar products were sold in Sierra Leone worth an estimated USD 811,740; sales volumes increased by 38% and cash sales revenue by about 2% between 2016 and 2017. During this period, approximately 89% of products sold in Sierra Leone were pico solar products, representing 91% of total cash sales in the country.
- **Imports:** The REASL estimates that 130,000 stand-alone solar systems and products (pico solar and solar home systems) were imported by its 28 members in 2017.<sup>171</sup>
- **Quality of Products:** Products considered are quality certified. GOGLA affiliated companies sell certified products, while the REASL is also committed to high standards and quality through its 2017 Code of Conduct has been established with guidelines on product quality and quality insurance.<sup>172</sup>

<sup>170</sup> "Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2017): [https://www.gogla.org/sites/default/files/resource\\_docs/gogla\\_sales-and-impact-reporth2-2017\\_def20180424\\_web\\_opt.pdf](https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf); and

"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2017): [https://www.gogla.org/sites/default/files/resource\\_docs/gogla\\_sales-and-impact-reporth12017\\_def.pdf](https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth12017_def.pdf); and

"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2016): [https://www.gogla.org/sites/default/files/resource\\_docs/final\\_sales-and-impact-report\\_h22016\\_full\\_public.pdf](https://www.gogla.org/sites/default/files/resource_docs/final_sales-and-impact-report_h22016_full_public.pdf); and

"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2016): [https://www.gogla.org/sites/default/files/resource\\_docs/global\\_off-grid\\_solar\\_market\\_report\\_jan-june\\_2016\\_public.pdf](https://www.gogla.org/sites/default/files/resource_docs/global_off-grid_solar_market_report_jan-june_2016_public.pdf)

<sup>171</sup> Stakeholder interviews, 2018.

<sup>172</sup> "Code of Conduct," REASL, (2017): <http://reasl.com/wp-content/uploads/2017/07/Code-of-Conduct-.pdf>. It is not clear however how REASL's 28-member companies integrate international standards (GOGLA, Lighting Africa)

➤ **Main Solar Products and Components**

**Table 40** lists the brands of common solar products and components in Sierra Leone. The list does not include non-certified brands that are also common in the country’s grey market.<sup>173</sup>

Table 40: Off-Grid Solar Products and Components in Sierra Leone

Systems	Companies
Distributors of Pico Solar Lanterns	Barefoot Solar Women Engineers, Easy Solar, Energen WAO, Energy Efficient Solutions, Helios, Sinergy Sierra Leone, FLS Power, Azuri Technologies/Teleficient, Solar Era, Greenlight Planet
Single Module distributors	Barefoot Solar Women Engineers, Easy Solar, Energen WAO, Energy Efficient Solutions, Helios, Sinergy Sierra Leone, World Hope International Mobile Power
Multi module system distributors	Aptech Africa Limited, BBOX SL Limited, Barefoot Solar Women Engineers, Energen WAO, Energy Efficient Solutions, FLS Power, Helios, Sinergy Sierra Leone
Very large system supplier	Aptech Africa Limited, BBOX SL Limited, Barefoot Solar Women Engineers, Western Africa Off-Grid (WAO), FLS Power, Helios, Sinergy Sierra Leone, World Hope International
Products/Components	Brands
Pico/Plug and Play System	Hollandio, Sun King, Omnivoltaic, d.light, Forsera, Azuri Technologies, Fosera, Greenlight Planet
Solar Module	Hollandio, Suntech, Axitex, GCL Solar
Inverter	Hollandio, Victron, SMA
Lead acid battery	Hollandio, BBOX Ltd, Victron, Hoppecke

Source: Stakeholder interviews

➤ **Market Prices**

**Table 41** presents average prices for off-grid systems and components in Sierra Leone’s solar market. Prices of solar products and components in Sierra Leone are slightly higher compared to more mature solar markets (e.g. Ghana).

Table 41: Estimated Price of Solar Systems and Components in Sierra Leone

Off-Grid System / Component	Estimated price in Sierra Leone (USD / per unit)	Estimate price in Ghana (USD / per unit)
Pico solar	\$60	\$25-40
Plug and play	\$200	\$70-230
Small SHS	\$250	-
SHS (average)	\$500-\$700	\$1,500
Inverter	\$250	\$154-6,000
Lead Acid Battery	\$450	\$144-500

Source: Stakeholder interviews

➤ **Importation Clearance Processes**

Though duties and importation restrictions were waived on Lighting Global OGS products, the process of clearing products is still time-consuming, inefficient and opaque.<sup>174</sup> The process of importing IEC

<sup>173</sup> In this context, “grey market” refers to products that are not Lighting Global or IEC certified that are typically sold over-the-counter at low prices. Some grey market products are counterfeit or replicas of certified products that undercut the markets of certified products.

<sup>174</sup> In 2017, duty relief was remanded and dozens of containers of solar products were suddenly asked to pay duties. This severely affected their margins and delivery timetables.

compliant products follows the following steps:

- The importer obtains a REASL certificate of Good Standing
- The Ministry of Energy provides a certification of attestation
- Documents are sent to the Ministry of Finance
- A special committee meets and approves the exemption
- The National Revenue Authority and Customs provides approval for the import

In the best case, importation paperwork takes approximately two weeks to be approved. More typically, it takes four to six weeks or longer. Work is on-going to make this process more efficient; it would involve the Standards Bureau instead of the MoE in order shorten the process. However, more stream-lining and collaboration between institutions is needed to speed up the process.

#### 2.4.4 Overview of Business Models

##### ➤ **Company Approach to Market**

Formal solar companies tend to deal in a range of products and have yet to specialize. They sell a wide range of products including solar lanterns, plug and play solar systems and very large systems (defined as systems above 1kW that required specialized design and installation including after sales services). In general, market players are established over-the-counter traders (informal market) and young formal solar suppliers (usually at Tier 1 stage). Surveyed formal companies have been in business between one and 10 years. The oldest formal solar companies have been in the market since 2008.<sup>175</sup> For most formal solar companies, their most important clients are large institutional groups such as NGOs and public health facilities or large high-income clients. A few firms are beginning to target low-income households as primary customers, and several are using PAYG financing to reach base of the pyramid sections of the market.

##### ➤ **Business Models**

There are four primary business models used in the market (**Table 42**), although in reality solar companies utilize a number of business models to reach a variety of clients:

- **Over-the-counter cash sales** include both informal and formal components and is estimated to account for over 70% of market share in terms of cash value. Many traders simply offer solar products over-the-counter. Formal sector solar companies also stock modules, batteries and balance of system and offer them over-the-counter to do-it-yourselfers and agents.
- **System integrators** handle large systems and projects. They design, procure and install systems which range from high-end residential sites, to institutional power to mini-grids. Local integrators represent international solar, inverter and battery brands with whom they partner with on projects.
- **Plug and play and pico suppliers** cooperate with many of the major OGS brands to distribute products in the country.
- **The PAYG sector** is in its early stages. Suppliers build up client bases that number in the tens of thousands and must evolve rapidly to develop credit mechanisms that fit with local income patterns. The margins are made from subscriptions of thousands of consumers who buy systems through created accounts. The task of installation and after sales services is undertaken by agents. Common products sold include plug and play systems that are fully designed.

<sup>175</sup> "Solar Market Analysis," Sierra Leone Opportunities for Business (SOBA), (August 2017): <http://sobasl.org/re-resource-soba-solar-market-analysis-2016/>

Table 42: Overview of Off-Grid Solar Business Models

Business Model	Strategy and Customer Base	State of Development
Over-the-counter solar market	<p><b>Formal:</b> Retailers in Sierra Leone are both large scale (acting as suppliers and distributors) and medium size and are mainly located in large cities and towns, such as Freetown, Bo and Kenema. They already sell lighting/ electrical products, including solar, pico systems and large panels.</p> <p><b>Informal:</b> Kiosks, street vendors form a key pico-product retailer segment (that has not been fully explored). They sell low priced products which are often short-lived. They have been seen as the entry points for black market low quality solar products to the country.</p>	<p>Mature commercial market</p> <p>Early stage commercial development</p>
System integrator	Integrators operate out of central offices with small specialized staff. They do not typically carry stock for sale over-the-counter. Instead, they deal directly with consumers and institutional clients and provide as per orders. Integrators target the NGO/donor market and participate in procurement tenders for supply and installation of larger systems.	Mature commercial market
Plug and Play system supplier	These suppliers distribute equipment to retailers' projects, rural agents, community groups and over-the-counter. Traders of plug and play often sell these devices as part of other businesses.	Early stage commercial development
PAYG Sales	PAYG companies seek to implement the rent-to-own payment-based models used successfully in other countries. The business model is data-driven and relies on mobile money services and a network of agents to meet last-mile customers. Innovative OGS PAYG collaborations between shop-owners, mobile-operators and other larger local businesses are being tested. A 'hybrid' model being piloted currently seeks to have customers pay a portion of the system cost up front with the remaining amount to be paid over 12-18 months.	Early stage commercial development

Source: African Solar Designs analysis; Stakeholder interviews



An over-the-counter retail shop (left) and a street vender (right) in Freetown.

➤ **Company Financing**

Distributors of solar household systems in Sierra Leone require significant working capital to purchase stock and conduct marketing campaigns. Working capital is also needed to cover field costs and the high costs associated with long term customer payment options such as PAYG. Some distributors of international OGS products receive basic trade finance and marketing support options, though typically limited. Most firms, however, are fully self-financed through cash flows covered by ongoing business transactions. A few companies are supported by donor and CSR funds, but these resources are limited for most.

Given that external finance is limited, the lack of equity or risk capital severely limits company growth and expansion. On the other hand, the small size of the overall Sierra Leone solar market reduces its attractiveness for larger companies. This makes trade difficult for players in the market, because large international companies do not have a business strategy for the country.

Local financiers are yet to develop an appetite for the solar sector. Local banks are extremely conservative with regard to solar enterprises (for example, some will not even honor major donor contracts as they view them to be risky). Commercial financiers – including banks and MFIs – are not set up to service solar distributor financing requirements. Local SME financing is not available to support businesses in their growth phase. If it was available, companies would make use of cash-flow/credit line financing against the signed contracts with major commercial clients, large NGOs or donors.

When importing, companies are exposed to considerable foreign exchange trading (FOREX) risks because they must cover costs of equipment in foreign currency. When projects are delayed, during seasonal low-income periods or when products are delayed in port, dealers must bear FOREX losses.

The lack of consumer financing arrangements impedes the growth of the solar market because distributors must take all finance risks and cannot plan with commercial or MFI financing to grow their business.

➤ **Evolving Business Models**

Sierra Leone presents a fertile ground for new business model innovations. New models will require partnerships between developers, solar distributors, telco companies, commercial finance and the retail sector. One of the results of the FGD discussions was a list of potential partnerships that can be explored to enhance existing and new business models (**Table 43**).

Table 43: Evolving Off-Grid Solar Business Models

Partnership	Description
Solar Distributors	<ul style="list-style-type: none"> <li>Improve efficiency within the supply/distribution chain, positioning them to be able to manage distribution, seek potential for long-term credit lines and capital infusions</li> <li>Develop better contract terms between large local suppliers in Sierra Leone with foreign manufacturers</li> <li>Test new sales and distribution strategies that increase sales at minimum cost</li> <li>Prove solar market potential, ultimately attracting a strong group of competing players that scale up solar product access</li> </ul>
Commercial financiers	<ul style="list-style-type: none"> <li>Commercial financiers are key to unlocking working capital and consumer finance and enabling the market by providing both the funds and means of transferring these funds</li> <li>Develop financial products for both distributors (financing for working capital needs) and off-grid solar consumers (consumer financing for purchase of systems)</li> </ul>
Telecommunications companies and technology providers	<ul style="list-style-type: none"> <li>Bring together telecommunications operators, mobile service providers and technology companies and solar supplier/distributor companies to develop Pay-As-You-Go technology platforms</li> <li>Encourage telecommunications partners to distribute off-grid solar systems through their existing network of agents</li> </ul>
Business/Retail Sector	<ul style="list-style-type: none"> <li>Comprises networks of retail stores that cover the entire country and provide all types of domestic and agriculture goods for the rural community</li> <li>Encourage linkages between specialized solar companies and these networks so as to facilitate the increase of the distribution network at a lowest cost possible</li> <li>Provide promotional tools for local retailers to promote solar products to households/SMEs</li> <li>Facilitate microfinancing for the domestic market through these networks</li> </ul>
Advocacy Bodies	<ul style="list-style-type: none"> <li>Capitalize on GoSL and donor efforts to (i) facilitate interagency dialogue and oversee policy proposals on new business models and (ii) enhance legislative changes to support the sector</li> </ul>

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

#### 2.4.5 The Role of Non-Standard Players in the Market

Stakeholder interviews and FGDs found that the over-the-counter informal market (which does not include REASL members) makes up between 60-80% of the overall market volume. Informal traders sell modules, inverters, batteries and pico-products. Given that informal sellers are largely unregulated and do not report sales figures, very little data is available on this sector. The sector, however, is very influential as it also controls the delivery of lighting products imported mainly from East Asia. Informal traders understand growing consumer interest in solar solutions and sell competitively-priced low-quality products. Informal traders do not actively cooperate with the REASL or formal projects.

Informal traders play an important role in the market because they respond to consumer demand rapidly. Many traders do provide IEC-approved components – this means knowledgeable consumers and technicians can assemble quality systems from over-the-counter selections of components that informal traders sell. It is notable that some informal traders are gaining skills and improving product offerings. The presence of a large informal market, however, leads to issues with equipment quality that hamper development of the country’s OGS market.

#### 2.4.6 Equipment Quality and the Impact of Uncertified Equipment

Sierra Leone’s solar market is largely dominated by informal market players, selling equipment through electronics shops, hardware stores, kiosks and even street vendors. The over-the-counter sales strategies of this group is to provide low-cost, fast moving products. As a sector, informal retailers provide widely-used lighting products mainly from East Asia to rural customers. However, most of their product range does not meet Lighting Global standards. Moreover, given that the most of their lighting products are low-cost and short-lived, they also ignore and avoid regulations and their products lack warranties.

REASL members have agreed to follow minimum Lighting Global standards and practices. However, REASL does not represent electronics shops, hardware store, kiosks and street vendors traders of solar products; this “grey market” sector does not abide by REASL quality agreements. Moreover, owing to the tedious importation processes explained above, informal over-the-counter traders often illegally import low-quality solar products.<sup>176</sup> This has led to a situation where the “grey market” of non-standard market players undercuts the suppliers of long-lived Lighting Global approved products. The solar market has been affected in the following ways:

- OGS which meet Lighting Global and IEC quality standards (and are theoretically exempted from duties) are minimally reflected in the market,
- Grey-market traders significantly undercut the prices of registered businesses who are still subject to taxes and import duties. Low prices of over-the-counter products make compliant products uncompetitive as many customers opt to buy non-compliant goods that are cheaper.
- Low-quality products are prone to failure and often have a lifespan of little more than a few weeks. This adversely affects perceptions of consumers.
- Poorly designed, configured and installed component-based system installations give a very bad reputation for solar. This especially relates to lead-acid batteries (usage, configuration, brands) as they are major cost of component-based SHS.

➤ **Competition between quality-verified products vis-a-vis non-standard products**

Focus group discussions made the point that a large majority of products sold in the market are of poor quality, imported into the country through the black market. Time-consuming approval processes for importing Lighting Africa and GOGLA certified solar systems was noted to be a main reason for the saturation of poor-quality products in the market.

Given that not all the solar products dealers are members of the REASL, enforcing the regulations (which requires traders to have a certificate from REASL) poses a challenge. While there have been attempts to enforce standards in the sector, a level playing field for compliant products has yet to be created. Informal traders are able to use importation “loopholes” to avoid the regulations. In order to overcome quality issues, the following points were made in FGDs:

- There are quite good Sierra Leone Electrical Regulations currently in place, modelled after the UK electrical regulations. The absence of experts that can sign off that the work and enforce compliance has greatly reduced enforcement of standards.
- Exemption duties for IEC/Lighting Global products are not applied in the market field as expected due to lack of capacity. Hence exemptions are not reflected on the market prices and quality products are penalized.
- There is a major role for REASL association in assisting enforcement of standards through mediation efforts between regulatory bodies, market players and consumers.

<sup>176</sup> This comment was made in a FGD and agreed to by all in attendance. Details on how traders avoid duties were not provided.

#### 2.4.7 Local Capacity to Manage Business Development, Installation and Maintenance

Sierra Leone's nascent solar market is poised to grow if requisite technical assistance (TA) is provided. The existing market environment is challenging for solar companies. To operate effectively, companies need a significant amount of both local and international technical and financial expertise, and an ability to make practical decisions about their operations. Companies face a number of technical competency requirements – the selection of approaches and solar PV technologies, the design of their associated marketing instruments and the implementation of related initiatives.

GIZ and EnDev have been on the forefront in developing local capacity in solar PV for the country. Yet, the synergy with formal training institutions has yet to be fully explored and most of the players in the industry are not adequately equipped with the skills needed to design and assess policies, understand and deploy technologies, grasp electricity user needs and ability to pay, and operate and maintain systems. Some of the other areas where TA and capacity building is needed to support growth of the solar market include:

- Provision of TA and training to public and private partners on the development of OGS power projects.
- Support in development of vocational training curricula for solar technicians by working with education institutions to adopt the curricula and implement training programs. This support could include development of community training materials to raise community awareness about the importance of solar PV technologies, the various uses ranging from household use, productive uses and institutional uses of energy, and related safety aspects.
- In order to ensure that interaction with local communities is seamless, the collaborating partners could develop a management training manual for villages addressing the different aspects of solar technologies as well. This could include supporting technicians with troubleshooting posters for on-site display that could help identify and tackle operational issues as they arise.
- Solar technicians were noted to be sparse for some areas and lacking in other areas; as a result, solar businesses send out teams from major cities/towns for any installation and maintenance work. Training people based locally in remote areas to support O&M of solar systems (e.g. battery replacement) could help address this issue and expedite market uptake.

#### 2.4.8 Capacity Building Needs of the Supplier Market Segment

An analysis of the supplier market segment revealed a number of interrelated challenges, including financial, capacity, awareness and regulatory challenges. The focus groups and supplier surveys found that:

- Among the three cluster of challenges mentioned, the common challenge was access to finance, mostly through access to loans for importation and distribution of goods. Of the participants in the FGDs, 90% cited no access to loans to support their business as a major hurdle.
- Reasons for denied finance by FIs included lack of collateral, lack of expertise in finance, the high cost involved in small transactions, and risk aversion.
- None of the participants were aware of government subsidies, but 40% received subsidies from NGOs.
- In order to reach the wider market, the training of technicians also presented a challenge to the supply segment, with one respondent claiming to be involved in training technicians in the villages through village agents but this was noted to be far from meeting demand. Actual numbers could not be ascertained. GIZ and EnDev were noted to be the best resource in training technicians in the country given their vast network.
- FGDs noted that there is need for a concerted effort to create a micro-financing friendly policy environment for formal institutions (rural banks and cooperatives), NGOs, and even informal sectors including money lenders and shopkeepers.

- There is need for a framework for procurement guidelines for implementing public-private partnerships (PPPs) in environmental infrastructure investment.
- Address the issue of import duty and or VAT on imported solar lighting products. Exemption is provided for all categories of solar products, this includes pico-solar products, which a number of suppliers are distributing in the market.
- Research on improving the capacity of the distribution channel including the players would go a long way in ensuring continuous improvement on the performance of the value chain. A collaboration between the country Renewable energy association and the respective partnering institutions would be helpful. Collaborations would include players, NGOs, village/ community-based groupings who operate country wide.
- There is a clear lack of expertise amongst customs officials in being able to identify with certainty which products should be considered part of this category and thus merit the exemptions.

**Table 44** presents various areas of support and associated capacity building for the OGS supply chain in Sierra Leone. Attention should be given to the following:

- **Importers:** Reducing the cost of financing for importing solar PV products. The tax exemption introduced has not been implemented optimally. Grow credit financing of solar PV products which enables gradual payment of solar product hence reduced shock on high upfront cost that lead to low adoption of the technology.
- **Over-the-counter/ System Integrators/ PAYG:** Focus on growing the number of solar technicians who are adequately skilled to support the supplier network, especially in rural areas. Formalizing this through regulation to require only licensed technicians to design and install solar PV systems is critical. This should be complemented by equally robust efforts to build the capacity of all stakeholders.
- **Consumers:** Deal with sociotechnical barriers: Although PV technology has advanced tremendously in the last decades, there are still several sociotechnical barriers to adoption, including the local conditions of the user’s environment, the political and financial arrangements of the market. Just like most countries in the region, various fake solar PV products have infiltrated the market. Implementation of the existing regulations on quality/standards could further boost market growth.

Table 44: Capacity Building and Technical Assistance to Support OGS Suppliers in Sierra Leone<sup>177</sup>

Area of Support	Description	Rationale
Tax exemptions on solar technology	Effective and consistent implementation of solar products exemption from VAT and import duties	<ul style="list-style-type: none"> <li>Costs of solar products are inflated by high import duties (40%); costs are passed on to customers, making solar less affordable.</li> </ul>
Consumer education programs	Supplier and consumer education and benefit awareness campaigns, targeting both segments, distributors and retailers	<ul style="list-style-type: none"> <li>Overcome investment fatigue / negative perceptions</li> <li>Influence purchase decisions and ease access to distribution channels</li> </ul>
Inventory financing facility (IFF)	Concessionary credit line so financial institutions can access liquidity for solar market lending; create frameworks that avail loans to solar companies (small household systems, larger PV installations, and mini-grids), pilot with aim of scaling out	<ul style="list-style-type: none"> <li>Long inventory financing periods present a key challenge to growth for solar lantern and solar home system distributors</li> <li>High upfront financing requirements present a key challenge to distributors of larger PV systems (including pumps)</li> </ul>
Credit guarantee scheme for IFF	Private sector lending portfolio is de-risked through guarantees and effect loss sharing agreements to cover irrecoverable inventory loans	<ul style="list-style-type: none"> <li>De-risking encourages private sector lending to solar sector</li> <li>Initial security until the proof case of economic viability of lending to solar businesses has been established</li> </ul>
Market entry and expansion grants	Combination of upfront grants and results-based financing to invest in infrastructure and working capital; mostly for scaling up	<ul style="list-style-type: none"> <li>Significant upfront investment to build distribution network and source inventories to serve household market</li> </ul>
Technical Assistance	Support solar companies to set up technology platforms for PAYG; incubation and acceleration of early-stage businesses; Capacity building for solar technicians to enable nationwide installation and maintenance of solar equipment	<ul style="list-style-type: none"> <li>Make the business environment more conducive and profitable</li> <li>Strengthen the overall ecosystem surrounding the solar market</li> <li>Ensure knowledge transfer from abroad for faster, more cost-efficient progress</li> </ul>

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

<sup>177</sup> Capacity building interventions are proposed for all ROGEP countries at national and regional level under ROGEP Component 1B: Entrepreneurship support, which includes TA and financing for companies in the solar product value chain. Through this component, technical assistance to solar companies can build on existing ECREEE training programs as well as through a new regional business plan competition. Technical assistance can leverage national solar ecosystem stakeholders, and operational national service providers identified and mobilized through this component. The market entry and expansion grants suggested here would also align with Component 1B planned financing interventions for matching grants, repayable grants, co-investment grants, and be connected to the technical assistance interventions.

## 2.5 Key Market Characteristics

This section reviews the main characteristics of the off-grid solar market in Sierra Leone, including a summary of key barriers to and drivers of market growth and an overview of gender considerations. The synopsis presented below is largely based on feedback obtained from interviews with local officials and industry stakeholders, as well as focus group discussions and surveys assessing the demand and supply side of the market (see **Annex 2**).

### 2.5.1 Barriers to Off-Grid Solar Market Growth

**Table 45** examines the key barriers to OGS market growth from the perspective of both the demand and supply side of the market. See **Section 1.3.5** for an overview of the gaps in the country’s off-grid policy and regulatory framework.

**Table 45: Key Barriers to Off-Grid Solar Market Growth in Sierra Leone**

Market Barrier	Description
<b>Demand<sup>178</sup></b>	
Consumers are unable to afford solar systems	<ul style="list-style-type: none"> <li>Low-income consumers, particularly in rural areas, lack of access to finance</li> <li>Sierra Leone is one of the poorest countries in the world and while the need for efficient solar power solutions is high, purchasing solar products of all varieties among end-consumers remains relatively low. The absence of end-consumer markets for solar PV systems deters many potential new entrants</li> </ul>
Lack of initial funding by HHs, businesses and institutions for the initial capital investment	<ul style="list-style-type: none"> <li>Relatively high costs of OGS systems</li> <li>Consumers rather choose cheaper one-off solutions – like generators and fuel – rather than more expensive up-front solutions that will be cheaper long-term (especially with incremental payments, e.g. PAYG)</li> </ul>
A lack of understanding of and trust in solar solutions among consumers impedes development of the market	<ul style="list-style-type: none"> <li>There is still considerable lack of general awareness about solar solutions</li> <li>There is an inability to distinguish between solar products or product quality</li> <li>Consumers lack information about the most suitable design options, funding options, PAYG benefits and options, points of sales and support, etc.</li> <li>Products are still not widely available in rural areas, so consumers are not familiar with them</li> <li>Any poor history / track record with OGS will deter consumers from taking expensive risks</li> </ul>
Informal sector competition and market spoilage	<ul style="list-style-type: none"> <li>The non-standard / unlicensed market still accounts for a majority of OGS product sales</li> <li>Consumers need to understand the quality and value issues of quality solar products vis-a-vis inferior over-the-counter lighting products and generators. Educated consumers drive markets.</li> </ul>
Lack of experience in maintaining the systems and sourcing qualified technicians	<ul style="list-style-type: none"> <li>A sustainable approach to O&amp;M is critical for long-term success</li> </ul>
<b>Supply</b>	
Technical capacity	<ul style="list-style-type: none"> <li>Technical skills lack through the supply chain within the sector, affecting both the upstream, midstream and downstream, thus adversely affecting the ability of the sector to pick up and grow. Majority of the firms decry lack of adequate number of technicians to support the downstream side of the market</li> </ul>
Transportation costs	<ul style="list-style-type: none"> <li>High transportation costs of inventory deter new entrants; devices and equipment are shipped either from China or from Europe, creating long delivery lead times of up to three months and long inventory holding times once products have arrived in country</li> <li>Typical supplier payment terms are 30% upon placement of the production order and the remaining 70% upon shipment before any cargo has even left its port of origin.</li> <li>Transport by container would reduce the costs dramatically; however, this requires purchases in bulk, which local solar distributors aren't able to make without financing</li> </ul>
Poor sales and performance history of the sector	<ul style="list-style-type: none"> <li>A lack of investment into the sector prevents growth; this is due to perceived high risks resulting primarily from lack of track record of sales</li> </ul>

<sup>178</sup> The barriers described here apply to some combination of the Household, Institutional, and SME / Productive Use market segments

	<ul style="list-style-type: none"> <li>Solar distributors have limited alternative financing options. Solar suppliers are unwilling to provide trade financing while commercial financiers in Sierra Leone, including banks and MFIs, are currently not positioned to service the financing requirements of solar distributors.</li> </ul>
Company finance	<ul style="list-style-type: none"> <li>Entrants into the sector require significant working capital, which is not readily available</li> <li>Equity investments are needed into the local distribution/sales companies. It is quite easy to obtain debt financing and other loans once the solar companies have sufficiently grown and reached the “level of interest” of the larger funds; however, until the number of customers and sales volumes are reached, they need some equity investors to share higher risks with the original founders of the companies</li> </ul>
Currency risk	<ul style="list-style-type: none"> <li>Very high currency risks make investment in stock and PAYG risky (products in rural areas are sold in Leones, which is depreciating at an increasing rate against USD, for which the products are bought outside the country)</li> <li>Currency / foreign exchange risk mitigation measures are needed for local companies, as majority of supplies are paid for in USD, while the exchange rate of Leone/USD keeps changing – the USD is appreciating against the Leone in increasing speed – and the suppliers face big risk of losses if they fix PAYG payments in Leones for 1-2 years</li> </ul>
Informal sector competition and market spoilage	<ul style="list-style-type: none"> <li>Several informal entrepreneurs have taken advantage of high import duties by illegally importing low-quality solar products ranging from solar lanterns to larger home installations</li> <li>Black-market traders are able to significantly undercut the prices of registered businesses who are still subject to high taxes and import duties</li> <li>These products are largely low-grade, failure-prone knock-offs with short product lifespans (sometimes of little more than a few weeks)</li> <li>Damaged perceptions of solar systems durability and reliability hinders market uptake</li> </ul>
Lack of data	<ul style="list-style-type: none"> <li>No clear figures on the actual needs, actual usage or experience of consumers</li> <li>The data for the private market players on the available opportunities is very limited and not concise due to fragmented data</li> </ul>
High 'transaction costs' for solar installations	<ul style="list-style-type: none"> <li>Cash-flow and bureaucratic hurdles for the local suppliers</li> <li>Sales and O&amp;M services in remote areas can be costly, especially for small businesses</li> </ul>

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

### 2.5.2 Drivers of Off-Grid Solar Market Growth

**Table 46** is a summary of the key drivers of OGS market growth in the country.

**Table 46: Key Drivers of Off-Grid Solar Market Growth in Sierra Leone**

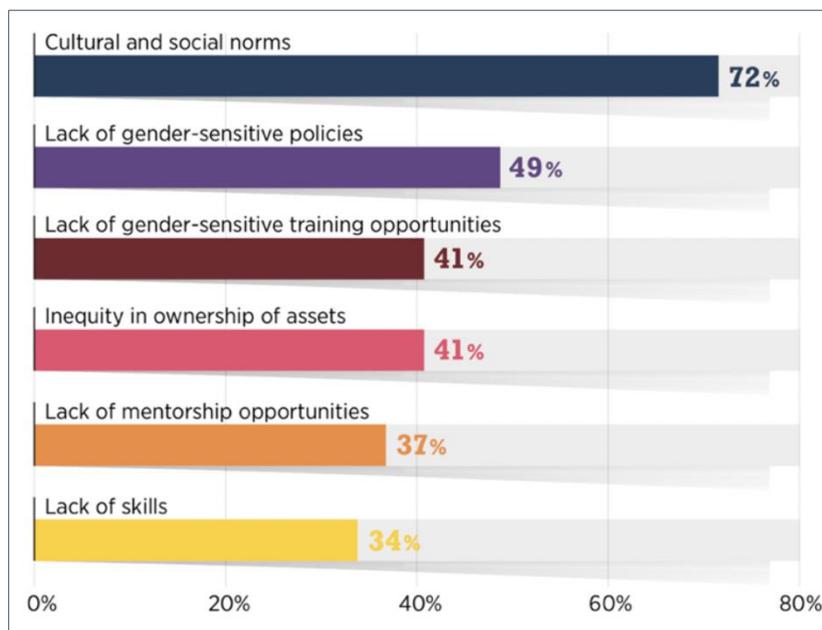
Market Driver	Description
Strong off-grid electricity demand	<ul style="list-style-type: none"> <li>Sierra Leoneans are aware of the high costs associated with energy access and consumption and are willing to take on quality, cost-effective alternatives; moreover, increasing rates of mobile phone ownership and mobile internet usage suggest the market is ready for PAYG solutions</li> </ul>
Willing government to support the industry	<ul style="list-style-type: none"> <li>The government is viewed by sector players as forward-leaning and action-oriented, creating and supporting momentum and positive attention for the solar sector, which helps attract substantial and sustained investment to the market</li> </ul>
Late adopter advantage	<ul style="list-style-type: none"> <li>Sierra Leone is, for a number of reasons, a late adopter of solar PV technology, and therefore able to leverage on the success and lessons learned from other regions</li> </ul>
Engaged and open-minded private sector	<ul style="list-style-type: none"> <li>Local OGS suppliers are actively engaged in efforts to improve / reform the sector, accept new business models and strategies and take measures to attract external investment</li> </ul>
Strong donor/NGO presence	<ul style="list-style-type: none"> <li>The EU, DFID, Millennium Challenge Fund, Toni Blair Institute for Global Change, Renewables Salone (among others) presence in the country provides confidence to the sector</li> </ul>

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

### 2.5.3 Inclusive Participation<sup>179</sup>

Given that the off-grid market is only beginning to emerge in Sierra Leone, women are not yet highly engaged in the sector. The overall lack of inclusive participation in the off-grid space is attributable to a wide range of factors. In a 2018 survey that assessed barriers to women’s participation in expanding energy access, nearly three-quarters of respondents cited cultural and social norms as the most common barrier, which reflects the need for gender mainstreaming (**Figure 35**). More than half of the women surveyed in Africa identified a lack of skills and training as the most critical barrier, compared to just one-third of respondents globally.<sup>180</sup>

Figure 35: Key Barriers to Women’s Participation in Expanding Energy Access



Source: International Renewable Energy Agency

As a starting point, electrification (whether grid-connected or off-grid) increases access to information, which can help challenge gender norms and increase the autonomy of women.<sup>181</sup> Access to electricity can save women time and/or enable them to complete domestic activities in the evening, thus allowing them to participate in paid work during the day. Many opportunities also exist for women in the productive use of energy, including solar-powered machinery that can support productive applications, particularly in the agricultural sector in the areas of irrigation, water pumping, and milling/food processing.<sup>182</sup>

Women, who are often the primary energy users in households, have a strong influence on the energy value chain. Women can take on different roles, including as engaged end-users, community mobilizers,

<sup>179</sup> See **Annex 4** for more details

<sup>180</sup> “Renewable Energy: A Gender Perspective,” International Renewable Energy Agency, (2019): [https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA\\_Gender\\_perspective\\_2019.pdf](https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf)

<sup>181</sup> “Productive Use of Energy in African Micro-Grids: Technical and Business Considerations,” USAID-NREL and Energy 4 Impact, (August 2018): [https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive\\_use\\_of\\_energy\\_in\\_african\\_micro-grids.pdf](https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive_use_of_energy_in_african_micro-grids.pdf)

<sup>182</sup> “Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Development,” UN Women, (2018): <http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/sdg-report-fact-sheet-sub-saharan-africa-en.pdf?la=en&vs=3558>

technicians, and part time and full-time employees and entrepreneurs.<sup>183</sup> Women also have unique social networks that typically offer greater access to rural households, which can be important to deploying energy access solutions.

Despite these opportunities, women are typically not part of key decision-making processes at nearly all levels of society. Women tend to have limited access to land and capital, as these are often determined by traditional and religious customs that remain deeply rooted in patriarchal traditions. Women also have more difficulty accessing finance due in part to lack of collateral required to guarantee payment and often resort to obtaining loans from money lenders who charge exorbitant interest rates.<sup>184</sup>

The gender analysis undertaken in Sierra Leone corroborated many of these trends, and revealed several interrelated challenges that women face in the off-grid sector:

- Women lack access to skills, technical capacity, and education/training
- Women broadly lack access to capital, asset ownership, collateral and credit (e.g. to start a business)<sup>185</sup>
- Extensive household responsibilities reduce their ability to generate income and service credit
- Financial literacy among women remains low and there is a lack of education and information available to women on access to financial resources

A number of initiatives exist that seek to address some of these challenges and help improve the rate of participation among women in Sierra Leone’s off-grid sector. In 2018, ECREEE partnered with the African Development Bank (AfDB) to launch a regional workshop to advance the participation of women in the renewable energy sector. The program intends to address the lack of inclusion of women in the energy value chain – only 2% of energy sector entrepreneurs in West Africa today are women. The initiative ultimately seeks to develop a pipeline of investment-ready, women-owned energy businesses across the region, including in Sierra Leone.<sup>186</sup>

A related development initiative is the USAID-funded Women Empowered for Leadership and Development (WELD) project, under which women in Sierra Leone benefit from entrepreneurship and basic trainings, improved farming technologies and grants that enable them to manage complex and medium enterprises effectively, to engage in formal transactions, and to expand their agricultural activities. Women now have access to loans and savings through the implementation of the WELD Program.<sup>187</sup>

The BWSEASL Training College (Centre) is an NGO supported by the Government that is providing solar related training mostly to women across the country. The BWSEASL was established through the program. Today, Barefoot solar engineers sustain and replicate solar technology in rural communities, change the perception of professionals for rural villages, and challenge both age and gender barriers. Every Woman Barefoot Solar engineer is *trained to train*; this unique skill implies that her ability to scale her own knowledge is without limitation.<sup>188</sup>

<sup>183</sup> “Renewable Energy: A Gender Perspective,” International Renewable Energy Agency, (2019): [https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA\\_Gender\\_perspective\\_2019.pdf](https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf)

<sup>184</sup> See **Section 3.2** for more details.

<sup>185</sup> This is a huge challenge for women in the country, particularly in rural areas, where the population depends on seasonal income from the agricultural sector for their livelihood, which makes loans inaccessible or only available at extremely high interest rates. This issue is examined in further detail in **Section 3.2**.

<sup>186</sup> “Feasibility study promotes women’s participation in energy transition,” ESI Africa, (May 7, 2018): <https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/>

<sup>187</sup> “Gender Equality and Women’s Empowerment: Sierra Leone,” USAID, (2018): <https://www.usaid.gov/sierra-leone/gender-equality-and-womens-empowerment>

<sup>188</sup> “Barefoot Women Solar Engineers: An Initiative having Impact in Africa,” The International Journal on Green Growth and Development, (2017): [http://bookstore.teri.res.in/docs/journals/IJGGD\\_Vol%203%20Issue1\\_Article\\_8.pdf](http://bookstore.teri.res.in/docs/journals/IJGGD_Vol%203%20Issue1_Article_8.pdf)

### III. ANALYSIS OF THE ROLE OF FINANCIAL INSTITUTIONS

This section begins with an introduction to financial products for the off-grid sector, including for end-users and stand-alone solar companies (**Section 3.1**). This is followed by a comprehensive overview of the country's financial market (**Section 3.2**), including a summary of any off-grid solar lending. **Section 3.3** examines other FIs (in addition to commercial banks) that are active in the country. **Section 3.4** presents a summary of key findings from the Task 3 analysis. The data presented in this section was obtained through desk research as well as interviews with/surveys of key officials and representatives from local FIs. **Annex 3** provides an overview of the Task 3 methodology.

#### 3.1 Introduction to Financial Products for the Off-Grid Sector

A wide range of financial products can be utilized to support development of the stand-alone solar sector in West Africa and the Sahel. These may include instruments such as matching grants, contingent loans, results-based financing (grants reimbursing cost after completion of work), equity investment (seed capital and later stages), concessional debt (subsidized interest or forgiveness of a portion of principal repayment), short-term commercial credits for inventory purchases and working capital, trade finance solutions (from export credit agencies (ECAs) or private trade funders) and medium-term loans secured on assets or receivables from a portfolio of installed projects. This “financial supply chain” consists of capital delivered at different stages of stand-alone solar enterprise development, by financial sector players that have risk appetites well matched to each specific stage. This section focuses on the roles of commercial FIs and MFIs providing debt financing to off-grid solar consumers and enterprises.

##### 3.1.1 Financial Products for End-Users

In order to determine what kinds of debt instruments are available to support stand-alone solar purchases for end-users, it is important to identify the different end-users.

##### ➤ Households

Households represent the majority of end-users in the West Africa and Sahel region and the level of cash flow this market segment has available for energy access depends heavily upon the formal and/or informal economic activity they are engaged in. In general, the ability for households to pay from their own internal resources declines as their distance from urban centers increases and their opportunity to participate in the formal economy with regular cash income declines. Meanwhile, external funding is typically not available for rural households as they remain largely off of the radar of mainstream FIs (with the exception of households where members have regular sources of income from urban centers). MFIs in fact are generally more appropriate sources of household finance. Most of a given country's households can access external funding typically only through microfinance or informal financial services such as local money lenders, cooperative societies and rotating savings and credit associations.

##### ➤ Public Institutions

The main public institutional facilities that require funding for off-grid electrification are directly linked to national, provincial or local administrations and budgets, including schools, health facilities, and other public buildings/lighting systems. Sustainable energy finance for community facilities is typically provided through a ministry, department or agency if the facility falls under the purview of the national or provincial budget. The challenge is that budget resources are severely limited and constantly face competing priorities; as a result, many public community facilities are left without access to energy.

In order to implement financial products targeting public institutional projects, a few critical questions need to be answered, such as who would be the borrower and whether there are sufficient financial resources available in the budget to pay for the service over a long period of time. This question is also important if these public community facilities end up being included alongside households as part of a local mini-grid.

➤ **Productive Use**

Financial instruments for SMEs as end-users of sustainable energy represent a very important category of products in that they tend to be commercially viable and are thus important for the long-term sustainability of energy systems. While households and community facilities use energy primarily for consumption, often resulting in other sources of income or budget being allocated to cover the cost of service, SMEs use energy for income-generating activities and can therefore cover electricity costs through the income generated by their business. An enterprise with positive cash flows gives financiers more comfort as well as an opportunity to design financial instruments that are commercial in nature. A loan product with parameters that match the company's ability to service the debt would be a strong and commercially viable option. MFIs often provide short-term loans to microenterprises on this basis while FIs often limit their lending to SMEs with strong balance sheets and available collateral.

➤ **Commercial and Industrial**

Commercial and industrial (C&I) facilities such as industrial plants, mining operations, shopping malls, logistics and distribution centers or commercial office buildings generally have considerable power consumption requiring energy supply from much larger solar systems that can range from several hundred kW to several MW in capacity. Where there is particularly high cost advantage for stand-alone solar systems over existing energy supply (i.e. vs. diesel generators), some C&I facility owners may find the payback of these investments so attractive that they will seek to purchase the solar power plant outright, often requiring debt financing to complete the transaction. This entails a corporate loan backed by the full faith and credit of the company, a pledge on the installed assets and usually supplemented by additional collateral and personal guarantees posted by the C&I facility owners. Many commercial FIs will offer credits to their existing C&I customers for this purpose but the C&I facility loan applicants are often unable or unwilling to post the required collateral for this specific purpose as their assets may already be encumbered for other business needs.

3.1.2 **Financial Products for Suppliers/Service Providers**

The stand-alone solar sector remains nascent in most markets across West Africa and the Sahel. The companies offering standalone solar products and energy services are therefore often at start-up or early development stage. Overall by number of players, small indigenous entrepreneurs are well in the majority; however, a few international companies dominate the overall market share. Most equipment is imported with purchases denominated in hard currency, while sales to consumers – whether on a direct purchase, Lease-to-Own (LTO) or Pay-As-You-Go (PAYG) basis – are almost always in local currency. At start-up or early stages of operation, local entrepreneurs, although in need of funding, are usually not ready to take on debt financing and should rely more on seed capital investment and grants until they are able to generate an initial book of business. Once orders begin to materialize, these enterprises have growing funding needs suitable for debt financing instruments which may include the following:

➤ **Working Capital**

All entrepreneurs need working capital to fuel their business growth and cover basic overheads for operations, marketing and sales. Throughout West Africa and the Sahel, there is a dearth of working capital financing for businesses in all sectors, and the situation is no different for stand-alone solar companies. When available, working capital loans have very short tenors of 3-12 months, must be secured on confirmable cash flows, have difficult-to-meet collateral requirements and carry high interest rates. Since their costs and income are in local currency, local entrepreneurs are best served by working capital loans also denominated in local currency. However, due to high cost of local currency debt, many companies will see advantages in borrowing at much lower interest rates in hard currency as the perceived risk of currency fluctuations across such short tenors is relatively low. Some international companies operating in the West African off-grid solar sector may prefer hard currency financing at the offshore holding company level, depending on how they have structured their local subsidiaries or affiliates in the region.

➤ **Inventory and Trade Finance**

To fulfill orders, solar system providers need inventory on hand. Equipment suppliers to the off-grid sector in West Africa and the Sahel are usually unwilling or unable to offer generous terms, often requiring down payments with balance due in full at cash-on-delivery (COD). Therefore, these businesses are in dire need of short-term loans of 6-12 months duration to finance inventory purchases. Yet, such loans are hard to come by for developing off-grid enterprises. Since equipment purchase arrangements are usually denominated in hard currency, loans also in hard currency over such short tenors are often acceptable. Trade finance from ECAs and private trade funders may also provide good solutions, but these lenders are often unwilling to finance orders under a few million USD or EUR in value.

➤ **Asset-Based or Receivables Financing**

Once stand-alone solar system providers achieve a portfolio of operating PAYG or LTO installations, the system assets and revenues from customer payments can be used to leverage debt financing to fund business activities and expansion. Typically, a Special Purpose Vehicle (SPV) is established to house the asset portfolio, which is sold by the solar provider to lenders. This form of financing has been widely deployed in East Africa and is also increasingly available in West Africa through a variety of regionally focused specialized debt funds that are focused on portfolio financings in the range of USD 1-10 million.<sup>189</sup>

➤ **Crowd Funding**

Crowd funding platforms have played an important role in offering working capital, inventory financing and smaller increment asset or receivables-backed loans to off-grid entrepreneurs. Loans of two-five years have been provided to both locally-owned and international solar enterprises with a good number of financings in the USD 150-500K range occurring in Nigeria, Ghana and Côte D'Ivoire.<sup>190</sup>

<sup>189</sup> A total of 11 such specialized debt funds were identified, including those managed by: Sunfunder, responsAbility, Lendable, Sima Funds, Solar Frontier, Neot, Deutsche Bank, Triple Jump, Crossboundary, Lion's Head, Shell and Solar Connect. Only a handful of these have vehicles that are fully funded and deploying capital but as of mid-2018 they reported expectations for financial closings that would make roughly USD 1.5 billion in off-grid focused debt available across Sub Saharan Africa by mid-2019.

<sup>190</sup> The most active crowd funding platforms in the off-grid space have been Kiva, TRINE, Lendahand and Bettervest with the latter two most focused on West Africa.

## 3.2 Financial Market Overview

### 3.2.1 Market Structure

Following more than a decade of civil war, a viable financial sector began to materialize and the number of banks and other FIs in Sierra Leone has since grown considerably. The banking sector is regulated and supervised by the Bank of Sierra Leone (BSL). **Table 47** below shows the number and categories of FIs that are regulated by the BSL.

Table 47: Licensed Financial Institutions in Sierra Leone<sup>191</sup>

License Type	Number of FIs
Apex Bank <sup>192</sup>	1
Commercial Banks	14
Community Banks	17
Credit-only microfinance institutions	12
Deposit-taking microfinance institutions	2
Discount houses	2
Foreign exchange bureau	54
Mortgage finance company	1
Leasing company	1
Mobile Financial Services Providers	3
Financial Service Associations (FSAs)	59
Stock Exchange	1

Source: Bank of Sierra Leone

The 14 commercial banks in the country, all concentrated in the urban areas, dominate the financial sector in terms of total assets (accounting for 99% of assets in the financial system), deposits and credit, while community banks, Financial Service Associations (FSAs) and MFIs play the role of extending financial services to rural communities, which are typically unable to access commercial banks.

Of the 14 commercial banks in the country, four are locally owned (two of these are Government-owned) while the remaining 10 are subsidiaries of foreign banks, including London-based Standard Chartered, US-based First International Bank, Ecobank and seven Nigerian banks – Guaranty Trust Bank, First Bank of Nigeria, Access Bank, Skye Bank, United Bank for Africa, Zenith Bank, and Keystone Bank. The two state-owned banks, Robel Commercial Bank (RCB) and Sierra Leone Commercial Bank (SLCB), continue to be key players with 28.6% of assets, 36.2% of deposits, and 23.8% of credit. These two banks (SLCB and RCB) together with Standard Chartered hold more than half of total assets of the industry, highlighting the concentrated market structure of the country’s banking sector.<sup>193</sup>

In 2017, the total assets of the banking system increased by 17.4% to SLL 7.43 trillion (USD 866 million), funded mainly by increases in deposits and shareholders’ funds. The total deposit base expanded by 4.0% to SLL 5.27 trillion (USD 614 million), while shareholders’ funds grew by 42.6% to SLL 1.05 trillion (USD 116 million), accounting for 11.6% of total liabilities in 2017.<sup>194</sup>

<sup>191</sup> Bank of Sierra Leone: [http://www.bsl.gov.sl/Banking\\_Supervision.html](http://www.bsl.gov.sl/Banking_Supervision.html)

<sup>192</sup> Apex bank’s mandate is to serve as a central bank for the community banks offering a central clearing service and performing first level regulatory and supervisory duties in addition to the overall oversight provided by the BSL.

<sup>193</sup> Bank of Sierra Leone, Financial Stability Report, 2017: [http://www.bsl.gov.sl/Financial%20stability%20Report%202017\\_Final.pdf](http://www.bsl.gov.sl/Financial%20stability%20Report%202017_Final.pdf)

<sup>194</sup> “Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy,” World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>;

➤ **Banking Sector Financial Soundness Indicators**

Although there have been significant improvements in the past 10 years, the Sierra Leonean banking sector remains constrained by high financing and operating costs, a low share of credit for the private sector and limited branch infrastructure. Furthermore, in recent years, the sector has faced significant challenges from external shocks – the contraction of the economy in 2015 due to the Ebola crisis and the collapse of iron ore prices. Both state-owned banks had to recognize long-standing asset problems in 2014, which caused an erosion of their capital base. A large share of the loans of RCB and SLCB were unauthorized overdrafts, indicating weak corporate governance arrangements.<sup>195</sup> In a 2017 report, the IMF warned that “a major challenge is the weak financial positions of the two public banks and poor asset quality in several other banks. A first step in improving the soundness of the banking sector will be to forcefully restructure the two-state owned banks.” As a result, the BSL has temporarily taken over management of the two banks and put in place mechanisms to limit new corporate lending. In addition, the GoSL is currently taking measures to restructure/privatize both banks. Nevertheless, the financial sector is broadly stable; however, non-performing loans (NPL) and commercial bank lending interest rates remain high.<sup>196</sup>

**Asset-Based Indicators:** The NPL ratio of the banking sector grew significantly in 2014-2015 (due to the previously mentioned asset problems of the two state-owned banks) but has since declined, dropping to 14.6% in 2017 (**Table 48**). Sierra Leone’s persistent fiscal deficit has led to a sharp increase in domestic debt as well as a build-up of huge arrears owed to government suppliers and contractors. The exposure of these suppliers and contractors to overdraft and loan facilities from commercial banks continues to weaken the loan portfolio of commercial banks.

In terms of liquidity, the banking system remains liquid; the overall liquidity ratio was 72% in 2013, 79% in 2014 and 83% in June 2015.<sup>197</sup> In 2017, overall liquidity moderated to 66.9% from 71.8% in 2016, driven largely by an increase in foreign currency deposits and the sharp depreciation of the Leone in 2016. Foreign exchange liquidity has become scarce with several banks increasingly facing challenges to clear U.S. transactions. The tighter monetary policy stance of the BSL has also led to tighter liquidity conditions in money markets with some commercial banks struggling to meet their liquidity needs on the interbank market. The BSL intervened by providing liquidity support through proactive open market operations, which allowed a few banks to meet their liquidity needs. Nonetheless, credit conditions remained tight as

“Sierra Leone: Privatization on the horizon in the financial sector,” Leading Edge, (February 27, 2018):

<http://www.leadingedgeguides.com/privatisation-horizon-financial-sector/>; and

“Sierra Leone Financial Inclusion Project: Combined Project Information Documents / Integrated Safeguards Datasheet,” World Bank, (November 2018): <http://documents.worldbank.org/curated/en/311571542650741656/pdf/Project-Information-Documents-Integrated-Safeguards-Data-Sheet-Sierra-Leone-Financial-Inclusion-Project-P166601.pdf>

<sup>195</sup> According to the 2016 Annual Report of the Auditor General of Sierra Leone, SLCB Management did not comply with prudential guidelines set by the BSL regarding classification and provision of loans and advances; the SLCB Management was reported to have continued issuing term loans of up to Le 38.27 billion to certain customers whose current accounts were already overdrawn <https://awoko.org/2018/07/27/sierra-leone-business-audit-blames-slcb-for-non-compliance-with-set-rules-for-loans/>

<sup>196</sup> “Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy,” World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>;

“Sierra Leone: Privatization on the horizon in the financial sector,” Leading Edge, (February 27, 2018):

<http://www.leadingedgeguides.com/privatisation-horizon-financial-sector/>; and

Bank of Sierra Leone, Monetary Policy Committee Statement, (June 2018):

[http://www.bsl.gov.sl/MP%20Statement%20\\_July%202018.pdf](http://www.bsl.gov.sl/MP%20Statement%20_July%202018.pdf)

<sup>197</sup> “Market Assessment Report on Clean Energy: Sierra Leone,” USAID Climate Economic Analysis for Development, Investment and Resilience (CEADIR), (June 2018): <https://www.climatelinks.org/resources/renewable-energy-lending-west-africa>

bank credit growth slowed to 4.9% in 2017 from 17.9% in 2016, reflecting a slowdown in economic activity.<sup>198</sup>

**Capital-Based Indicators:** The average capital adequacy ratio (CAR) of the banking sector increased from 30.7% in 2016 to 34.2% in 2017, indicating a strong capacity for loss absorption (**Table 48**). Although CAR appears high, it does provide significant buffers because credit risk is not adequately captured, and situations vary widely across banks. The stress of the two largest banks in the system continues to represent a significant strain on the financial system.<sup>199</sup>

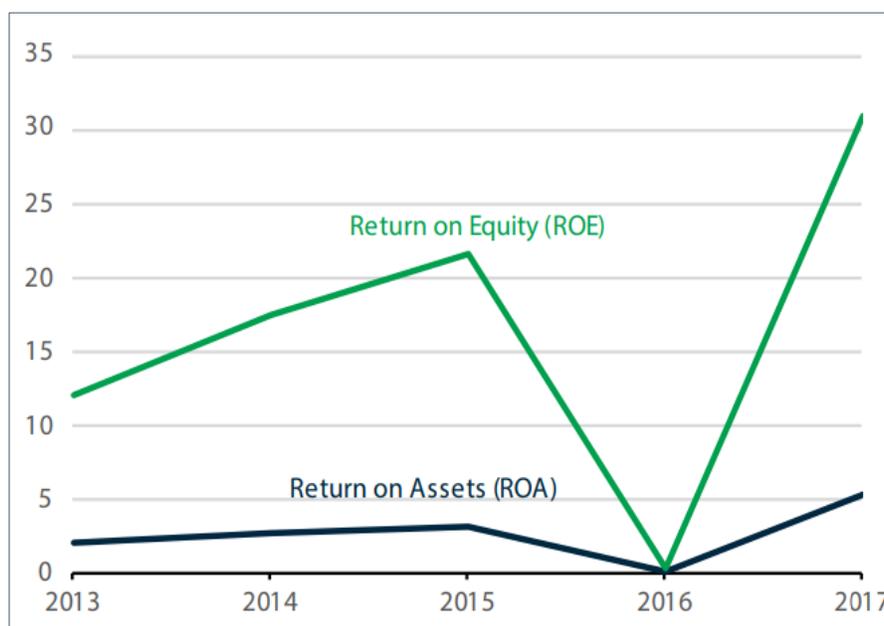
Table 48: Banking Sector Capital Adequacy and Asset Quality

Indicator	2015	2016	2017
Capital Adequacy Ratio	34%	30.7%	34.2%
Non-performing loans to gross loans	31.7%	22.7%	14.6%

Source: Bank of Sierra Leone

**Profitability Indicators:** As illustrated in **Figure 36**, the profitability of the banks improved in 2017 as both return on assets (ROA) and return on equity (ROE) increased from their 2016 levels.<sup>200</sup>

Figure 36: Banking Sector Profitability Indicators



Source: World Bank

<sup>198</sup> "Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy," World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>

<sup>199</sup> Bank of Sierra Leone, Financial Stability Report, 2017: [http://www.bsl.gov.sl/Financial%20stability%20Report%202017\\_Final.pdf](http://www.bsl.gov.sl/Financial%20stability%20Report%202017_Final.pdf)

<sup>200</sup> "Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy," World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>

➤ **Distribution of Credit by Sector**

GoSL borrowing has increased in recent years, which is crowding out private lending (**Table 49**). In 2017, credit to the Government increased by 28.7% to SLL 1.1 billion (USD 128,000), underpinned by huge borrowing by the GoSL to finance the persistent fiscal deficit while private sector credit grew by a mere 4.9% to SLL 66.6 billion (USD 7.7 million), reflecting both liquidity constraints faced by banks due to the tighter policy stance of the BSL and the general slowdown in economic activities.<sup>201</sup>

Table 49: Private Sector Credit

Indicator	2015	2016	2017
Private sector credit as % of GDP	7.5%	5.8%	5.1%
Share of credit to the Government	5.5%	16.8%	17.6%

Source: World Bank

In terms of sectoral distribution of credit, historically, the commerce and finance sector, which includes international and domestic trade, tourism, and financial services, received the largest share of total bank lending between 2006 and 2013, amounting to 33.2% of the market by the end of 2013. “Other services” and construction were second and third in bank lending, reaching 30% and 18.7% by 2013, respectively. By contrast, the share of total bank lending to agriculture, forestry, and fishing is relatively small, whereas these sectors accounted for nearly half of the growth of Sierra Leone’s economy. Manufacturing also made up a relatively small share of total bank lending. From 2006 to 2013, these sectors (agriculture, forestry, and fishing and manufacturing) together received less than 15% of total bank lending.<sup>202</sup>

3.2.2 Financial Inclusion

➤ **Access to Financial Services**

Access to financial services represents an ongoing challenge in West Africa and the Sahel. Overall, about three-quarters of the region’s population remains financially excluded, lacking access to banking and financial services through formal institutions (**Figure 37**).<sup>203</sup> There are, however, notable signs of progress. Between 2011 and 2017, the share of the population covered by formal FIs increased by nearly 10%.<sup>204</sup> Many countries across the region, including Sierra Leone, have also seen a sharp increase in mobile money ownership (**Figure 38**) and transaction volume (**Figure 39**).

<sup>201</sup> “Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy,” World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>

<sup>202</sup> “Sierra Leone: Country Financial Sector Profile,” Making Finance Work for Africa, (2016):

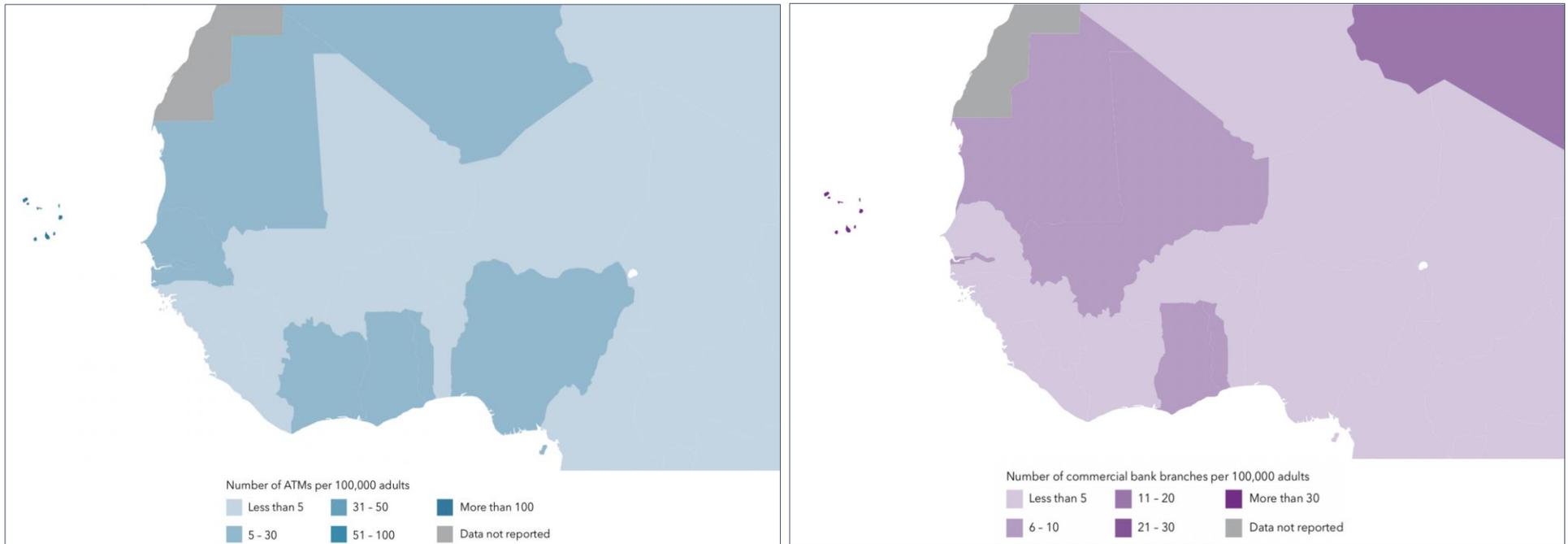
[https://www.mfw4a.org/fileadmin/data\\_storage/documents/MFW4A-documents/Country\\_FSP\\_SIERRA\\_LEONE.pdf](https://www.mfw4a.org/fileadmin/data_storage/documents/MFW4A-documents/Country_FSP_SIERRA_LEONE.pdf)

<sup>203</sup> “Le secteur bancaire en Afrique De l’inclusion financière à la stabilité financière,” European Investment Bank, (October 2018):

[https://www.eib.org/attachments/efs/economic\\_report\\_banking\\_africa\\_2018\\_fr.pdf](https://www.eib.org/attachments/efs/economic_report_banking_africa_2018_fr.pdf)

<sup>204</sup> Demircuc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., “The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution,” World Bank, (2017): <http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf>

Figure 37: ATMs and Branches of Commercial Banks per 100,000 Adults in West Africa and the Sahel, 2017<sup>205</sup>

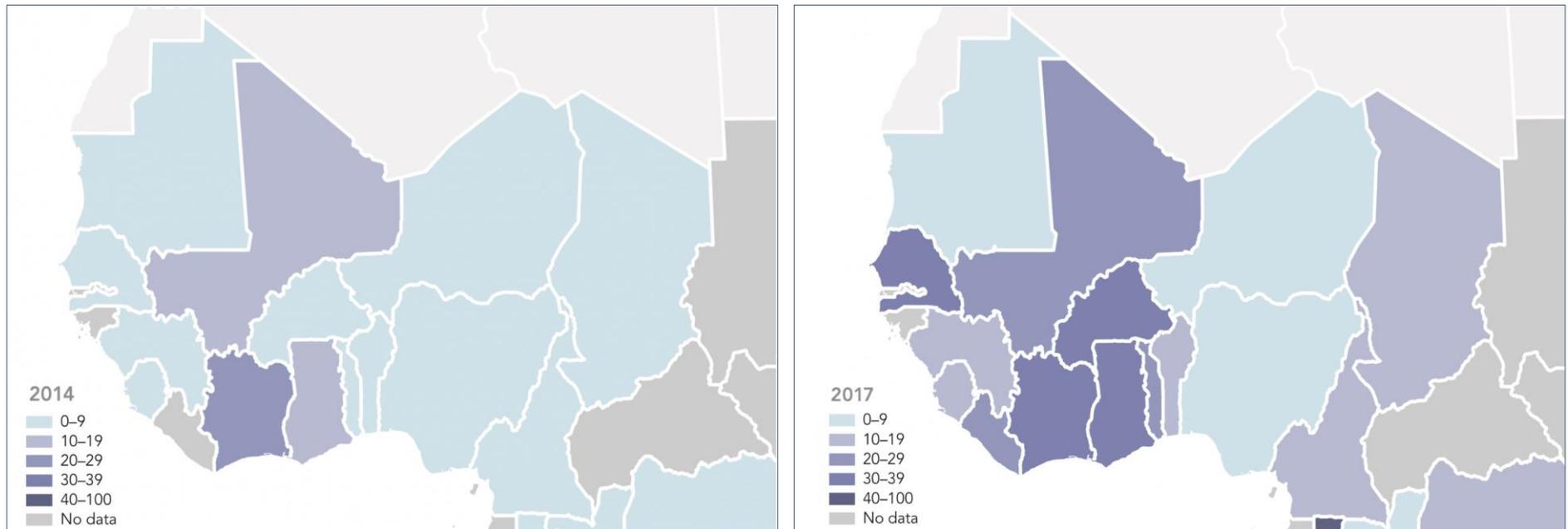


Source: International Monetary Fund

**Figure 37** shows the number of ATMs (left) and commercial bank branches (right) per 100,000 adults across West Africa and the Sahel. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. As of 2017, Côte d'Ivoire, Ghana, Mauritania, Nigeria, Senegal and Togo had a relatively higher number of ATMs per 100,000 adults compared to the rest of the region, while The Gambia, Ghana, Mali, Mauritania and Togo had a relatively higher number of commercial bank branches per 100,000 adults. Cabo Verde ranked above all countries in the region on both indicators.

<sup>205</sup> International Monetary Fund – Financial Access Survey: <http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C&slid=1460054136937>

Figure 38: Share of Adults with a Mobile Money Account in West Africa and the Sahel (%), 2014 and 2017<sup>206</sup>



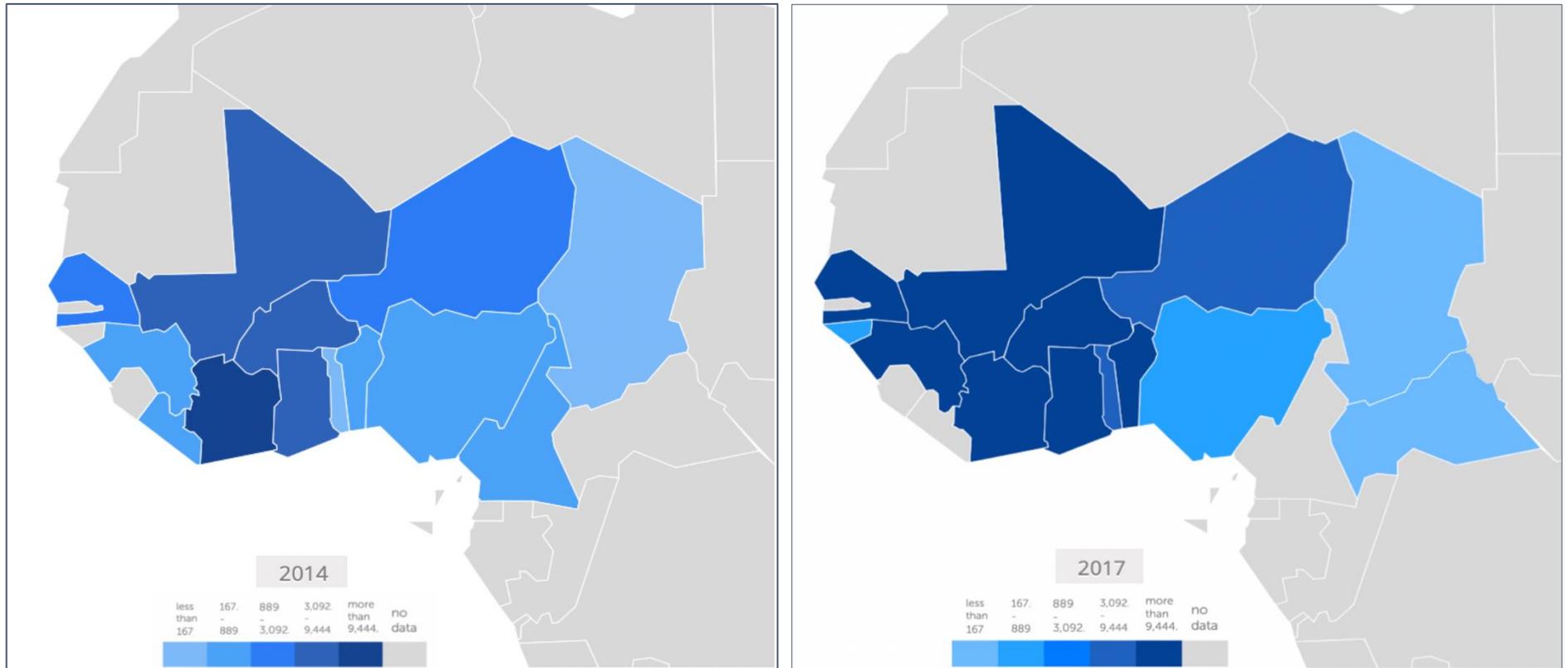
NOTE: Maps exclude Cabo Verde (no data)

Source: World Bank Global Findex Database

**Figure 38** shows the increase in the share of adults (%) owning a mobile money account across West Africa and the Sahel between 2014 and 2017. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. As of 2017, the share of adults owning a mobile money account is about 33% in Burkina Faso, Côte d'Ivoire, and Senegal, and 39% in Ghana. Between 2014 and 2017, mobile money account ownership also increased significantly in Benin, Cameroon, Chad, Guinea, Mali, **Sierra Leone** and Togo, while growth in account ownership was slower in Niger, Nigeria and Mauritania. There was either no data or insufficient data available to assess account ownership in Cabo Verde, Central African Republic, The Gambia, Guinea-Bissau, and Liberia.

<sup>206</sup> Demircuc-Kunt et al., 2017.

Figure 39: Mobile Money Transactions per 1,000 Adults in West Africa and the Sahel, 2014 and 2017<sup>207</sup>



NOTE: Maps exclude Cabo Verde (no data)

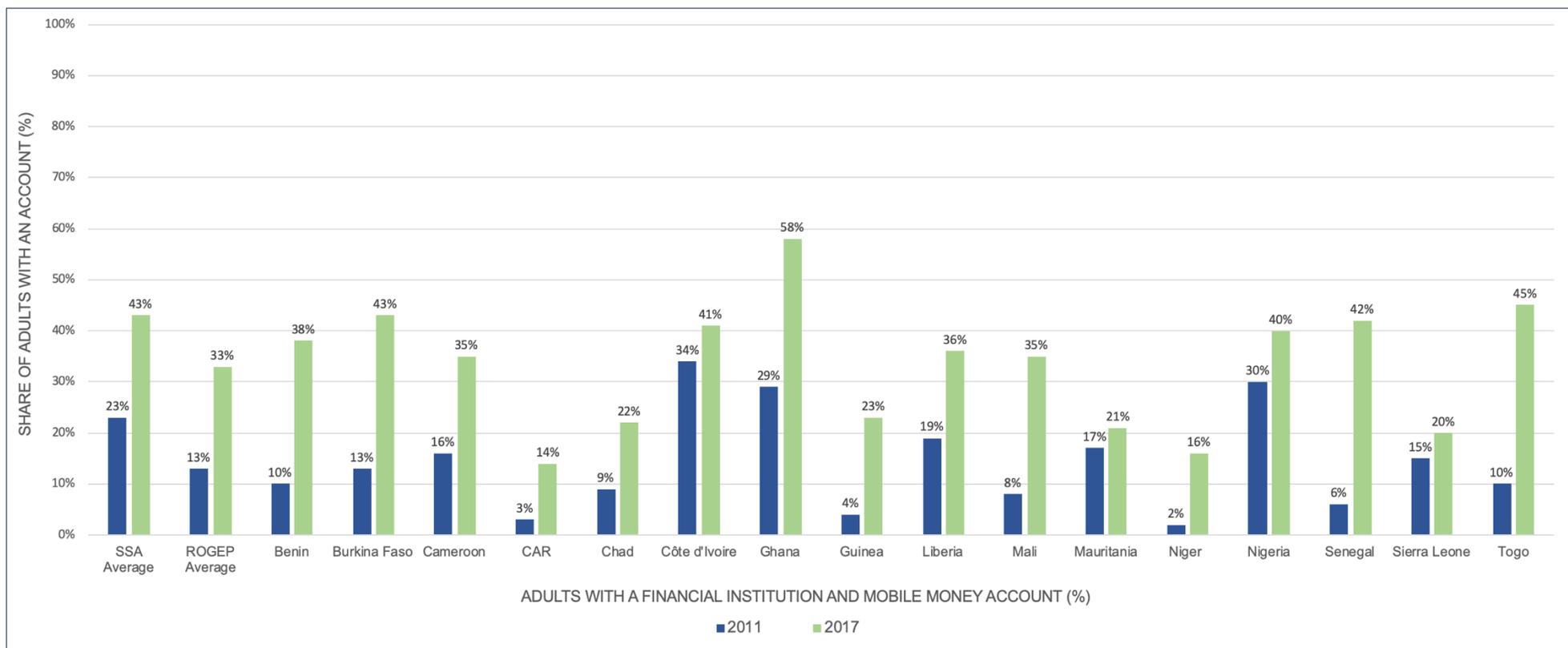
Source: International Monetary Fund

**Figure 39** shows the increase in the number of mobile money transactions across West Africa and the Sahel between 2014 and 2017. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. Between 2014 and 2017, mobile money transaction volume increased significantly in Benin, Burkina Faso, Côte d’Ivoire, Ghana, Guinea, Mali, Niger, Senegal and Togo, while growth in transaction volume was slower in Nigeria and Chad. There was either no data or insufficient data available to assess transaction volume in Cabo Verde, Cameroon, Central African Republic, The Gambia, Guinea-Bissau, Liberia, Mauritania and Sierra Leone.

<sup>207</sup> International Monetary Fund – Financial Access Survey: <http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C&slid=1460054136937>

In 2017, 20% of Sierra Leone’s adult population had an account at a FIs or with a mobile money service provider, up from 15% in 2011. In 2017, the country had one of the lowest rates of financial inclusion in West Africa and the Sahel, 13% below the region’s average and 23% below the average for Sub-Saharan Africa (**Figure 40**).

Figure 40: Share of Adults with Access to Financial Services in West Africa and the Sahel (%), 2011 and 2017<sup>208</sup>



NOTE: Cabo Verde, Guinea-Bissau and The Gambia excluded (no data); data for Côte d'Ivoire is from 2014 and 2017

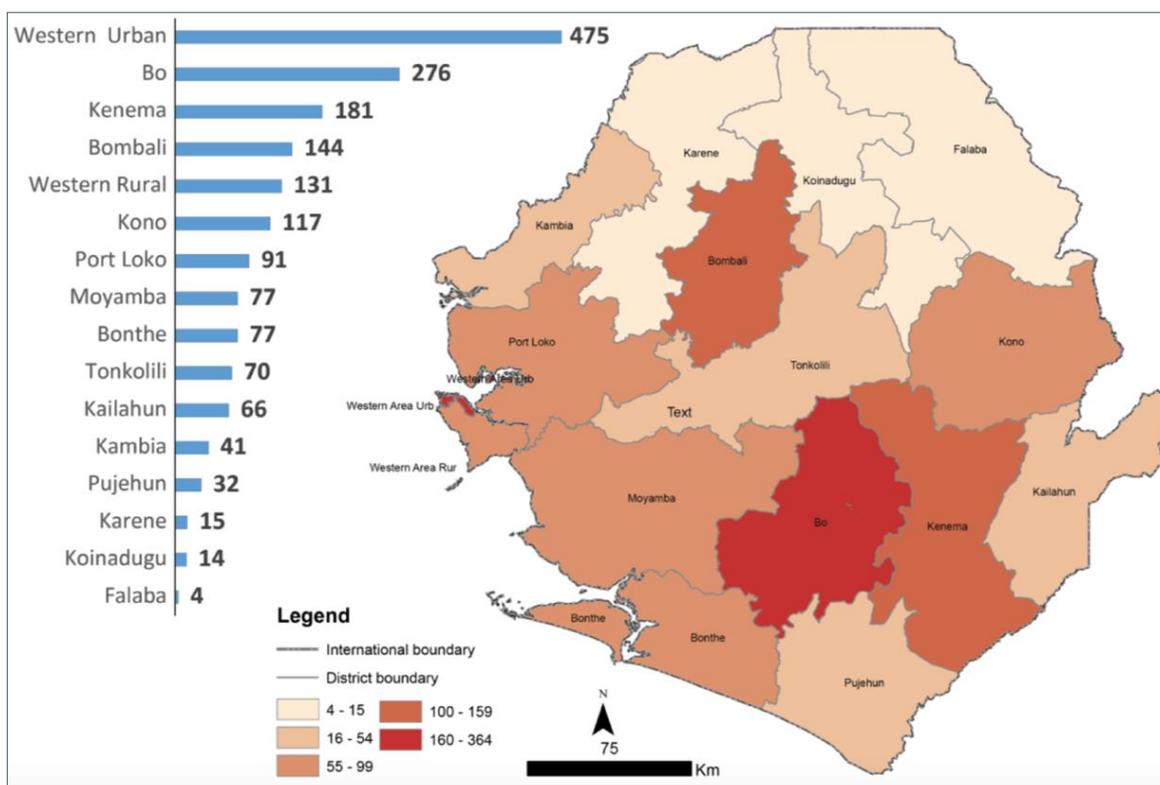
Source: World Bank Global Findex Database

<sup>208</sup> Demirguc-Kunt et al., 2017.

A vast majority of Sierra Leoneans lack access to financial services. According to the 2017 Global Findex survey, only 20% of the population has an account with a formal FIs or mobile money provider, compared to an average of 42.6% and 34.9% in Sub-Saharan Africa and low-income countries, respectively. FI levels are lower for women (15.4%), the poorest 40% of the population (12.9%), and those living in rural areas (14.4%). The use of formal financial services (i.e. the use of FIs for borrowing or saving) remains especially low, with only slightly above 5% of the population making use of formal institutions.<sup>209</sup>

In addition, a geospatial mapping survey carried out in 2017 found that 41.5% of chiefdoms in the country do not have any financial service access points, while the majority of these access points (commercial banks, MFIs, mobile money agents, community banks, FSAs and exchange bureaus) are concentrated in Freetown and a few other districts (**Figure 41**).<sup>210</sup>

Figure 41: Distribution of Financial Service Access Points by District, 2017



Source: Bank of Sierra Leone

Sierra Leone’s progress towards financial inclusion began with the 2008 Financial Sector Development Plan, the Government’s first comprehensive strategy for financial reform. As part of the reforms, the BSL revived rural banking by facilitating the establishment of community banks, MFIs and FSAs.<sup>211</sup> More

<sup>209</sup> “Sierra Leone Financial Inclusion Project: Combined Project Information Documents / Integrated Safeguards Datasheet,” World Bank, (November 2018): <http://documents.worldbank.org/curated/en/311571542650741656/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Sierra-Leone-Financial-Inclusion-Project-P166601.pdf>

<sup>210</sup> Kandeh, J., “Geospatial Data Analysis and Mapping for Financial Inclusion Report,” Bank of Sierra Leone: Financial Sector Development Plan Support Project, (November 2017): [https://www.bsl.gov.sl/BSL\\_Mapping\\_Report\\_Final\\_Final\\_30Nov2017.pdf](https://www.bsl.gov.sl/BSL_Mapping_Report_Final_Final_30Nov2017.pdf)

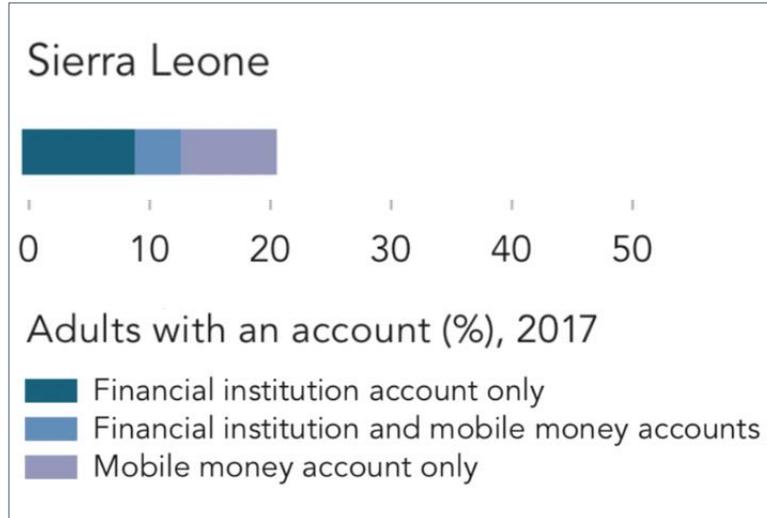
<sup>211</sup> Mahdi, I., “Informal finance in Sierra Leone: Why and how it fits into the financial system,” (May 2018): [https://www.microfinancegateway.org/sites/default/files/publication\\_files/informal\\_finance\\_in\\_sierra\\_leone-working\\_paper\\_i.m\\_final\\_160718\\_1.pdf](https://www.microfinancegateway.org/sites/default/files/publication_files/informal_finance_in_sierra_leone-working_paper_i.m_final_160718_1.pdf)

recently, the BSL also launched the National Strategy for Financial Inclusion (NSFI) 2017–2020 with the objective of making financial services available, accessible and affordable to all Sierra Leoneans and MSMEs, and support inclusive and resilient private-sector-led growth.<sup>212</sup>

One of the key areas central to the NSFI is digital financial inclusion; the GoSL has taken a number of legislative and regulatory actions to foster the development of digital financial services in the country. Digital payments received an unplanned boost during the Ebola crisis, when mobile wallets were used to make fast, accurate, and secure payments to some 30,000 relief workers. Digitization cut payment times from over a month to about a week. The results of the latest Annual Provider Survey show that, though still in early stage of development, Sierra Leone’s mobile money market is progressing with 10 providers currently offering digital financial services, including two mobile network operators and eight banks. The survey revealed that as of 2017, there were 385,000 active customer accounts (90 days) through which 6.1 million transactions were conducted, for a total value of SLL 310 billion (USD 36 million).

As of 2018, digital financial services were the second-largest provider of financial services and made up 90% of access points in the country. Yet, there are still large parts of the country with no access points. As a result, the BSL continues to take measures to support expansion of mobile money services and platforms in order to take advantage of the country’s 3.5 million mobile phone subscribers and its vast telecommunications network, which covers 94% of the country (**Figure 32**). Accordingly, the BSL is collaborating with the World Bank to ensure interoperability between digital finance service providers and all other financial service providers in the country.<sup>213</sup> The growing importance of mobile money services in improving financial inclusion in the country is also reflected in the findings of the World Bank’s 2017 Global Findex survey (**Figure 42**).<sup>214</sup>

Figure 42: Financial Institution Account Ownership



Source: World Bank Global Findex Database

<sup>212</sup> “Sierra Leone: Privatization on the horizon in the financial sector,” Leading Edge, (February 27, 2018): <http://www.leadingedgeguides.com/privatisation-horizon-financial-sector/>

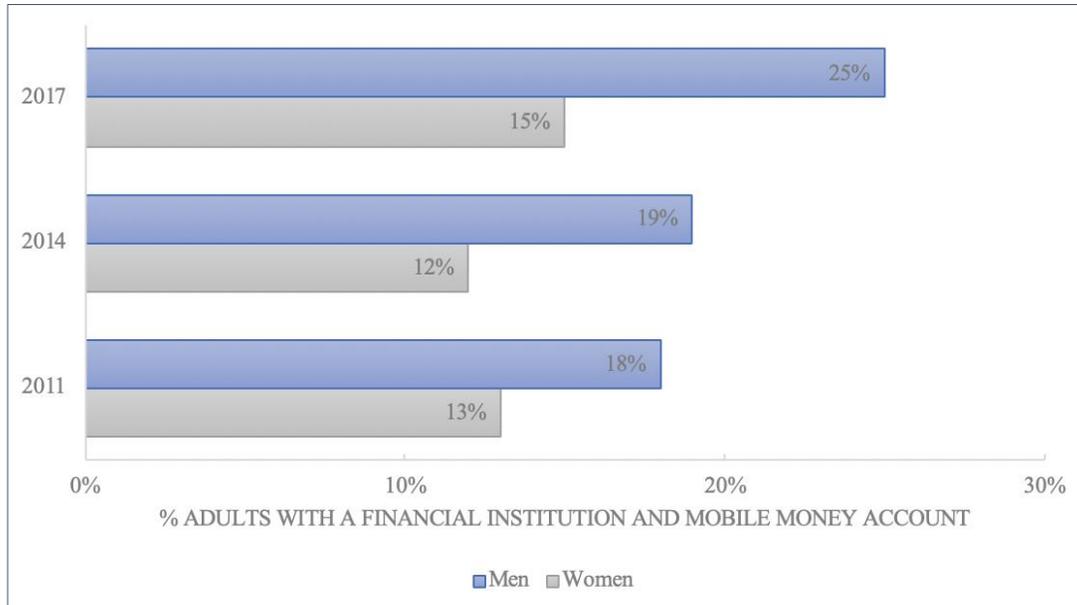
<sup>213</sup> “The State of Digital Financial Services in Sierra Leone,” United Nations Capital Development Fund, (June 20, 2018): <http://www.unCDF.org/article/3772/the-state-of-digital-financial-services-in-sierra-leone>

<sup>214</sup> Demircuc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., “The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution,” World Bank, (2017): <http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf>

➤ **Gender and Women’s Financial Inclusion**

According to data from the World Bank’s 2017 Global Findex survey – which examines, among many things, the extent of financial inclusion in Sub-Saharan Africa (SSA) – women in the region are about 10% less likely to have an account at an FI or with a mobile money service provider than men. An equivalent gender gap exists in Sierra Leone, where only 15% of women had an account at an FI or with a mobile money service provider in 2017, compared to 25% of men (Figure 43).<sup>215</sup>

Figure 43: Financial Inclusion Gender Gap in Sierra Leone



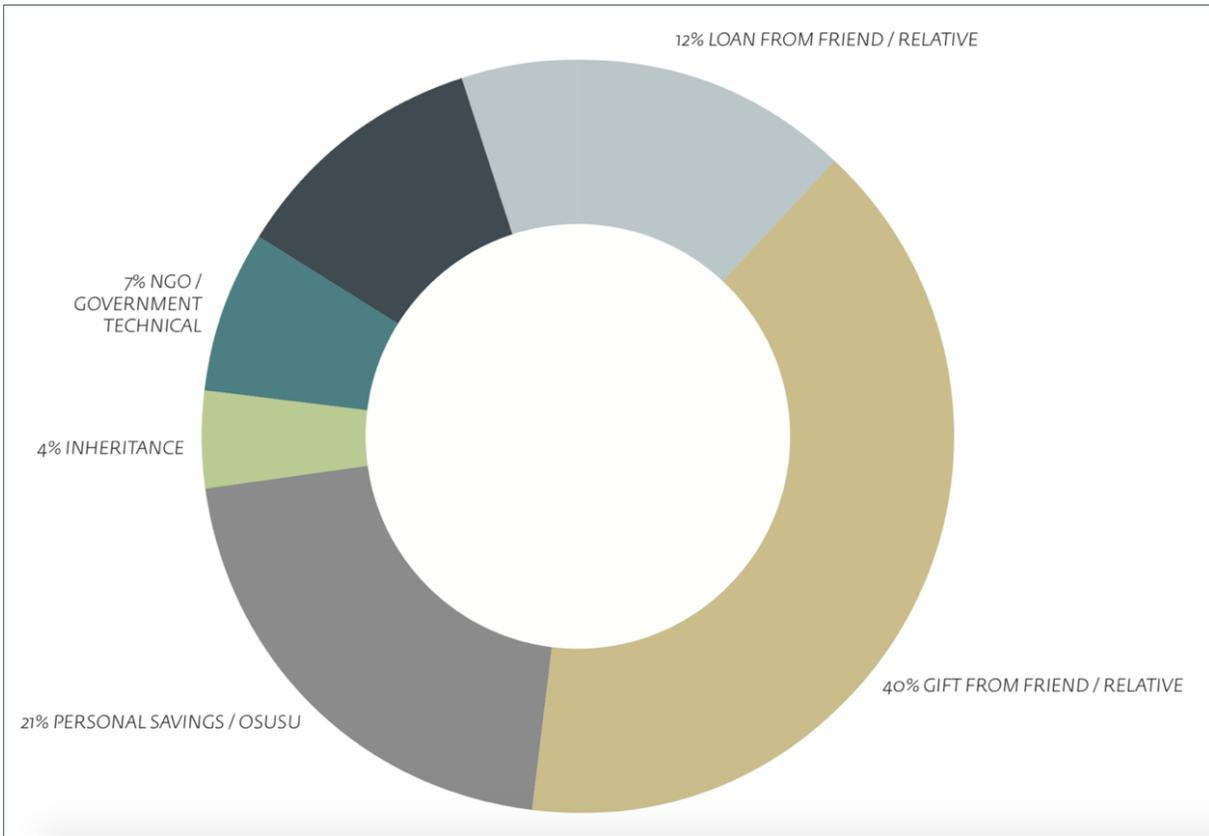
Source: World Bank Global Findex Database

Women in Sierra Leone experience financial exclusion mainly due to low or irregular sources of income and limited access to land and credit. The country’s elevated levels of poverty, social and cultural norms, and lower levels of education and rates of literacy make it difficult for women to access and use financial services. Women entrepreneurs also find it very difficult to access finance from formal FIs to support business growth. A national study on women’s access to financing undertaken by the International Finance Corporation (IFC) in 2014 revealed that over 80% of start-up finance for women entrepreneurs came from personal and informal sources of finance; almost none of the women surveyed had received a start-up loan from a commercial bank or from an MFI (Figure 44). As a result, women often turn to FIs that serve the country’s informal financial sector, such as MFIs, community banks and FSAs; women make up a significant portion of loan recipients from these institutions – 44% in the case of FSAs.<sup>216</sup>

<sup>215</sup> Demirguc-Kunt et al., 2017.

<sup>216</sup> “Sierra Leone Financial Inclusion Project: Combined Project Information Documents / Integrated Safeguards Datasheet,” World Bank, (November 2018): <http://documents.worldbank.org/curated/en/311571542650741656/pdf/Project-Information-Documents-Integrated-Safeguards-Data-Sheet-Sierra-Leone-Financial-Inclusion-Project-P166601.pdf>

Figure 44: Sources of Start-up Finance for Women Entrepreneurs in Sierra Leone<sup>217</sup>



Source: International Finance Corporation

Studies have found that increasing financial inclusion can significantly empower women by increasing savings, reducing levels of inequality, and improving decision-making power in the household. Government policies and regulatory frameworks are therefore critical to overcoming the barriers that women face and driving overall progress towards financial inclusion.<sup>218</sup> As described above, the GoSL is taking measures to address these issues and increase access to financial services for women. In addition to the NSFII, the Government has also partnered with the World Bank to implement the Bank’s ‘Universal Financial Access 2020’ initiative, which aims to improve overall access to and participation in the formal financial services sector through a wide range of targeted interventions, which include measures to empower women and other disadvantaged groups.<sup>219</sup>

<sup>217</sup> “National Study on Women’s Access to Financing in Sierra Leone,” International Finance Corporation, (November 2014): <http://www.cherieblairfoundation.org/wp-content/uploads/2015/10/National-Study-on-Women’s-Access-to-Financing-in-Sierra-Leone.pdf>

<sup>218</sup> El-Zoghbi, M., “Measuring Women’s Financial Inclusion: The 2017 Findex Story,” Consultative Group to Assist the Poor (CGAP), (30 April 2018): <https://www.cgap.org/blog/measuring-womens-financial-inclusion-2017-findex-story>

<sup>219</sup> “UFA 2020 Overview: Universal Financial Access by 2020,” World Bank, (October 1, 2018): <http://www.worldbank.org/en/topic/financialinclusion/brief/achieving-universal-financial-access-by-2020>

### 3.2.3 Commercial Lending Environment

#### ➤ Maturity Structure of Bank Deposits and Credit

Standard tenors available do not exceed three years, with most banks preferring to limit tenors to one year. Most loans of three years are associated with a specific scheme that offers some form of risk mitigation (a guarantee or other credit support) attached to it.<sup>220</sup>

#### ➤ Interest Rates

In 2017, the monetary policy rate (MPR) was increased gradually from 11% to 14.5% as the monetary policy committee (MPC) pursued a tight monetary policy. The band around the policy rate was also widened, with lending and deposit facilities rates raised to 19.0% and 12.0%, respectively. Inflationary pressures subsequently eased in 2017, although the rate remained high, declining to 15.3% from 17.4% in 2016.<sup>221</sup> In July 2018, the MPC decided to further increase the MPR by 150 basis points to 16.5% due to uncertainty resulting from domestic food price increases arising from seasonal food supply shocks, the depreciating leone and rising international prices of fuel and rice.<sup>222</sup> The band around the policy rate was also further widened, with the lending and deposit facilities rates raised to 20.5% and 13.5%, respectively.

**Table 50** shows interest rate trends from 2016 to 2018 were generally mixed. The data presented shows that despite the increase in the MPR, the average lending and saving deposit rates for commercial banks have remained flat since 2016, at 21.35% and 2.38%, respectively. Interest rate spreads – the difference between lending and deposit rates – have therefore remained stable, indicating a lack of, or limited improvement in, banking sector development in the country.<sup>223</sup>

Table 50: Interest Rates

Indicator	Jan 2016	Dec 2016	Dec 2017	July 2018	Aug 2018
91-day Treasury bill rate	1.2%	9.4%	8.2%	8.2%	8.3%
182-day Treasury bill rate	2.6%	16.2%	9.7%	8.4%	8.1%
364-day treasury bill rate	13.4%	30.2%	21.2%	23.1%	23.2%
Interbank rate	2.8%	9.8%	13.2%	14.3%	14%
Standing Lending Facility	10.5%	12%	19%	20.5%	20.5%
Standing Deposit Facility	10%	5.5%	12%	13.5%	13.5%
Monetary Policy Rate	9.5%	11%	14.5%	16.5%	16.5%
Average Lending rate	21.5%	21.4%	21.4%	21.4%	21.4%
Lending (Prime)	18.1 - 24.8%	17.9 - 24.8%	17.9 - 24.8%	17.9 - 24.8%	17.9 - 24.8%
Savings deposits	2.5%	2.4%	2.4%	2.4%	2.4%

Source: Bank of Sierra Leone

<sup>220</sup> “Market Assessment Report on Clean Energy: Sierra Leone,” USAID Climate Economic Analysis for Development, Investment and Resilience (CEADIR), (June 2018): <https://www.climatelinks.org/resources/renewable-energy-lending-west-africa>

<sup>221</sup> Bank of Sierra Leone, Monthly Economic Review, (December 2017): [https://www.bsl.gov.sl/MER\\_DEC\\_2017.pdf](https://www.bsl.gov.sl/MER_DEC_2017.pdf)

<sup>222</sup> Bank of Sierra Leone, Monetary Policy Committee Statement, (June 2018):

[http://www.bsl.gov.sl/MP%20Statement%20\\_July%202018.pdf](http://www.bsl.gov.sl/MP%20Statement%20_July%202018.pdf)

<sup>223</sup> Bank of Sierra Leone, Monthly Economic Review, (August 2018):

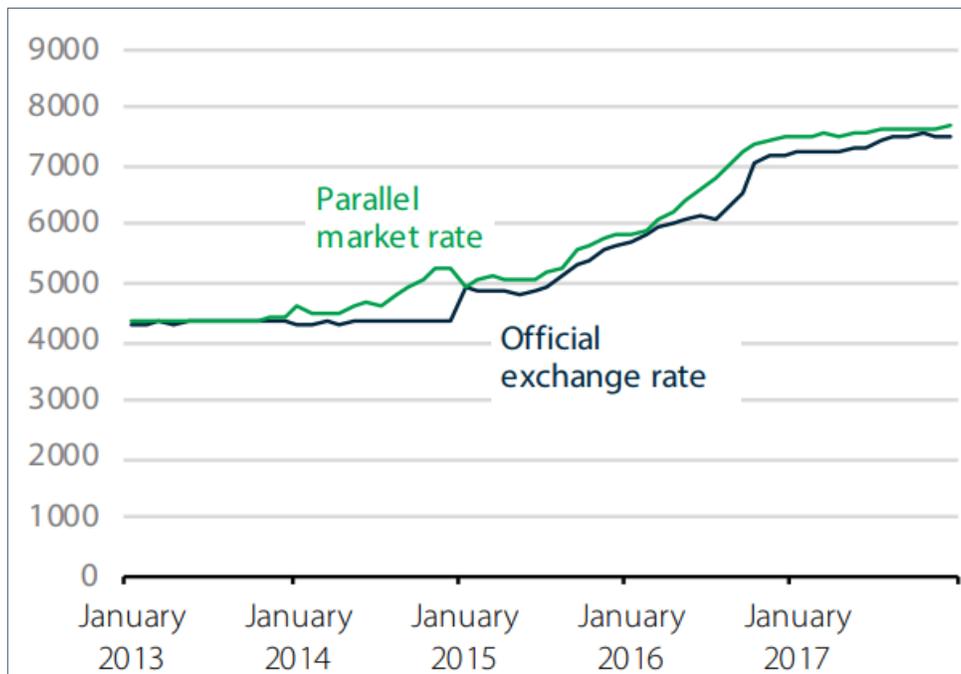
<http://www.bsl.gov.sl/MER%20August%202018%20Finalised%20Version.pdf>

The BSL is expected to continue tightening its monetary policy, along with policies aimed at exchange rate stability and fiscal consolidation with the aim of reducing inflation from 15% to 8% over the medium term.<sup>224</sup>

➤ **Foreign Exchange Market**

Sierra Leone operates a flexible exchange rate regime, wherein the forces of demand and supply determine the exchange rate. Consequently, the leone has generally been depreciating since 2015 largely due to the decrease in export earnings following the collapse in iron ore prices and the end of Ebola-related donor inflows as shown in **Figure 45**. The exchange rate between the leone and the US dollar depreciated rapidly between 2015 and 2016 by 28% before stabilizing in 2017, reflecting the tighter monetary policy stance of the BSL, inflows to the financial account and suspension of the weekly foreign exchange auction, which reduced speculation in the market. The annual average exchange rate depreciation against the U.S. dollar slowed to 17.4% in 2017 from 21.6% in 2016.<sup>225</sup>

Figure 45: Exchange Rate (SLL-USD)



Source: World Bank

The BSL sought to promote more flexibility of the exchange rate in order to improve external balance. It suspended the weekly foreign exchange auctions in May 2017, which significantly reduced its interventions in the foreign exchange market and helped to offset short-run volatility in the exchange rate and to maintain

<sup>224</sup> “Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy,” World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>

<sup>225</sup> “Sierra Leone News: Iron Ore and Ebola fuel Depreciation of the Leone,” (November 14, 2016): <https://awoko.org/2016/11/14/sierra-leone-news-iron-ore-and-ebola-fuel-depreciation-of-the-leone/>

external reserve buffers.<sup>226</sup> However, after the March 2018 elections in the country, the exchange rate began to depreciate even further due to a variety of factors including a huge trade deficit, the weak recovery of the mining sector - the country's major FOREX earner,<sup>227</sup> and the suspension of donor assistance to the country's budget, due to an unresolved feud with the IMF in the run-up to the elections that ushered in the new government. This led the BSL to re-commence the auction of US Dollars in August 2018 as part of efforts to boost money supply in the market and stem the depreciation of the leone.<sup>228</sup>

### ➤ Collateral Requirements

Banks in Sierra Leone have standard collateral requirements typically between 120–140% of loan principal and typically require traditional collateral such as land and buildings.<sup>229</sup> This eliminates commercial credit from the purview of many Sierra Leonean businesses, especially MSMEs, due to their inability to provide acceptable collateral. In a bid to address this, the BSL with support from the World Bank Group set up a Collateral Registry to improve access to finance, particularly for MSMEs. The Collateral Registry, established under Part II of the Borrowers and Lenders Act 2014, is a web-based system that allows lenders to search for any prior security interests, as well as establish their security interests over movable assets provided as collateral. The Collateral Registry facilitates the use of movable / personal assets as collateral that may remain in possession or control of the borrowers and thereby improves access to secured finance. The registry also provides a platform for searches, so that an interested party may find out if there are prior registrations against the assets offered by the borrower as collateral for a loan.<sup>230</sup> The registry went live in December 2016, and as of June 2017, 72 registrations had been entered in the system for various types of collateral.<sup>231</sup>

#### 3.2.4 Lending to the Off-Grid Solar Sector

While there are several donor and DFI-funded programs and initiatives that have provided financing to support development of Sierra Leone's off-grid solar market, these funds have not been channeled through local commercial banks or MFIs. The small balance sheets of local banks, restrictions on foreign currency lending imposed by the BSL, and the limited internal capacity of these institutions have combined to inhibit lending to the OGS sector.

ROGEP is therefore a pioneering initiative in the country, as it endeavors to boost OGS lending via engagement with local financial partners. Local FIs are increasingly becoming more aware of the opportunities in the off-grid space, and interviews FIs revealed a willingness to participate in providing financing to the sector.

<sup>226</sup> "Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy," World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>

<sup>227</sup> The country's major mineral exporter – Chinese company Shandong – which mined iron ore, shut down its operations in Nov. 2017.

<sup>228</sup> "Sierra Leone auctions US dollar to stem local currency depreciation," APA News, (August 22, 2018):

<http://apanews.net/index.php/en/news/sierra-leone-auctions-us-dollar-to-stem-local-currency-depreciation>

<sup>229</sup> "Market Assessment Report on Clean Energy: Sierra Leone," USAID Climate Economic Analysis for Development, Investment and Resilience (CEADIR), (June 2018): <https://www.climatelinks.org/resources/renewable-energy-lending-west-africa>

<sup>230</sup> Sierra Leone Collateral Registry: <https://www.slcr.gov.sl>

<sup>231</sup> "World Bank launches collateral registry in Sierra Leone to boost access to finance," Financial Nigeria, (21 June 2017):

<http://www.financialnigeria.com/world-bank-launches-collateral-registry-in-sierra-leone-to-boost-access-to-finance-sustainable-863.html>

### 3.2.4.1 Programs Supporting Financial Institutions in Off-Grid Solar Lending

#### ➤ USAID Climate Economic Analysis for Development, Investment, and Resilience (CEADIR)

The CEADIR engagement in West Africa took place from 2016 to 2018. The program's objective was to strengthen the capacity of FIs for clean energy lending in eight West African countries (Côte d'Ivoire, Ghana, Guinea, Liberia, Niger, Nigeria, Senegal and Sierra Leone) addressing their common challenges by developing the capacity of bank staff to provide loans for various clean energy technologies and business models and adapting their support to the specific context each country. CEADIR supported local banks by delivering a national workshop on stand-alone solar and mini-grids, which was complemented with one-on-one technical assistance to help banks develop clean energy lending strategies.<sup>232</sup> In Sierra Leone, seven commercial banks participated in the program in some capacity. CEADIR provided tailored technical assistance to two FIs (FBN SL and UBA SL) as described below.<sup>233</sup>

**FBN Sierra Leone:** The Bank diagnostics carried out revealed that FBN SL required support in developing financial models and structuring loans for clean energy projects. The CEADIR team supported the bank in developing a sample operational model for a PayGo Solar/Mobile Phone Transaction as well as development of a corresponding draft legal document for the transaction. The CEADIR team also provided training/coaching during the development of a specialized lending product for the transaction and assessed the suitability of the bank's existing payment collection software for PayGo integration. Additional TA included support (i) for a risk assessment to assess potential clean energy investments, particularly PayGo; (ii) in structuring complex PayGo lending products; and (iii) in utilizing payment collection software for PayGo transactions.

**UBA Sierra Leone:** CEADIR also initiated discussions between UBA SL and Easy Solar, a local off-grid solar service provider, and provided advisory support on the development of a viable solution to the banking restrictions in the country.<sup>234</sup> The parties are interested in structuring a facility whereby Easy Solar guarantees local currency loans from UBA SL by opening a USD 1 million offshore account to use as collateral. In addition, CEADIR facilitated a relationship between a UNOPS mini-grid project and UBA SL. UBA has opened an account for UNOPS to support operation of mini-grid projects under the Rural Renewable Energy Project (RREP).

#### ➤ REASL / SLAMFI Household Solar Pilot Project

In 2016, the Sierra Leone Association for Microfinance Institutions (SLAMFI) and the Renewable Energy Association of Sierra Leone (REASL) launched a pioneering household solar pilot project in the country. The project will enable 1,000 families to affordably purchase solar home systems with support from the local financial sector. The project is designed to help raise awareness about the country's financing challenges and the potential of the off-grid solar sector. The pilot aims to unlock significant commercial capital to help the GoSL meet its target of universal energy access by 2025. Within the pilot scheme, MFIs will provide consumer financing to their customers to enable them to purchase SHS. The solar systems will be supplied by companies in the REASL that are registered and certified as compliant with quality standards, and who will be able to provide after sales support to customers.<sup>235</sup>

<sup>232</sup> USAID CEADIR: <https://www.climatelinks.org/resources/renewable-energy-lending-west-africa>

<sup>233</sup> "Market Assessment Report on Clean Energy: Sierra Leone," USAID CEADIR, (June 2018): <https://www.climatelinks.org/resources/renewable-energy-lending-west-africa>

<sup>234</sup> BSL imposes a number of restrictions on how banks can lend and operate, including limitations on accessing international resources.

<sup>235</sup> "First household solar pilot project launched in Sierra Leone," Awoko, (December 5, 2016): <http://awoko.org/2016/12/06/sierra-leone-news-first-household-solar-pilot-kits-launched-in-sierra-leone/>

### 3.2.4.2 Key Barriers to Off-Grid Solar Lending

#### ➤ **Unfamiliarity with the Off-Grid Solar Sector**

Much like other African markets, local FIs in Sierra Leone are unfamiliar with lending to off-grid solar projects and companies and have a limited understanding of the nascent sector. Off-grid solar lending is generally seen as presenting additional risk because most FIs do not know how to conduct credit-risk analysis for these projects, remain skeptical that meaningful cash flow can be generated from solar projects, or that the cash flow can be relied upon to repay loans. Many of the interviewed FIs emphasized a need for technical support, particularly in conducting due diligence/technical assessments of solar companies, structuring off-grid solar loans and training of credit officers.

#### ➤ **Low Private Sector Credit**

The 2019 Doing Business Report ranks Sierra Leone at 161<sup>st</sup> out of 190 countries in getting credit.<sup>236</sup> The country's financial system is characterized by extremely low levels of credit penetration; in fact, the total amount of credit offered by the banking sector to the private sector is less than 5% of GDP, well below the Sub-Saharan Africa regional average of 30%.<sup>237</sup> According to the IMF, reversing this trend will be challenging in the short term. Over the medium term, even with declining credit to government as a share of GDP, only a modest increase in credit to the private sector is foreseen, as banking system net foreign assets increase.<sup>238</sup> In addition, SMEs are almost entirely neglected by commercial banks, as only 8% of SMEs received a bank loan in 2017 compared to 42% of large firms; furthermore, the largest share of credit constitutes loans to the five largest borrowers in the country, indicating a limited pool of funds for smaller firms.<sup>239</sup> One of the reasons for this is that the country's nascent collateral movable registry has experienced little uptake to date, thereby precluding the securitization of loans and the guarantee for lenders on recovering assets in the event of default. Consequently, lending is largely focused on corporate entities and trade as banks are less willing to lend to SMEs and the agricultural sector due to their higher perceived risk.

#### ➤ **High Interest Rates and Collateral Requirements**

Given the limited credit available to the private sector and SMEs in the country, when credit is available, it comes with extremely high interest rates and stringent collateral requirements. The commercial bank prime lending rate ranges between 18 to 25% p.a., while microfinance institutions charge up to 36%.<sup>240</sup>

#### ➤ **Lack of Credit History**

The lack of credit history of off-grid solar consumers, businesses and service providers is another major bottleneck hampering financing of the sector as banks consider it too risky. Given that they have limited/no experience lending in this space, banks in Sierra Leone would impose prohibitively high interest rates and require overly stringent collateral requirements from potential borrowers. In an effort to address this, the BSL set up a Credit Reference Bureau (CRB) in 2011 to provide credit reference reports to commercial

<sup>236</sup> "Doing Business 2019: Sierra Leone Economy Profile," World Bank:

<http://www.doingbusiness.org/content/dam/doingBusiness/country/s/sierra-leone/SLE.pdf>

<sup>237</sup> "Financing Small Businesses in Sierra Leone," Triple Jump, (29 August 2018): <https://triplejump.eu/2018/08/29/financing-small-businesses-in-sierra-leone/>

<sup>238</sup> "Sierra Leone: Privatization on the horizon in the financial sector," Leading Edge, (February 27, 2018):

<http://www.leadingedgeguides.com/privatisation-horizon-financial-sector/>

<sup>239</sup> "Sierra Leone Economic Update: Reviving Urban Development: The Importance of Freetown for the National Economy," World Bank, (June 2018): <http://documents.worldbank.org/curated/en/304841528737912303/pdf/127049-WP-PUBLIC-SierraLeoneEconomicUpdatev.pdf>

<sup>240</sup> Sierra Leone Association for Microfinance Institutions: <http://slamfi.sl/activities-services/>

banks about their individual and business clients. However, the current excel-based credit registry is prone to human error, susceptible to fraud, and time intensive, among other issues.<sup>241</sup> In September 2018, the GoSL announced it had signed a Memorandum of Understanding with the UNDP, U.N. Capital Development Fund (UNCDF) and leading technology nonprofit, Kiva, to strengthen and modernize its National Digital Identification and CRB process. The partnership would create a national digital identification system using distributed ledger technology, which will capture a wide range of financial transactions – from bank loans to credit from informal FIs – to increase access to financial services for the population. The rollout of the system is planned for 2019.<sup>242</sup>

➤ **Foreign Exchange Regulations and Risk**

The BSL foreign exchange guidelines restrict lending in foreign currencies to local businesses irrespective of the funding source. All lending must be in local currency, and thus banks are only able to offer loans at local rates. In addition, the cash reserve ratio that the BSL requires means that SMEs must deposit up to 30% of their cash reserve requirement in their accounts to obtain a loan. These requirements have severely constrained local financing and limited the importation of off-grid solar components and working capital.<sup>243</sup>

In addition to regulatory constraints, FX risk is also inhibiting lending to the sector. Given the high cost of local currency capital, local FIs cannot affordably lend to off-grid sector stakeholders. Yet, taking up hard currency denominated credit lines presents severe challenges for local lenders, who would have to bear the FX risk. When pricing in a hedge to cover this risk, many hard currency denominated credit lines become unattractive because the all-in cost of capital to the FI becomes too high to provide a competitive offer to borrowers.

<sup>241</sup> “Sierra Leone Financial Inclusion Project: Combined Project Information Documents / Integrated Safeguards Datasheet,” World Bank, (November 2018): <http://documents.worldbank.org/curated/en/311571542650741656/pdf/Project-Information-Documents-Integrated-Safeguards-Data-Sheet-Sierra-Leone-Financial-Inclusion-Project-P166601.pdf>

<sup>242</sup> <https://www.prnewswire.com/news-releases/kiva-sierra-leone-and-united-nations-agencies-partner-to-implement-credit-bureau-of-the-future-300720556.html>

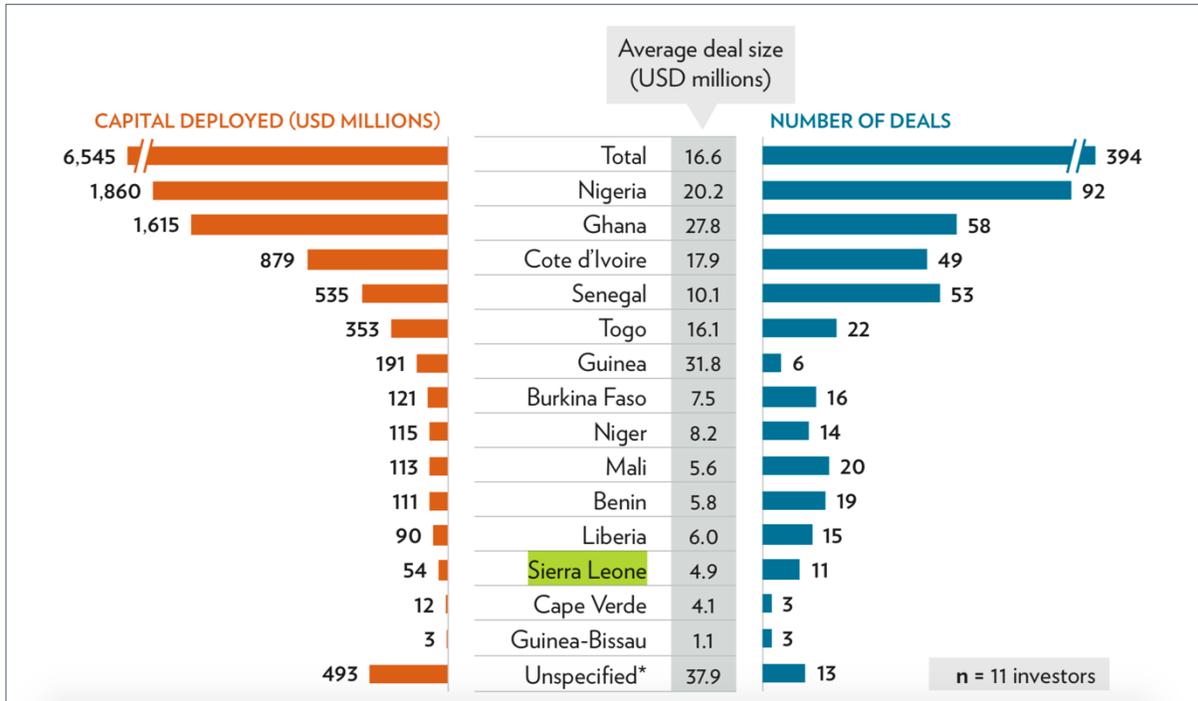
<sup>243</sup> “Market Assessment Report on Clean Energy: Sierra Leone,” USAID Climate Economic Analysis for Development, Investment and Resilience (CEADIR), (June 2018): <https://www.climatelinks.org/resources/renewable-energy-lending-west-africa>

### 3.3 Financial Institutions<sup>244</sup>

#### 3.3.1 Development Finance Institutions

Between 2005 and 2015, Sierra Leone received a total of USD 54 million in DFI funds with an average deal size of USD 4.9 million; the amount comprised under 1% of the total DFI investment across West Africa over this period (**Figure 46**).<sup>245</sup>

Figure 46: DFI Investment in West African Countries, 2005-2015



Source: Global Impact Investing Network and Dahlberg

Several DFIs are active in Sierra Leone, including AfDB, AFD/Proparco, IFC, and KfW/DEG among others. The identified DFI programs relevant to the energy and off-grid solar sector in the country are described below.

➤ **African Development Bank Sustainable Energy Fund for Africa / Facility for Energy Inclusion**

The **Sustainable Energy Fund for Africa (SEFA)** is a USD 60 million multi-donor trust fund administered by the African Development Bank with the objective of supporting sustainable private sector led economic growth in African countries through the efficient utilization of clean energy resources and support small- and medium-scale renewable energy project development.<sup>246</sup>

<sup>244</sup> Excluding commercial banks, which are reviewed in detail in **Section 3.2**.

<sup>245</sup> "The Landscape for Impact Investing in West Africa: Understanding the current trends, opportunities and challenges," Dalberg and Global Impact Investing Initiative, (December 2015):

[https://thegiin.org/assets/upload/West%20Africa/RegionalOverview\\_westafrika.pdf](https://thegiin.org/assets/upload/West%20Africa/RegionalOverview_westafrika.pdf)

<sup>246</sup> "Sustainable Energy Fund for Africa," African Development Bank, (2018): <https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/sustainable-energy-fund-for-africa/>

The **Facility for Energy Inclusion (FEI)** is a USD 500 million Pan-African debt facility created by the AfDB to support the achievement of its access to energy goals by providing debt capital to SHS companies, small independent power producers and mini-grid developers. The FEI Off-Grid Energy Access Fund (OGEF), structured by Lion's Head in partnership with the Nordic Development Fund, supports transaction structuring, provides local currency options to reduce risk for borrowers and their customers, and also offers technical assistance to companies to support off-grid market development.<sup>247</sup>

The launch of the FEI in 2016 led to a significant increase in AfDB financing for distributed renewable energy throughout Sub-Saharan Africa.<sup>248</sup> The FEI OGEF, which launched in 2018, will initially focus on East Africa, Côte d'Ivoire, Ghana and Nigeria.<sup>249</sup>

### ➤ International Finance Corporation

Among all DFIs, IFC has been particularly active in improving access to finance in the country, including through its Africa MSME Program, the Microfinance Program, the Trade Finance Program, and the Leasing Program. IFC's Conflict Affected States in Africa (CASA) Initiative is helping strengthen small businesses in the country and is working with the GoSL and private sector partners to introduce regulatory measures to improve the overall investment climate. Under this initiative, IFC is also helping strengthen Sierra Leone's financial system by supporting development and implementation of the Credit Bureau and the Collateral Registry.<sup>250</sup>

In 2016, IFC and the BSL entered into a partnership to promote improved performance in the country's banking sector by helping FIs adopt best practices in corporate governance. Under the partnership, IFC provides training and skills development programs for the country's banking sector.<sup>251</sup> Also in 2016, IFC, signed a Cooperation Agreement with the Sierra Leone Investment and Export Promotion Agency (SLIEPA) to promote leasing as an alternative financing solution for MSMEs. Under the agreement, IFC is supporting SLIEPA with establishment of a viable leasing industry. IFC is also providing risk capital and advisory services to small businesses in the country through its SME Ventures Program.<sup>252</sup> In 2017, the IFC, under its Africa Corporate Governance Program, kickstarted a Corporate Governance Board Leadership Training of Trainers Program in Sierra Leone in partnership with the Institute of Chartered Accountants of Sierra Leone (ICASL) in order to improve corporate governance in the country, thereby strengthening private sector growth.<sup>253</sup>

### 3.3.2 Microfinance Institutions

The expansion of microfinance has been a key policy agenda of the GoSL in the post-war years as a mechanism for accelerating access to finance. In line with this objective, the BSL has collaborated with various stakeholders including KfW, UNCDF, UNDP and CORDAID under the Microfinance Investment

<sup>247</sup> Facility for Energy Inclusion – Off-Grid Energy Access Fund: <https://www.ogefafira.com>

<sup>248</sup> Lee, A. Doukas, A. and DeAngelis, K., "The African Development Bank and Energy Access Finance in Sub-Saharan Africa: Trends and Insights from Recent Data," Oil Change International and Friends of the Earth U.S., (November 2018): <http://priceofoil.org/content/uploads/2018/11/AfDB-Energy-Access-Finance-report-high-quality.pdf>

<sup>249</sup> "African Development Bank, Nordic Development Fund and Partners launch Off-Grid Energy Access Fund with US\$ 58 million," African Development Bank Group, (August 27, 2018): <https://www.afdb.org/en/news-and-events/african-development-bank-nordic-development-fund-and-partners-launch-off-grid-energy-access-fund-with-us-58-million-18432/>

<sup>250</sup> IFC's CASA Initiative in Sierra Leone: <https://www.ifc.org/wps/wcm/connect/6d5275004af24c2c81dafb888d4159f8/SierraLeone.pdf?MOD=AJPERES>

<sup>251</sup> "IFC, BSL Partner to Improve Banking Sector," All Africa, (12 February 2016): <https://allafrica.com/stories/201602161161.html>

<sup>252</sup> Delay, P. and Kargbo, M., "IFC, SLIEPA Sign Agreement to Promote Leasing Industry in Sierra Leone," (13 December 2016): <http://slipepa.org/ifc-slipepa-sign-agreement-to-promote-leasing-industry-in-sierra-leone/>

<sup>253</sup> "Freetown: IFC and ICASL build capacity of Boards," The Patriotic Vanguard, (18 May 2017): <http://www.thepatrioticvanguard.com/freetown-ifc-and-icasl-build-capacity-of-boards>

and Technical Assistance Facility (MITAF) to promote the growth of the microfinance sector to make financial services accessible to the marginalized. Based on these efforts, currently, there are two deposit-taking and 10 credit-only MFIs registered with the BSL operating in the country with a total of 101 branches. In addition to these, there are several other MFIs operating in the country. However, they are registered with the Non-Governmental Organization (NGO) department of the Ministry of Finance and Economic Development (MoFED).

To date, the microfinance sector has served segments of the population that were previously not served by the formal financial sector with the total outreach of the main players in the sector estimated at 100,000 customers in 2015. However, the sector continues to face various challenges limiting its expansion. These challenges include poor infrastructure such as bad roads in rural areas which makes it difficult for MFIs to set up operations in certain parts of the country. MFIs have limited funding and mostly borrow externally (from donors and other foreign investors) at high costs, which limits the amount they can access and thus on-lend. MFIs also have limited tools for screening potential clients as the CRB established by the BSL does not serve MFIs. As a result, MFIs mainly rely on qualitative screening methods when assessing their clients; this leads MFIs to take certain precautions such as having restrictive credit policies which stipulate that they do not fund start-ups. Furthermore, there is a maximum loan amount above which MFIs do not give to first time clients regardless of their credit needs/capacity of the client. **Table 51** is an example of typical loan amounts provided by MFIs at each loan round.<sup>254</sup>

Table 51: Loan Amounts Provided by MFIs at each Loan Round<sup>255</sup>

Loan Round	Loan Amount (SLL)	USD Equivalent <sup>256</sup>
1	Le 400,000	\$47.50
2	Le 500,000	\$59.30
3	Le 600,000	\$71.20
4	Le 800,000	\$94.90
5	Le 1,000,000	\$118.60

Source: University of London, School of Oriental and African Studies

The MFIs in Sierra Leone mainly employ a group lending approach, since most of their clients do not own property to use as collateral. In addition, some banks take an upfront deposit, between 20%-30% of the loan granted, as a form of cash collateral. However, the loans offered do not address the needs of the majority of the rural populace, who are essentially small-scale farmers, due to their short maturity, monthly repayment structure, and the lack of any grace period.<sup>257</sup>

As with the other sub-sectors of the Sierra Leonean financial system, the Ebola crisis had severe impacts on the MFI sector as MFI growth plans were disrupted, and implementation of business plans were widely suspended. Prior to the Ebola crisis, eight MFIs had achieved or were approaching 100% Operational Self-Sustainability (OSS), but the crisis largely derailed their path to growth and sustainability as seven of these MFIs had registered a decline in OSS and the sector had an average OSS of only 78% by the end of 2014 at the peak of the crises. Furthermore, the high level of delinquency in the sector worsened with portfolio-

<sup>254</sup> Mahdi, I., "Informal finance in Sierra Leone: Why and how it fits into the financial system," (May 2018): [https://www.microfinancegateway.org/sites/default/files/publication\\_files/informal\\_finance\\_in\\_sierra\\_leone-working\\_paper\\_i.m\\_final\\_160718\\_1.pdf](https://www.microfinancegateway.org/sites/default/files/publication_files/informal_finance_in_sierra_leone-working_paper_i.m_final_160718_1.pdf)

<sup>255</sup> Mahdi, I., "Access to Credit, Indebtedness and Debt-refinancing amongst microenterprises in Freetown, Sierra Leone: An Institutional Approach," School of Oriental and African Studies (SOAS), University of London, 2015.

<sup>256</sup> Based on an exchange rate of SLL 8,429.79 to 1 USD

<sup>257</sup> "Rural Finance and Community Improvement Programme – Phase II (RFCIP 2): Detailed Design Report," UN International Fund for Agricultural Development, (2013): <https://webapps.ifad.org/members/lapse-of-time/docs/english/EB-2013-LOT-P-2-Project-Design-Report.pdf>

at-risk over thirty days (PAR>30) doubling from 11% in June 2014 just before the crisis to 22% by December 2014, while an additional 3,074 clients fell into delinquency during the period.<sup>258</sup> The most immediate impact observed was the 36% decline in loan disbursements during the peak crisis period of July to December 2014, compared to the same period in 2013. Since the crises came to an end in 2016, the MFI sector has been steadily recovering.<sup>259</sup>

### 3.3.3 Community Banks

Along with the rest of the financial sector, rural banking collapsed as a result of the civil war. In order to mitigate the limited reach of commercial banks and the inadequacies of MFIs in the country, the BSL restarted rural banking by setting up six community banks (CBs) between 2003 and 2006. CBs offer standard banking services to the rural populace. The deposit services of the CBs include demand, savings, and fixed deposits and other accounts such as school fees savings accounts. The CBs also offer both individual and group loans. Initially, the CBs' lending was mainly limited to individuals, but they moved towards the group lending format utilized by the MFIs. The loans offered by CBs are mainly short-term (4-8 months) with interest rates similar to those of commercial banks (and in some cases higher) but with simpler loan requirements and less time-consuming procedures.

However, these banks encountered difficulties arising from poor corporate governance practices. Consequently, with support from the International Fund for Agricultural Development (IFAD)-funded Rural Finance and Community Improvement Programme, Phase I (RFCIP-I), these CBs were restructured while seven additional CBs were established. In order to further strengthen the CBs, the Apex Bank was set up in 2013 to provide first level supervision and technical support to the CBs. The number of CBs has since grown to 17 with support from RFCIP-II.<sup>260</sup>

**Table 52** presents key performance indicators of the Community Banks between 2014 and 2017. Over this period, the number of depositors of the CBs grew from 46,490 to 74,175, of which 43% were women and 37.7% were youths (less than 35 years old), while total deposits increased from SLL 19.8 billion (USD 2.3 million) to SLL 29.7 billion (USD 3.4 million), indicating rising confidence of the public in the CBs. Similarly, the gross loan portfolio of the CBs significantly increased from SLL 11.7 billion (USD 1.3 million) in 2014 to SLL 41.5 billion (USD 4.8 million) in 2017, as the number of active borrowers grew from 14,292 in 2015 to 25,866 in 2017, of which 41.2% were women and 41.9% were youths. Portfolio quality has also improved over the years, however the portfolio at risk (PAR 30 days) is still above the

<sup>258</sup> NOTE: BRAC SL fully suspended operations and froze its portfolio in June 2014, when PAR>30 stood at 4.30%. If the BRAC stoppage is viewed as causing 100% of its loan portfolio to be at risk, the consolidated delinquency rate for the nine participating microfinance providers would be 33%, rather than 22%.

<sup>259</sup> "Sierra Leone: The Impact of the Ebola Crisis on the Microfinance Sector," Cordaid, Sierra Leone Association of Microfinance Institutions (SLAMFI) and Ayani Inclusive Financial Sector Consultants, (March 2015): [http://www.findevgateway.org/sites/default/files/publication\\_files/sierra\\_leone\\_the\\_impact\\_of\\_ebola\\_crisis\\_on\\_the\\_microfinance\\_sector.pdf](http://www.findevgateway.org/sites/default/files/publication_files/sierra_leone_the_impact_of_ebola_crisis_on_the_microfinance_sector.pdf)

<sup>260</sup> The RFCIP-II is a USD 38.1 million program that was approved in April 2013 and became effective in June 2013, with a nine-year duration ending in 2022. RFCIP-II is intended to consolidate and build on the achievements and success of RFCIP-I by strengthening and broadening the rural financial system in Sierra Leone and establishing stronger linkages with the agricultural sector. The key expected outcomes at the end of the program lifetime are that 285,000 households will be using financial services, and that all the existing CBs and FSAs and the Apex Bank are 100% operationally self-sufficient with PAR 30 days less than 5%. As of August 2017, an estimated total of 164 849 households are accessing financial services through the CBs and FSAs.

See: Mahdi, I., "Informal finance in Sierra Leone: Why and how it fits into the financial system," (May 2018): [https://www.microfinancegateway.org/sites/default/files/publication\\_files/informal\\_finance\\_in\\_sierra\\_leone-working\\_paper\\_i.m\\_final\\_160718\\_1.pdf](https://www.microfinancegateway.org/sites/default/files/publication_files/informal_finance_in_sierra_leone-working_paper_i.m_final_160718_1.pdf); and

"Rural Finance and Community Improvement Programme – Phase II (RFCIP 2): Detailed Design Report," UN International Fund for Agricultural Development, (2013): <https://webapps.ifad.org/members/lapse-of-time/docs/english/EB-2013-LOT-P-2-Project-Design-Report.pdf>

international standard of 5% (PAR 30 days) for CBs at 8.6% as of August 2017, with only four of the 17 CBs reporting a PAR below 5%.

The CAR which reflects the risk absorption capacity of the CBs, increased from -5.06% in December 2015 to 23.3% as of August 2017, indicating that CBs are becoming more resilient in their ability to absorb risk. The increase was a result of both growth in share capital and net profit excluding grants. However, the CAR for four of the CBs was below the required standard of 10% as of 2017. The average Operational Self Sufficiency (OSS), which demonstrates the extent of coverage of operating revenue over operating expenses, has fluctuated, but has been above the 100% benchmark since 2016. The average OSS increased from 129.4% in 2016 to 193.7% in 2017 as a result of increased revenue generation of the CBs, with all 17 CBs having OSS ranging between 109% and 394% and all reporting net profit excluding grants as of 2017. Nevertheless, the CBs continue to face challenges ranging from poor corporate governance and internal controls, to lack of qualified staff, remoteness of locations, lack of basic infrastructure and weak technology. Furthermore, most of the CBs are undercapitalized and unable to meet the demand for loans as RFCIP funded support is gradually being phased out.<sup>261</sup>

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<sup>261</sup> “National Study on Women’s Access to Financing in Sierra Leone,” International Finance Corporation, (November 2014): <http://www.cherieblairfoundation.org/wp-content/uploads/2015/10/National-Study-on-Women’s-Access-to-Financing-in-Sierra-Leone.pdf>; and

“Rural Finance and Community Improvement Program (RFCIP-II): Republic of Sierra Leone,” UN International Fund for Agricultural Development, (2017): <https://operations.ifad.org/documents/654016/71ddf63c-26d8-4c3f-86ff-f4a3aa393200>

Table 52: Community Bank Financial Performance Indicators<sup>262</sup>

Indicator	Dec 2014	Sep 2015	Dec 2015	Mar 2016	Sep 2016	Dec 2016	Aug 2017
<b>Deposits</b>							
Number of Depositors	46,490	58,010	59,721	58,447	66,933	68 590	74 175
% Women	42%	42.14%	41.93%	39.55%	42.15%	42.0%	43.0%
% Youth	39%	38.52%	38.33%	33.95%	37.43%	37.0%	37.7%
Deposits SLL (thousand)	19,833,576	21,681,742	24,184,159	22,396,436	29,969,995	26,952,605	29,722,513
<b>Loans</b>							
Portfolio at Risk 30 days (PAR 30 days)	-	29.70%	13.48%	9.19%	8.5%	8.9%	8.6%
Number of Active borrowers	-	14,292	14,963	15,594	19,438	20 170	25 866
% women	-	40.02%	42%	38.75%	42.02%	40.0%	41.2%
% Youth	-	39.41%	40%	40.54%	39.41%	42.0%	41.9%
Gross Loans SLL (thousand)	11,728,393	25,509,769	18,772,903	23,627,774	28,928,934	31,741,739	41,544,903
<b>Capital Adequacy</b>							
Capital adequacy ratio (CAR)	0.36	0.26	-5.06%	3.29%	8.08%	9.9%	23.3%
Debt to equity ratio	2.82	2.46	-75.27%	773.11%	127.81%	-	-
<b>Profitability</b>							
Return on Assets (ROA)	-	-3.71%	-17%	3.13%	3.35%	-	-
Operational Self Sufficiency (OSS)	109%	99.89	68.07%	152.08%	138.9%	129.4%	193.7%
CBs with OSS > 100%	12	7	4	13	15	-	17
Financial Self-Sufficiency	-	78.38%	56%	136.30%	115.22%	-	-
Profit (excluding grants) SLL (thousand)	-	-	-	-	-	2,682,685	4,779,231
Profit (including grants) SLL (thousand)	-	-	-	-	-	5,003,163	5,903,812
<b>Efficiency</b>							
Loan officer productivity	-	427.69	478.45	581.89	642.46	-	-
Operating expense ratio	-	41.65%	82.77%	17.45%	24.74%	-	-
<b>Liquidity</b>							
Deposits as a percent of total assets	35%	36.47%	49.97%	44.59%	48.28%	-	-
Deposits as a percent of loan portfolio	156%	84.18%	113.20%	87.92%	91.42%	-	-
Cash as a percent of Deposits	111%	89.36%	69.59%	66.12%	40.46%	-	-
Cash & cash equivalents as a percent of deposits	111%	89.41%	84.34%	69.59%	43.32%	-	-
<b>Shareholders' Funds</b>							
Number of shareholders	-	14,393	16,253	17,557	21,856	23,050	27,406
Share capital SLL (thousand)	-	2,515,001	2,798,923	2,298,204	2,595,414	2,770,726	3,708,196

Source: UN International Fund for Agricultural Development

<sup>262</sup> IFAD: <https://operations.ifad.org/documents/654016/71ddf63c-26d8-4c3f-86ff-f4a3aa393200>; and <https://operations.ifad.org/documents/654016/0e7416d2-e9b5-4d8f-96cb-cb18063f0ff3>

### 3.3.4 Financial Services Associations

FSAs or village banks as they are commonly referred to, were set up in Sierra Leone in 2007 as part of an IFAD program to expand financial services in the rural areas and to complement the services being offered by the community banks. A total of six FSAs in four districts were initially established. By 2011, the network of FSAs had expanded to 26 with a membership of 21,082, and currently there are 59 FSAs operational which serve 70,000 clients. FSAs are membership based, meaning that the members own shares of the FSAs and manage the FSAs while loans are made available from a pooled fund.<sup>263</sup> FSAs are characterized by simple systems and procedures and a narrow range of financial services offered. These characteristics enable FSAs to maintain low-cost organizational structures and to rely on local management. There has been a wide acceptance amongst the village communities of both the structure of the FSAs and the products and services that they offer. Thus far, the FSAs have been impactful by providing affordable credit (average loan size is less than USD 200) for the rural poor while also instilling a savings culture.<sup>264</sup>

Table 53: Financial Services Associations Financial Performance Indicators<sup>265</sup>

Indicator	Dec 2013	Dec 2014	Sep 2015	Dec 2015	Mar 2016	Sep 2016	Dec 2016	Aug 2017
Cumulative Net Income (SLL thousand)	58,307	437,805	996,260	1,440,548	545,117	2,850,417	3 837 318	3 280 650
OSS >100%	21	37	37	37	40	48	N/A	52
Avg. OSS	98%	151%	185%	144%	160%	168%	169.9%	185.9%
No. with PAR > 5%	21	8	12	14	17	25	N/A	33
Average PAR 30 days	8%	17%	11%	11%	9%	5.8%	6.7%	5.9%
No Shareholders	8 262	10,846	12,941	71,519	75,837	83,925	83,400	90,674
% Women	43%	41%	43%	43%	43%	41.7%	44.7%	43.4%
% Youth	-	-	-	42%	41%	39.3%	40.3%	40.0%
Active Loan Clients	1 765	3,221	2,957	17,825	13,345	22,924	23 872	27 741
% Women	43%	41%	43%	43%	43%	41.7%	43.0%	47.7%
% Youth	N/A	N/A	N/A	42%	41%	39.3%	39.2%	41.2%
Loan Outstanding (SLL thousand)	1,535,754	2,576,135	4,115,434	18,630,411	21,280,221	26,843,263	28,930,970	32,080,368
Avg. Loan / FSA (SLL thousand)	30,113	50,512	80,695	365,302	417,259	454,971	490,355	543,735
Share Capital (SLL thousand)	1,219,525	1,768,557	2,245,842	10,267,738	11,020,783	12,427,834	13,202,462	14,293,282
Avg. Share Cap/FSA (SLL thousand)	23,912	34,678	44,036	201,328	216,094	210,641	223,771	242,259

Source: UN International Fund for Agricultural Development

As shown in **Table 53**, the number of shareholders of the FSAs has grown rapidly from 8,262 in 2013 to 90,674 in 2017, of which 43.4% were women and 40% were youths (less than 35 years old). Similarly, the

<sup>263</sup> A Shareholder can access a loan four times the share value or 10% of the total share capital raised at any given time, whichever is less (see: <http://www.npcu.org/fsa.html>)

<sup>264</sup> "FSA Initiative: Sierra Leone Update," UN International Fund for Agricultural Development: <https://operations.ifad.org/documents/654016/488032/FSA+Initiative-Sierra+Leone+Update/8d08d054-6399-4bb7-ad17-1934d289098d>; and

Mahdi, I., "Informal finance in Sierra Leone: Why and how it fits into the financial system," (May 2018): [https://www.microfinancegateway.org/sites/default/files/publication\\_files/informal\\_finance\\_in\\_sierra\\_leone-working\\_paper\\_i.m\\_final\\_160718\\_1.pdf](https://www.microfinancegateway.org/sites/default/files/publication_files/informal_finance_in_sierra_leone-working_paper_i.m_final_160718_1.pdf)

<sup>265</sup> IFAD: <https://operations.ifad.org/documents/654016/71ddf63c-26d8-4c3f-86ff-f4a3aa393200>; and <https://operations.ifad.org/documents/654016/0e7416d2-e9b5-4d8f-96cb-cb18063f0ff3>

number of shares purchased by the FSAs increased from SLL 1.2 billion (USD 140,000) in 2013 to SLL 14.3 billion (USD 1.6 million) in 2017 depicting growing confidence in the FSAs by the rural communities. Also, the gross loan portfolio of the FSAs increased from SLL 1.5 billion (USD 175,000) in 2013 to SLL 32.1 billion (USD 3.7 million) in 2017, with the number of active borrowers also increasing from 1,765 in 2013 to 27,741 over the same period, of which 47.7% were women and 41.2% were youths.

It is evident that the gross loan portfolio is significantly higher than the shares mobilized. This finance gap was funded by credit lines from donor programs through the Apex Bank. Yet, there is still a huge appetite for loans that is not being satisfied as a result of shortfall in capital. This is currently a major impediment to the growth potential of the FSAs. In addition, the average OSS of the FSAs has remained above the standard 100% requirement since 2014, at 185.9% as of August 2017. However, seven of the 59 FSAs had OSS below 100% (ranging between 36% and 83%) with losses in their operations as of August 2017. The average portfolio at risk (PAR 30 days) still remains above the 5% international standard, although it has improved significantly from 17% in 2014 to 5.9% in 2017, with 26 of the 59 FSAs reporting PAR below 5% while the remaining 33 had a PAR between 5% and 18%.

In addition to being under-capitalized, other issues limiting the growth of the FSAs include non-payment of dividends to the shareholders, limited range of financial services offered by the FSAs. For instance, money for safekeeping collected by the FSAs from their clients increased from SLL 1.6 billion (USD 186,000) in 2016 to SLL 1.9 billion (USD 221,000) in 2017 indicating the need for that service by the communities. Consequently, the registration of FSAs as companies which would enable them to enlarge their scope of services, in particular for savings (currently limited to safekeeping service) is in progress. There is also an issue of high level of frauds involving nine FSAs.<sup>266</sup> To address this, the Apex Bank plans to retain an attorney to address the pending fraud cases and is also considering the possibility of employing Risk and Internal Control Officers to be posted to the FSAs to review operations on a daily basis as safeguard against fraud. More capacity building is required in credit administration. There is also a pressing need for additional training and support in credit administration for the managers of the FSAs.<sup>267</sup>

### 3.3.5 Credit Unions

Sierra Leone had a thriving cooperative movement prior to its collapse during the civil war. Following the war, the credit union movement started in 2009 with support from SEND Sierra Leone, a training program supported by the Canadian Cooperative Association (CCA) in partnership with Irish League of Credit Union Foundation (ILCUF). By 2010, 10 credit unions were in operation with a total membership of 2,000. In 2012, in order to further enhance the development of credit unions in the country, ILCUF in collaboration with CCA began to provide financial and technical support in several areas including financial management, social performance and credit control to the credit unions. ILCUF together with Co-operative Development Foundation of Canada (CDF) also provided to the National Cooperative Credit Unions Association of Sierra Leone (NACCUA SL), which was founded in 2013.

However, in May 2014, the credit union movement was again hit, and nearly wiped out when the country was struck by the Ebola crisis – people lost their businesses, credit unions closed, members used their savings to cope, and thousands died – many of whom were credit union members. After Sierra Leone was declared Ebola free in November 2015, ILCUF commenced work in re-building these credit unions and in 2017 it continued its work through an Irish Aid co-funded project. As a result of these efforts, there has been consistent growth of credit unions in the country since 2015 as presented in **Table 54**. These credit

<sup>266</sup> This concerns a total of 15 Rural Finance Institutions (six CBs and nine FSAs) for a total amount of SLL 775 million, of which only 11% has been recovered.

<sup>267</sup> "Rural Finance and Community Improvement Program (RFCIP-II): Republic of Sierra Leone," UN International Fund for Agricultural Development, (2017): <https://operations.ifad.org/documents/654016/71ddf63c-26d8-4c3f-86ff-f4a3aa393200>

unions are member-owned and are operated by a volunteer board and one or two staff. The members can make deposits and apply for loans, with typical loan requests of EUR 5 loan, while dividends are paid to the members at the end of each year.<sup>268</sup>

Table 54: Financial Performance Indicators of Credit Unions<sup>269</sup>

Indicator	Dec 2015	Dec 2016	Oct 2017	Dec 2017
Number of Credit Unions	22	27	30	31
Membership	4,825	5,498	6,406	7,033 <sup>270</sup>
Loan Portfolio (SLL billion)	3.1	3.6	-	4.6
Shares (SLL billion)	0.7	0.757	0.937	1.1
Savings (SLL billion)	2.6	3.2	3.43	4.1

Source: National Cooperative Credit Union Association of Sierra Leone

### 3.3.6 Informal Financial Institutions

A 2017 World Bank study found that 38% of adults in Africa had borrowed money from an informal FI as opposed to 5% who borrowed from a formal FI. Although informal borrowing occurs at different rates across Africa, roughly 100 million adults in Sub-Saharan Africa use informal sources of finance.<sup>271</sup> The informal financial sector often serves as a major source of savings and credit services for women, the low-income population and others who lack access to formal institutions. Informal FIs typically include individual money lenders as well as collective entities such as Rotating Savings and Credit Associations (ROSCAs) and Village Savings and Credit Associations (VSLAs), among other groups.<sup>272</sup>

Much like other African states, informal financial services are widely available in Sierra Leone (**Figure 47**). Data from this sector remains limited, largely due to the informal nature of these institutions, which does not facilitate access to information on their practices, cost standards and transaction levels. The overall lack of geographic coverage by FIs in rural areas of the country means that a significant portion of the rural population either relies exclusively on informal sources of finance at the community level or utilizes a combination of informal and formal credit and savings methods.

ROSCAs, known locally as Osusu groups, involve a scheme whereby members contribute money over a period and distribute it later or contribute over a period and give it to one person until all members collect their shares. Osusu groups are common throughout rural communities in the country. As of 2013, it was estimated that 33% of the population (mainly women) participate in the informal Osusu system. In addition, most rural areas have a moneylender who is well known in the local villages. These moneylenders make loans at short notice and without any lengthy bureaucratic procedures. However, the loans are extremely

<sup>268</sup> Irish League of Credit Unions Foundation, Annual Report 2017: <http://ilcufoundation.ie/wp-content/uploads/2018/11/ILCU-Foundation-2017-Annual-Report.pdf>

<sup>269</sup> "Credit Union increases savings to over Le 4 billion," Awoko, (June 11, 2018): <https://awoko.org/2018/06/12/sierra-leone-news-credit-union-increase-savings-to-over-le4b/>;

"Credit Unions have given loans of up to Le 3.6 billion – CCA," Awoko, (April 19, 2017): <https://awoko.org/2017/04/19/sierra-leone-news-credit-unions-have-given-loans-of-up-to-3-6-billion-cca/>; and

"Salone Credit Union celebrates success," Awoko, (October 20, 2017): <http://awoko.org/2017/10/21/sierra-leone-news-salone-credit-union-celebrates-success/?pr=67283&lang=en>

<sup>270</sup> 3,710 men and 2,689 are women

<sup>271</sup> Demircuc-Kunt, A., Klapper, L., and Singer, D., "Financial Inclusion and Inclusive Growth: A Review of Recent Empirical Evidence," World Bank Policy Research Working Paper 8040, (April 2017): <http://documents.worldbank.org/curated/en/403611493134249446/pdf/WPS8040.pdf>

<sup>272</sup> Klapper, L., Singer, D., "The Role of Informal Financial Services in Africa," Journal of African Economies, (24 December 2014): [https://academic.oup.com/jae/article-abstract/24/suppl\\_1/i12/2473408?redirectedFrom=fulltext](https://academic.oup.com/jae/article-abstract/24/suppl_1/i12/2473408?redirectedFrom=fulltext)

expensive with interest rates often as high as 25% a month flat, with physical collateral frequently demanded, and unpleasant methods sometimes employed in the collection of repayments. The ease of access and the speed of disbursement, though, do represent a level of service that other rural lenders are yet to match. While no data seems to exist on the activities of these moneylenders, their usage is very widespread in the country.<sup>273</sup>

Several factors have been identified for the continued existence and relevance of the informal financial sector. First, the formal system does not adequately cater for the financial services needs of small businesses and households. The majority of commercial banks in the country are focused primarily on urban areas and still do not want to incur the high administrative costs involved with dealing with microbusinesses, while the MFIs have restrictive lending policies and the CBs are limited in funding and capacity to serve marginalized groups.

In the event where businesses are unable to obtain the full amount from MFIs, they look to informal sources to make up for the remainder of the capital required. Also, the savings needs of microfinance clients are not fully met as there are only two deposit-taking MFIs in the country. Despite the potential of FSAs to assist in addressing the access to credit challenge, the FSA format is limited in its ability to fully capture the portion of the populace that usually relies on informal finance as only shareholders can access loans and members must have been shareholders for a certain period before they can access loans.

Another reason for the continued prevalence of informal FIs is that most Sierra Leoneans, especially the rural low-income segment of the population, do not see the need to save money with a formal FI. There is a perception amongst this segment of the population that they do not have enough money to save at a bank. In addition, low literacy levels and specifically low financial literacy rates amongst a large share of the population also contributes to the limited understanding of the need for formal financial services.

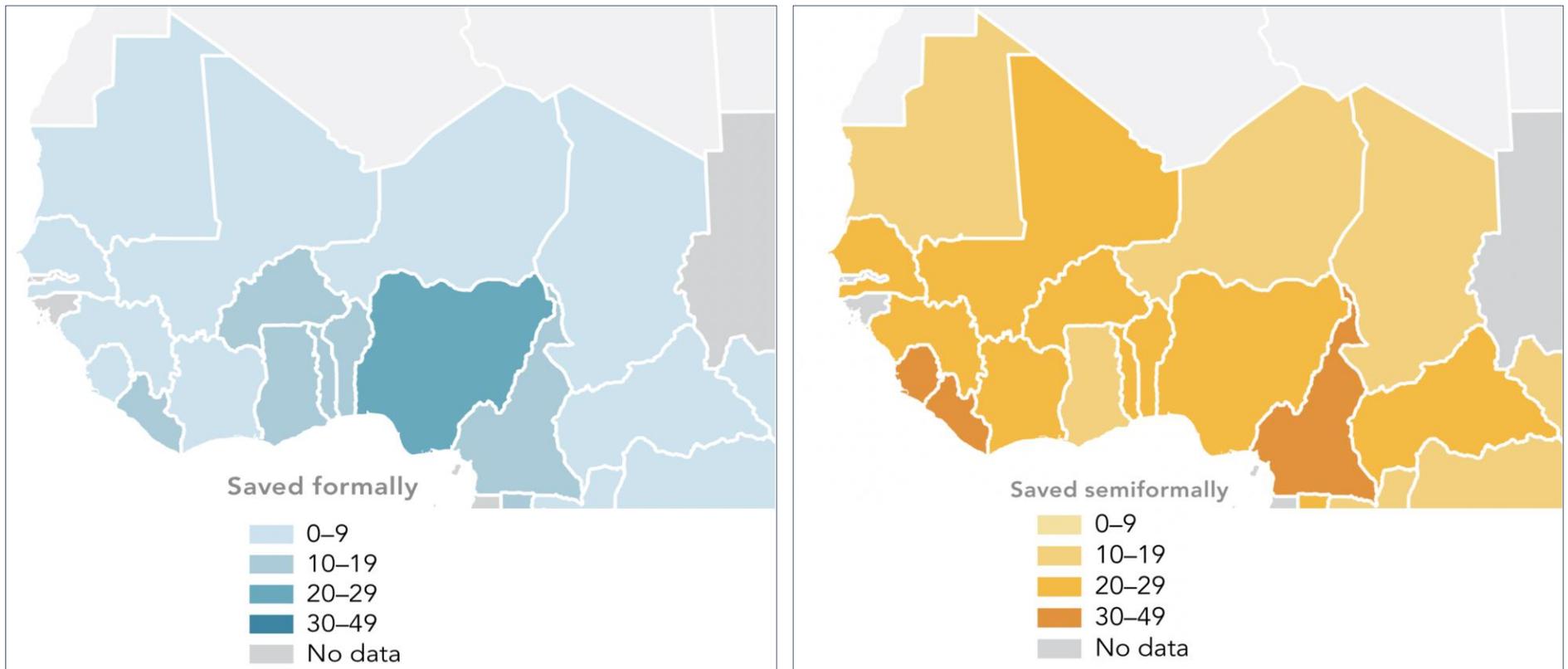
An additional contributing factor to the continued use of informal finance in the country is the interdependence between informal and formal finance. It has been found that most clients served by the microfinance sector rely on savings/loans from Osusu groups to finance their loans from MFIs, suggesting that the policy objective of eliminating the informal financial system is not being achieved. Similarly, the wealthier players in the informal sector such as the moneylenders and Osusu Masters utilize commercial banks for safe keeping of monies they have collected.<sup>274</sup> It can thus be concluded that as long as this interdependence persists, the informal financial sector will continue to exist in the foreseeable future.<sup>275</sup>

<sup>273</sup> "Sierra Leone: The Impact of the Ebola Crisis on the Microfinance Sector," Cordaid, Sierra Leone Association of Microfinance Institutions (SLAMFI) and Ayani Inclusive Financial Sector Consultants, (March 2015): [http://www.findevgateway.org/sites/default/files/publication\\_files/sierra\\_leone\\_the\\_impact\\_of\\_ebola\\_crisis\\_on\\_the\\_microfinance\\_sector.pdf](http://www.findevgateway.org/sites/default/files/publication_files/sierra_leone_the_impact_of_ebola_crisis_on_the_microfinance_sector.pdf)

<sup>274</sup> Osusu Master is the group member that is responsible for managing the funds of the Osusu group. He/she is usually responsible mostly for collecting monies from other members and also to make payments to members.

<sup>275</sup> Mahdi, I., "Informal finance in Sierra Leone: Why and how it fits into the financial system," (May 2018): [https://www.microfinancegateway.org/sites/default/files/publication\\_files/informal\\_finance\\_in\\_sierra\\_leone-working\\_paper\\_i.m\\_final\\_160718\\_1.pdf](https://www.microfinancegateway.org/sites/default/files/publication_files/informal_finance_in_sierra_leone-working_paper_i.m_final_160718_1.pdf)

Figure 47: Share of Adults Saving in the Past Year (%), 2017<sup>276</sup>



NOTE: Maps exclude Cabo Verde (no data)

Source: World Bank Global Findex Database

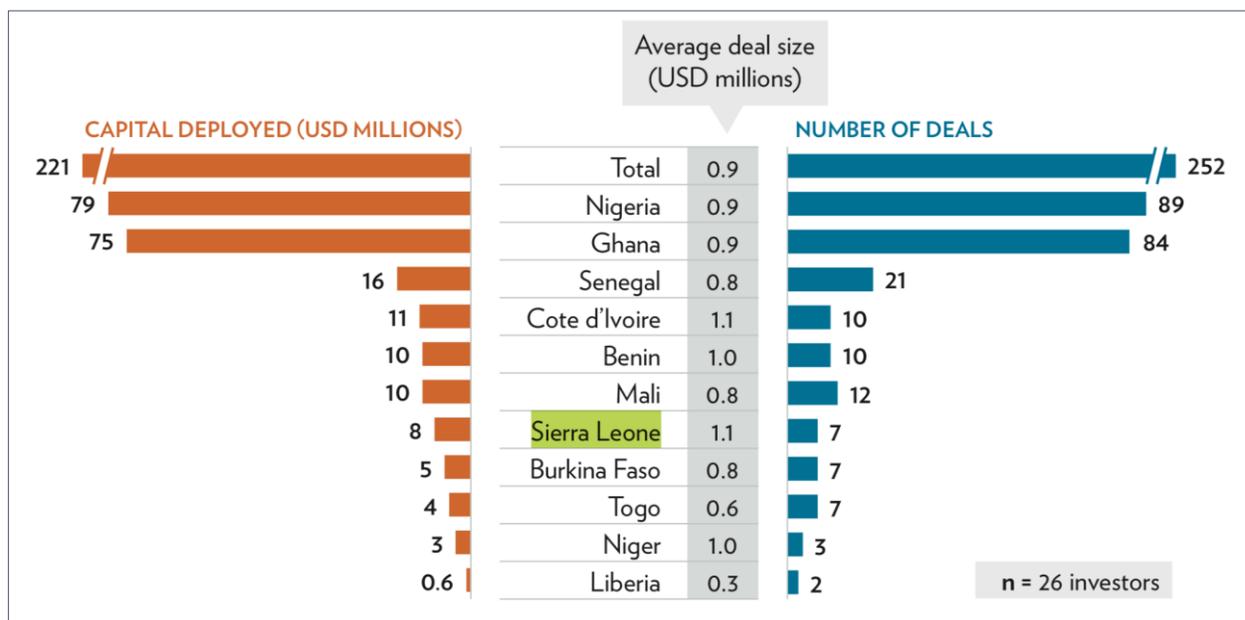
**Figure 47** shows how the savings behavior of adults varies in West Africa and the Sahel. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. Saving semi-formally is much more common than saving formally across the region, including in Sierra Leone.

<sup>276</sup> Demircuc-Kunt et al., 2017.

### 3.3.7 Impact Investors

Sierra Leone’s recovery after its civil war prompted a number of impact investors to begin investing in the country starting around 2006. An assessment carried out by the Global Impact Investing Network (GIIN) found that while impact investing steadily increased across Africa between 2005-2015, most of the investment in West Africa has been highly concentrated. During this period, impact investors deployed seven direct investments totaling USD 8 million in Sierra Leone (**Figure 48**). Most of this investment went to the country’s microfinance sector.<sup>277</sup>

Figure 48: Non-DFI Investment in West African Countries, 2005-2015



Source: Global Impact Investing Network and Dahlberg

Three impact investors have been active in the off-grid solar sector in Sierra Leone – Acumen, Gaia Impact Fund and Cordaid Investment Management (CIM).

#### ➤ Acumen

Acumen is an international impact investor providing patient capital via debt or equity instruments in early-stage enterprises that are focused on low income consumers in the healthcare, water, housing, alternative energy, or agricultural sectors. In February 2018, Acumen announced it invested in Easy Solar, a pay-as-you-go off-grid solar distribution company operating in Sierra Leone. The Easy Solar investment was the second investment under Acumen’s Pioneer Energy Investment Initiative, an effort that was launched in 2017 to help bridge the funding gap in off-grid energy and accelerate access across the developing world.<sup>278</sup>

<sup>277</sup> “The Landscape for Impact Investing in West Africa: Understanding the current trends, opportunities and challenges,” Dalberg and Global Impact Investing Initiative, (December 2015): [https://thegiin.org/assets/upload/West%20Africa/RegionalOverview\\_westafrica.pdf](https://thegiin.org/assets/upload/West%20Africa/RegionalOverview_westafrica.pdf)

<sup>278</sup> “Acumen Makes First Investment in Sierra Leone,” Acumen, (February 13, 2018): <https://acumen.org/blog/press-releases/acumen-makes-first-investment-in-sierra-leone/>

➤ **Gaia Impact Fund**

Gaia Impact Fund is a French impact investment fund specialized in renewable energy investments with a focus on start-ups, SMEs, and infrastructure projects that have a strong social and environmental focal point. Gaia partnered with Acumen to invest in Easy Solar.

➤ **Cordaid Investment Management**

CIM is the investment management subsidiary of the Catholic Organization for Relief and Development Aid, which is one of the largest development aid organizations in the Netherlands. It has operations worldwide and operates several programs in Sierra Leone covering various sectors—SMEs, agriculture, health, and microfinance. To date, CIM has provided local currency debt financing to Easy Solar and provided business development services and microfinance loans and grants to selected local SMEs. The loans have tenors of up to five years with interest rates of approximately 19%.<sup>279</sup> CIM typically requires collateral valued at 60% of the loan amount in form of personal guarantee, cash collateral, landed property and inventory/receivables. As a fund, CIM is not regulated by the BSL.

3.3.8 Crowd Funders

➤ **Kiva**

Easy Solar has successfully raised funding from the social lending crowdfunding platform, Kiva. In June 2017, Easy Solar secured a USD 30,000 no-interest loan with 14-month tenor from 588 lenders on the platform for the sales of solar lamps and solar home systems in off-grid villages in Sierra Leone.<sup>280</sup>

Easy Solar also received dollar-for-dollar match funding from UK Aid through Crowd Power. Crowd Power is a UK Aid-funded program implemented by Energy 4 Impact that was set-up with the intention to research energy access related crowdfunding in Sub-Saharan Africa and Asia and experiment with different intervention types – to test their use and effectiveness. Four incentive types were deployed over the course of the program which ran from 2015 to 2018: match funding, lump-sum payments, gift vouchers and first-loss guarantees (guarantees and co-guarantees). The program had a research and innovation budget of USD 1.35 million (GBP 850,000), funded by UK-Aid, to support various donation, reward, debt and equity campaigns.<sup>281</sup>

➤ **Kickstarter**

In May 2018, Mohamed Kamara, a local entrepreneur, raised USD 1,823 in 45 days from 34 contributors on Kickstarter to fund a social enterprise – Light Salone – aimed at deploying small-scale renewable energy systems (small hydropower, solar, wind, waste-to-energy) to rural areas of the country.<sup>282</sup>

<sup>279</sup> “Making Solar Energy Affordable Through Local Currency Debt Financing,” Cordaid, (17 September 2018): <https://www.cordaid.org/en/news/making-solar-energy-affordable-through-local-currency-debt-financing/>

<sup>280</sup> Kiva: <https://www.kiva.org/lend/1299524>

<sup>281</sup> Crowd Power: [https://assets.publishing.service.gov.uk/media/5be2c2bced915d6a105b794d/e4i\\_crowd\\_power\\_iv\\_paper\\_0.pdf](https://assets.publishing.service.gov.uk/media/5be2c2bced915d6a105b794d/e4i_crowd_power_iv_paper_0.pdf); and [https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/e4i\\_crowdpower\\_sf\\_paper\\_web.pdf](https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/e4i_crowdpower_sf_paper_web.pdf)

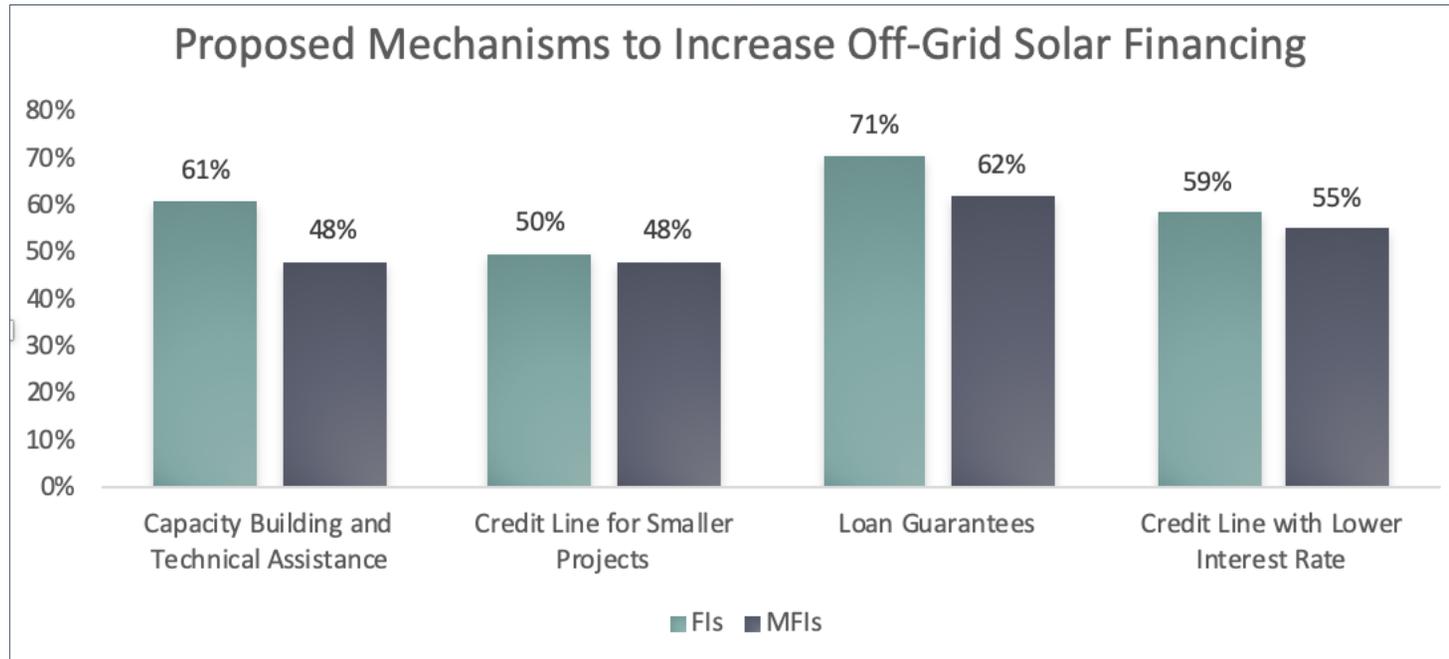
<sup>282</sup> <https://www.kickstarter.com/projects/1139664066/light-salone-small-scale-renewable-energy-for-sier/description>

### 3.4 Summary of Findings

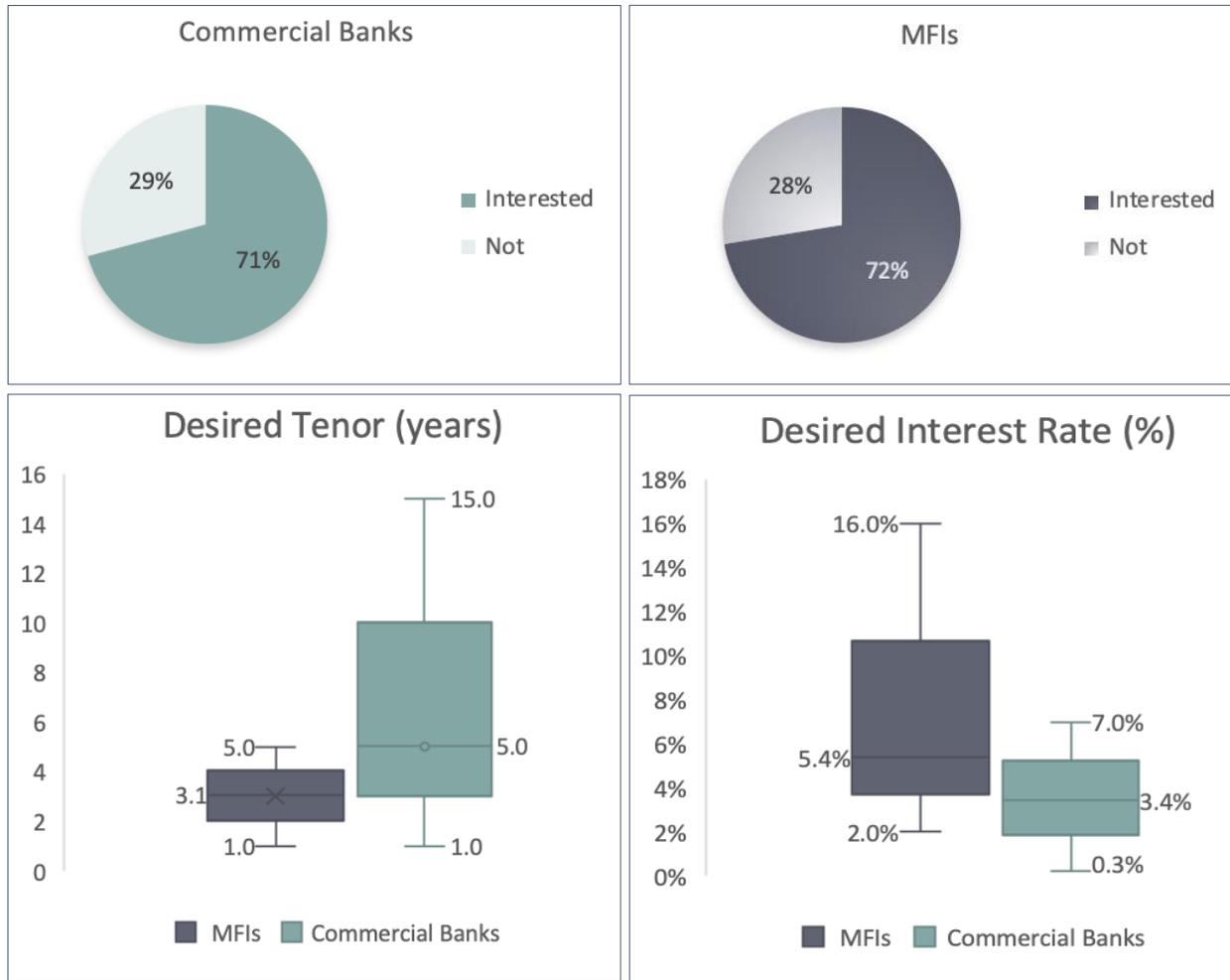
- **Opportunity for ROGEP Credit Lines:** The Sierra Leonean banking sector remains characterized by low levels of private sector credit due to increase in government borrowing. Liquidity challenges further constrain the ability of banks to extend loans to local businesses. Furthermore, all loans by local banks in Sierra Leone are required by the BSL to be denominated in local currency. However, local currency cost of capital remains so high for FIs that pricing for loans remains in the range of 18-25% for commercial banks and up to 36% for MFIs typically with very short tenors. This severely constrains OGS market lending. Taking up hard currency denominated credit lines presents severe challenges for local lenders in Sierra Leone who would have to bear the FX risk. When pricing in a hedge to cover this risk, most hard currency denominated credit lines become unattractive because the cost of capital to the FI becomes too high to provide a competitive offer to borrowers. All of the interviewed FIs stressed the need to access alternative funding options with low interest rates and longer tenors for on-lending to providers and end users/SMEs, in order to make OGS projects attractive. Stakeholder interviews suggest that there is a potential for ROGEP to place as much as USD 42 million in credit lines if priced reasonably. Hard currency denominated lines of credit from ROGEP would need to be offered at deeply concessional pricing in the range of 3-5% with tenors of 2-3 years in order to be widely accepted by FIs operating in the market.
- **Collateral Requirements:** Commercial banks in Sierra Leone typically require collateral valued at up to 150% of loan principal in form of land or real estate property. Most local OGS companies cannot meet these requirements. Therefore, the use of third-party *pari-passu* guarantees as an alternative form of collateral would enable banks to extend loans to borrowers without such high collateral requirements. Accordingly, nearly all of the interviewed FIs emphasized the need for partial credit guarantees to encourage lending to the OGS space (50% coverage is helpful; 70-80% coverage could be transformative). However, pricing from most available third-party guarantors can be in the range of 3%+ per annum, which most lenders view as too high to remain competitive. This creates an opportunity for ROGEP to either provide low-cost guarantees directly or to subsidize the premiums offered by existing third-party guarantors such as GuarantCo, Afrexim and Africa Guarantee Fund.
- **Risk Perception of New Lenders:** Although some commercial banks in Sierra Leone (e.g. UBA SL and UTB) have engaged in off-grid solar lending, most local FIs remain cautious of entering the market due to high perceived risk. In order to attract lenders to this market segment, there is a need for reasonably priced credit enhancement mechanisms. To cover these “market entry” risks for lenders that are unwilling to enter the market, guarantee instruments that cover first loss are needed. However, first-loss coverage does not address the key issue of collateral and is therefore likely insufficient on its own to stimulate growth in FI engagement unless it is coupled with third-party guarantee coverage.
- **Technical Assistance:** A well designed TA intervention is just as important as reasonably priced credit lines and credit enhancements in accelerating OGS lending in the country. All of the interviewed FIs emphasized the need for TA in various forms and most are willing to share the cost of training. Recommended key areas of focus include training of bank credit department and account representative personnel to originate deals and appropriately assess the credit risk of standalone solar firms and projects, extensive due diligence support to qualify products and approve vendors; and support to new lenders to the space in product structuring and development as well as building deal flow. The TA intervention should build upon previous programs such as USAID CEADIR. Special attention should also be paid to offering advisory services on the side of the standalone solar enterprises. Lenders opine that these entrepreneurs often do not have proper financial management and accounting systems in place, are unable to present quality financial models and lack the expertise required to structure their companies to take on debt obligations.

- **Digital Financial Services:** The advent of digital financial services and mobile money is one of the most important developments in off-grid solar market development to date, as it has allowed new and innovative business models to emerge that are now driving unprecedented growth in the sector. Mobile communication technology facilitates payments for solar products and systems (lease-to-own, pay-as-you-go) and/or for electricity usage (energy-as-a-service) and enables monitoring for operations and maintenance of equipment. Expanding access to mobile money services also creates new opportunities to better serve women, the lower-income population, and other groups that are traditionally excluded from the formal financial system. The Government should take steps to support capacity building of and foster linkages between off-grid solar companies operating in the market and key stakeholders from various sectors, including energy access policymakers and regulators, financial and telecommunications companies, mobile network operators, financial service providers (commercial banks and microfinance institutions), mobile money service providers, international organizations, NGOs and civil society groups involved in financial inclusion etc.

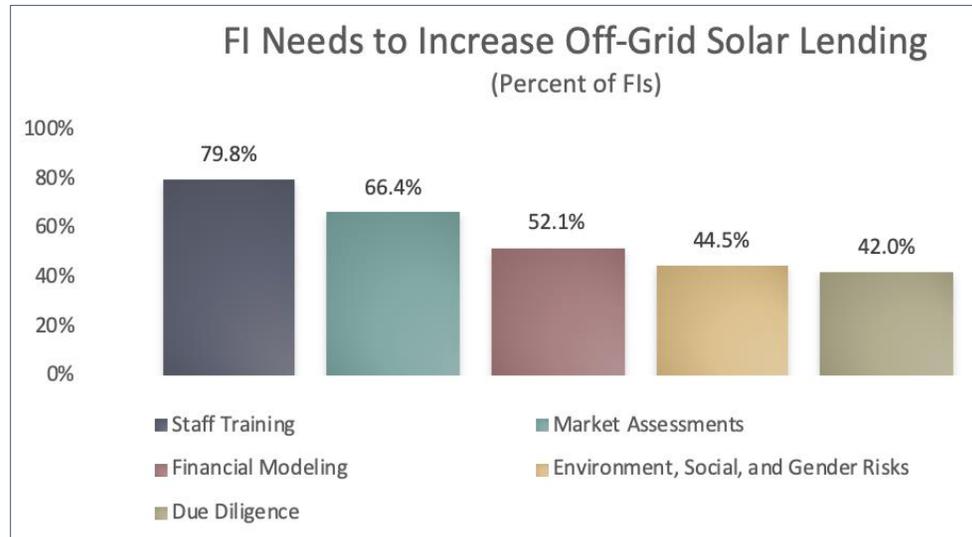
Key findings from the Task 3 FI survey activity are presented below. The results are based on feedback from a total of 121 FIs (including commercial banks, microfinance institutions and other non-bank FIs) that were interviewed across the 19 ROGEP countries. This summary only focuses on responses from commercial banks and MFIs, which together account for 92% of all respondents. See **Annex 3** for more details.



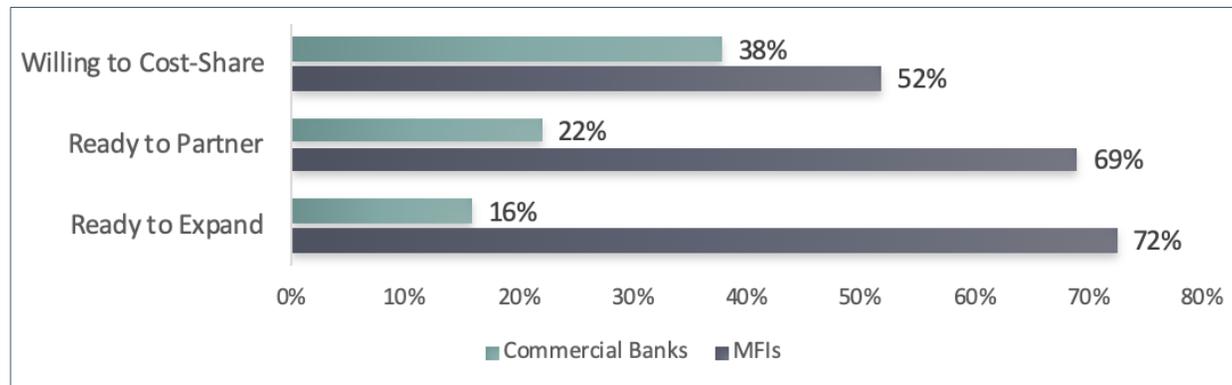
According to the survey, there is strong financial-sector interest across ROGEP countries to finance renewable energy projects, especially in off-grid solar. Commercial banks and MFIs identified loan guarantees as the most important measure that could improve their capacity to lend to the renewable energy sector. Most of the surveyed institutions also identified clear interest in credit lines.



More than 70% of surveyed commercial banks and MFIs are interested in a credit line to finance off-grid solar projects. Commercial banks want tenors of 1-15 years and interest rates from 0.25-7%. MFIs are seeking tenors of 1-5 years with interest rates from 2-16%. On average, commercial banks want a credit line with a 5-year tenor and 3.4 % interest rate, and MFIs want a 3.1-year tenor with 5.4% interest rate.



In addition to their clear interest in credit lines and loan guarantees to finance off-grid projects, surveyed financial institutions (commercial banks and MFIs) in ROGEP countries also identified several areas of internal capacity that require improvement in order to lend (or increase lending) to the off-grid solar sector.



Compared to commercial banks, MFIs reported a greater willingness to cost-share capacity building activities and a higher level of readiness to partner with solar companies and expand operations to serve rural and off-grid areas.

## ANNEX 1: TASK 1 METHODOLOGY

### STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT

Data presented in this section was collated from a range of public documents and reports as well as primary source documents either provided by ECREEE or obtained through supplemental market research (desk research and interviews with local public officials and industry stakeholders). These findings were subsequently corroborated by attendees of national validation workshops held in each country at the conclusion of the market assessment. Information obtained from the Task 2 focus group discussions and surveys of industry stakeholders (see **Annex 2**) was also used to support the Task 1 analysis.

### GIS DATA ANALYSIS APPROACH / METHODOLOGY

#### 1. Categorizations, key definitions and datasets for geospatial least-cost analysis

The main steps of the GIS analysis are as follows:

- (i) Categorization/definition of settlements: scenario 2023;
- (ii) Categorization/definition of settlements: scenario 2030;
- (iii) Definition of un-electrified settlements within grid areas; and
- (iv) Determination of population per settlement

##### 1.1. Categorization/definition of settlements: Scenario 2023

- 1.1.1. *Electrification by grid extension* – settlements which are located within 5 km of the current electrical grid network<sup>283</sup> (according to WAPP densification plans).
- 1.1.2. *Electrification by mini-grid* – settlements that:
  - Are located within 15 km of areas that have a high night-lights value (above 50/225 on grayscale raster)<sup>284</sup> and outside the buffer area established for the electrification by grid extension
  - Are located within areas that have a population density of more than 350 people per km<sup>2</sup> (as defined by Eurostat for rural areas)<sup>285</sup>, plus an additional 50 people per km<sup>2</sup> for greater feasibility of mini-grids<sup>286</sup> and are within 1 km<sup>287</sup> of a social facility (education center or health facility) and existing mini-grids of 2018.
- 1.1.3. *Electrification by off-grid stand-alone systems* – settlements that do not fall into the above categories

##### 1.2. Categorization/definition of settlements: Scenario 2030

- 1.2.1. *Electrification by grid extension* – settlements which are located within 15 km of the current electrical grid network (average distance mentioned by energy utilities in West Africa) or within 5 km of planned future line extensions<sup>288</sup> and outside the buffer area established for the electrification by grid extension

<sup>283</sup> NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)

<sup>284</sup> The 50/225 classification represents the areas emitting light of the country with reduction of scattering light. The classification was first introduced in the USAID report ZAMBIA ELECTRIFICATION GEOSPATIAL MODEL and evaluated in cross-checks throughout the country. USAID: [https://pdf.usaid.gov/pdf\\_docs/PA00T2JC.pdf](https://pdf.usaid.gov/pdf_docs/PA00T2JC.pdf)

<sup>285</sup> <http://ec.europa.eu/eurostat/web/rural-development/methodology>

<sup>286</sup> Identified in discussions with different international mini-grid developer.

<sup>287</sup> Preferred maximum distance for mini-grids from discussions with different international developer.

<sup>288</sup> NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)

1.2.2. *Electrification by mini-grid* – settlements that:

- Were defined as mini-grid settlements in scenario 2023
- Are located within 1 km of the above mini-grid settlements, which is the preferred distance of mini-grid developers for their grid according to discussions with several international developers.
- Are located within 15 km of economic growth centers – airports, mines and urban areas; average worker distance in Africa is 10 km, a distance of 5 km is added to include the growth of businesses in the periphery of the growth centers.<sup>289</sup>

1.2.3. *Electrification by off-grid stand-alone systems* – settlements that do not fall into the above categories

**1.3. Definition of un-electrified settlements within grid areas**

To identify settlements that are located close to the national electrical grid but are not served by it, the following criteria were used:

- Within the main grid line zones (see buffer zones for *electrification by grid extension* above)
- Outside 15 km night-lights of buffered areas to capture the densification within 5 years
- Within areas of low population density (less than 350 people per km<sup>2</sup>)

**1.4. Determination of population per settlement**

A key component of the least-cost analysis was the number of people living in each settlement (city, town, village, hamlet) of a given country. While there are different publicly available sources of information on total population (e.g. World Bank demographic data), a more granular view of the population distribution was necessary to perform the geospatial analysis.

Another difficulty was the identification of locations of settlements. The exact location of each settlement (with given coordinates) was not available / accessible in many of the countries. As a result, the least-cost analysis had to revert to other studies of population distribution – such as the population distribution developed by WorldPop. WorldPop utilizes a range of geospatial datasets to develop accurate population data:

*“New data sources and recent methodological advances made by the WorldPop program now provide high resolution, open and contemporary data on human population distributions, allowing accurate measurement of local population distributions, compositions, characteristics, growth and dynamics, across national and regional scales. Statistical assessments suggest that the resultant maps are consistently more accurate than existing population map products, as well as the simple gridding of census data.”<sup>290</sup>*

A Voronoi polygon analysis<sup>291</sup> was used to create boundaries for each identified settlement. These boundaries were then used in combination with the population density layer to estimate the total settlement population of the given year. The current annual national population growth rate of 2.2%<sup>292</sup> was applied to the geospatial analysis to project populations for the Scenario 2023 and 2030 analyses.

<sup>289</sup> “Africa’s Cities: Opening Doors to the World,” Lall, S.; Henderson, J.; Venables, A., World Bank, (2017): <https://openknowledge.worldbank.org/handle/10986/25896>

<sup>290</sup> <https://www.worldpop.org>

<sup>291</sup> To learn more about Voronoi polygons, see wikidot: <http://djjr-courses.wikidot.com/soc128:qgis-voronoi-polygons>

<sup>292</sup> <https://data.worldbank.org/indicator/SP.POP.GROW?locations=SL>

## 2. Summary of Key Datasets

The table below summarizes the key datasets used for scenarios 2023 and 2030 as well as the criteria applied and sources used.

Overview of Key Datasets of the Least-Cost Electrification Analysis								
Dataset	Description	Criteria used by technology						Source and Year
		Scenario 2023			Scenario 2030			
		On-grid	Mini-grid	Off-grid	On-grid	Mini-grid	Off-grid	
Electricity grid network (current)	Current national grid network (HV & MV lines)	≤ 5km distance	≥ 5km distance	≥ 5km distance	≤ 15km distance	≥ 15km distance	≥ 15km distance	EGTC, 2018 <sup>293</sup>
Electricity grid network (planned)	Future network planned to be built (HV & MV lines)	Not considered	Not considered	Not considered	≤ 5km distance	≥ 5km distance	≥ 5km distance	EGTC, 2018 <sup>294</sup>
Mini-grids	Existing mini-grids in 2018 and mini-grids with construction plans for 2018/2019	Not considered	≤ 1km distance	≥ 1km distance	Not considered	≤ 1km distance from all identified mini-grids in Scenario 2023	≥ 1km distance from all identified mini-grids in Scenario 2023	RREP, 2017 and ECOWREX, 2018 <sup>295</sup>
Night-lights	Night-time light emissions used to identify electrified areas	Not considered	≤ 15km distance	≥ 15km distance	Not considered	Not considered	Not considered	NASA Earth Observatory, 2016
Population density	Population distribution in people per km <sup>2</sup> .	≥ 350 people per km <sup>2</sup> <sup>296</sup>	≥ 350 people per km <sup>2</sup>	≤ 350 people per km <sup>2</sup>	Not considered	Not considered	Not considered	WorldPop, 2015
Settlements	Settlement layer giving location of settlements across Sierra Leone (cities, towns, villages, hamlets)	Used	Used	Used	Used	Used	Used	Bureau of Statistics, 2015

<sup>293</sup> Electricity Generation and Transmission Company (EGTC), digitized from grid map which was drawn by Yakuba Bah

<sup>294</sup> Ibid.

<sup>295</sup> Sierra Leone Rural Renewable Energy Programme (RREP), digitized by EVA; ECOWREX: <http://www.ecowrex.org/mapView/index.php?lang=eng>

<sup>296</sup> Based on Eurostat definition plus an additional 50 people per km<sup>2</sup> for greater feasibility of mini-grids as identified in discussions with different international mini-grid developer. Source: <http://ec.europa.eu/eurostat/web/rural-development/methodology>

**ECREEE: OFF-GRID SOLAR MARKET ASSESSMENT AND PRIVATE SECTOR SUPPORT FACILITY DESIGN**

Social facility: education centers	All education centers with coordinates of 2015; Indicator of active local economy	Not considered	≤ 1km distance <sup>297</sup>	≥ 1km distance	Not considered	Not considered	Not considered	Bureau of Statistics, 2015
Social facility: health centers	Hospitals, health centers, clinics and posts as collected by the Standby Task Force; Indicator of active local economy	Not considered	≤ 1km distance <sup>298</sup>	≥ 1km distance	Not considered	Not considered	Not considered	Humanitarian Data Exchange (HDX), 2015
Growth center: airport, mines, urban areas	Economic growth centers for the analysis up to 2030; Urban areas as defined by Electricity Demand	Not used	Not used	Not used	Not considered	≤ 15km distance	≥ 15km distance	airports: HDX, 2017 mines: Grid Map from EGTC, 2018 urban areas: ECOWREX website, 2015 <sup>299</sup>

<sup>297</sup> Preferred maximum distance for mini-grids from discussions with different international developer.

<sup>298</sup> Preferred maximum distance for mini-grids from discussions with different international developer.

<sup>299</sup> <http://www.ecowrex.org/mapView/index.php?lang=eng>

## ANNEX 2: TASK 2 METHODOLOGY

### OFF-GRID SOLAR PV MARKET ASSESSMENT METHODOLOGY

Focus Group Discussions (FGDs) were held in Freetown in June 2018 with key stakeholders from each of the four off-grid market segments analyzed under Task 2: (i) household, (ii) institutional, (iii) productive use, and (iv) supplier. Focus group participants included representatives from government, the donor community, NGOs, solar companies, business and industry associations, academia, community groups, and women's groups. Each market segment had its own dedicated meeting, although some stakeholders attended more than one discussion. Each FGD lasted approximately 90 minutes and covered a range of topics related to demand for off-grid solar vis-à-vis each market segment.

In addition to the FGDs, three additional survey activities were undertaken to support the Task 2 analysis: (i) a survey of large-scale international solar companies to gauge their level of interest in the country and wider region; (ii) a survey of local small-scale retail suppliers of solar equipment; and (iii) an assessment of an off-grid village to better understand how solar was being utilized for productive uses. The FGDs and surveys largely yielded qualitative inputs to supplement the quantitative analysis that was undertaken.

The methodology and assumptions utilized to assess each market segment under Task 2 is presented below.

#### 1. HOUSEHOLD DEMAND

##### 1.1 Household market segments

- 1.1.1 Total population without access to electricity was calculated using World Bank total population figures,<sup>300</sup> multiplied by electricity access rates from the International Energy Agency (IEA),<sup>301</sup> and translated to households using World Bank open data average household size. This method is used to align population data throughout the report, with IEA seen as an overarching source for energy access data and the World Bank providing important population and household income data. See **Annex 1** for more details.
- 1.1.2 Based on the country demographic and income data, the household solar market was broken down into segments by income quintile, as shown in **Section 2.1.1**. For the purpose of this analysis, income quintiles were aligned with energy tiers, as indicated by the Multi-Tier Energy Access Framework, which is roughly determined by household ability to pay for tier levels of energy. Quintiles were also aligned roughly with geographic segments.
- 1.1.3 World Bank demographic data used does not provide household income data broken down by rural, urban, on-grid or off-grid. For example, the data shows the total population falling under a certain poverty line, shows the total population that does not have access to electricity, and shows the total population that is rural, but does not cross reference any of these indicators to e.g. show the total rural population without access to electricity living under the poverty line. For this reason, assumptions were made regarding the number of households per income quintile that are off-grid (detailed in section 1.3.1 of these assumptions). It was assumed that the majority of off-grid households are rural. The data gap prevents the presentation of an overlapping map of the traditional poverty line income pyramid with electricity access.

<sup>300</sup> World Bank Open Data, 2017: <https://data.worldbank.org/>

<sup>301</sup> IEA Energy Access Outlook, 2017:

[https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_EnergyAccessOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf)

1.1.4 Tier 4 is not included in this analysis since the off-grid solar systems that can provide a Tier 4 level of service are beyond the reach of the vast majority of the population.

**1.2 Household energy expenditure and potential savings**

1.2.1 Current household expenditure on energy-related items (believed to be candidates for replacement with solar products) was estimated using information from the FGDs

1.2.2 From the existing household expenditures, “typical” monthly costs were estimated that households would incur in order to receive a standard level of electricity service according to the Multi-Tier Energy Access Framework.

1.2.3 The unit monthly costs were used for each of the energy-related items identified above.

1.2.4 The cumulative monthly expenditure was then determined for each tier.

1.2.5 Monthly expenditure by tier was compared with monthly cost associated with OGS products by tier to estimate potential household cost savings. Monthly cost for OGS products was based on representative data from Sierra Leone.

1.2.6 In the process of this analysis, the following assumptions were made:

1.2.6.1 Solar system sizes and costs:

- Cost per watt on solar systems vary greatly and have changed rapidly in the past five years. Smaller pico and plug and play systems have a much higher per cost per watt. The USD/Watt prices are based on sample cost ranges from Lighting Global equipment available on the open market.
- Average system size by watts: values are chosen as representative values for solar systems from each of the Tier values. They are intended to represent system sizes that typical members of each group would purchase.
- Average system life values represent typical expected operating life of Lighting Global products.

1.2.6.2 Current household energy usage:

Current Household Energy Usage (# Units/HH)				
Technology	Tier 1	Tier 1.5	Tier 2	Tier 3
Torch lights/Lanterns	1	2	3	
Mobile Phone Charging	1	1	2	
DC Radio	-	1	-	-
DC Music Player/Radio	-	-	1	-
Small Generator	-	-	-	1

- Numbers of units of torch lights/lanterns, cell phones, dc radio, and small generator represent the numbers of appliances that are demonstrated to be in use in typical households of each tier based on FGDs and multiple survey documents.

1.2.6.3 Current household energy costs

- Typical purchase and operation costs of HH off-grid appliances were based on FGDs, field energy surveys and reports.

### 1.3 Total Cash and Financed Market for Off-Grid Solar

1.3.1 Beginning with World Bank demographic and population data for Sierra Leone, the number of off-grid households by income quintile was derived. For this, a percentage of off-grid households by quintile was assumed, as follows:

Quintile	% Off-Grid
Highest 20%	70%
Fourth 20%	90%
Third 20%	95%
Second 20%	100%
Lowest 20%	100%

It was assumed that there is a general correlation between income and access to electricity. The highest quintile has the highest percentage of population that are both urban and connected to the grid. Evidence indicates that the vast majority of households connected to the grid are from the top two quintiles. Similarly, it was assumed that virtually all people in the bottom two quintiles are off-grid.

1.3.2 From this, average household energy expenditure was determined based on income, with the assumption that all households spend an average of 10% of their income on energy.

Average rural household expenditure on energy varies considerably. A study from Sierra Leone found that the “cost of lighting, on average, occupied between 10-15% of household incomes. Households using generators were found to spend a greater proportion of their income (upward of 20%) on lighting.”<sup>302</sup> Other research has shown household energy spending between 6-12% for low income segments in sub-Saharan Africa.<sup>303</sup> For the purpose of this research, we have assumed that households can allocate 10% of their income on average to energy.

1.3.3 The monthly energy budget for each household per quintile was calculated by multiplying monthly Household income by the assumed 10% of Household income spent on energy. Monthly Household income per month was calculated by multiplying per capita income per month by the avg. # of persons/household. Per capita income per month for each quintile is calculated by dividing the Share of the country GDP for each quintile by the population of each quintile, which is one-fifth of the country population. The share of the country GDP for each quintile is based on World Bank, World Development Indicators demographic data.

1.3.4 A simple model was used to evaluate the market using the World Bank income quintile data and average energy expenditures as input data.

1.3.5 In determining the monthly energy expenditure related to each tier, the following assumptions were made with guidance from the FGDs output:

<sup>302</sup> Lai et. al., 2015.

<sup>303</sup> 10% is an acceptable figure for lighting and cell phone charging costs for low income groups. See:

<https://www.brookings.edu/blog/africa-in-focus/2017/03/17/figures-of-the-week-benefits-of-off-grid-electricity-solutions/>

- **Tier 0:** Assumed to be an absolute energy poor household, relying solely on kerosene and charcoal both for cooking and lighting.
- **Tier 1:** The household was assumed to have access to 1 torch light/lantern powered by dry cells, charging services for a phone charged on average 8 times a month.
- **Tier 1.5:** The household was assumed to have access to 1 torch light and 1 lantern each powered by dry cells, one regular cell phone charged on average 8 times a month, and a radio powered by dry cells (assume access to 2 low quality cells) replaced 4 times a month.
- **Tier 2:** The household was assumed to have access to 1 torch light and 2 lanterns each powered by dry cells, one regular cell phone charged on average 8 times a month, and one smart phone charged on average 16 times a month, a radio/music player powered by dry cells (assume access to 4 low quality cells), replaced 4 times a month.
- **Tier 3:** The household was assumed to have access to a generator powering a number of appliances but available only for 2-3 hours a day.
- **Annualized energy costs** for each of the systems =  $([\text{Capital system cost}/\text{average system life in years}] + [\text{Monthly operating cost} * 12])$

1.3.6 The **potential market size** for each solar tier was then calculated by multiplying the number of off-grid households per quintile that will be willing to pay for each solar tier by the cost of each system (system cost is based on representative data from Sierra Leone, as shown in 2.2.5).

1.3.7 In determining the **number of off-grid households per quintile that will be willing to pay for each solar tier**, the key assumption of the model is that each off-grid household purchases only one system and that they will opt for the highest solar system tier they can afford.

- For cash purchases, the assumption was that they will be willing to save (set aside) up to 3 months (number of months can be adjusted on the 'HH Assumptions' tab) of their monthly energy budget to purchase the system.
- For PAYG/financed, the assumption was that they will be willing if their monthly energy budget is less than or equal to the monthly PAYG payment AND if the PAYG upfront payment is less than or equal to 3 months of their monthly energy budget.

1.3.8 The interest rate for consumer finance was estimated to be 30% p.a., an average based on data from the Sierra Leone Association of Microfinance Institutions.<sup>304</sup>

### 2023 and 2030 Household Demand Scenario: Assumptions

1. The GIS analysis<sup>305</sup> estimated that by 2023, 26.9% of the population will be grid connected, 31% will be connected by mini-grids while 42.1% of the population will be connected by off-grid stand-alone solutions. By 2030, the GIS analysis estimated that 62% of the population will be grid connected, 25% will be connected by mini-grids while only 13% of the population will be connected by off-grid stand-alone solutions. Based on these dynamics in the demographic patterns, coupled with the existing government plans, the following assumptions regarding the off-grid population based on the quintiles were made:

- In the 2023 scenario, it was assumed that as the grid gets extended and mini-grids are deployed (based on GIS data), the households in the quintiles with the highest income will be given priority due to their relatively higher power demand and ability to pay for power consumption.

<sup>304</sup> These terms are provided by the Sierra Leone Association of Microfinance Institutions (<http://slamfi.sl/activities-services/>). They provide a maximum lending rate of 36% and a minimum of 25%; an average of the two is used for our analysis.

<sup>305</sup> See **Annex 1** for GIS methodology

Hence, the highest quintile was assumed to have only 1% off-grid households, while the second highest quintile was assumed to have 2% off-grid households with the third quintile having 48% off-grid households. It is also assumed that virtually all the households in the bottom two quintiles remain off-grid. These assumptions have been made such that the total number of off-grid households assumed is equal to the GIS data 2023 estimate.

- Similarly, in the 2030 scenario, it was assumed that the higher income quintiles will be prioritized for electrification, based on economic considerations, above the lower quintiles. Hence, the highest four quintiles were assumed to have only 1%, 2%, 3%, and 4% off-grid households respectively, while the lowest quintile was assumed to have 55% off-grid households. These assumptions have been made such that the total number of off-grid households assumed is equal to the GIS data 2030 estimate.

Quintile	% Off-Grid (2023)	% Off-Grid (2030)
Highest 20%	1%	1%
Fourth 20%	2%	2%
Third 20%	9%	3%
Second 20%	99%	4%
Lowest 20%	100%	55%

2. Inflation rates for Sierra Leone: According to the IMF World Economic Outlook data, inflation in Sierra Leone is estimated to be at 7.2% in 2023. It was assumed that the rate will remain the same through 2030. Based on this assumption, the expected prices of the current household energy technologies and the solar alternatives were estimated using an annual price escalation factor of 1.072.
3. Based on a 2.2% population growth rate from the World Bank<sup>306</sup> and the population density dataset used in the study, the estimated total population will be 7,789,313.02 in 2023 and 9,322,463.30 in 2030.
4. The least-cost electrification analysis found that the share of the population with access to electricity via the national grid and mini-grids will be 57.9% in 2023 and 87.0% in 2030.
5. To estimate GDP, it was assumed that the current annual GDP growth rate of 5.7% will be maintained through 2023 and 2030:

Parameter	2023	2030
Population	7,789,313.02 (GIS estimate)	9,322,463.30 (GIS estimate)
GDP (constant 2010 USD)	\$4,873,976,700	\$7,184,695,387

6. According to the Lighting Global Off-Grid Solar Market Trends Report 2018,<sup>307</sup> the price of pico solar products is expected to fall to USD 10.60 in 2020 and USD 10.10 in 2022 down from USD 10.90 in 2016. Based on these 2020 and 2022 figures, the average annual decrease in prices from 2020 was estimated at 2.36%. It was assumed that the annual price decrease will be maintained at this rate through 2030 (annual cost reduction factor of 0.98)

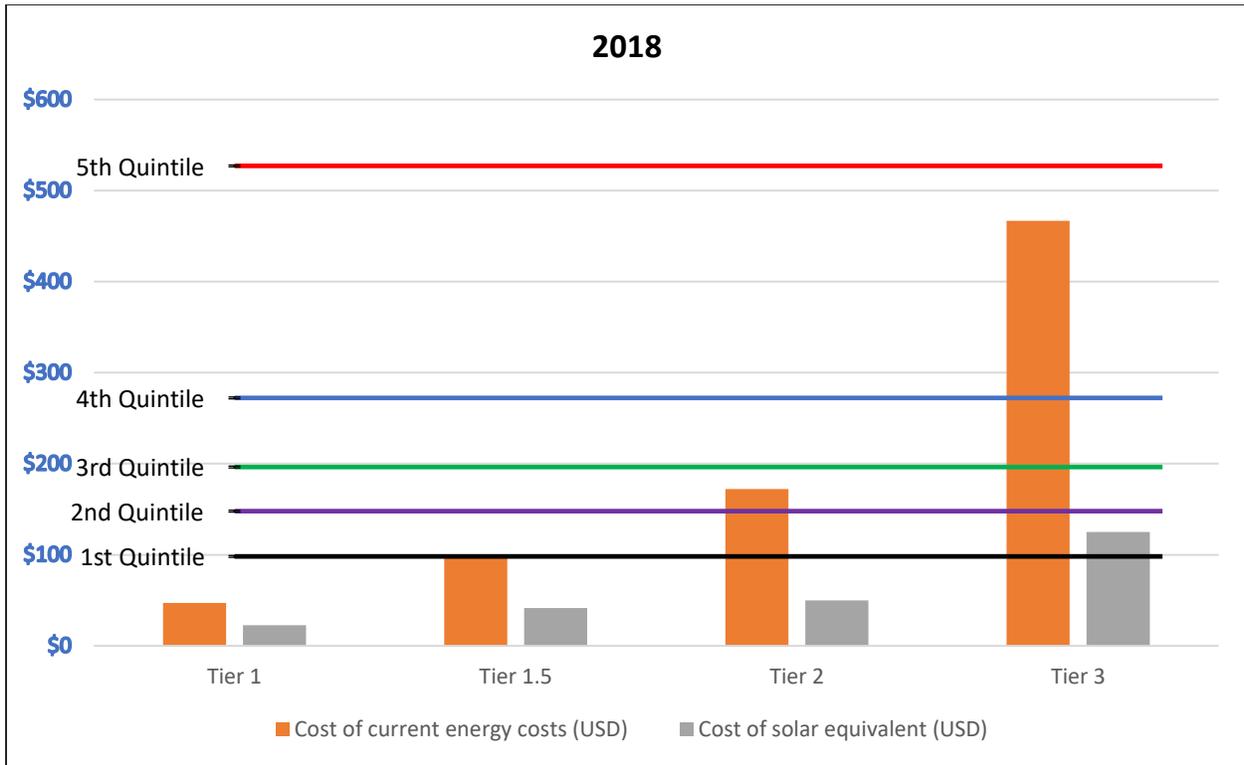
<sup>306</sup> <https://data.worldbank.org/indicator/SP.POP.GROW?locations=BJ>

<sup>307</sup> "Off-Grid Solar Market Trends Report 2018," Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018): [https://www.lightingafrica.org/wp-content/uploads/2018/02/2018\\_Off\\_Grid\\_Solar\\_Market\\_Trends\\_Report\\_Full.pdf](https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf)

7. According to the same report, the price of small SHS components is expected to fall to USD 60.40 in 2020 and USD 47.40 in 2022, down from USD 77.80 in 2016. Based on these 2020 and 2022 figures, the average annual decrease in prices from 2020 was estimated at 10.76%. It was assumed that the annual price decrease will be maintained at this level through 2030 (annual cost reduction factor of 0.89).
8. It was assumed the interest rates in Sierra Leone will stagnate at the current rate of 30% or possibly decline.

Household Cost Savings and Affordability Calculation

Annual Household Energy Budget by Quintile, Annual Energy Costs and Annual Costs of Solar Equivalents



- This analysis presents annualized costs (not including financing cost) of current energy technologies for each energy tier, compared with the annual cost of an equivalent solar product. The same analysis was also completed for the 2023 and 2030 scenarios.
- Both the annual costs of current energy technologies and equivalent solar solutions considered the capital cost of each unit as well as the operating cost over the average lifetime of a unit.

These costs were compared with a 10% monthly energy budget for households of different income quintiles. The analysis did not assess affordability for a cash vs. financed purchase over time.

## 2. INSTITUTIONAL DEMAND

### 2.1 Country Categorization

To assess institutional sector demand, the ROGEP countries were grouped into four categories based on income and population density, which are two key factors that influence the number of public service institutions in a given country. The countries were categorized as follows:

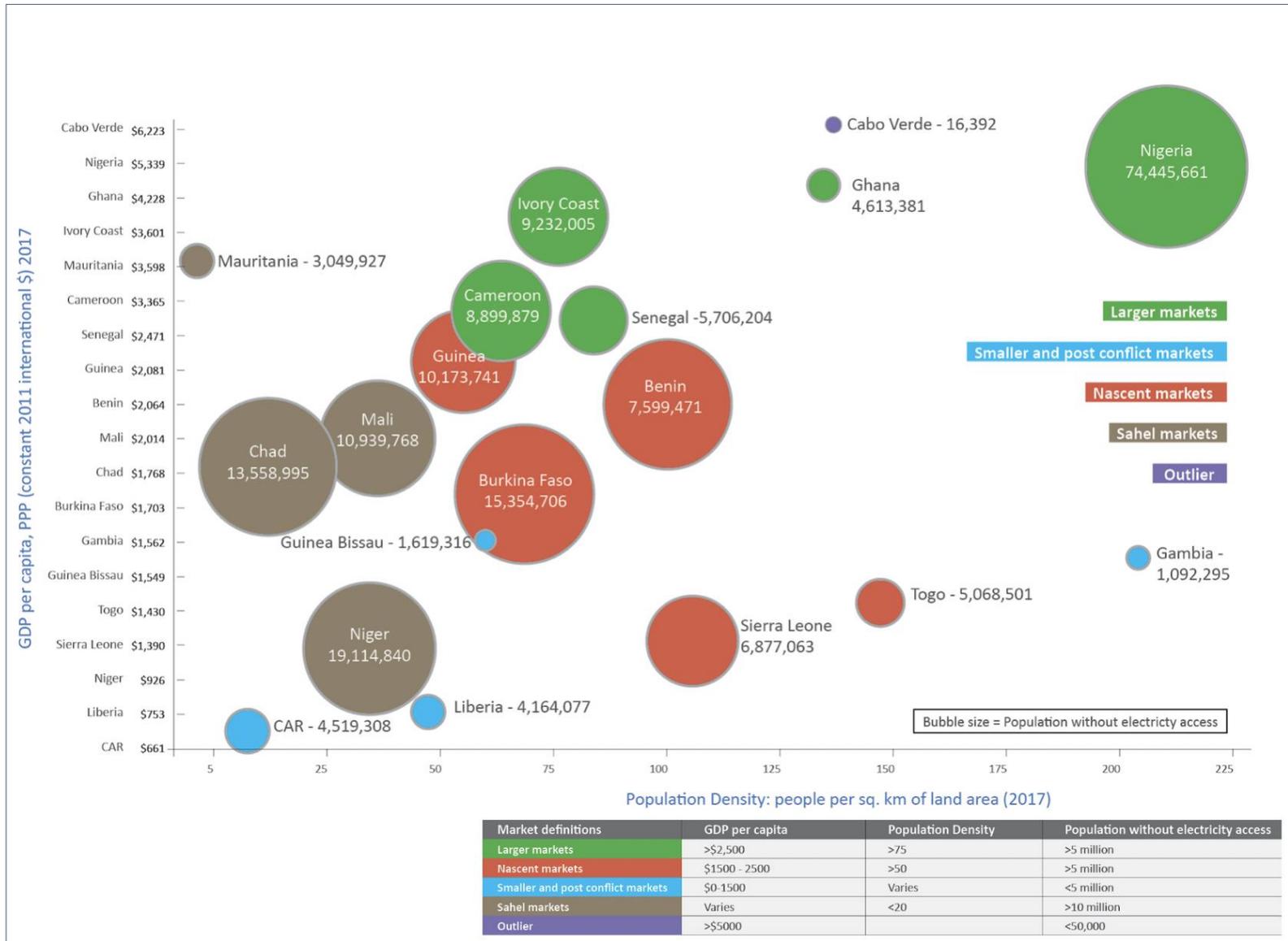
Country Categorization by Income and Population Density			
Category 1: Low-income / low population density	Category 2: Low-income / high population density	Category 3: High-income/ low population density	Category 4: High-income / high population density
Niger Burkina Faso Chad Mali Guinea Guinea-Bissau Central African Republic Liberia	Benin Sierra Leone Togo Gambia	Cameroon Côte d'Ivoire Mauritania Senegal	Nigeria Ghana Cabo Verde

These categories were used to address data gaps, as obtaining accurate and comprehensive data on the number of off-grid public institutions in many of the countries was challenging. Where data was not available, per capita assumptions based on data from similar countries in the same category were used. The following countries were used as reference countries for each category:

Category 1	Guinea, Liberia, Niger
Category 2	Benin, Sierra Leone
Category 3	Côte d'Ivoire
Category 4	Ghana

Categories are defined as follows (and illustrated in the figure below):

- Low population density: <95 people per square km of land area
- High population density: >95 people per square km of land area
- Low income: <\$2,200 GDP per capita
- High income: >\$2,200 GDP per capita



Source: African Solar Designs analysis

## 2.2 Energy Needs by Institutional Market Segment

Institutional Sector	Description	Rating (W)	Time of use (hrs)	Total Wh/day	Total Load	Recommended system (W)
<b>Water Pumping</b>						
Low power		1,500	6	9,000		1,500
Medium power		4,000	6	24,000		4,000
High power		10,000	6	60,000		10,000
<b>Healthcare</b>						
HC1 Health post	Lighting	30	8	240		
	Communication	20	8	160		
	ICT	100	8	800	1,200	250
HC2 Basic healthcare facility	Lighting	200	8	1,600		
	Maternity	200	4	800		
	Vaccine refrigeration	100	8	800		
	Communication	100	4	400		
	Medical exams	200	2	400		
	ICT	200	8	1,600		
	Staff housing	50	8	400	6,000	1,500
HC3 Enhanced healthcare facility	Lighting	400	8	3,200		
	Communication	200	8	1,600		
	Medical exams	600	2	1,200		
	ICT	300	8	2,400		
	Maternity	600	4	2,400		
	Laboratory	1,000	2	2,000		
	Sterilization	1,200	1	1,200		
	Vaccine refrigeration	150	8	1,200		
	Staff housing	200	8	1,600	16,800	4,200
	<b>Education</b>					
Primary school	Communication	20	8	160		
	Lighting	80	8	640		
	ICT	100	8	800		
	Staff house	50	8	400	2,000	500
Secondary school	Communication	20	8	160		
	Lighting	240	8	1,920		
	ICT	400	8	3,200		
	Laboratory use	100	8	800		
	Staff house	200	8	1,600	7,680	1,920
<b>Public Lighting</b>						
Street lighting	Lights	200	8	1,600	1,600	500

Source: The estimates in the table above are based on data obtained from local experts, interviews with solar industry stakeholders and corroborated by secondary desk research.

CALCULATIONS: Rating of systems is based on data for sizes of the appliances from a 2016 GIZ solar PV catalogue.<sup>308</sup> The solar PV sizing factor is based on the peak sun hours available across most of Africa.

<sup>308</sup> "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): [https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ\\_2016\\_Catalogue\\_PV\\_Appliances\\_for\\_Micro\\_Enterprises\\_low.pdf](https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ_2016_Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf)

Energy Needs Assumptions:

**Water Supply:** Power requirements (low, medium, high) are based on the type of water point:

- Borehole: 40% low power pumps; 40% medium power; 20% high power
- Protected dug well: 80% no pump; 10% low power pumps; 10% medium power; no high-power
- Unprotected dug well: No pump
- Protected spring: No pump
- Unprotected spring: No pump
- Public tap/standpipe (stand-alone or water kiosk): No pump
- Sand/Sub-surface dam (with well or standpipe): No pump
- Piped water into dwelling/plot/yard: No pump
- Rainwater harvesting: No pump

**Healthcare:** The size of the healthcare facility (HC1, HC2, HC3) determines the amount of energy each facility requires.

**Education:** The size of the school and number of students determines the amount of energy each school requires.

**Public lighting:** It was assumed that two [2] public lighting points would be required to meet the energy needs of a town/market center.

**2.3 Institutional Market Sizing Calculations**

Household systems, cost and price per watt:

System Type	Tier Rating	USD/Watt <sup>309</sup>	Average Size (Watts)	Total Cost (USD)
Pico solar system	Tier 1	\$15.00	3	\$45.00
Basic Plug and Play system	Tier 1.5	\$12.50	10	\$125.00
Small HH solar system	Tier 2	\$5.00	50	\$250.00
Medium HH solar system	Tier 3	\$2.50	250	\$625.00

Size of systems used in institutional sector market sizing calculation:

Sector	Description	Size (corrected for time of use)	HH systems
Water Supply	Low Power	1,500	N/A
	Medium Power	4,000	N/A
	High power	10,000	N/A
Healthcare	HC1	250	Tier 3
	HC2	1,500	N/A
	HC3	4,200	N/A
Education	Primary	500	N/A
	Secondary	1,920	N/A
Public lighting		500	N/A

<sup>309</sup> Cost per watt derived from African Solar Designs analysis and from IRENA:  
<https://www.irena.org/publications/2016/Sep/Solar-PV-in-Africa-Costs-and-Markets>

Institutional Sector Market Sizing Calculations:

NOTE: Prices cover only solar components (except for the HC1 tier 3 system, which comes with lighting)

Water Supply						
# of water pumps	X	Size of solar system (watts) (low, medium, high power)	X	Cost per watt for pumping (\$2.50) divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Water Supply Sector

Healthcare						
# of healthcare facilities	X		X		=	Estimated Annualized Off-Grid Solar Market Potential for Healthcare Sector
HC 1		Cost per tier 3 system (\$625)		Divided by system lifetime of 5 years		
HC 2		Size of solar system in Watts (1500W)		Cost per watt (\$2.50) divided by system lifetime of 20 years		
HC 3		Size of solar system in Watts (4200W)		Cost per watt (\$2.50) divided by system lifetime of 20 years		

Education						
# of schools	X		X		=	Estimated Annualized Off-Grid Solar Market Potential for Education Sector
Primary		Size of solar system in Watts (500W)		Cost per watt (\$3) divided by system lifetime of 20 years		
Secondary		Size of solar system in Watts (1920W)		Cost per watt (\$2.50) divided by system lifetime of 20 years		

Public Lighting						
# of off-grid market centers	X	Size of solar system in Watts (500W)	X	Cost per watt (\$3) divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Public Lighting Sector

**2.4 Data Collection Approach by Institutional Market Segment**

SIERRA LEONE			
Water Supply	Healthcare	Education	Public Lighting
GIS data	GIS data	GIS data	Per capita assumption

Data was collected on the total number of off-grid institutions by institutional market segment for Sierra Leone from a combination of available GIS data, input from local experts, stakeholder interviews and desk research. Where there were gaps in available data, per capita assumptions were made, as explained in **Section 2.2**.

Assumptions:

**Water Supply:** Of the identified potable water points, it was assumed that 50% would be equipped with a solar-powered water pump. Of the equipped water sources, the division of pumps between low, medium and high-powered pumps was: 50%, 35% and 15%, respectively. The lower cost of the low power pumps

is the driving factor for this assumption. Where this information was not available, a per capita comparison was made with a country in the same category.

**Healthcare:** Wherever possible, specific data on the number of off-grid healthcare facilities by size was used (i.e. HC1, HC2, HC3). Where this information was not available, a per capita comparison was made with a country in the same category.

**Education:** Wherever possible, specific data on the number of off-grid primary and secondary schools was used. Primary schools encompass both primary and nursery schools. Vocational schools and universities were not considered because they tend to be in cities, which are often grid-electrified. Where this information was not available, a per capita comparison was made with a country in the same category. The following per-capita assumptions were made:<sup>310</sup>

- Primary school: Per capita calculation using the off-grid population that is 0-14 years
- Secondary school: Per capita calculation using the off-grid population that is 15-19 years

**Public lighting:** Using population figures by region, and assuming that the population per market center was 5,000 people, the number of market centers was calculated. An assumption of two [2] public lighting points per market center was used in the calculation. No data on street lighting was included, as it was assumed that street lighting projects are linked to road infrastructure rather than institutions.

## 2.5 Ability to Pay Analysis (Strongest Potential Market Segment)

Data was not available to estimate the monthly energy expenditures of institutional users. Secondary data was available through government and donor program annual budgets for public services but was not comprehensive. A rudimentary analysis was undertaken based on these funding sources and compared to the total solar product market estimate for each institutional market segment in order to discuss the realistic potential market outlook based on the ability to pay. Due to a lack of data, the analysis was not able to take into account other potential sources of funding, such as funds pooled at the national or local level, fees for services etc.

<sup>310</sup> Population without access to electricity:

[https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_EnergyAccessOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf)

Population ages 0-14: <https://data.worldbank.org/indicator/SP.POP.0014.TO>

Population ages 15-19: <https://data.worldbank.org/indicator/SP.POP.1519.MA.5Y>;

<https://data.worldbank.org/indicator/SP.POP.1519.FE.5Y>

### 3. PRODUCTIVE USE DEMAND

#### 3.1 PUE Applications for Off-Grid Microenterprises (barbers and tailors)

The market sizing calculation for the barbers and tailors sector assumed that hair cutting and sewing appliances will be retrofitted to be powered by a Tier 3 DC solar system (5-year system life). By using a single price for all of the ROGEP countries, this methodology does not take into account country-specific cost and supply chain constraints.

Microenterprises					
# of financially constrained SMEs <sup>311</sup>	X	Cost per tier 3 system (\$625)	Divided by system lifetime of 5 years	=	Estimated Annualized Off-Grid Solar Market Potential for SMEs

#### 3.2 Value-Added PUE Applications

Available data from various sources such as the World Bank, the UN’s Food and Agriculture Organization and GSMA was used to estimate the potential OGS market for productive use applications in each of the analyzed market segments – solar pumping for agricultural **irrigation**, solar powered **milling** and solar powered **refrigeration**.

##### 3.2.1 Irrigation

The market sizing calculation for solar-powered irrigation was based on smallholder irrigation potential (i.e. the amount of irrigable land suitable for smallholder farmers) that could benefit from a solar pumping system (\$650, 6-year system life, 120 W system). This methodology does not take into account affordability (ability to pay) nor does it account for country-specific cost and supply chain constraints.

Value-Added PUE Applications – Solar Irrigation											
Irrigation Potential (hectare) <sup>312</sup>	X	=	Smallholder Irrigation Potential (hectare) <sup>313</sup>	Divided by 0.3 <sup>314</sup>	=	Estimated No. of Smallholder Farms Suitable for Solar Irrigation	X	\$650 (cost of solar pumping kit) <sup>315</sup>	Divided by 6 year (life of system)	=	Estimated Annualized Off-Grid Solar Market Potential for irrigation

#### Methodology for identifying areas suitable for irrigation activities on farms:

The areas for potential irrigation activities were calculated using the visible cropland<sup>316</sup> adjacent to permanent surface water sources. As identified by experts in a study in Zambia<sup>317</sup> and based on other expert consultations, beyond a 5 km distance from surface water, the returns are not economically feasible. **Figure 30** is a map of the cropland within a 5 km distance from permanent surface water.

<sup>311</sup> “MSME Finance Gap,” SME Finance Forum: <https://www.smefinanceforum.org/data-sites/msme-finance-gap>

<sup>312</sup> AQUASTAT – Food and Agriculture Organization: <http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en>

<sup>313</sup> Assumption that 25% of irrigable land irrigated by smallholder farmers;

See: “Lessons Learned in the Development of Smallholder Private Irrigation for High Value Crops in West Africa,” World Bank, (2011): [http://siteresources.worldbank.org/INTARD/Resources/West\\_Africa\\_web\\_fc.pdf](http://siteresources.worldbank.org/INTARD/Resources/West_Africa_web_fc.pdf)

<sup>314</sup> Assumption that smallholder private irrigation consists of small farms (0.3 hectare);

See: “Off-grid Solar Market Assessment in Niger and Design of Market-based Solutions,” World Bank, (December 2017): <https://www.lightingafrica.org/publication/off-grid-solar-market-assessment-niger-design-market-based-solutions/>

<sup>315</sup> 120W solar pumping kit: <https://futurepump.com/futures-bright-farmers-kenya/>

<sup>316</sup> “Prototype Land Cover Map over Africa at 20m Released,” Esa, (February 2018): <https://www.esa-landcover-cci.org/?q=node/187>

<sup>317</sup> “Zambia Electrification Geospatial Model,” USAID and Power Africa, (April 2018): [https://pdf.usaid.gov/pdf\\_docs/PA00T2JC.pdf](https://pdf.usaid.gov/pdf_docs/PA00T2JC.pdf)

### 3.2.2 Milling

The market sizing calculation for solar-powered milling utilized a series of inputs from the UN Food and Agriculture Organization to estimate the smallholder milling potential that could benefit from a 6.5 kW solar powered milling system (20-year system life). Cereals (e.g. rice, maize, millet and sorghum) as well as roots and tuber crops (e.g. cassava, yams and potatoes) were analyzed, as they provide an opportunity for value addition through hulling or milling.

Value-Added PUE Applications – Solar Milling													
Cereals, roots tuber crops (tons) <sup>318</sup>	X	70% <sup>319</sup>	X	50% <sup>320</sup>	=	Smallholder Milling Potential (tons)	Divided by 2 tons per day X 70% capacity factor <sup>321</sup>	=	Estimated No. of Solar Mills	X	6,500 W x \$2.50 per watt Divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Milling

Ultimately, the ability for an agricultural community to benefit from productive use applications has as much to do with access to markets and improved crop inputs, as it has to do with the pricing and availability of financing to purchase the equipment. Hence, the macroeconomic approach used to carry out this market sizing does not account for country-specific cost and supply chain constraints.

### 3.2.3 Refrigeration

The market sizing calculation for solar-powered refrigeration utilized the estimated number of off-grid market centers in each country to estimate the number that could benefit from a 5.5 kW solar refrigeration system (20-year system life).

Value-Added PUE Applications – Solar Refrigeration							
# Off-Grid Market Centers by country <sup>322</sup>	X	5,500 W <sup>323</sup>	X	\$2.50 per watt	Divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Refrigeration

### 3.3 PUE Applications for Connectivity/Mobile Phone Charging Enterprises

The market sizing calculation for solar-powered phone charging enterprises was based on each country’s mobile phone penetration rate (number of unique subscribers), rural population rate, and the average costs of OGS phone charging appliances (\$862, 5-year system life, 400 W system).

Mobile Phone Charging Enterprises							
# of Mobile Phone Subscribers in 2017 <sup>324</sup>	X	% rural population	Cost of solar phone charging appliances* divided by lifetime of 5 years	X	0.01 (assuming 1 phone charger per 100 mobile phone users)	=	Estimated Annualized Off-Grid Solar Market Potential for Phone Charging Enterprises

<sup>318</sup> Food and Agriculture Organization: <http://www.fao.org/faostat/en/#data/RF>

<sup>319</sup> Assumption that 70% of crops are milled

<sup>320</sup> Assumption that 50% of milled crops are processed at smallholder farmer level

<sup>321</sup> Solar mill (6.5 kW system) can mill 2 tons of produce per day; assume capacity factor of 70% (for maintenance/seasonality)

See: “Off-grid Solar Market Assessment in Niger and Design of Market-based Solutions,” World Bank, (December 2017):

<https://www.lightingafrica.org/publication/off-grid-solar-market-assessment-niger-design-market-based-solutions/>

<sup>322</sup> <https://www.citypopulation.de>

<sup>323</sup> 5.5kW solar powered refrigeration system – See: <https://www.deutschland.de/en/solar-powered-coldhubs-nigeria>

<sup>324</sup> “The Mobile Economy, Sub-Saharan Africa,” GSMA Intelligence, (2017):

<https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download>

\* Indicative Costs for Phone Charging Appliances<sup>325</sup>

Charging Stations	Cost (USD)	Manufacturer
Charging ECOBOXX Qube (sizes - 50) 5Wp panel	\$83	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Charging ECOBOXX Qube (sizes - 90) 10Wp panel	\$205	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Charging ECOBOXX Qube (sizes - 160) 2*10Wp panel	\$209	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station ECOBOXX 300	\$681	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station ECOBOXX 600	\$965	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable Charging Station ECOBOXX 1500	\$1,532	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station BOSS Kit Portable	\$3,025	Phaesun GmbH
Charging Sundaya Charging Station	\$193	Sundaya
<b>Average Cost</b>	<b>\$862</b>	

Source: GIZ and African Solar Designs analysis

Identifying areas of phone network coverage

The mobile phone network geographic coverage was mapped across each country (**Figure 32**). The source for this data is GSMA, which gives a radius ranging between 2-30 km. The radius is affected by a number of variables including tower height, power output, frequencies in use, and antenna type. Since this does not indicate the quality of network, the data was compared with data from OpenSignal, which tracks the signal from users registered on the platform.



Green: Strong Signal (>-85dBm)

Red: Weak Signal (<-99dBm)

Source: Open Data Signal

<sup>325</sup> "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): [https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ\\_2016\\_Catalogue\\_PV\\_Appliances\\_for\\_Micro\\_Enterprises\\_low.pdf](https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ_2016_Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf)

#### 4. SUPPLY CHAIN ANALYSIS

The Task 2 supply chain analysis was based on the following key sources of data:

- Supplier focus group discussions held in Freetown in June 2018
- Survey of 10 locally-based solar companies/suppliers in the country
- Survey of 10 larger international solar product suppliers
- ECREEE supplier database
- GOGLA semi-annual sales reports<sup>326</sup>
- Additional supplemental desk research and solar industry stakeholder interviews

These findings were subsequently corroborated by attendees of national validation workshops held in each country at the conclusion of the market assessment.

A list of identified solar companies that are active in Sierra Leone is included below:

1	Aptech
2	Axitex
3	Azuri Technologies/Teleficient
4	Barefoot Women
5	BBOX Agent
6	d.Light
7	Easy Solar
8	Energy Efficient Solutions, EES
9	Energen Wao
10	FLS Power
11	Forsera
12	GCL Solar
12	Greenlight Planet
13	Helios
14	Hollandio
15	Hoppecke
16	Omnivoltaic
17	SMA
18	Solar Era
19	Synergy Sierra Leone
20	Sun King
21	Suntech
22	Victron
23	Western Arica Off-grid (WAO)
24	World Hope International Mobile Power

Source: ECREEE, Focus Group Discussions; Stakeholder interviews

<sup>326</sup> “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (January – June 2018): [https://www.gogla.org/sites/default/files/resource\\_docs/global\\_off-grid\\_solar\\_market\\_report\\_h1\\_2018-opt.pdf](https://www.gogla.org/sites/default/files/resource_docs/global_off-grid_solar_market_report_h1_2018-opt.pdf)  
 “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (July – December 2017): [https://www.gogla.org/sites/default/files/resource\\_docs/gogla\\_sales-and-impact-reporth2-2017\\_def20180424\\_web\\_opt.pdf](https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf)  
 “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (January – June 2017): [https://www.gogla.org/sites/default/files/resource\\_docs/gogla\\_sales-and-impact-reporth12017\\_def.pdf](https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth12017_def.pdf)  
 “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (July – December 2016): [https://www.gogla.org/sites/default/files/recource\\_docs/final\\_sales-and-impact-report\\_h22016\\_full\\_public.pdf](https://www.gogla.org/sites/default/files/recource_docs/final_sales-and-impact-report_h22016_full_public.pdf)  
 “Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data,” GOGLA, Lighting Global and World Bank, (January – June 2016): [https://www.gogla.org/sites/default/files/recource\\_docs/global\\_off-grid\\_solar\\_market\\_report\\_jan-june\\_2016\\_public.pdf](https://www.gogla.org/sites/default/files/recource_docs/global_off-grid_solar_market_report_jan-june_2016_public.pdf)

## ANNEX 3: TASK 3 METHODOLOGY

### FINANCIAL INSTITUTION ASSESSMENT

Data collection under Task 3 included a combination of desk research, collaboration with local experts, and extensive stakeholder engagement with key officials and representatives from local and regional commercial banks, microfinance institutions and other development banks and agencies in Sierra Leone. Interviews were also conducted with regional development banks (namely BOAD and EBID) and other financiers active in the African off-grid solar sector, including ECAs, trade funders, crowd funders and impact investors.

The stakeholder engagement activity, which included both phone interviews as well as in-person meetings with key representatives from each FI, was undertaken across the 19 countries with extensive support from ECREEE. As a follow up to each interview/meeting, a questionnaire was administered in order to gather critical data on each institution, including *inter alia* their level of experience and capabilities with off-grid sector lending, SME and consumer lending, relationships with local and international partners etc. Feedback from the interviews and questionnaire, as well as quantitative data from each bank's published annual reports, was compiled and analyzed in order to assess which FIs could be most suitable local partners / implementing agents for the proposed ROGEP facility.<sup>327</sup>

The questionnaire that was administered to FIs in the country and across the ROGEP region is included below.<sup>328</sup> The results of the survey are summarized in **Section 3.4**.

- Has the bank provided any loans to any segment of the off-grid sector? If so, please describe.
- Has the bank received any inquiries from any segment of the off-grid sector? How many inquiries?
- Did the bank engage in serious discussions or dismiss the inquiry(ies) as not within the bank's area of lending or not interesting as a new business line? If dismissed, please provide the bank's reasons.
- If the bank engaged in serious review/discussions and rejected the opportunity, please describe the bank's due diligence approach and reasons for rejection.
- Is the bank interested to pursue lending to any segment of the off-grid sector? Which segment and which of the bank's departments and existing products apply?
- Describe the bank's current loan products and lending activity for the SME, Corporate, Consumer and Agri markets. Please provide rough figures on volumes in number of loans and value in each category. For each category please provide average margins, pricing, loan tenors to borrowers, collateral requirements.
- Does the bank have a structured finance department? Has the bank provided financing to any IPPs? If so, please provide details on the transactions (location, technology, size, maturity, portion of bank engagement in the total financing)
- Does the bank have a trade finance department? What are standard terms and conditions? What are the volumes in number of loans and values?
- Does the bank operate nationwide or only in certain regions? Does the bank have a presence in rural areas and is rural consumer and SME and Agri lending a key business focus?
- Does the bank have experience with managing DFI credit lines? In which sectors/departments? Which DFIs? What volumes? Were the lines fully committed and disbursed? What was the bank's overall experience with these credit lines?
- Has the bank had dealings with the ECOWAS Bank for Investment and Development (EBID)? What type of relationship? Credit lines? Co-lending? Credit enhancement? Have the experiences been positive?
- What is the bank's view on accepting hard currency credit lines and on-lending in hard currency? Would the bank hedge hard currency credit lines and on-lend in local currency?

<sup>327</sup> The results of this assessment and corresponding recommendations were prepared for ECREEE in a separate, confidential report.

<sup>328</sup> The survey was adapted based on the type of FI that was being interviewed (commercial banks, MFIs, Regional Development Banks)

- Is the bank interested to explore a credit line with ROGEP? What size of credit line would the bank be comfortable launching with initially?
- Does the bank feel that it would need a third-party guarantee in order to reduce risk enough to make loans to off-grid enterprises? If so, would it be enough if a guarantor were to cover 50% of losses on par with the bank? Or will the bank need the guarantor to take the first 10-20% of losses in an off-grid loan portfolio?
- What pricing does the bank consider to be fair and affordable for third party pari-passu guarantees? For first loss coverage?
- Has the bank had experience with any of the following as guarantors on the bank's loans: Africa Guarantee Fund, Africa Trade Insurers, Afrexim Bank, GuarantCo, IFC, USAID DCA? Has their pricing been fair and affordable? Does the bank have any preference in working with one over the others?
- To engage in lending to the off-grid market segments, would Technical Assistance be helpful? What types of TA would be most useful? Outside consultants to help design specific loan products and underwriting guidelines for the off-grid sector? Outside consultants to develop deal flow and conduct due diligence? Training of bank credit department and account representative personnel? Direct funding to the bank to develop marketing and promotional materials and hire staff?
- Does the bank adhere to and is in compliance with all aspects of the Basel II and III accords?
- Does the bank adhere to and have implemented controls for the Equator Principals and the World Bank/IFC Environmental and Social Standards?

## ANNEX 4: GENDER ASSESSMENT

### 1. Context and Purpose of the Gender Analysis

Within the context of this assignment, a gender-focused analysis was undertaken to assess the level of participation of women in each country's off-grid energy sector. This analysis is critical to the overall market assessment given the clear linkages between energy and gender, namely different rates of access and use as well as the impacts of energy sources and appliances in the home, community and wider society. Energy sector studies often fail to obtain gender-disaggregated data, which is necessary to inform policymakers and better understand the needs and priorities of women in the context of sustainable development.

Women in energy-poor households are at substantially higher risk of illness attributable to indoor air pollution and solid fuel (biomass) use.<sup>329</sup> Moreover, the significant time burdens that women and girls face in collecting fuel and water, cooking and processing food often keep girls from attending school; there is evidence that electrified milling equipment and water pumps can significantly reduce this burden. Lack of access to electricity also means that women do not have access to information and communication technologies that could improve their lives.<sup>330</sup>

As a region, West Africa and the Sahel has remained traditionally gender-stratified whereby males on average have greater access to resources, are more empowered by society and have more opportunities than women.<sup>331</sup> To address these challenges, governments across the region have adopted a range of policies to improve gender equality and promote gender mainstreaming. Member states of ECOWAS have adopted a Policy for Gender Mainstreaming in Energy Access, an initiative committed to promoting favorable policies and frameworks and mobilizing resources to more fully engage women in all areas of energy access, including as energy suppliers, planners, financiers, educators and customers.<sup>332</sup> ECREEE, the agency that is administering this policy throughout the region, is supporting implementation of regulatory and institutional measures that aim to improve inclusive energy access in each country by 2030. ECREEE has also partnered with AfDB to launch a separate regional initiative to advance the participation of women entrepreneurs in the renewable energy sector.<sup>333</sup>

Outside of ECOWAS, Cameroon, Chad and Central African Republic are pursuing gender mainstreaming at a regional level through the Economic Community of Central African States (ECCAS) Regional Policy for universal access to modern energy services and economic and social development (2014-2030).<sup>334</sup> Mauritania is also implementing a national policy to address this issue – the National Strategy of Institutionalization of Gender (la Stratégie Nationale d'institutionalisation du genre).

<sup>329</sup> "The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa," UNDP and World Health Organization, (2009): <http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Sustainable%20Energy/energy-access-situation-in-developing-countries.pdf>

<sup>330</sup> Rewald, R., "Energy and Women and Girls: Analyzing the needs, uses, and impacts of energy on women and girls in the developing world," Oxfam, (2017): <https://www.oxfamamerica.org/static/media/files/energy-women-girls.pdf>

<sup>331</sup> "Situation Analysis of Energy and Gender Issues in ECOWAS Member States," ECREEE, National Energy Laboratory, (2015): <https://www.seforall.org/sites/default/files/Situation-Analysis-of-Energy-and-Gender-Issues.pdf>

<sup>332</sup> Ibid.

<sup>333</sup> "Feasibility study promotes women's participation in energy transition," ESI Africa, (May 7, 2018): <https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/>

<sup>334</sup> "Central Africa Regional Integration Strategy Paper," African Development Bank, (2011-2015): <https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/RISP%20CENTRAL%20AFRICA-ECCAS%20English%20FINAL.pdf>

➤ **Description of Approach / Methodology**

While the data collection for this assignment was not sex dis-aggregated (which was beyond the scope of work), a gender-focused perspective was applied to the overall analysis. The methodology adopted to carry out this exercise included a combination of desk research, literature review, FGDs and face-to-face interviews with key gender “focal points” identified by ECREEE in each country. Representatives from women’s groups, female-led businesses and energy sector organizations attended the focus group meetings that were held in Freetown in June 2018 to share their insights and inform the overall market study. A gender questionnaire was also distributed to key stakeholders in Sierra Leone to assess the main barriers/constraints for inclusive participation in the country. The survey was structured to assess each market segment analyzed under Task 2 and examined a number of key gender issues, including *inter alia* access to credit, access to education and information, entrepreneurial and income-generating activities for women (including productive use of energy), representation of women in leadership positions in business and government.

➤ **Gender Questionnaire**

The following questionnaire was administered to key stakeholders in each country. Respondents were asked to reply Yes/No to each question and elaborate as needed.

**HOUSEHOLD**

Are women generally involved in influencing decisions on household energy use/services?

Are off-grid solar solutions (E.g. solar lanterns, solar home systems) largely accessible/made available to the household sector, particularly women-headed households?

Are there any related programs and initiatives (donor, government, private sector, NGO etc.) that are specifically targeting energy access for women in the household sector?

Are off-grid solar products and services generally affordable for households headed by women? If not, are Microfinance Institutions or other organizations in the country providing credit/financing (grants/loans) to the household sector, particularly women-headed households to increase energy access?

Are women aware of the health impact of unclean energy (e.g. fuel-wood for cookstoves) and the solutions (i.e. solar) to address it?

**COMMUNITY/INSTITUTIONAL**

Are women represented in any high-level energy sector positions? Please provide names/examples, if available, of women in senior management positions in government, committees, boards etc.

Is the mobility and safety of women constrained due to poor energy services (e.g., unavailability of streetlights due to unreliable electricity supply)?

**PRODUCTIVE USE**

What kind of productive use activities do women engage in and what women-led productive use activities can be supported by off-grid solar solutions?

- Agriculture (irrigation, water pumping etc.)
- Shops (retail, artisanal/handicrafts, grocery, salons etc.)
- Restaurants (bar, cafe etc.)
- Kiosks (e.g. mobile money etc.)
- Tourism
- Other

**SUPPLIER**

Please describe the level of engagement that women have in in the off-grid energy services sector. Are women highly employed in this area (e.g. is there data collected on the number of women-owned businesses/SMEs)?

Are there any related programs and initiatives (donor, government, private sector, NGO etc.) that provide training for women to manage or be employed by energy-related enterprises?

**ADDITIONAL:**

What are the main barriers women face to access information?

What are the main barriers/constraints for women entrepreneurs to have access to credit?

Do women have equal access to capacity building and training services (e.g. vocational training/technical education) or do they experience discrimination in access to these services?

What policy, regulatory and institutional framework(s) exist, if any, to address gender mainstreaming<sup>335</sup> (e.g. national gender action plans/related policies etc.)?

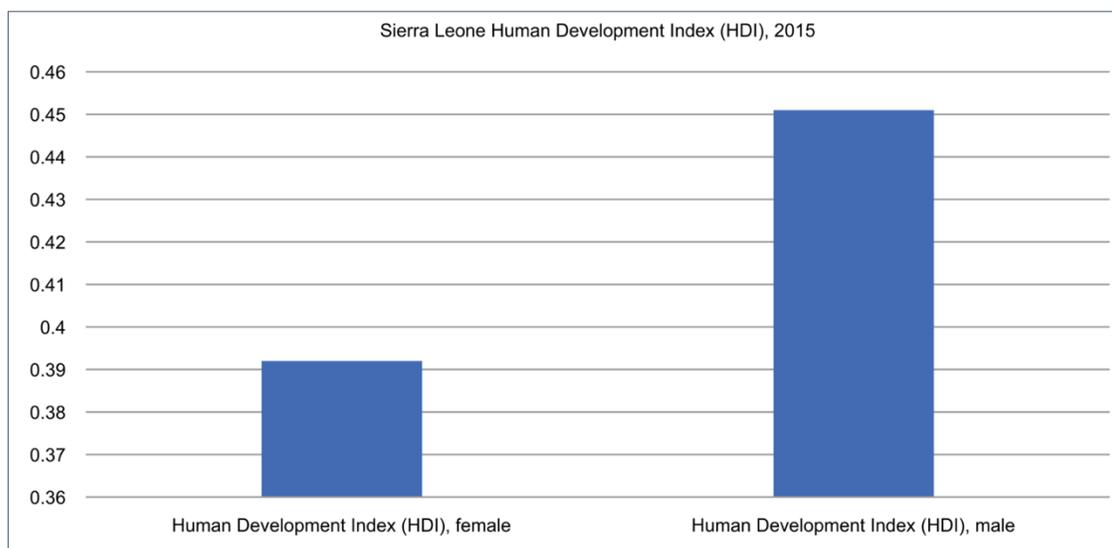
Are gender-related issues taken into consideration in energy policy provisions and/or are energy-related issues reflected in gender policies (e.g. existence of ‘gender units’ within public sector agencies and/or ‘gender audits’ in energy sector)?

**2. Gender Profile**

**2.1 The state of gender equality in Sierra Leone**

In post-war Sierra Leone, structural inequalities and gender discrimination against women and girls persist, as inclusive participation remains an ongoing challenge. The gender assessment found that while there have been modest improvements in recent years to certain social indicators such as access to primary education as well as healthcare, gender disparities still exist across the economy, particularly in access to resources, higher education, land ownership, inheritance systems, political power and decision-making. These findings are supported by UNDP Human Development Index (HDI) rankings, which reveals that women in Sierra Leone have a far lower HDI than men.<sup>336</sup>

Sierra Leone Human Development Index by Gender



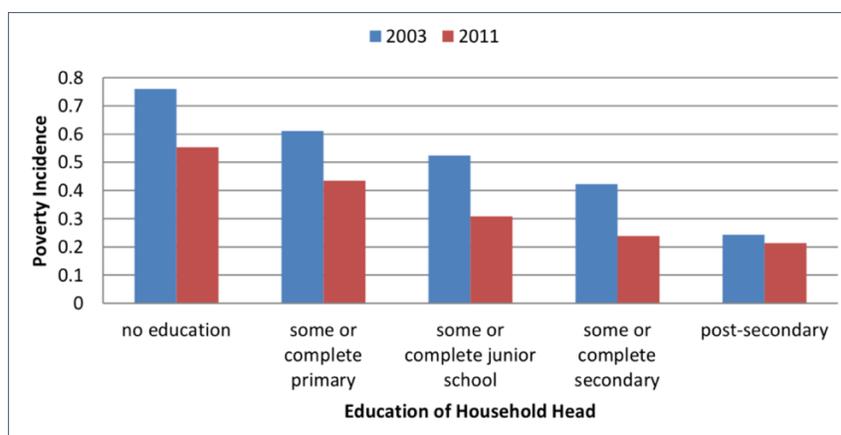
Source: UN Human Development Indicators

<sup>335</sup> **Gender mainstreaming:** The process of ensuring that women and men have equal access to and control over resources, development benefits and decision-making, at all stages of development process, projects, programs or policy.

<sup>336</sup> “National Gender Profile of Agriculture and Rural Livelihoods: Sierra Leone,” Food and Agriculture Organization of the United Nation, (2018): <http://www.fao.org/3/I9554EN/i9554en.pdf>

## 2.2 Gender and poverty

Unlike many countries in the region, more than half of Sierra Leone’s population lives in urban areas (mainly in Freetown and its surrounding areas). Although rates of poverty have gradually decreased, poverty remains widespread, particularly in rural areas. An estimated 75% of the labor force is considered working poor at PPP USD 3.10/day.<sup>337</sup> Female access to education and enrollment rates in Sierra Leone remain low compared to men. This has troubling implications given the relationship between education and poverty – a 2014 analysis carried out by Statistics Sierra Leone examining poverty in the country found that households with lower levels of education of the head are more likely to be poor.<sup>338</sup>



Source: Statistics Sierra Leone and World Bank

A 2015 Census found that female-headed households are more exposed to poverty than those headed by their male counterparts, with fewer female-headed households in paid employment to provide resources for improved quality of life for members of the household (e.g. access to electricity, education etc.)<sup>339</sup>

## 2.3 Gender, Human Capital and Economic Empowerment

### 2.3.1 Education, Skills Development and Training

Sierra Leone remains among the lowest ranked countries in the world in a wide range of UN Human Development Indicators.<sup>340</sup> A 2011 study found that 64% of women had never attended formal school compared to 47% of men.<sup>341</sup> The disparity was higher in rural areas compared to urban areas – 73% compared to 31%. While the education gap between boys and girls in primary school has improved to reach parity, gaps still exist in higher levels of education – according to the UNDP, as of 2017 only 19.2% of women aged 25 and older had at least some secondary education compared to 32.3% of men.<sup>342</sup>

<sup>337</sup> “UN Human Development Indicators: Sierra Leone,” UN Development Programme, (2018): <http://hdr.undp.org/en/countries/profiles/SLE>

<sup>338</sup> “A Poverty Profile for Sierra Leone,” World Bank Poverty Reduction and Economic Management Unit and Statistics Sierra Leone, (2014): [https://www.statistics.sl/images/StatisticsSL/Documents/poverty\\_profile\\_for\\_sierra\\_leone.pdf](https://www.statistics.sl/images/StatisticsSL/Documents/poverty_profile_for_sierra_leone.pdf)

<sup>339</sup> “Sierra Leone 2015 Population and Housing Census: Thematic Report on Gender,” Statistics Sierra Leone (SSL), (October 2017): [https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report\\_correction.pdf](https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report_correction.pdf)

<sup>340</sup> “UN Human Development Indicators: Sierra Leone,” UN Development Programme, (2018): <http://hdr.undp.org/en/countries/profiles/SLE>

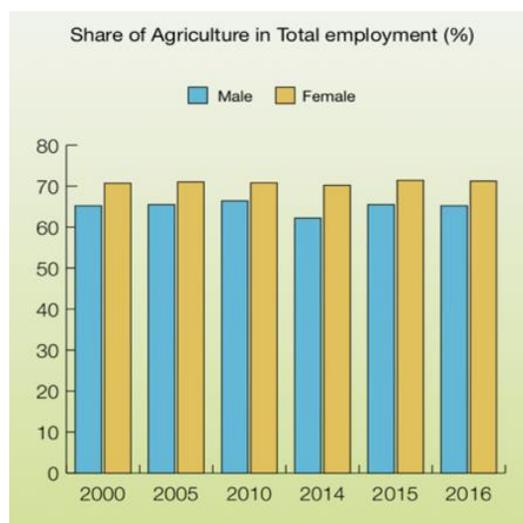
<sup>341</sup> “A Poverty Profile for Sierra Leone,” The World Bank Poverty Reduction and Economic Management Unit and Statistics Sierra Leone, (2014): [https://www.statistics.sl/images/StatisticsSL/Documents/poverty\\_profile\\_for\\_sierra\\_leone.pdf](https://www.statistics.sl/images/StatisticsSL/Documents/poverty_profile_for_sierra_leone.pdf)

<sup>342</sup> “UN Human Development Indicators: Sierra Leone,” UN Development Programme, (2018): <http://hdr.undp.org/en/countries/profiles/SLE>

The Sierra Leone 2015 Population and Housing Census Thematic Report on Gender found that records of school attendance were low (42% of those surveyed had never been to school), while 51% of men and only 44% of women are literate.<sup>343</sup> Only 16.8% of adult women have reached at least a secondary level of education compared to 29.7% of their male counterparts. The Census also found gender disparities in rates of enrollment in vocational, technical and nursing institutions (55.9% male compared to 44.1% female). Moreover, a higher percentage (16%) of men have access to the internet compared to women (only 10%).<sup>344</sup>

Although technical training is still largely male-dominated, since 2009 the Forum for African Women Educationalists (FAWE), with funding from the Danish International Development Agency, has provided scholarships to 200 girls to study electrical technology, auto mechanics, carpentry, masonry, plumbing, and printing, among other subjects that are conventionally seen as male professions. In addition, nongovernmental interventions have promoted girls' education in the country, such as the Ambassador Girls' Scholarship Programme sponsored by the United States Agency for International Development (USAID), FAWE and UNICEF's mentoring program for girls in the Western Area and Northern Province, as well as the creation of the Sierra Leone Gender and Education Network (SLGEN) to provide support to female students nationwide.

According to the UN, as of 2017, only 15.4% of women in Sierra Leone had an account at a FI or with a mobile money service provider.<sup>345</sup> This can be attributed to the country's elevated levels of poverty, low or irregular sources of income, low rates of financial literacy, and a perceived lack of need. This is also a result of the fact that most banks are focused on serving the formal sector, while many women remain engaged in informal economic activities – especially subsistence agriculture, which has consistently employed over 70% of the country's female labor force over the last two decades.<sup>346</sup>



Source: African Development Bank

<sup>343</sup> "Sierra Leone 2015 Population and Housing Census: Thematic Report on Gender," Statistics Sierra Leone (SSL), (October 2017): [https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report\\_correction.pdf](https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report_correction.pdf)

<sup>344</sup> Ibid.

<sup>345</sup> "Human Development Indices and Indicators: 2018 Statistical Update," UN Development Programme, (2018): [http://hdr.undp.org/sites/default/files/2018\\_human\\_development\\_statistical\\_update.pdf](http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf)

<sup>346</sup> "Indicators on Gender, Poverty the Environment and Progress toward the Sustainable Development Goals in African Countries," African Development Bank, (2017): [https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/GENDER\\_Poverty\\_and\\_Environmental\\_Indicators\\_on\\_African\\_Countries-2017.pdf](https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/GENDER_Poverty_and_Environmental_Indicators_on_African_Countries-2017.pdf)

### 2.3.2 Fertility Rates and Reproductive Health

As of 2017, the fertility rate in Sierra Leone remained high, at 4.36 children per woman. Sierra Leone's maternal mortality rate is among the highest in the world; for every 100,000 live births, 1,360 women die from pregnancy-related complications. The infant mortality rate also remains extremely high at 83.3 per 1,000 births. As of 2018, 25% of women had an unmet need for family planning.<sup>347</sup>

### 2.3.3 Participation and Decision-Making

Socio-cultural perspectives in Sierra Leone remain male-dominated, as conventional gender roles continue to hold women back. This is reflected in household decision-making, which often plays a role in restricting the rights and empowerment of women. This remains a huge challenge in Sierra Leone, where 72% of households in the country are headed by men.<sup>348</sup> These dynamics are also reflected in the rates of representation of women in the labor market as well as in leadership positions in business and government. As of 2018, women hold only 12.4% of the country's seats in parliament.<sup>349</sup> Female representation remains an ongoing challenge, with only a few women in high-level positions – such as Board members in the Electricity Utility (EDSA), the REASL President, etc., - estimated at only around 5%.<sup>350</sup>

In the private sector, Nthabiseng Mosia is the female co-founder and CFO of Easy Solar, a for-profit enterprise with a social mission to make clean energy affordable to off-grid communities throughout the country.<sup>351</sup>

## 2.4 Gender Policy, Institutional and Legal Framework in Sierra Leone

### 2.4.1 Gender Mainstreaming initiatives by the Government

Gender equality gained widespread support in post-war Sierra Leone's development planning and discourse as a result of the extreme brutalities that women endured during the country's 11-year conflict. As a result, the Government of Sierra Leone adopted gender mainstreaming as a pathway to achieve not only equality between the sexes, but also to address poverty reduction, economic growth, sustainable development and the improved well-being of its citizenry.

Sierra Leone's policy framework for promoting gender equality and women's empowerment is guided mainly by its two national policies: (i) the National Policy on the Advancement of Women, and (ii) the National Policy on Gender Mainstreaming. Both policies were adopted in 2009 to guide the Government's efforts to create an enabling environment to improve women's status and their participation in the development process. These policies were reinforced by the National Gender Strategic Plan (2009-2012) and the Sierra Leone National Action Plan (SILNAP).

The 1991 Sierra Leone Constitution includes a Bill of Rights guaranteeing the human rights of all Sierra Leoneans irrespective of their sex. The GoSL has enacted various laws to ensure the protection of women,

<sup>347</sup> "Human Development Indices and Indicators: 2018 Statistical Update," UN Development Programme, (2018):

[http://hdr.undp.org/sites/default/files/2018\\_human\\_development\\_statistical\\_update.pdf](http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf)

<sup>348</sup> "Sierra Leone 2015 Population and Housing Census: Thematic Report on Gender," Statistics Sierra Leone (SSL), (October 2017):

[https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report\\_correction.pdf](https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report_correction.pdf)

<sup>349</sup> "UN Human Development Indicators: Sierra Leone," UN Development Programme, (2018):

<http://hdr.undp.org/en/countries/profiles/SLE>

<sup>350</sup> In March 2018, Yvonne Aki Sawyerr became the first woman since 1980 to be elected mayor of Freetown.

<sup>351</sup> Rajgopaul, D., "This SA entrepreneur creates solar solutions for communities in Sierra Leone," (7 May 2018):

<https://www.iol.co.za/business-report/entrepreneurs/this-sa-entrepreneur-creates-solar-solutions-for-communities-in-sierra-leone-14819523>

including the Anti-Human Trafficking Act (2005), the Sierra Leone Citizenship Amendment Act (2006), Gender Acts on domestic violence, customary marriages and divorces and the devolution of estates (2007), and the Child Rights Act (2007). The GoSL Gender Mainstreaming Policy further reinforces the overall development objectives in the country, emphasizing the government’s commitment to gender-responsive development and seeks to strengthen and provide a legal basis for gender-oriented sectoral policies.

The Ministries of Education, Science and Technology, Agriculture, Forestry and Food Security, Finance and Economic Development and Labour, Employment and Industrial Relations have designated Gender Desk Officers (GDOs)/Focal Points in their institutions. As part of the decentralization process, all Local Councils have established Gender and Social Welfare Committees. The Ministry of Social Welfare Gender and Children’s Affairs (MSWGCA) is mandated to formulate gender-responsive policies and to coordinate and monitor their implementation within different sectors of the society.

The demand for gender quotas in Sierra Leone derives its legitimacy from the provisions of the Truth and Reconciliation Commission (TRC), which recommended 30% representation for women in elected assemblies, cabinets and other political posts, with the aim of achieving gender parity within the next 10 years. Quotas are already in use in Sierra Leone to promote representation of women at the local government level. Sierra Leone has also established political party quotas within the Movement for Progress Party, which targets 50% female candidates for elections.<sup>352</sup>

In the energy sector, the GoSL addresses gender equality in their energy policies by recognizing gender differentiated data in the following areas (i) energy needs and use, including agriculture; (ii) impacts of energy use; (iii) resource ownership; and (iv) participation in energy sector. The policy aims to promote alternatives to firewood and charcoal in order to address the health concerns associated with poor indoor air quality that many women in rural areas face. The policy includes provisions to raise awareness of these issues to promote sustainable development and educate and train women on the impacts of energy use. The GoSL also established a Gender Focal Point within the MoE to further address these issues.

Sierra Leone’s National Energy Strategy Plan (2009) proposes empowering village women’s groups when establishing strategies to distribute Renewable Energy Technologies.<sup>353</sup> In the off-grid sector, the most notable gender-based work is being done by Barefoot Women Training College (Centre) – an NGO supported by the Government that is providing solar related training to women across the country.<sup>354</sup> Another related program is the EU-funded PRESSD-SL project, which has provided solar lighting infrastructure for households as well as public and private institutions across the country since 2015.<sup>355</sup>

The ECOWAS Policy for Gender Mainstreaming in Energy Access is another initiative adopted by the GoSL that is committed to promoting favorable policies and frameworks and mobilizing resources to more fully engage women in all areas of energy access.<sup>356</sup> The regional policy aims to achieve this by securing the local support of a gender focal point in government to integrate gender into energy policies and by conducting gender audits of the sector.

<sup>352</sup> “Women participation in Politics,” I Know Politics: [www.iknowpolitics.org](http://www.iknowpolitics.org)

<sup>353</sup> “Energizing Equality: Sub-Saharan Africa’s integration of gender equality principles in national energy policies and frameworks,” IUCN and USAID Power Africa, (May 2018): [https://www.climatelinks.org/sites/default/files/asset/document/2018\\_IUCN\\_Energizing-Equality-Sub-Saharan-Africa%27s-Integration-of-Gender-Equality-Principles-Energy-Policies\\_accessible.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2018_IUCN_Energizing-Equality-Sub-Saharan-Africa%27s-Integration-of-Gender-Equality-Principles-Energy-Policies_accessible.pdf)

<sup>354</sup> [http://www.energy.gov.sl/Barefoot\\_Solar\\_Women.html](http://www.energy.gov.sl/Barefoot_Solar_Women.html)

<sup>355</sup> “Situation Analysis of Energy and Gender Issues in ECOWAS Member States,” ECREEE and National Renewable Energy Laboratory, (2015): <https://www.seforall.org/sites/default/files/Situation-Analysis-of-Energy-and-Gender-Issues.pdf>

<sup>356</sup> *Ibid.*

## 2.4.2 Gaps in the Gender Policy/Legal Framework

Despite the Government’s policy initiatives and legislative reforms, gender inequality remains an ongoing challenge across the country’s political, economic and socio-cultural landscape, as women still face many barriers to inclusive participation. Although there is a general lack of sex-disaggregated data and statistics in Sierra Leone to make gender inequalities more visible, in 2017 the GoSL published a guide for policymakers – the Sierra Leone Population and Housing Census Thematic Report on Gender – which acknowledged that a lot of work still remains to be done.<sup>357</sup> The report recognized that a clear divide between men and women persists in educational attainment – a disparity that negatively impacts economic growth and development and constrains the country’s ability to eradicate poverty, improve health and mortality rates and overall living standards for the population.<sup>358</sup>

Closely related to educational attainment are rates of illiteracy, which remain higher among women. Women are often curtailed in their access to information and decision-making. Moreover, Sierra Leone’s legal system consists of statutory, customary, and religious laws, leading to contradictions and inconsistencies among the three.

Overall, the country ranks very poorly in the UNDP’s Gender Inequality Index.<sup>359</sup> While multiple deprivation characterizes life for a sizable share of African women, rates are significantly higher in West Africa and the Sahel – with Sierra Leone ranking among the six worst nations in Africa.<sup>360</sup>

<sup>357</sup> “Sierra Leone 2015 Population and Housing Census: Thematic Report on Gender,” Statistics Sierra Leone (SSL), (October 2017): [https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report\\_correction.pdf](https://sierraleone.unfpa.org/sites/default/files/pub-pdf/Gender%20report_correction.pdf)

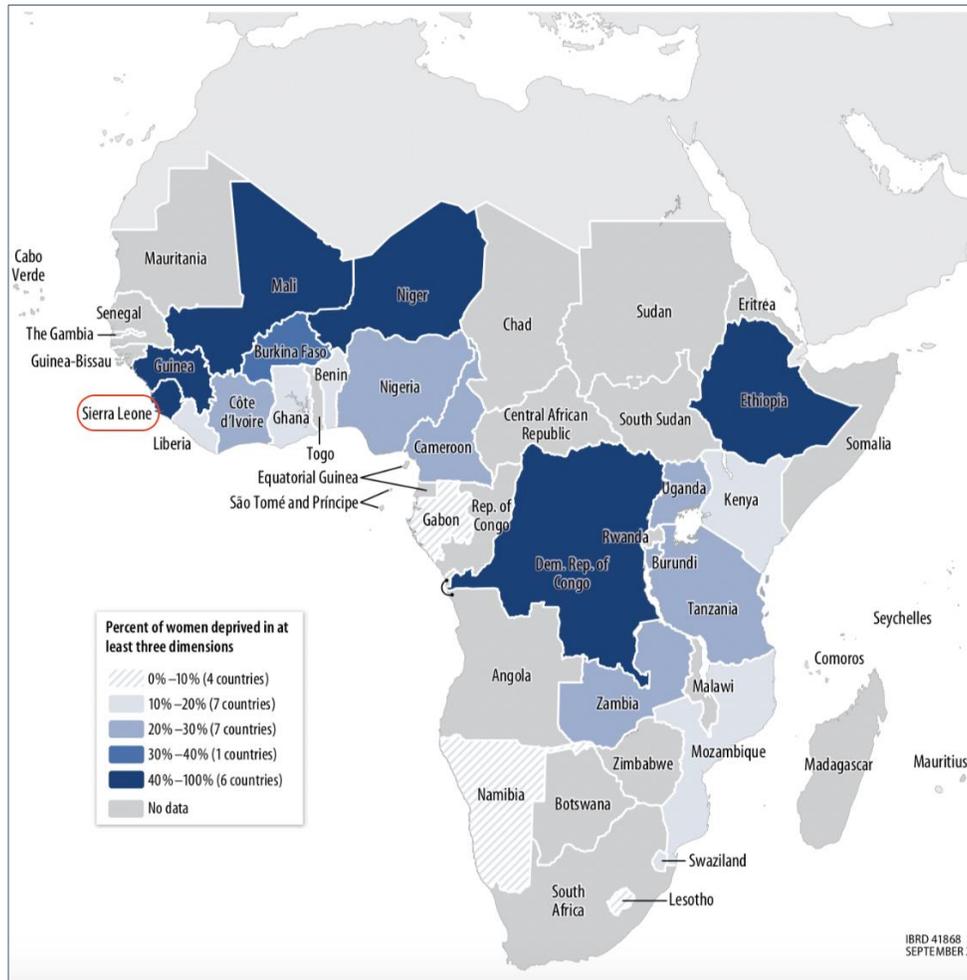
<sup>358</sup> *Ibid.*

<sup>359</sup> “Gender Inequality Index,” UNDP, (2015): <http://hdr.undp.org/en/composite/GII>

<sup>360</sup> “Poverty in a Rising Africa: Africa Poverty Report,” World Bank Group, (2016):

<https://www.un.org/africarenewal/sites/www.un.org.africarenewal/files/Poverty%20in%20a%20Rising%20Africa%20Overview.pdf>

Socioeconomic Deprivation of Women in Africa



Source: World Bank Group: Poverty in a Rising Africa

2.5 Summary of Recommendations

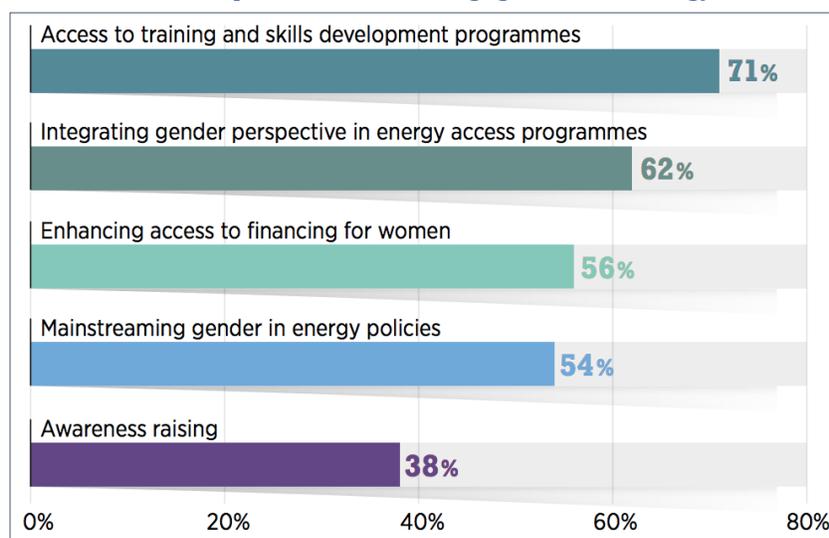
Given the increased attention that gender inclusion has received in development planning, there are a number of tools that are now available to policymakers that can be utilized to support gender mainstreaming and encourage women’s participation in the energy sector. Despite encouraging progress in the discourse on gender and energy access, substantial efforts are still needed, especially in enabling women’s participation in the sector in different roles, including as energy entrepreneurs and in leadership positions.<sup>361</sup>

In seeking solutions to improve women’s engagement in energy access, a 2018 IRENA survey found that access to necessary technical, business or leadership skills development programs was the single most important measure that could be taken. Over half of survey respondents also highlighted the need to integrate gender perspectives in energy access programs as well as enhanced access to finance.<sup>362</sup>

<sup>361</sup> “Renewable Energy: A Gender Perspective,” International Renewable Energy Agency, (2019): [https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA\\_Gender\\_perspective\\_2019.pdf](https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf)

<sup>362</sup> Ibid.

### Measures to Improve Women’s Engagement in Energy Access



Source: International Renewable Energy Agency

In addition to the measures highlighted in the figure above, below is a list of additional policy recommendations that could further improve gender equality in Sierra Leone’s energy sector.<sup>363</sup>

- At the international level, ratify the Protocol to the African Charter on Human and Peoples’ Rights on the Rights of Women in Africa (Maputo Protocol); Sierra Leone is currently a signatory to the Charter but has yet to formally ratify it.<sup>364</sup>
- Take measures to close the gender gap in access to education, particularly in higher levels of education
- Implement a quota system to increase the number of women employed in government’s energy ministry and ensure that women are part of decision-making processes in the energy sector
- Implement policy and budgetary measures to support programs that aim to raise awareness and promote opportunities for women as energy customers, suppliers, financiers, and educators
- Commission studies to collect, synthesize and publish gender-specific/sex-disaggregated data on women’s energy access and usage to inform (i) public policy development to improve rates of access for women; and (ii) private sector on potential customer needs (e.g. clean cooking technologies, productive use of energy applications etc.)
- Undertake a “gender audit” of the energy sector and develop a gender action plan to inform long-term policy objectives targeting gaps in the existing framework and promoting inclusive participation (e.g. by adding gender categories to policies/projects and accounting for gender impacts in planning).
- Establish a Gender Focal Point or Unit within key national and local institutions in order to administer targeted gender policies and programs
- Raise awareness / provide training and technical support to private sector businesses / SMEs on (i) the benefits of gender inclusion and in viewing business decisions through a gender lens; (ii) the value of gender-disaggregated data; and (iii) how to develop and implement gender strategies to encourage inclusive participation.<sup>365</sup>

<sup>363</sup> **NOTE:** This is not an exhaustive list of recommendations as it is only intended to address inclusive participation in the energy sector; there are many gender-related challenges that warrant further study and attention within the context of the country’s complex economic and social structures that are beyond the scope of this analysis

<sup>364</sup> “Ratification Table: Protocol of the African Charter on Human and Peoples’ Rights of the Rights of Women in Africa,” African Commission on Human and Peoples’ Rights: <http://www.achpr.org/instruments/women-protocol/ratification/>

<sup>365</sup> “ECOWAS-CTCN Project on Mainstreaming Gender for a Climate Resilient Energy System in ECOWAS Countries: Final Report,” ECREEE and CTCN, (May 2018): [https://www.ctc-n.org/system/files/dossier/3b/180627\\_final\\_report-uk.pdf](https://www.ctc-n.org/system/files/dossier/3b/180627_final_report-uk.pdf)



Meeting with off-grid community group in the coastal village of Kent, Sierra Leone, June 2018.

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