SUSTAINABLE ENERGY FOR ALL

EXECUTIVE SUMMARY

INCREASING ENERGY ACCESS IN SIERRA LEONE

Mini-grid survey analysis on tariffs, subsidies and productive use

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IN SUPPORT OF

EXECUTIVE SUMMARY

The purpose of this study is to provide practical guidance and recommendations to the Government of Sierra Leone (GoSL) for the sustainable development of the country's mini-grid sector by building upon lessons learned from the ongoing Rural Renewable Energy Project (RREP) as well as from mini-grid sector development in Nigeria. Important lessons can be learned from the two countries with respect to their mini-grid policy and regulatory frameworks, market development approaches, and potential options for agricultural productive use of electricity (PUE) to facilitate both mini-grid electrification and rural economic development. This report — and this Executive Summary — is broadly structured as follows: **Part I** covers mini-grid regulatory frameworks, tariff structures and subsidies; **Part II** focuses on PUE and mini-grid site selection. This Executive Summary concludes with a **summary of the report's main findings and recommendations** for policymakers and key energy sector stakeholders.

1 MINI-GRID FRAMEWORKS, TARIFFS AND SUBSIDIES

Mini-Grid Electrification Planning and Market Development in Sierra Leone and Nigeria

Most mini-grid projects in nascent markets have slim or non-existent profit margins, as projects require significant resources for pre-feasibility, development and operation relative to potential revenue, driven by the need to engage communities, the remoteness of sites and the tailor-made nature of mini-grid projects. A supportive policy and regulatory framework that de-risks projects for developers is therefore critical, as nascent markets are particularly sensitive to overly-burdensome regulation.[1] Above all, the goal of a regulatory framework for mini-grids should be to promote good service at the lowest possible cost-recovery tariffs, while remaining predictable but flexible enough to evolve as the market matures.[2]

Mini-Grid Policy and Regulatory Frameworks in Sierra Leone and Nigeria

Sierra Leone has one of the lowest rates of electricity access in the world; the country has a national electrification rate of 26 percent, although this figure declines to 6 percent in rural areas where the majority of the population lives.[3] Where main grid connections exist, power supply is often unreliable, with fewer than one-third of firms and households reporting reliable access to electricity when surveyed.[4] There are a number of barriers to expanding grid-based electricity access and improving service quality, including a weak and limited transmission and distribution system; non-technical deficiencies with the utility, which result in high technical and commercial losses; insufficient generation capacity; seasonal variability in hydropower production; and institutional and regulatory constraints.

In Nigeria, access to electricity remains an ongoing challenge and is a key barrier to economic development; the country has a national electrification rate of 57 percent, while the rural electricity access rate is 31 percent.[5] Where the grid is available, consumers experience frequent power cuts ranging from four to 15 hours per day.[6] Nigeria has a significant electricity supply deficit, with only one-third of its 12.5 GW of installed generation capacity typically available. Meanwhile, tens of millions of on-site diesel generators are used to meet the country's actual daily

1 Practical Guide to the Regulatory Treatment of Mini-Grids, National Association of Regulatory Utility Commissioners, 2017.
2 Mini-Grids for Half a Billion People, World Bank ESMAP, 2019.
3 Tracking SDG7: The Energy Progress Report 2020.
4 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
5 Tracking SDG7: The Energy Progress Report 2020.
6 State of the Global Mini-Grids Market Report 2020.

peak electricity demand, which is estimated to exceed 40 GW. This situation is the result of several factors: a stagnation of on-grid generation due to limited additions of new generation capacity; the poor state of the national grid and a corresponding lack of investment in grid maintenance and new transmission networks; liquidity issues faced by electricity utilities and DisCos; and associated issues of commercial and technical losses.

A key difference between the two countries is that Sierra Leone does not have an agency such as the Nigerian Rural Electrification Agency (REA) dedicated exclusively to rural electrification and energy access; all rural electrification planning in Sierra Leone is currently managed by the Ministry of Energy (MoE). While Sierra Leone does not have a rural electrification master plan, its off-grid electrification strategies are broadly defined in its various energy policy documents, including the Electricity Sector Reform Roadmap 2017–2030, which provides a framework for restructuring the power sector to achieve long-term electrification objectives over the next decade. Despite the existence of this roadmap, there has been no formal adoption of its recommendations, which means new energy projects are not implemented as part of, or in support of an integrated sector plan. In the mini-grid sector, the Electricity and Water Regulatory Commission (EWRC) has developed a comprehensive regulatory framework — the 2019 Mini-Grid Regulations — that provides specific guidance on licensing procedures, consumer service, grid interconnection and commercial arrangements to support the development of mini-grids.

In Nigeria, the government adopted the 2017 Rural Electrification Strategy and Implementation Plan (RESIP), under which the REA provides developers with financial incentives and technical support to expand rural electricity access. The Mini-Grid Regulations enacted by the Nigerian Electricity Regulatory Commission (NERC) in 2016 provide the necessary regulatory and permitting guidelines for the development and operation of mini-grids in the country, including clear guidance on tariff setting through the REA Mini-Grid Tariff Tool methodology.

Mini-grid development in Sierra Leone has not been part of a national strategy but rather implemented under two donor-funded projects,[7] the largest of which – the RREP – followed a public-private partnership (PPP) model of public ownership and private management driven by a top-down approach. In Nigeria, mini-grid development has followed a more bottom-up, private sector-led approach (see **Section 2.1**).

Mini-Grid Tariff Frameworks in Sierra Leone and Nigeria

Mini-Grid Regulations

In June 2019, the EWRC approved the 2019 Mini-Grid Regulations, which were subsequently ratified by parliament later that year. The mini-grid regulations in Sierra Leone closely mirror those enacted by the NERC in 2016; both regulations include provisions for market-entry, cost-reflective retail tariffs, contractual arrangements, technical and service standards, and the arrival of the main grid, with unique guidelines and licenses for mini-grid projects based on capacity and whether they are isolated and interconnected. **Section 3.1.1.1** and **Section 3.1.1.2** cover each component of the regulation in detail in Sierra Leone and Nigeria, respectively.

Tariff Affordability and Cost of Service

In 2016, prior to the rollout of the RREP in Sierra Leone, a demand assessment carried out by the project encompassing 68 rural communities, 2,500 interviews, and feedback from 1,950 household respondents found that households would benefit from savings of up to 52 percent with the advent of mini-grid electricity, based on average costs of alternative sources of energy (i.e., expenditures on kerosene, batteries, fuel etc.). The survey estimated the average amount rural customers were able to pay was approximately USD 6/month (SLL 59,400/month), mainly for lighting, mobile phone charging and other household uses. The study also found that rates of electricity demand could increase by a factor of 20 with the arrival of mini-grid electrification, with average consumption between 3.5 and 6.3 kWh per month per household. Subsequent studies conducted by the MoE following the inception of the project found evidence that the cost of electricity from mini-grids remains lower than alternative sources of energy.

After the Work Package 1 (WP-1) mini-grids began operating in 2019 (see **Section 1.1.2** for a description of the RREP Work Packages), 80 percent of mini-grid community respondents surveyed by the GreenMax field research team who did not connect to the mini-grid cited

7 (1) The EU-funded Promoting Renewable Energy Services for Social Development in Sierra Leone (PRESSD-SL) and (2) the RREP.

affordability of the electricity tariff as the main reason for not connecting.[8] The initial tariffs for WP-1 sites ranged from USD 0.82/kWh to 0.87/kWh, with an average tariff level of about USD 0.85/kWh. Given the focus on providing access for WP-1 sites (i.e., targeting smaller sites in order to avoid deliberate selection of only larger and more economically attractive locations), these initial sites had a lower targeted number of customers. This dynamic — smaller sites with relatively limited demand — combined with high project development and overhead costs for developers, contributed to a higher tariff, which was necessary to make projects bankable. Another factor that increased costs was the initial requirement for operators to maintain a reserve account for WP-1 batteries,[9] which has since been addressed through an FCDO subsidy under Work Package 7 (WP-7) of the RREP.[10]

Under the next phase of the project, Work Package 2 (WP-2), operators are co-investing in the development of 40+ larger mini-grids under a "split asset" model in which the GoSL is covering the capital costs of the distribution assets. As the operators begin to connect more customers and bring larger mini-grid systems online, project development costs are gradually decreasing. The most recent round of tariff negotiations, combining the WP-1 and WP-2 sites, resulted in a range of USD 0.74/kWh to 0.82/kWh, with an average tariff of USD 0.79/kWh.[11]

By comparison, according to the REA, mini-grid tariffs in Nigeria range from USD 0.39/kWh to 0.79/kWh (NGN 150/kWh – 300/kWh), with an average tariff level of about USD 0.58/kWh (NGN 220/kWh).[12] Interviews with mini-grid operators in Nigeria found that there have been relatively few complaints from communities surrounding tariff affordability, as the majority of end users spend less on electricity from the mini-grid than they did on expensive and polluting alternative sources of energy prior to the mini-grid's installation. For instance, the levelized cost of electricity (LCOE) from a small diesel generator is at least USD 0.75/kWh (NGN 250/kWh) and is vulnerable to fuel price volatility.[13]

Key Drivers of the Disparity in Tariffs between Sierra Leone and Nigeria

It is important to provide context around these numbers in order to understand what is driving the disparity in tariffs between the two countries. Despite the above-mentioned similarities in their mini-grid policy and regulatory frameworks, there are also several important differences between the mini-grid markets in Sierra Leone and Nigeria, including *inter alia*:

The two mini-grid markets are at different stages of development and have pursued different mini-grid planning approaches (see **Section 2.1**) and subsidy schemes (see **Section 3.2**).

The larger size of the Nigerian market (and increased scale of electricity demand) plays an important role in driving cost reductions vis-à-vis Sierra Leone, where there are fewer mini-grid customers in more sparsely populated rural villages.

Household income levels are lower in Sierra Leone (56.8 percent national poverty headcount ratio compared to 40.1 percent in Nigeria in 2018), contributing to a lower household consumption rate.[14]

It is important to emphasize that although the mini-grid tariff in Sierra Leone is considered unaffordable by many, a large number of mini-grid customers had never used electricity in this form prior to the arrival of the mini-grid and ended up consuming more electricity than they could afford. Public and private sector resources should therefore focus heavily on community sensitization, consumer education and training around electricity usage and expenditures, energy efficiency, mini-grid load capacity, appliance usage, PUE, and other benefits and cost savings of mini-grid electrification. As consumer awareness around energy usage and expenditures improves over time, mini-grid usage can be optimized.

As the Sierra Leonean mini-grid market continues to evolve and electricity demand increases, tariffs are expected to continue to decrease. Indeed, as is indicated above, the

8 NB: These findings do not reflect the fact that perceptions on affordability do not take into account the increase in consumer spending on electricity from the mini-grid as a result of the use of appliances, they also do not reflect a like-to-like comparison of end-user spending on electricity from the mini-grid in comparison to expensive and polluting alternative sources of energy prior to the mini-grid's installation.

9 A substantial delay between the time the mini-grid systems were installed and the sites were electrified (mainly due to delays in the tendering process) led to the capacity reduction of batteries.

10 http://www.energy.gov.sl/wp-content/uploads/2020/10/Fact-sheet_RREP-Updated-September-2020.pdf

11 Stakeholder consultations, 2021.

12 Figures are from solar hybrid mini-grids ranging in size from 30-234 kWp that have been commissioned under the AfDB/World Bank Nigeria Electrification Project (NEP) Performance-Based Grant Programme and the EU/GIZ Nigerian Energy Support Programme I (NESP I); see Table 8 in Section 3.2.1.2.

13 "Mini-Grid Investment Report: Scaling the Nigerian Market," Rocky Mountain Institute, (2018): https://rmi.org/wp-content/uploads/2018/08/RMI_Nigeria_Minigrid_Investment_Report_2018.pdf

14 World Bank: Poverty headcount ratio at national poverty lines: https://data.worldbank.org/indicator/SI.POV.NAHC?locations=NG-SL

most recent tariffs in Sierra Leone are already comparable to the higher end of the spectrum of mini-grid tariffs in Nigeria.

Section 3.1.2.2 provides a detailed summary of findings vis-à-vis mini-grid tariff frameworks in Sierra Leone and Nigeria.

Mini-Grid Subsidy Schemes in Sierra Leone and Nigeria

In Sierra Leone, the RREP utilized donor and government funds to cover all of WP-1 construction expenses and also provided an 'in-kind' subsidy to operators by covering the capital costs of the distribution assets under WP-2, thereby enabling them to charge a lower connection fee to customers. However, when interviewed, operators indicated that the pre-financing mechanism under the RREP was not necessarily their preferred approach, as they would have preferred an alternative structure that may have provided them with more flexibility.[15]

In addition, the Finance Act of 2017 provides duty exemptions on the importation of solar equipment (excluding ancillary materials such as batteries and inverters etc.) that meets International Electrotechnical Commission (IEC) global quality standards, and the Finance Act of 2021 provides corporate tax exemptions and a goods and services tax (GST) waiver for mini-grid projects. While these fiscal incentives should ostensibly result in lower tariffs, the process for the 2017 tax exemption is not fully clear and requires the adoption of streamlined procedures to make it simpler for operators to apply for them.[16] The 2021 exemptions have yet to be implemented, so it is too early to draw any conclusions regarding their efficacy.

A comparative analysis of previous and ongoing mini-grid subsidy programmes in Sierra Leone and Nigeria is presented in **Table ES-1**.

15 Stakeholder interviews, 2020.
16 AfDB Green Mini-Grid Market Development Programme - Mini-Grid Market Opportunity Assessment: Sierra Leone, 2019.

Photo: GreenMax Capital Advisors Inc.

TABLE ES-1

Mini-Grid Subsidy Programmes in Sierra Leone and Nigeria

Indicator	Summary of Lessons Learned
Speed of delivery	• Similar to most programmes of its size, scope and ambition, the RREP is complex in its design, involving lengthy negotiation and financing processes that require significant resources to manage; programme delays were largely attributed to extended application processes to obtain licenses and other permits, as well as to ongoing general elections in Sierra Leone in early 2018. Continuous learning by doing (by regulators, developers and communities) and the subsequent refinement and streamlining of permitting/contract negotiation processes is a key lesson learned. • A key area of consideration for mini-grid contracts is that contract negotiations for energy projects in Sierra Leone typically take 18 months from the start of the negotiation process to approval at the cabinet level. These processes were transferred to the negotiation of the RREP PPP contract, which involved all the same stakeholders as energy IPP contracts. • The first mini-grid deployed under the Nigeria Electrification Project (NEP) that utilizes results-based financing (RBF) was commissioned in December 2019 – just three months after the project's grant agreement signing under the performance-based grant (PBG) component of the programme and nine months after the programme was launched. According to the REA, the transparency and speed of the NEP process is due to the e-procurement method utilized together with the national data management platform, Odyssey.[17] • Recent experience with various auction programmes in Nigeria (MST, MAS, IMAS, REF) suggests that this structure is generally more prone to delays. Nevertheless, it is worth noting that the NEP has also faced some delays related to a lack of access to finance, developers' limited capacity and engagement with distribution companies (DisCos). • A key takeaway from the experience in Nigeria thus far is the need for some early disbursement of subsidies, particularly in the context of the COVID-19 crisis, as 40 percent of the RBF payments under the NEP PBG had to be paid up-front to reduce delays due to financing difficulties, while the balance is paid after 90 days according to the original payment schedule. There is also a need for the provision of concessional local currency debt facilities (e.g., the above-mentioned Nigeria Infrastructure Debt Fund) as well as technical assistance (TA) to support developers with access to finance needed to cover the portion of capex not covered by subsidies.

17 Odyssey Energy Solutions is a web-based data platform to simplify, streamline, and reduce the costs of developing and financing mini-grids in emerging markets.

Photo: GreenMax Capital Advisors Inc.

Indicator	Summary of Lessons Learned
Tariff Reduction	• Average end-user mini-grid tariffs for solar hybrid mini-grids in Sierra Leone started with an average of USD 0.85/kWh (USD 0.82/kWh – 0.87/kWh) for WP-1 sites in 2019, which recently came down to an average of USD 0.79/kWh (USD 0.74/kWh – 0.82/kWh) for WP-1 and WP-2 sites combined, while the average tariff in Nigeria is USD 0.58/kWh, with a range of USD 0.39–0.79/kWh. • In Sierra Leone, as operators begin to connect more customers and bring larger mini-grid systems online, project development costs are gradually decreasing. • In Nigeria, there is a direct correlation between the level of subsidy and the tariffs. A comparison of the REF and NEP PBG programmes shows that REF subsidies cover 50-70 percent of capex, while the NEP PBG covers only about 30 percent. Consequently, tariffs for NEP sites are generally higher by 25-108 percent compared to tariffs for REF sites. It is worth noting that there are other factors that influence tariffs, including location, presence of productive uses, cost of financing, site accessibility etc.
Economies of scale	• Operators in Sierra Leone opined that the RREP was structured in a way that does not allow them to sufficiently take advantage of economies of scale. • In Nigeria, discussions with the REA revealed that it would like to see private companies develop large portfolios of mini-grid sites to realize economies of scale, which could potentially lead to a reduction in tariffs. Under the NEP Minimum Subsidy Tender, developers are allowed to develop 40-50 sites together. However, given that the programme has yet to progress to the implementation stage, the cost reduction impacts of this mechanism cannot be assessed.

2 PRODUCTIVE USE OF ENERGY AND SITE SELECTION

Productive Use of Electricity and Mini-Grids

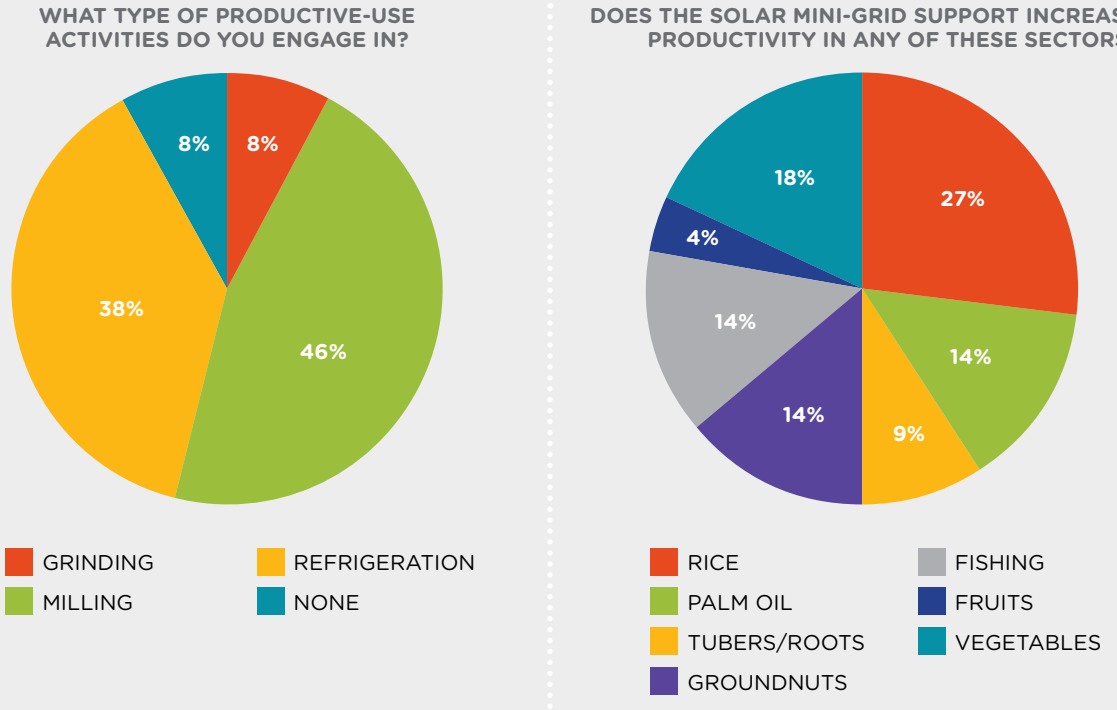
In Sierra Leone, where most of the population lives in rural areas and engages in subsistence agriculture, mini-grids can power rural agricultural productivity and create new businesses or expand existing ones linked to the agricultural value chain.

Consultations with rural mini-grid community stakeholders in Sierra Leone found that milling and refrigeration are among the most common productive-use applications, while solar mini-grid electrification can support increased productivity across a variety of agricultural sectors, led by rice, palm oil, fish, vegetables and groundnuts via agricultural processing and cold storage applications (**Figure ES-1**).

In Sierra Leone, the ability to pay for mini-grid electrification among rural agrarian communities is highly dependent upon the seasonality of income, crop yield etc. This makes the utilization of PUE a critical tool going forward, as it can provide a steady source of income and help increase the purchasing power of communities in the long term. Operators will also need the support of key public and private sector partners to expand PUE; these private sector partnerships and financing arrangements are already being pursued under WP-6 of the RREP with funding from the FCDO.

Winch Energy, operating in Sierra Leone, has already formed several key partnerships to develop local enterprises and expand access to appliances in its WP-1 mini-grid communities. The company has partnered with EasySolar to offer consumers electrical appliances

FIGURE ES-1
Mini-Grid Community Productive Use Survey Results



Source: GreenMax Capital Advisors field surveys, 2020

available on microcredit and is working with the telecommunications operator Orange to expand access to mobile money services in its communities.[18] In Nigeria, under the NEP, the REA and its development partners rolled out a successful PUE equipment-financing scheme (in partnership with PowerGen). Under the Energizing Economies Initiative (EEI), the REA pursued an end-to-end approach for electrifying commercial hubs/economic clusters. Both the NEP and EEI initiatives can serve as a blueprint for Sierra Leone to integrate PUE into mini-grid development (more on PUE in **Section IV**).

Mini-Grid Site Selection in Sierra Leone and Nigeria

In Sierra Leone, the RREP beneficiary communities were selected in 2016 by a steering committee led by the MoE based on a nationwide list of villages with Community Health Centres (CHCs) provided by the Ministry of Health and Sanitation (MoHS) in the wake of the Ebola crisis. The GoSL selected the sites based on the following criteria: (i) existence of a CHC; (ii) size of the community with respect to households, businesses and population density (a minimum of 250 structures was required in order to ensure economic viability); (iii) distance of the community to the CHC (to reduce the cost of using medium voltage lines); and (iv) distance of the community to any existing or planned transmission lines and/or the existence or plan for any other electrification project. The criteria for selecting mini-grid sites were the same for both WP-1 and WP-2; however, less emphasis was placed on demand-side considerations during the initial WP-1 site selection, which above all prioritized supplying electricity to the CHCs. In contrast, WP-2 focused more on PUE opportunities, with several studies commissioned by UNOPS to support the operators in this regard (see **Section 4.3.1**).

In Nigeria, under the NEP, an RBF mechanism provides financial incentives for private sector-led development of identified off-grid sites with high customer density characteristics that are best suited for mini-grid electrification. At the commencement of the NEP mini-grid programme in 2017, the REA supported a detailed survey that prioritized over 200 sites with demand of at least 100 kW across five states. The assessment utilized georeferenced data to assess the following key parameters for site selection: (i) sufficient load/density; (ii) productive-use, daytime, and flexible loads; (iii) supportive local and state government; (iv) community engagement; and (v) accessibility. Detailed surveys were carried out in each selected community using a computer-aided personal interview app on a mobile device.

The REA is working hard to engage with and sensitize the identified mini-grid communities, including through the promotion of productive activities designed to increase employment and income and in turn enable local capacity and willingness to pay.[19] **Section V** provides more details surrounding the site selection approaches under the RREP in Sierra Leone and the NEP in Nigeria.

18 "Winch Energy celebrates project success in Sierra Leone," African Review, (26 October 2020): https://www.africanreview.com/energy-a-power/renewables/winch-energy-celebrates-project-success-in-sierra-leone

19 Mini-Grid Investment Report: Scaling the Nigerian Market, Rocky Mountain Institute, 2018.

3 SUMMARY OF RECOMMENDATIONS

A summary of recommendations for mini-grid policymakers, regulators and operators in Sierra Leone is presented in **Table ES-2**. For more details, see also **Section 3.3**, **Section 4.5** and **Section 5.3**.

NOTE: The analysis/findings presented in this report are based on a market assessment (interviews, survey activities etc.) that was carried out in early to close gap mid-2020. The mini-grid markets in Sierra Leone and Nigeria are extremely dynamic, with frequent changes and new developments in programme structures, regulatory frameworks, and other public and private sector activities in the sector. For example, in late 2020, RREP WP-2 sites in Sierra Leone started coming online; the FCDO provided a new tariff subsidy under WP-7; and the EWRC switched its tariff regulation methodology to a multi-year tariff order (MYTO) tool. In Nigeria, the NEP's mini-grid components and programmes are only just launching, making it difficult to draw any conclusions or lessons learned. The COVID-19 pandemic has only complicated things further. Wherever possible, the authors have tried to account for these developments, but it is suggested that this document be viewed as a working document to be updated as the mini-grid markets in both countries continue to evolve.

TABLE ES-2
Summary of Recommendations

Indicator	Summary of Recommendations
GoSL policymakers should…	
Policy and Regulatory Framework	• Develop and implement a coherent **long-term strategy** that builds upon the strong foundation of the RREP and the existing regulatory framework and aligns the priorities of all market actors — government, developers, end users and financiers — to de-risk and mobilize mini-grid financing and expand mini-grid electrification in the country. This can be in the form of a '**master plan**' but should include **clear national targets for mini-grid expansion in the long-term**. This will foster private sector participation and provide clarity and predictability to mini-grid market players, notably for investors and companies who need to consider multi-year plans involving significant capital expenditure or borrowing. • **Expand the internal capacity of the MoE** and/or create either a separate **directorate within the MoE** or an entirely new **rural electrification agency** dedicated to managing the rollout of a national mini-grid programme, with a long-term vision and targets in order to provide clarity and predictability to mini-grid market players. • Adopt policy and planning approaches that create opportunities for developers to take advantage of **economies of scale** (with fixed costs spread over far larger volumes of kWh sold) to reduce costs and expedite market development (i.e., allow for a **bottom-up approach** to coexist in the market). • **Streamline import duty exemptions** for solar equipment, including the adoption of clear guidelines for all relevant public institutions; consider expanding existing import duty exemptions to cover ancillary equipment such as distribution equipment, inverters and batteries to further reduce development costs. • Implement policy measures to **ensure standards/quality** of equipment in the off-grid/mini-grid sector. • Support local market growth through collaboration with the Renewable Energy Association of Sierra Leone (**REASL)** (e.g., to certify and train local entrepreneurs), as the use of local suppliers and engineers will reduce project development costs.

Indicator	Summary of Recommendations
Tariff Setting	• Utilize available data to propose a **benchmark return** on equity based on existing market conditions in Sierra Leone (or financing opportunities for mini-grids internationally) to simplify the tariff review process and provide a **clear market signal to developers** on the profitability of their potential investments. • Make explicit the required subsidy to reach a certain tariff (e.g., via RBF, per kWh or % capex subsidies), which would provide clarity to the private sector and clear benchmarks for government on costs of decentralized electrification vs. central grid expansion.
Subsidy Mechanisms	• Adopt an **up-front cash grant/RBF hybrid scheme** (as opposed to an 'in-kind' subsidy) **to reduce project costs and potentially lower tariffs**; the hybrid structure will reduce developers' up-front capital constraints while also ensuring quality of service as developers are fully paid based on the deployment and verification of the connections; the value of the subsidy should be high enough to achieve tariff reduction. • Adopt a **simplified, streamlined and consistent process** across all relevant public agencies to **reduce complexity** and the amount of time/resources required of developers for licensing and permitting. • Adopt a **framework contract** that can be used on an ongoing basis to streamline project approvals, save time and reduce project delays/costs. • Design subsidy programmes to **ensure quality of construction** by making developers/ subsidy recipients responsible for installing and testing all mini-grid assets. • Incorporate **long-term maintenance** of mini-grids in subsidy design. • Identify areas where project developers may need support and provide **technical assistance** through the MoE and/or donor-funded programmes (e.g., to access available financing, transaction advisory services etc.). • Utilize **data analytics and e-procurement** to increase transparency and speed of project delivery. • Consider how subsidies will eventually be removed; a **three-phase approach** can be adopted to gradually transition towards a sustainable market (see **Figure 16** in **Section 3.2.1**).
Productive Use of Electricity	• Develop and implement programmes providing technical and financial support to mini-grid developers to stimulate **PUE** and revenue-generating activities in mini-grid communities, which provide anchor clients for mini-grid power supply and increase customer income levels and purchasing power. Rolling out PUE in mini-grid communities on a large scale will require **extensive coordination across various public agencies** (e.g., MoE, Ministry of Agriculture and Forestry, Ministry of Planning and Economic Development, Ministry of Local Government and Rural Development), **as well as private sector support**, including from the local financial sector (e.g., Sierra Leone Association of Microfinance Institutions) to improve access to local currency financing for the sector. • Raise awareness of the **benefits and long-term cost savings associated with switching to equipment powered by clean energy**; off-grid communities typically use equipment that is powered by diesel generators; thus, there is a need for interventions in order to raise customer awareness and provide associated training (e.g., on how to use new solar-powered equipment and appliances).

Indicator	Summary of Recommendations
Productive Use of Electricity	• Incorporate **productive-use appliance and equipment financing for households and small and medium-sized enterprises (SMEs)** into mini-grid business models and planning; providing business support services to SMEs on the use of appliances will increase productive activities, stimulate electricity demand, and thus increase their overall capacity to pay for electricity consumed; grant funding has already been made available by the FCDO under Work Package 6 (WP-6) to increase access to PUE among the RREP mini-grid communities. • Provide **technical assistance (TA) and financing to help local businesses grow and expand their access to a wider market** for their products (beyond their communities). • **Apply lessons learned from Nigeria**: In Nigeria, under the EEI, the REA identified suitable commercial and agricultural hubs that could benefit from mini-grid electrification, then carefully selected and integrated appropriate PUE equipment through an appliance-financing mechanism with ongoing business development support (see **Section 4.5**). Policymakers in Sierra Leone can refer to the EEI as a blueprint for Sierra Leone to follow to integrate PUE into mini-grid development.
Site Selection	• Adopt a **private sector-led model with a dual focus on increasing connections and improving the commercial viability of sites**. In Nigeria, under the NEP, the REA pursued a comprehensive site selection approach that included detailed site assessments and community sensitization initiatives. • Utilize **GIS/georeferenced data** and other **consumer and market intelligence tools**[20] to support the site selection process; in Nigeria, the REA implemented a **national data management platform** (Odyssey) that provides information to developers (e.g., demand forecasting, tariff calculation etc.) in an effort to streamline project development and improve customer demand estimation and avoid power underutilization. • Emphasize **productive-use activities as the primary method of stimulating electricity demand** in the community. Electricity demand assessments currently focus more on personal consumption at the household level (e.g., lighting and phone charging etc.), which may lead to lower levels of electricity uptake for projects. Developers need both financial and technical assistance from the government and/or development partners to support robust assessments of PUE potential during the site selection process. • Pursue a robust **community sensitization and consumer education and training campaign** as part of the site selection process. Given that mini-grid electrification remains cheaper than alternative sources of energy currently utilized by rural communities (e.g., purchasing of kerosene for lighting, diesel for generators etc.), it can be deduced that the inefficient use of energy from the mini-grid is at least partially contributing to misperceptions surrounding affordability in Sierra Leone. End users who are receiving electricity access for the first time may lack an understanding of how much they can afford to spend on power. Public and private sector resources should therefore focus heavily on community sensitization, consumer education and training around electricity usage (especially vis-à-vis monthly expenditures), mini-grid load capacity, appliance usage, PUE, and other benefits and cost-savings of mini-grid electrification. As consumer awareness around energy expenditures improves over time, mini-grid usage can be optimized. In Nigeria, during the rollout of the NEP, the REA led a comprehensive effort to raise awareness and sensitize rural communities by mobilizing locals to form/join Electricity Users Cooperative Societies (EUCSs).

20 Off-grid energy services companies are increasingly making more demand-side data available through customer and market insights. For example, Nithio provides data on customer creditworthiness, expenditure patterns; Fraym offers advanced geospatial data solutions (see: http://www.nithio.com and https://fraym.io)

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