SUSTAINABLE ENERGY FOR ALL

Global Energy Alliance for People and Planet

Foreign, Commonwealth & Development Office

Powering Social Infrastructure in Sierra Leone:

Market Assessment and Roadmap for Health Facilities

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Market Assessment and Roadmap for Health Facilities

Acknowledgements

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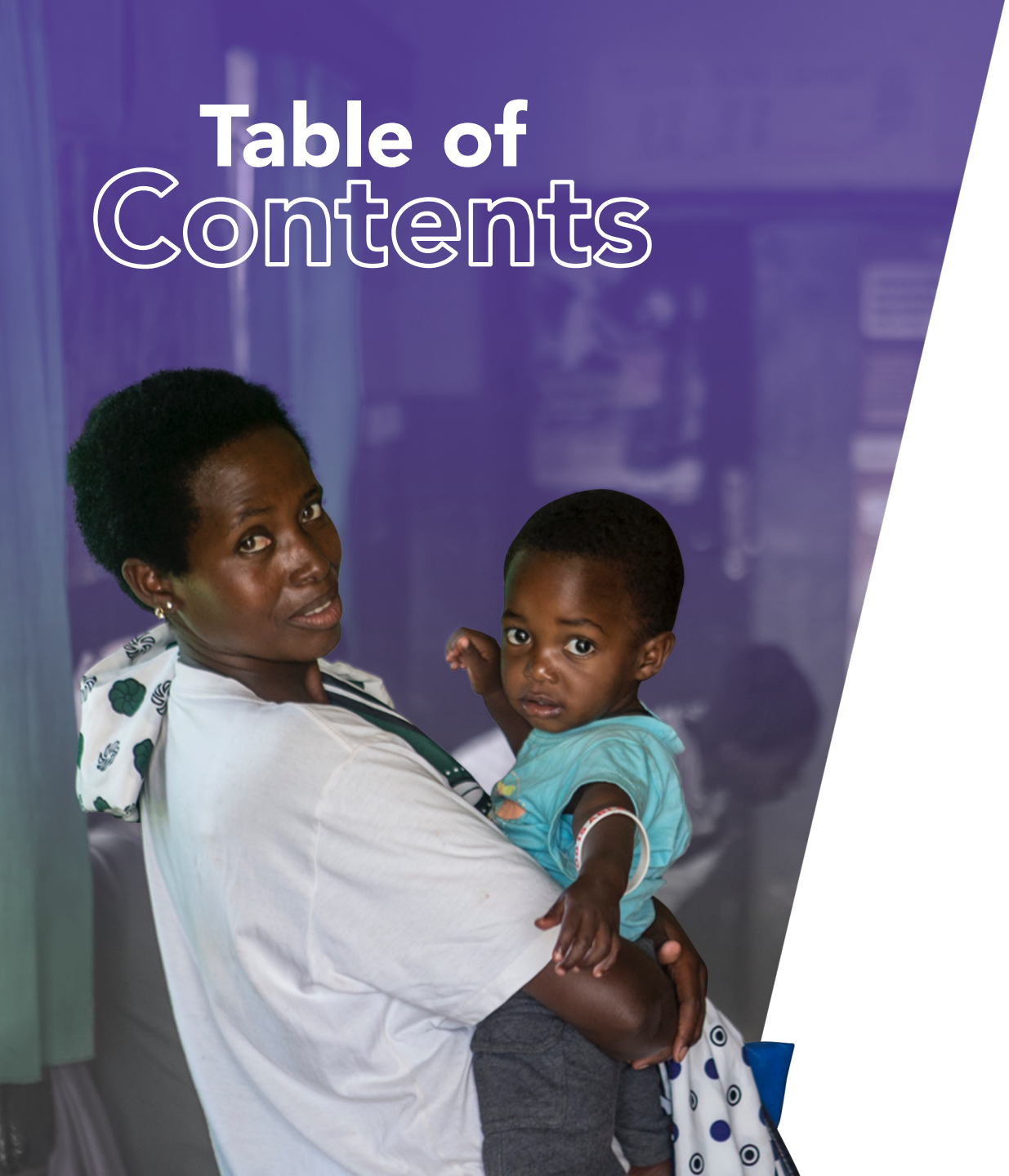
Acronyms

Term	Definition
ADRA	Adventist Development and Relief Census
BEmONC	Basic Emergency Obstetric and Newborn Care
BMZ	German Federal Ministry for Economic Cooperation and Development
CapEx	Capital expenditures
CDC	Centre for Disease Control
CEmONC	Comprehensive Emergency Obstetric and Newborn Care
CHCs	Community Health Centres
CHOs	Community Health Officers
CHPs	Community Health Posts
CLSG	Côte d'Ivoire, Liberia, Sierra Leone and Guinea electricity networks interconnection
COOPI	Cooperazione Internazionale
CUAMM	Doctors with Africa
DFR	Directorate of Financial Resources
DHMT	District Health Management Teams
DHS	Demographic and Health Survey
DMO	District Medical Officer
DPHC	Directorate of Primary Health Care
DPs	Development Partners
DPPI	Directorate of Policy, Planning and Information
DSTI	Directorate of Science, Technology and Innovation
EERP	Economic Rehabilitation and Recovery Program
EFO/ENFO	Energy For Opportunity
ENDEV	Energizing Development
EPA_SL	Environmental Protection Agency - Sierra Leone
EPCs	Engineering, Procurement, and Construction (EPC) solar company
EPG	Education Partnerships Group
ESCO	Energy Services Company
ESMAP	Energy Sector Assistance Management Program
EU	European Union
FCDO	Foreign and Commonwealth Development Office
FHCI	Free Health Care Initiative
GAVI	Global Alliance for Vaccines and Immunization (The Vaccine Alliance)

GDP	Gross Domestic Product
GEAPP	Global Alliance for People and Planet
GFF	Global Financing Facility
GGHE	General Government Expenditure on Health
GOAL	International humanitarian response NGO working in Sierra Leone
GoSL	Government of Sierra Leone
HDP	Health Development Partners
HFE	Health Facility Electrification
HIS	Health Information System
HRH	Human Resources for Health
HSDSSP	Health Service Delivery & System Support Project
HSSC	Health Sector Coordinating Committee
HSSP	Health System Strengthening Project
ICT	Information and Communications Technology (or Technologies)
IDA	International Development Association (The World Bank)
IDCOL	Infrastructure Development Company Limited
IHPAU	Integrated Health Project Administration Unit
IPs	International Partners
IsDB	Islamic Development Bank
JICA	Japan International Cooperation Agency
JSI	Global public health consulting organization
MCH Aides	Maternal and Child Health Aides
MCHPs	Maternal and Child Health Posts
MDAs	Ministries, Departments, and Agencies
MEL	Monitoring Evaluation and Learning
MICS	Multiple Indicator Cluster Survey
MNCH	Mortality rates of neonates, infants and children under five
MoE	Ministry of Energy
MoHS	Ministry of Health and Sanitation
MRC	Medical Research Centre
NGOs	Non-governmental Organizations
NHIS	National Health Information System
O&M	Operation and Maintenance
ODA	Official Development Assistance
ODCH	Ola During Children's Hospital
OOP	Out-of-pocket expenditure
OpEx	Operating expenses
PCMH	Princess Christian Maternity Hospital

PHUs	Public Health Units
PPP	Public Private Partnership
PPP	Purchasing Power Parity
PSI	Powering Social Infrastructure
REASL	Renewable Energy Association of Sierra Leone
REDISSE	Regional Disease Surveillance Systems Enhancement
RREP	Rural Renewable Energy Project
SDG7	Sustainable Development Goal 7
SECHNs	State Enrolled Community Health Nurses
SEforALL	Sustainable Energy for ALL
SEND	A non-governmental organisation working in Sierra Leone
SLESHI	Sierra Leone Social Health Insurance Scheme
TENN	The Energy Nexus Network
TTA	Trama TecnoAmbiental
UHC	Universal Health Coverage
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
WAO	West Africa Off-grid
WASSCE	West African Senior School Certificate Examination
WHH	Welthungerhilfe
WHO	World Health Organization



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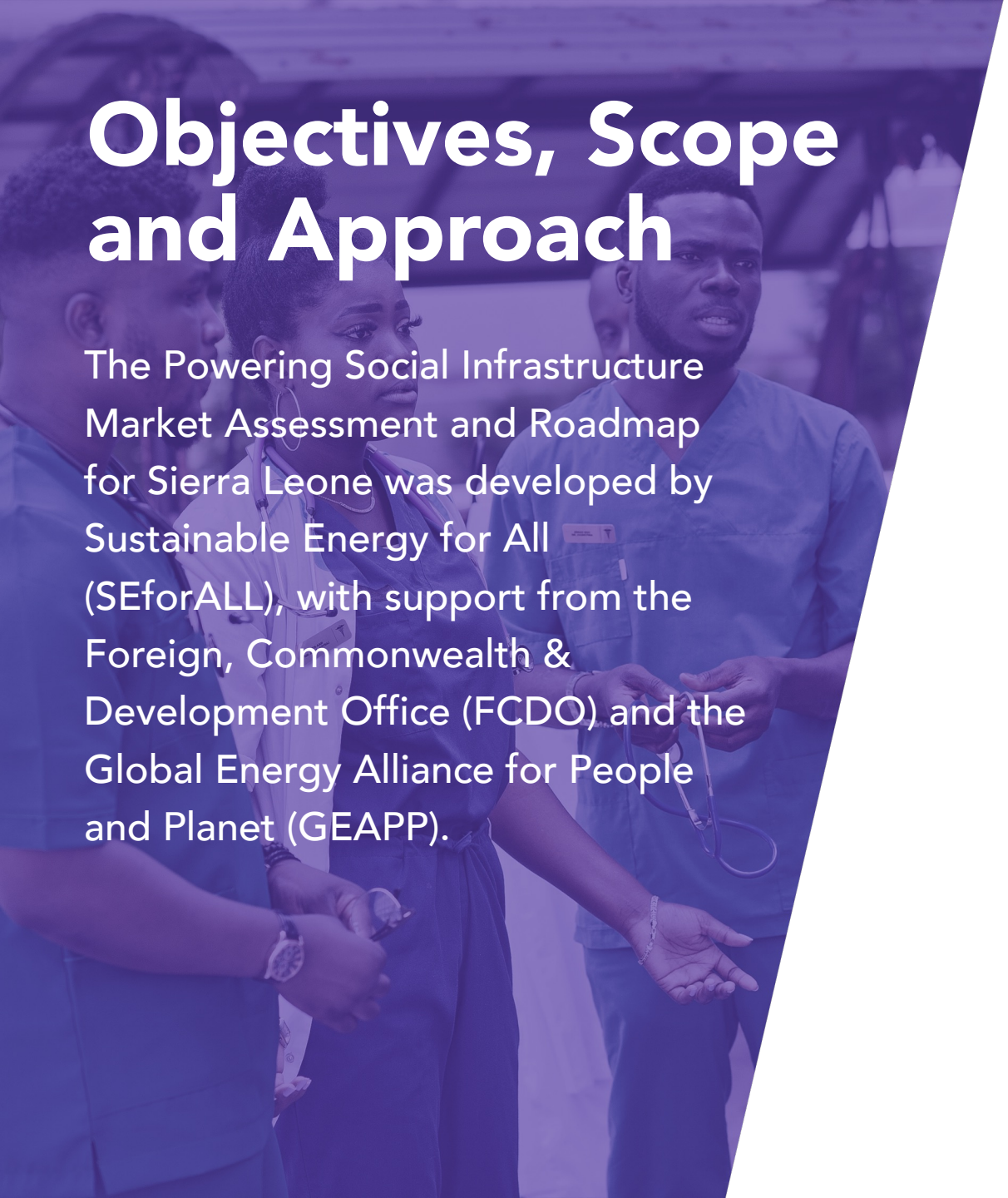


Objectives, Scope and Approach

The Powering Social Infrastructure Market Assessment and Roadmap for Sierra Leone was developed by Sustainable Energy for All (SEforALL), with support from the Foreign, Commonwealth & Development Office (FCDO) and the Global Energy Alliance for People and Planet (GEAPP).

Rationale

- Data on powering social infrastructure (healthcare facilities and schools) is sparse, outdated, and/or stored in multiple locations.
- There is limited coordination between energy and health and education sector actors (e.g., choice of locations for interventions, maintenance of installed infrastructure, appliances and investments in social infrastructure).
- There is a need to understand the investment need to bridge the energy access gap in schools.
- There is a lot of duplication happening across multiple interventions (e.g., needs assessment tools, system design, research on medical appliances, testing sustainable delivery models).

Roadmap objectives

01 Provide the government and its development partners with market intelligence and the evidence base for advancing electrification of healthcare facilities and schools in Sierra Leone

02 Provide the strategic information and implementation guide needed by the government and their partners to increase investment on powering social infrastructure and efforts on their sustainability.

03 Provide practical recommendations targeted at the government and its development partners in terms of the planning and coordination of electrification efforts for schools and healthcare facilities in Sierra Leone.

Methodology

Data was collected through various qualitative and quantitative methods including:

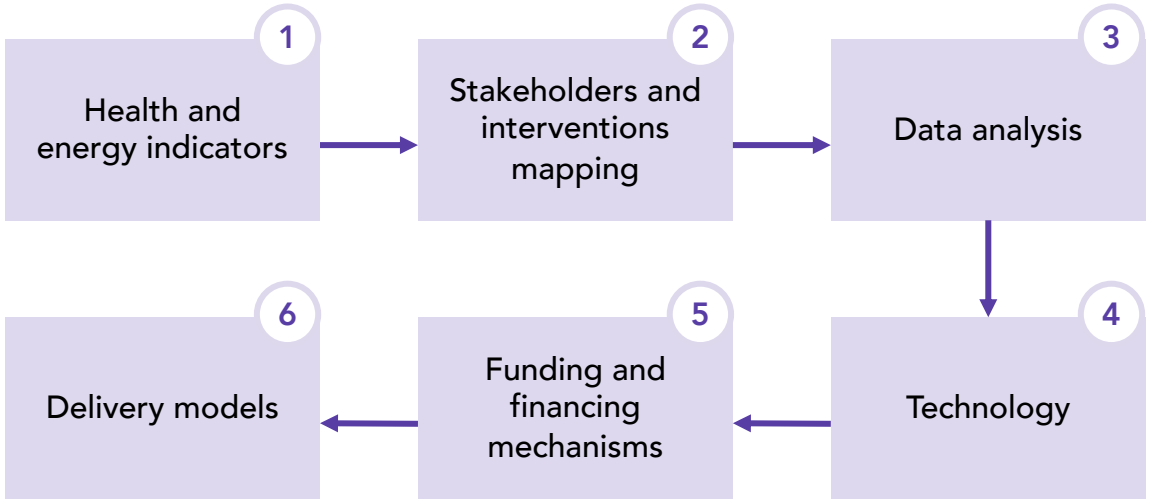
- Documents review, meta-analysis and synthesis;
- Stakeholder mapping;
- Semi-structured interviews;
- Energy needs assessment at 7 hospitals, 10 primary health facilities, and 10 secondary schools;
- Design and costing of standardized, customized and modular PV solar technology systems based on the energy needs assessment; and
- Co-creation, validation and dissemination of market assessment and roadmap.

The Market Assessment and Roadmap was developed in close collaboration with key stakeholders in the energy, health and education sectors, including the Ministry of Energy (MoE), Ministry of Health and Sanitation (MoHS) and the Ministry of Basic and Secondary School Education (MBSSE) and several other key stakeholders representing international development partners, NGOs and the private sector in Sierra Leone.

Approach

The Market Assessment and Roadmap consists of several components, including mapping of stakeholder and interventions, data analysis, technology assessment, funding and financing mechanisms, delivery models and roadmap for powering healthcare facilities (PHUs) and schools in Sierra Leone. The Market Assessment and Roadmap for Health Facilities is presented in the following chapters, whereas the Market Assessment and Roadmap for Schools can be accessed here.

Market assessment and roadmap



02 | Market Assessment

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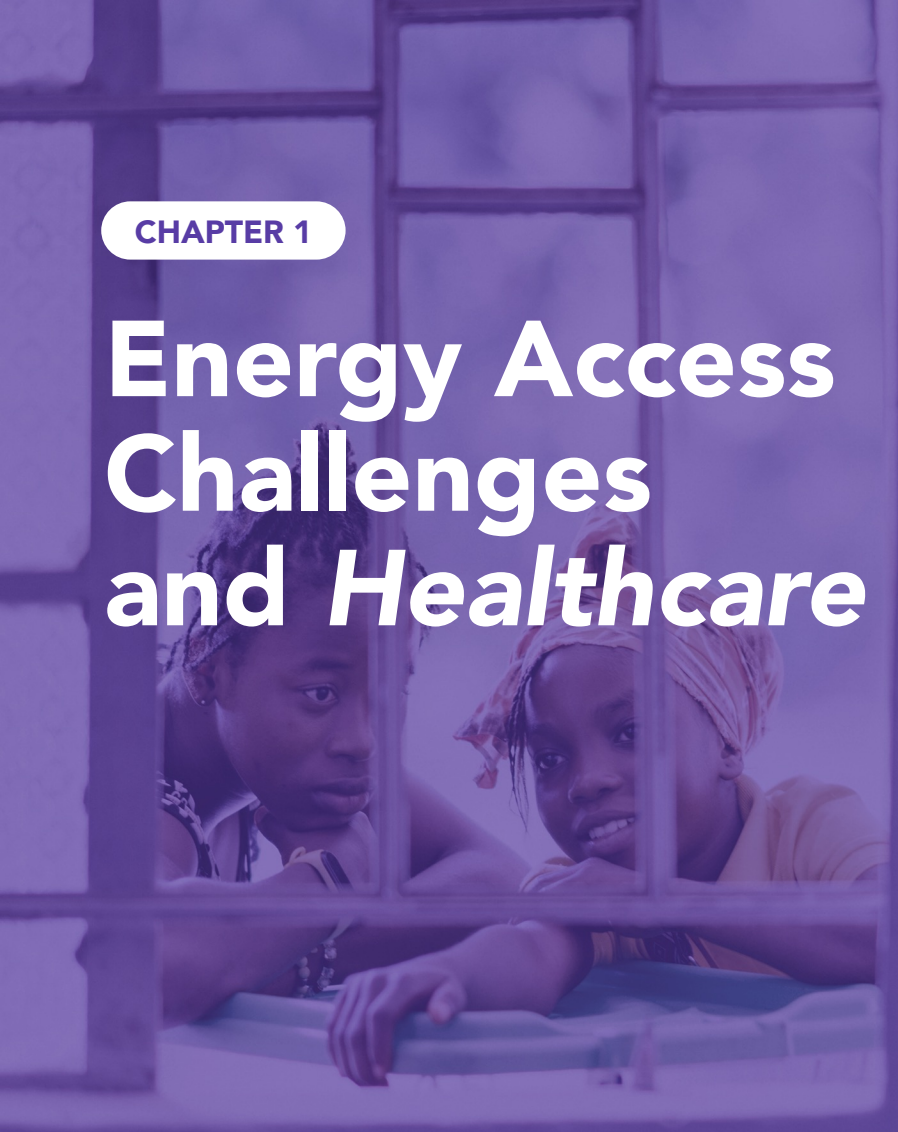
CHAPTER 1

Energy Access Challenges and *Healthcare*



26%

Population with access to electricity

Rural: 5%

Urban: 55%

~38%

Share of health facilities providing primary healthcare without electricity

1,120/100,000

Maternal mortality rate (2017)

Average global: 211

Average sub-Saharan Africa: 533

8.75%

Health expenditure (% of GDP)

Health expenditure/capita: $12.34

(<15% of the national budget)

80/1,000

Infant mortality (up to 1y)

Average global: 27

Average sub-Saharan Africa: 44

54.3 years (2019)

Life expectancy

Female: 55.1 / Male: 53.5

Average global: 72.7 years

Sources: Tracking SDG7 – ESMAP; Global Health Observatory, WHO online portal – Sierra Leone Country Profile; UNICEF Data: Monitoring the situation of children and women - Sierra Leone Country Profile https://data.unicef.org/country/sle/; WHO/UNICEF/UNPF/World Bank, Trends in Maternal Mortality: 2000 to 2017 WHO, Geneva, 2019; Barr et al., 2019 Health sector fragmentation: three examples from Sierra Leone, Globalization and Health; Chukwu et al., 2022_Electricity Computing Hardware and Internet Infrastructures in HF in SL. JMIR Medical Informatics

Health Policy Context

Landmark policies and plans

National Health Sector Strategic Plan (2017-2021)

The NHSSP remains the high-level planning document for the health sector in Sierra Leone. It provides a strategic direction and guidance to improve the health of the population with special focus on the needs of mothers, children, and the poor. Its goal is to reduce inequalities and improve the health status of people through the strengthening of the national health system.

Basic Package of Essential Health Services (2015-2020)

Provided a framework and guiding document for improving health service delivery in Sierra Leone. It represented a commitment from the GoSL through MoHS to ensure that a basic level of essential health care service delivery is available to its people.

Human Resources for Health (HRH) Policy (2017-2021)

Provides a clear vision for the health workforce, strengthening the health workforce to provide high-quality, equitable, and accessible health services to all Sierra Leoneans. The corresponding HRH Strategy 2017-2021 was developed in tandem to guide the implementation of the HRH Policy.

Landmark programmes and interventions

- The Free Health Care Initiative (FHCI, 2010) was introduced in the first year of the National Health Sector Strategic Plan (2010 – 2015) to ensure free preventive and curative health services for pregnant women, lactating mothers and children under five years of age in any government facility in Sierra Leone as a first step toward universal health coverage attainment.
- GoSL and partners have invested heavily in the health information system (HIS) for service delivery, surveillance, reporting, and monitoring. GoSL launched the National Digital Health Strategy (2018-2023) in 2018 followed by a broader National Innovation and digital strategy in 2019. The health-pillar direction will use big data and AI to improve healthcare in general, with a particular focus on maternal and child health.
- GoSL has embarked on the development of a health financing strategy that will outline clear steps to address health financing issues and to move closer to UHC in Sierra Leone. Meanwhile, the Health Financing Unit under the Directorate of Policy, Planning and Information and other health partners has published a situation analysis on health financing in Sierra Leone, which includes a detailed description of financing arrangements from various sources and services.

Health Facilities Categorization and Operating Structure

Teaching/tertiary hospital	• Three out of 24 hospitals in Sierra Leone are teaching/tertiary hospitals. • Connaught (largest hospital) - provides specialty care across many areas. • Princess Christian Maternity Hospital, which provides maternity services. • Ola During Children's Hospital, which provides care for Sierra Leone's children.
General hospital	• Several other specialty care hospitals exist in the Western Area, e.g., Kissy Mental Hospital. • Other hospitals provides secondary referral care, with at least one hospital per district functioning as a Comprehensive Emergency Obstetric and Newborn Care (CEmONC) center.

Peripheral Health Unit – Level 3: Community Health Centers (CHCs)	• Generally larger facilities meant to cover a catchment area (population) of about 10,000-20,000 individuals. • Typically, CHCs employ higher-skilled staff, such as Community Health Officers (CHOs), midwives, nurses. • Focus on epidemiology & environmental health, with some facilities also functioning as Basic Emergency Obstetric and Newborn Care (BEmONC) centers.
Peripheral Health Unit – Level 2: Community Health Posts (CHPs)	• Medium-sized facilities designed to serve a population of roughly 5,000-10,000 individuals. • CHPs are generally staffed by lower-skilled health workers, such as State Enrolled Community Health Nurses (SECHNs) and Maternal and Child Health Aides (MCH Aides).
Peripheral Health Unit – Level 1: Maternal and Child Health Posts (MCHPs)	• MCHPs are the most numerous of the various levels of healthcare. • MCHPs are meant to provide the first point of contact with the facility-based health system. • MCHPs are usually located at the village level and serve populations of less than 5,000 individuals. • They are largely staffed by MCH Aides.

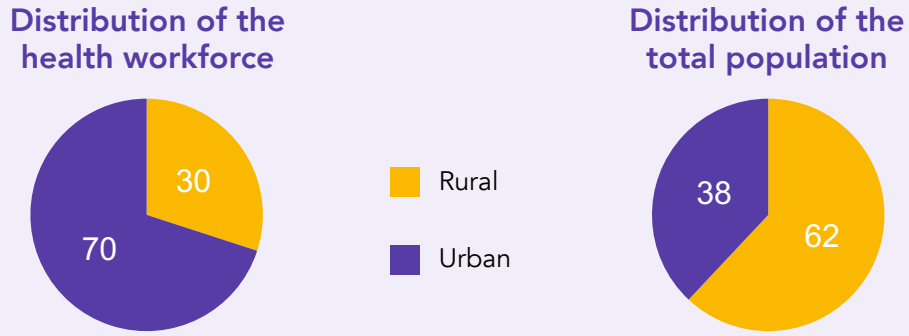
Health Facilities Geographic Distribution

1.86 healthcare facilities per 10,000 people

2020 data provided by MoHS states a total of 1404 healthcare facilities in Sierra Leone

- Healthcare facilities are unevenly distributed across the five regions (Western Area and four Provinces) in Sierra Leone.
- There is an urban–rural split, with many doctors preferring to live and work in urban areas.
- The rural-urban split in healthcare personnel is exacerbated by a healthcare system that is understaffed, with 1.4 doctors, nurses and midwives per 10,000 population in Sierra Leone (WHO recommends 23 doctors, nurses, and midwives per 10,000 population).
- Nevertheless, the number of healthcare facilities have continued to increase steadily, with improvements in services offered and some improvements in key health outcomes, even if marginally.

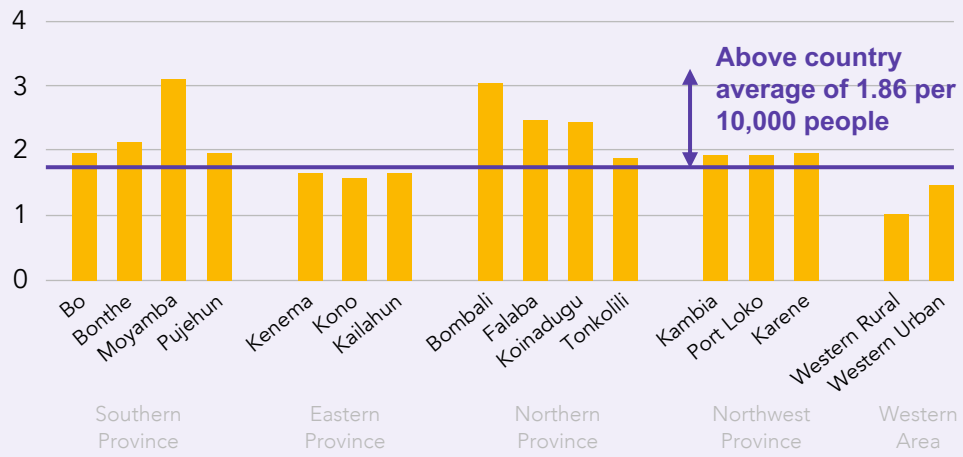
Sources: MoHS database on healthcare facilities in Sierra Leone; USAID Data for Impact; World Health Organization. (2010). Monitoring the building blocks of health systems: a handbook of indicators and their measurement strategies. World Health Organization. https://apps.who.int/iris/handle/10665/258734; Robinson, 2019, Primary health care and family medicine in Sierra Leone, African Journal of Primary Health Care & Family Medicine



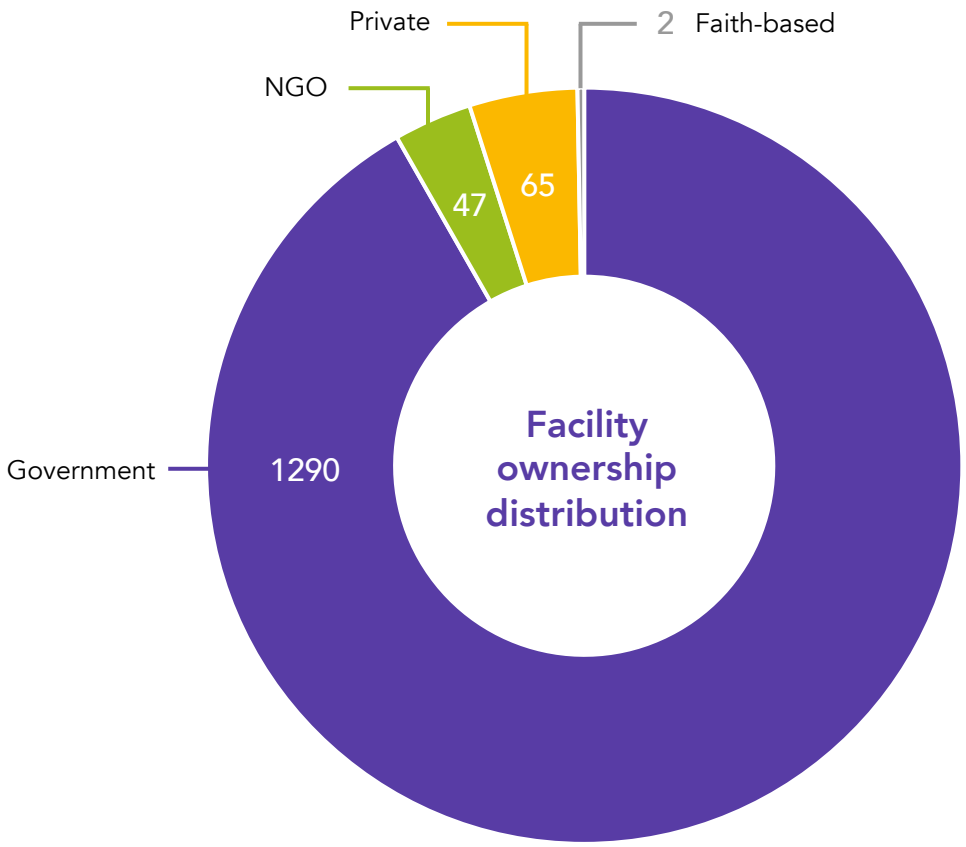
Source: Ministry of Health and Sanitation. Human resources for health strategy 2017-2021. Freetown: Government of Sierra Leone; 2017

Variation among regions

Healthcare facilities per 10,000 people



Ownership of Health Facilities



- Healthcare in Sierra Leone is provided by government, private, NGOs and faith-based organisations.
- The updated 2022 data from the MoHS shows that most healthcare facilities (92%) are owned and operated by the Government through the MoHS.
- There are few healthcare facilities owned and operated by private (4.5%), faith-based organizations (< 1%) and NGOs (3%).
- The data shows that communities don't own and run healthcare facilities although they usually provide land for the construction of healthcare facilities owned by the Government, NGOs and faith-based organizations at no cost.
- Community involvement, cooperation and ownership of healthcare facilities is strongly encouraged by the government through MoHS, NGOs, community mobilizers, healthcare facility management teams and local traditional leaders.

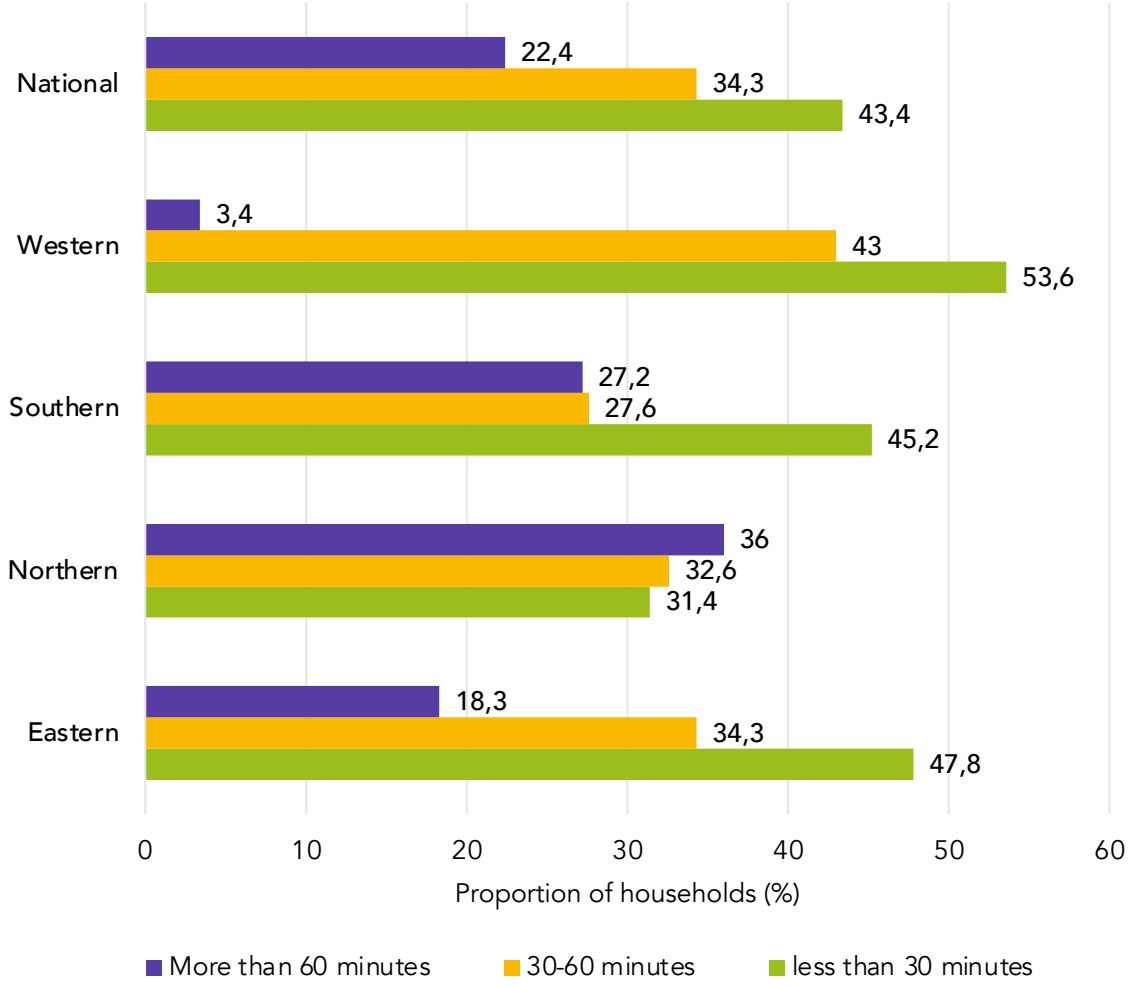
Key Health Indicators/Outcomes – Trends Between 2014 and 2020

Impact indicator	WHO 2014	WHO 2016	WHO 2018	WHO 2020
Neonatal mortality rate (per 1,000 live births)	36	34	33	31
Infant mortality rate (per 1,000 live births)	96	90	85	80
Under-five mortality rate (per 1,000 live births)	140	125	116	108
Population using at least basic sanitation services (%)	15	15	16	17
Population with household spending on health greater than 10% of total household budget (%)	-	-	-	16
Population with household spending on health greater than 25% of total household budget (%)	-	-	-	3

Sources: The Global Health Observatory Sierra Leone (who.int)

- Mortality rates of neonates, and children under five (MNCH coverage indicators) are steadily decreasing.
- There have been some improvements in MNCH coverage indicators with the introduction of the Free Health Care Initiative (FHCI). For example, infant mortality rate fell gradually from 194/1000 live births in 1971 to 80/1000 live births.
- The population using basic sanitation services has been remained constant to 15-17%
- On ability to pay for health, 16% of households spent more than 10% of the total household budget and only 3% above 25% of the total budget.
- These figures represent the persistent challenges faced by women and children in Sierra Leone as the government and development partners work together to transform poor healthcare practices and sub-standard and ill-equipped healthcare facilities into functional facilities.

Access to Health Facilities Remains a Challenge for a Large Part of the Population



- Access to healthcare facilities in last mile communities remains a challenge for most of the population.
- The present policy on the location of PHUs is within the range of 5 km radius from each community. However, there are underserved communities and in some rural areas, communities are more than 8 km from the health facility.
- Access to health facilities is relatively better in the Western Area where > 96% of the population lives within less than an hour (walk or using some kind of motorized transport) from the nearest health facility.
- Only < 4% of households are located more than 60 minutes from the nearest health facility. This is roughly 5-10 times higher for households in the four provincial divisions. In the Northern Province, for example, 36% of households are located > 60 minutes away from the nearest healthcare facility.

Sources: Government of Sierra Leone Human Capital Development Project Report (Oct 2020); World Bank, World Development Indicators (online portal citing WHO, 2019; https://data.worldbank.org/indicator/SH.STA.MMRT?locations=SL&most_recent_value_desc=true); World Bank Policy Brief, Optimization of geographic accessibility to maternal health in Sierra Leone (https://documents1.worldbank.org/curated/en/099140306242266169/pdf/P1635190926dc70d60935006b237e223e56.pdf)

Access to electricity could transform challenges into opportunities for improved healthcare service delivery

Access to improved healthcare services could lead to improved health outcomes

Unreliable energy access leads to poor healthcare services and outcomes

- 74% of population do not have access to electricity
- Only 38% of PHUs have access to electricity, with 6-10 hours average power supply from any combination of sources
- Healthcare facilities lack electronic health, logistics and financial information systems
- Health sector fragmentation continues to impede healthcare service delivery
- Improvements in health outcomes is constrained by geographical barriers, high out-of-pocket expenditures, shortage of skilled medical staff, and poor service quality
- Maternal mortality 1,120/100,000 live births;
- Infant mortality 80/1,000 live births rank: 185/193;
- Life expectancy: 54.2 years (average global: 72.7 years)

Demand challenges

- The electrification gap is still very large. Although access to electricity is improving, the rate of electrification is still slow as the demand for electricity continues to grow rapidly.
- Lack of access to financing mechanisms for providers and end users
- Inadequate access to electricity for social/public services such as healthcare facilities

Healthcare financing and donor funding

- GoSL is strengthening public–private partnerships for healthcare services delivery in Sierra Leone
- GoSL has shown strong leadership, determination and political will to increase healthcare spending to 15% of the national budget
- GoSL has plans to track donor resources through a regularly updated national health database system.

Key Policy Actions

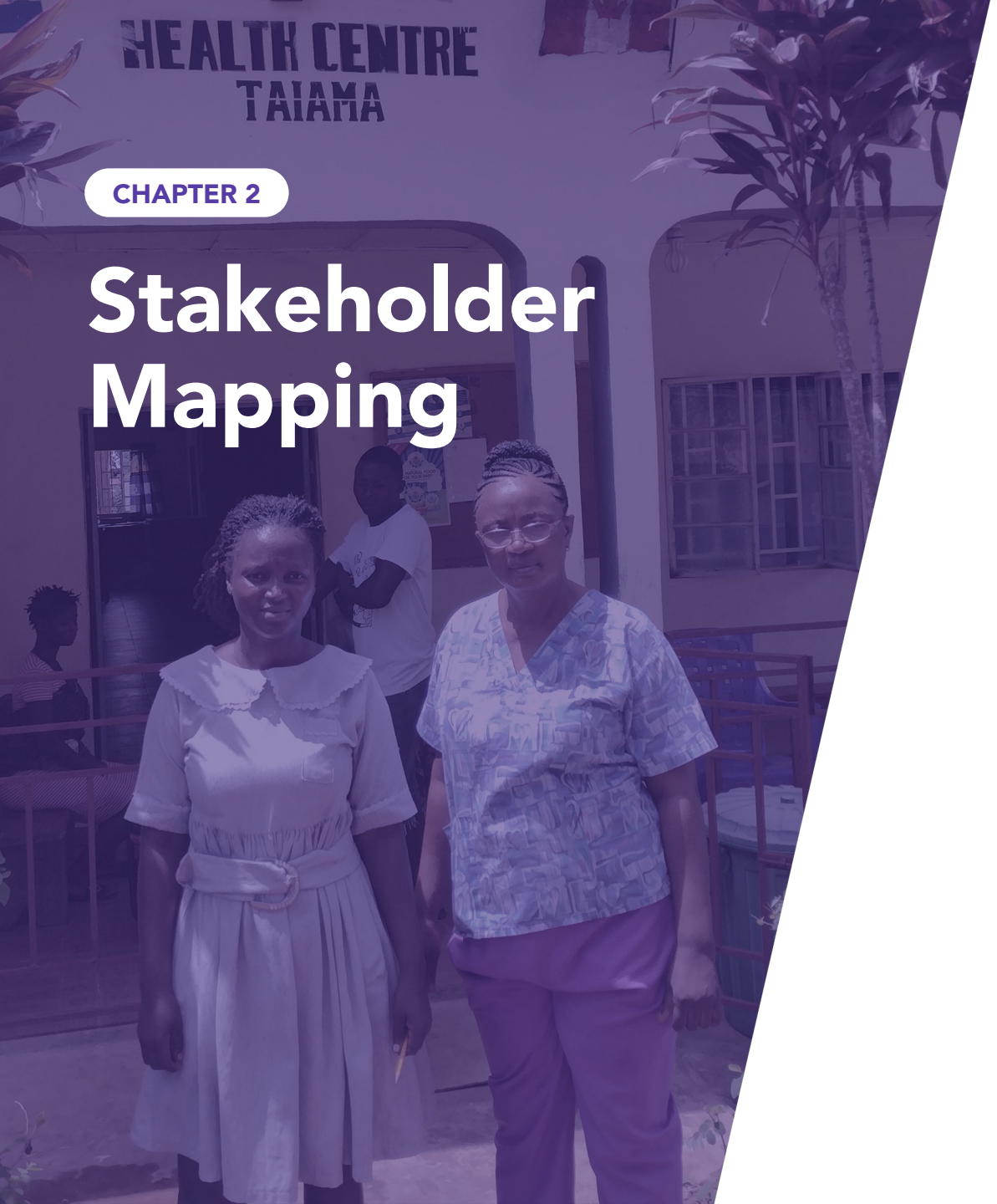
GoSL remains committed to:

- Improved governance at all levels and ensuring rural electrification is done through engagement and involvement of key stakeholders, including the private sector.
- Improved policy and regulatory environment – e.g., GoSL unbundled the power sector in 2015 and created new state utilities.
- Exploring the potential of renewable energy sources, especially solar and hydro-power and increase investment
- Sustaining the implementation of the FHCI that was launched in 2010.
- Strengthening the Health Management and Information System through the digitalization of healthcare systems and processes.
- Strengthening the capacity of medical regulatory bodies through the review of a legal and policy regulatory framework in line with regional and international benchmarks.

Improved energy access will lead to improved quality of healthcare services and better health outcomes

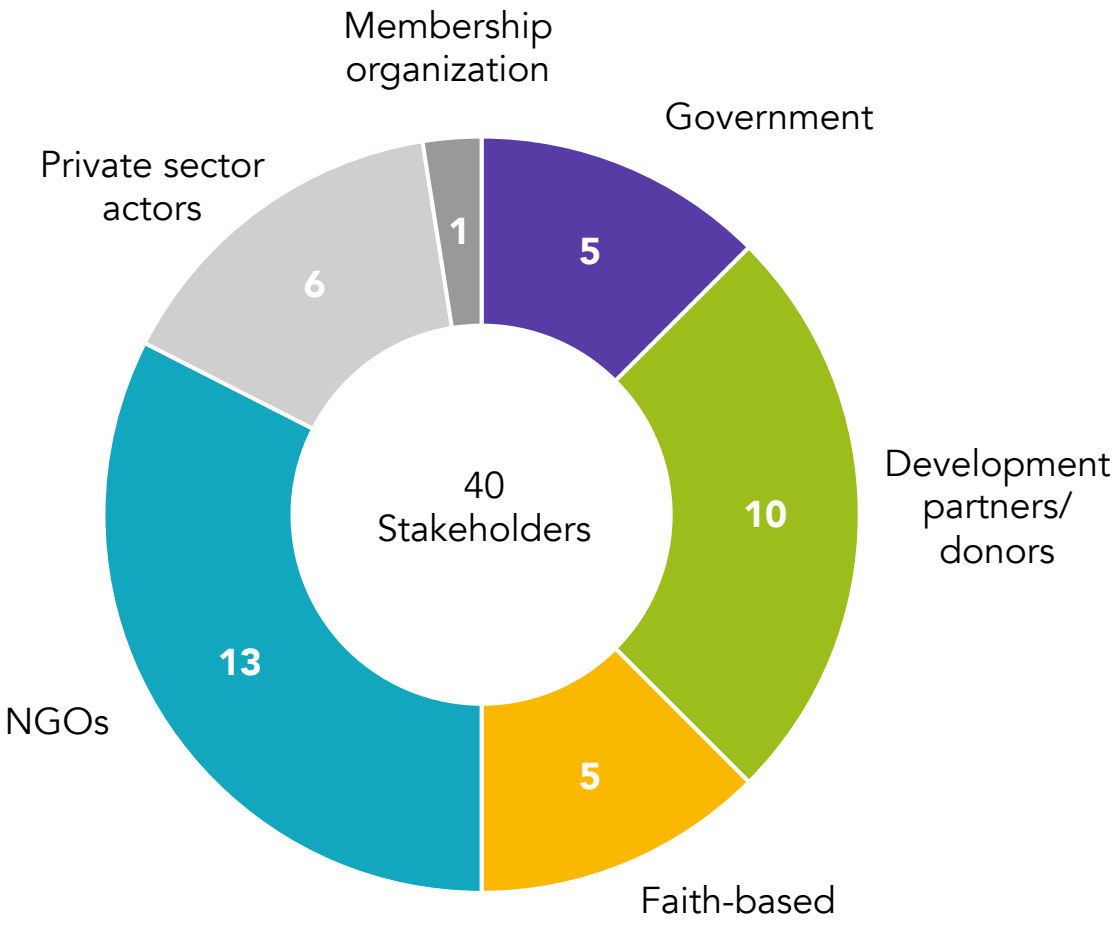
- GoSL plans to increase installed electricity capacity from 160 MW (in 2022) to 850 MW by 2030 and restore electricity in all district headquarters and cities.
- GoSL plans to increase renewable energy contribution to 80% by 2030 from 31% in 2022.
- These electrification plans could help transform the health sector from an under-resourced, ill-equipped, and inadequate delivery system into a well resourced and functioning national health-care delivery system that is affordable for everyone and accessible to all.

Source: MoE. Energy transformation. Sector goals and Development partner alignment. June 2022



CHAPTER 2

Stakeholder Mapping



Stakeholder consultations

Over 40 public and private sector stakeholders were consulted and interviewed as part of the development of the Market Assessment & Roadmap.

Ministry of Energy (MoE)
Ministry of Health & Sanitation (MoHS)
Ministry of Basic & Senior Secondary Education (MBSSE)

Key Interventions Mapping

Intervention	Brief description	Status	Funder	Implementing organizations	Stakeholder categories
HealthGrid Sierra Leone (HealthGrid)	• PV electricity generation equipment for 31 remote, off-grid, healthcare facilities; • Installing internet connections and WASH systems	Planned	USAID	RESOLVE/Health-grid (lead); Orange-SL, World Vision, GAVI	Donor/State/ NGO/Private
Enhancing the Impact of Rural Renewable Energy in Sierra Leone	• 300 kWp of generation capacity in 6 rural communities under Bo district . Fully funded.	Ongoing. Estimated commissioning by June 2023	Government of Japan (GoJ)	UNOPS (on behalf of MoE). Winch Energy is the operator	Donor/State/ Private
UNICEF Renewable Energy (Solar) Market Assessment	• Energy needs assessment covering all 16 Districts; • 30 healthcare facilities and 30 schools	Ongoing	UNICEF	UNICEF (lead)	Not applicable
Electrification through Mini-grids and Standalone Systems	• Approx. 1.4 MW of generation capacity in 10 communities (Moyamba generation capacity + distribution and generation capacity in 9 other communities) • 700 standalone systems for 500 schools and 200 CHCs.	Ongoing. All the sites to be completed by December 2023	The World Bank	UNOPS (on behalf of MoE)	Donor/State/ Private
SEforALL Powering Social Infrastructure "Market Assessment and Roadmap"	• Energy needs assessment/audits of 7 hospitals, 10 peripheral healthcare facilities and 10 secondary schools, with technical design (standardized/customized) options; • Evaluation of existing funding and financing models for powering healthcare and schools • Roadmap and support on technical deep dives for GoSL, IPs and other stakeholders on powering healthcare and schools in Sierra Leone.	Ongoing	FCDO, GEAPP	SEforALL (lead) in partnership with GoSL - MoHS, MoE, MBSSE	Donor/State/ NGO
Pilot Projects – Building Resilient Energy Ecosystems Around Decentralized Renewable Energy	• Providing DRE solutions to power and light up healthcare facilities in rural Sierra Leone • Small solar PV stand-alone solutions for lighting and powering small equipment	Ongoing	Village Empowerment Inc	Global SDG7 Hubs (lead) and TENN	Donor/State/ NGO/Private

Key Interventions Mapping

Intervention	Brief description	Status	Funder	Implementing organizations	Stakeholder categories
Enhancing Sierra Leone Energy Access Project (ID: P171059)	• Three components - grid extension (CLSG), mini-grids and stand-alone solar systems • Targeting 700 health facilities and schools in total	Ongoing	IDA; GFF	UNOPS (lead) on behalf of World Bank & MoE)	Donor/State/ Private
Rural Renewable Electrification Project (RREP)	• 5MW of renewable energy to 94 communities • WP1/1+: 16-36 kWp solar PV generation systems (50 sites). Supported fully through grant financing. • WP2: 44 larger solar PV generation systems (36 - 300 kWP). Co-financed distribution grids and indoor connections are grant supported. Generation assets are financed by the private operators (PowerGen, Power Leone, and Winch Energy).	WP1/1+: Completed WP2: 26 sites completed and operational. The remaining sites to come online by Dec. 2022	FCDO	UNOPS (lead on behalf of MoE); UNOPS handed over all 94 sites to operators (PowerGen, Power Leone, Winch Energy) under a PPP contract	Donor/State/ Private
WASH and Electrification Support for Healthcare Facilities in Rural Sierra Leone	• Stand-alone solar PV systems (510 Wp) and submersible pumps in (1600 Wp) in 177 health centers • Stand-alone solar PV systems (2500 Wp) in 10 health centers	Completed	Advancing Partners and Communities	JSI, GOAL, BMZ, WHH, SEND, ENFO IMC Solar, ADRA, Save the Children, ACF	Donor/State/ NGO
Promoting Renewable Energy Services for Social Development in Sierra Leone (PRESSD-SL)	• Electrification of public infrastructure; existing and sufficient awareness and capacity on renewable energy • Installed standalone PV in 25 health centers and 12 schools • Two mini-grids of 128 kWp in Segbwema and 66 kWp in Panguma)	Completed	Funded by European Union	COOPI, Deutsche Welthungerhilfe, Oxfam Ibis, EFO, IBIS	Donor/State
Child Health and Mortality Prevention Surveillance (CHAMPS)	• Tracking the causes of under-five mortality and stillbirths through epidemiologic surveillance in Bombali District, • Energy needs assessment at 23 healthcare facilities	Completed	-	Crown Agents (lead), Emory Uni; MoHS	Donor/State/ NGO
Support for Expanded Programme on Immunization, Sierra Leone	• 1373 solar powered fridges (370 Wp) in health centers • Solar fridges (300 Wp) in 6 health centers in Kono District	Completed (2015)	USAID; ENDEV	MoHS (EPI), UNICEF (lead)	Donor/State/ NGO

Key Interventions Mapping

Intervention	Brief description	Status	Funder	Implementing organizations	Stakeholder categories
Strengthening Primary and Community Health Services in Sierra Leone	• Revitalization of 305 health facilities to provide various levels of support: • Improved water and sanitation; Installed solar power systems for lighting; Provided basic medical equipment;	Completed	USAID	Advancing Partners & Communities (lead); (MoHS)	Donor/State
Rural Energy Activating Livelihoods	• Installed SHS (10-20 Wp) in 36 schools • Installing stand alone solar systems in 16 health centers, 14 schools	Completed (2015)	EU, Playhouse Foundation	Environmental Foundation for Africa (lead)	Donor/state
Partners in Health (PIH) – Sierra Leone	• Provided 24-hour electricity and running water • Maintains a steady flow of vital medical supplies and medications	Completed	-	Partners in Health (lead); MoHS	Donor/State/ NGO
Project Bo	• Providing a stable power supply to treat vulnerable babies at the Bo Government Hospital, Sierra Leone • Supplies 24-hour electricity to the neonatal unit	Completed	Rahul Boyle Foundation/ Liebreich Foundation	We Care Solar (lead); Energy for Opportunity	Donor/State/ NGO
We Care Solar - Solar Suitcase project	• UNFPA Country Office support to GoSL • Installed solar PV suitcases in 516 maternal health clinics in 13 districts in Sierra Leone	Completed (2016-2021)	UNFPA, Friends of PCMH	We Care Solar (lead), UNFPA, MoHS, MRC, CUAMM	Donor/State/ NGO
Barefoot Women Solar Engineers - solarizing healthcare in rural areas	• Installation of SHS/solar fridge in 2 staff quarters, 4 schools, 4 training centers, and 19 Peripheral Healthcare Unites (CHCs, MCHPs, CHPs) in Western Rural District. • GOSL invested ~ $820,000 in Barefoot women project.	Completed	GoSL; Tools To Work; PUM; EnDev	Barefoot Women Solar Engineers; MoHS	Donor/State/ NGO
Solar and Water Projects at Mattru	• 100kVA PV and water purification/packaging project providing electricity to Mattru hospital and selling excess electricity to a limited number of consumers in the community. • The SOLA WATA business on the hospital campus sells packaged drinking water in the surrounding villages to generate income and maintain the PV system	Completed (2018)	UBGlobal	UBGlobal	Donor/NGO

Inter-sectoral coordination on powering social infrastructure

- There is currently no formal inter-ministerial coordination platform that focuses on electrification of social infrastructure such as healthcare facilities and schools. Therefore, coordination between MoHS and MoE or MBSSE and MoE is ad-hoc and driven by emerging needs. Also, there is currently no mechanism for coordination between ministries and stakeholders specifically on powering healthcare or schools.
- However, several coordination mechanisms exist to facilitate discussions on intervention among key players in the sectors. For instance, the Health Sector Coordinating Committee (HSSC) is the highest coordinating body for the MoHS and its development partners. Similarly, the Health Development Partners (HDP) forum and Health NGOs forum both meet monthly. Both are occasionally attended by government stakeholders in order to brief the partners on various activities and issues.
- MoHS is currently examining the issue: senior advisers to the Ministers are currently working through the office of the Deputy Minister to coordinate all interventions related to health facility electrification, with proposed plans to establish a maintenance unit within MoHS that will be responsible for O&M of installed solar PV systems at healthcare facilities countrywide. It is expected that this unit will coordinate with officials at MoE. No such plans are currently envisaged for MBSSE in the education sector.
- Informal discussions are currently ongoing for a multistakeholder platform on powering social infrastructure (incl. civil society, donors, private sector and government stakeholders). Virtual and in-person meetings have been held to discuss key issues related to powering social infrastructure in Sierra Leone, such as the sustainability of solar PV technology after installations and the related O&M issues.

Stakeholders and intervention mapping: findings and recommendations

Situation

- The mapping exercise shows that in the last 8 years since the Ebola outbreak in West Africa, the largest single intervention targeted the electrification of approximately 100 CHCs.
- A similar model is being pursued for an additional 60 mini-grids that will provide power to primary healthcare facilities and other social infrastructure, including schools.
- Most of the other mapped interventions are small-scale stand-alone solar PV interventions installed by a range of stakeholder and spread all over the country, although the distribution of interventions is uneven. All 16 districts in Sierra Leone have benefited from several different projects.
- Most of the mapped interventions have been completed. There are currently 5 ongoing interventions with two planned interventions that will support the electrification of social infrastructure.
- Electrification interventions are still heavily donor dependent with most of the interventions funded and implemented by development partners
- Several needs assessments and mapping exercises have taken place, ranging from district surveys to nation-wide studies, including GIS-based assessments.

Findings and gaps

Public sector

- The public sector has a long-standing involvement in powering social infrastructure, in particular for healthcare, following the Ebola outbreak of 2014-2015. GoSL supports and facilitates interventions countrywide.
- MoHS is examining plans to establish a maintenance unit within the Ministry that will be responsible for O&M of installed solar PV systems at healthcare facilities countrywide. It is expected that this unit will coordinate with officials at MoE.

Private sector

- Private sector involvement remains minimal and primarily limited to procurement and installation of power solutions. There is growing interest and involvement from private sector actors to play a more expanded role, covering longer-term O&M (as is already the case for mini-grid operations).

Coordination

- There has been limited dialogue and alignment between energy and health/education sectors in the planning and coordination of health/education sector electrification interventions. However, there are structures in place with MoHS and MBSSE to facilitate dialogue and coordination at the policy and programme levels.
- As interest in this topic is growing, a working group on powering social infrastructure is gradually developing. SEforALL is working with sector actors to establish a working group that meets regularly to discuss and coordinate activities.

Situation

Selection criteria

- There are no established criteria for site selections with respect to interventions on powering healthcare and schools. Decision are taken based on key stakeholder interests, donor priorities, and advice from the Ministries.
- Increasingly, digital and GIS-based analysis is being used to locate and collate information from high-need areas, e.g., by overlaying location of facilities with night-light satellite data and distance from the grid.

Data

- Lack of multi-sectoral data visibility, sharing and evidence-based planning for powering social infrastructure

Delivery and scope

- Most of the interventions have been directed primarily towards healthcare facilities in (off-grid) rural areas; only a handful of interventions have included schools.
- There is no clear technology preference or minimum standard: power solutions deployed to date range from pico-solar solutions to mini-grids that are anchored at healthcare facilities.
- The majority of the projects have followed a traditional donor-led EPC model, which has resulted in long-term sustainability challenges in particular on O&M.

Recommendations

- Development of a policy and partnership framework to clarify national priorities and national strategies on energy, health, and education.
- Increased cross-sector coordination, leveraging the emerging working group on powering social infrastructure; this could result in better evidence-based implementation, resource utilization, funding/financing flows and alignment towards achieving national targets and SDGs 3, 5, 7 and 13.
- Increased participation from public sector stakeholders (both centralized and decentralized) in intersectoral dialogue to foster accelerated progress towards the electrification of all social infrastructure

CHAPTER 3

Data Insights

1287 / 1134
Total number of primary healthcare facilities (PHUs) / PHUs with unreliable power

96.2%
Health facilities providing basic/primary care services (PHUs)

~38%
Share of PHUs without access to electricity

~80%
Fraction of PHUs not connected to the national grid

34%
Share of PHUs which do not yet use solar PV power

0-24 hours
Large variance of power supply from any combination of sources

Multiple Sources of Data on Health Facilities is challenging

Data sources

Data on healthcare facilities can be accessed from multiple sources, some with geo-tagged locations of healthcare facilities across the country

Datasets

Datasets include classification of healthcare facilities according to the level of service provided at different sub-national levels.

Facility types

Terminology for classification of healthcare facilities according to the level healthcare services provided is consistent for all data sources.

Scope

The datasets vary in scope, with some providing the number healthcare facilities by type only; few data sources has data on the status of infrastructure such as electricity and WASH facilities; no data is provided on the functionality of facilities

Facility ownership and management

Datasets categorize facilities by ownership/management type (public, private, NGO, or faith-base) for all levels of healthcare

Electrification status

Electrification status is either binary (yes/no). Quality and duration of electricity supply is often not provided. Energy loads by category of healthcare is not provided

Healthcare electrification status: general overview and analysis

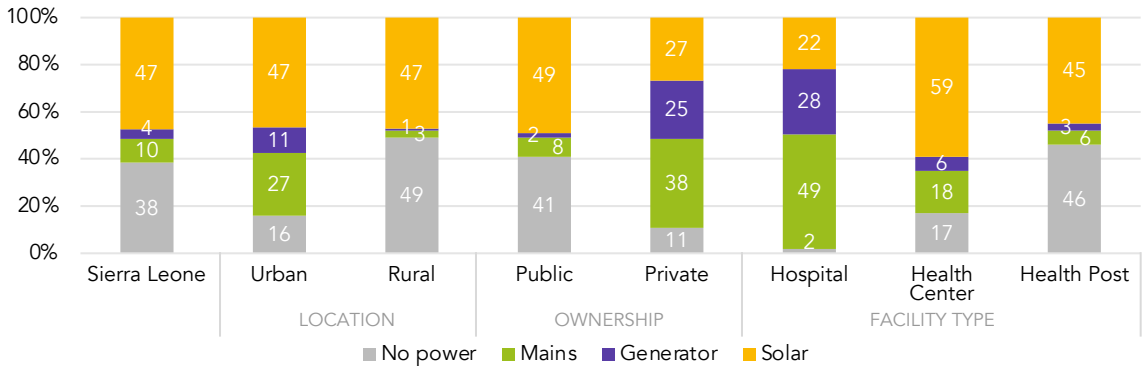
1 Access to power is improving

Over the years, several nationwide surveys have estimated the electrification rate of health facilities. These include:

2012 SARA survey:	2017 SARA survey:	2018 SDI survey:
15% access rate	**23% access rate**	**62% access rate**

While progress has been made, this needs to be qualified by power availability (e.g., many pico-solar and SHS type solutions) and reliability (frequent power outages and sub-optimal performance of installed solar systems are common; some facilities have electricity but for a single room only or type of loas e.g., lights).

Sources of electricity by facility type



Source: 2018 SDI (https://microdata.worldbank.org/index.php/catalog/4038/download/50704

2 Power availability varies significantly between districts

- Energy access rates for healthcare facilities vary greatly across districts, getting progressively lower with the level of healthcare from tertiary and secondary care (hospitals/clinics) to various levels of primary healthcare facilities (PHUs).
- In general, healthcare facilities in Western Urban and Western Rural – where the capital Freetown is located – have higher access rates (95.4% and 89.9%, respectively) compared to Kenema (26.9%), Kailahun (46.0%), Kono (38.7%) or Koinadugu (41.6%).

Percentage access to electricity for health facilities by district

Bo	Bombali	Bonthe	Kailahun	Kambia	Kenema	Koinadugu
79	57	81	46	58	27	42

Kono	Moyamba	Port Loko	Pujehun	Tonkolili	Western Rural	Western Urban
39	52	71	85	64	90	95

3 Electrification data on quality shows large gaps in reliability as well as availability

- There are varying levels of electricity access at healthcare facilities with respect to the quality and duration of electricity available. Many secondary and tertiary healthcare facilities (hospitals/clinics) are connected to the national grid, but they suffer from frequent power outages. These facilities still require backup power sources like gensets and/or stand-alone PV solar systems.
- A small number of facilities at all levels of healthcare facilities have solar PV systems with 24/7 access to electricity. However, for most facilities at the primary healthcare (PHU) level, installations were typically very small systems designed to power a refrigerator and/or providing lighting for only a few health services, usually the maternity room/wing of the facility.
- In many locations and at all levels of healthcare, the stand-alone solar PV systems operate sub-optimally, with many systems providing electricity for less than 12hrs.

4 Electricity access rates drops significantly for remote and lower-tiered PHUs

- Access rates drop significantly with remoteness from a large town/city with grid connection. The majority of the approximately 80% PHUs without access to the national grid are lower tiered healthcare facilities located further away from large towns/cities that are connected to the national grid.

5 Low-tiered PHUs lack long-term O&M

- A noticeable key challenge of PV stand-alone systems at many lower-tiered healthcare facilities is the lack of long-term operation and maintenance regimes or sustainability plans; this leads to declining performance of the equipment, e.g., faulty wirings, dysfunctional batteries, and broken light bulbs.

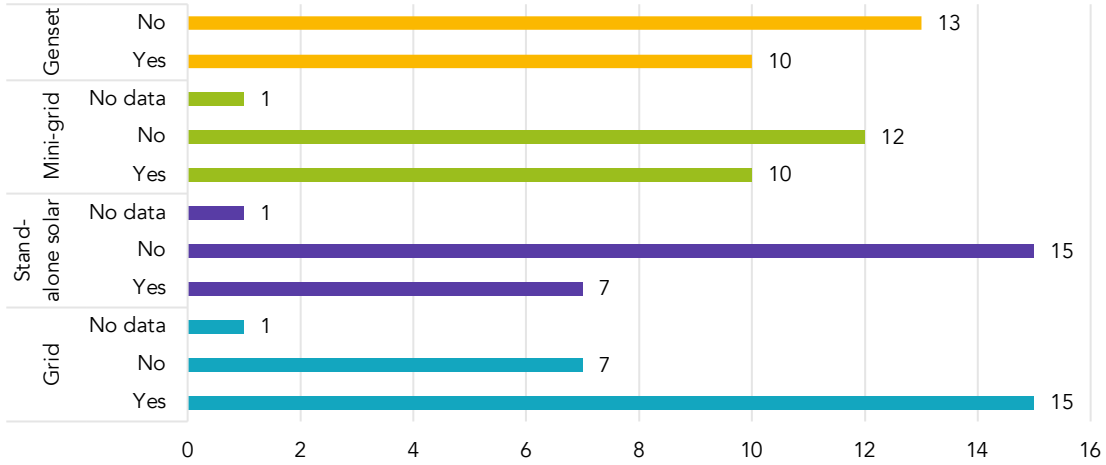
Electrification Status Analysis: Crown Agents (2021-2022; 23 facilities)

Overview

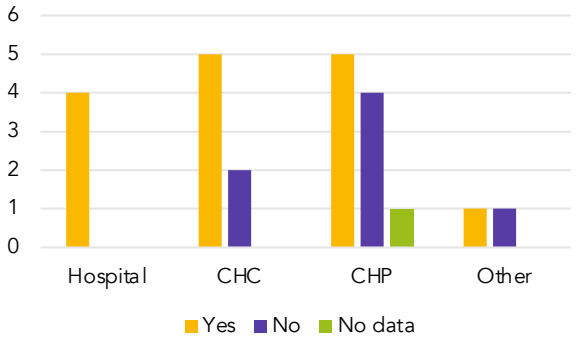
District(s): **Bombali**
Sample size: **23 facilities**
Facility type:

- **4 hospitals**
- **7 Community Health Centres (CHCs)**
- **10 Community Health Posts (CHPs)**
- **2 other facilities**

Power sources (technology)



Grid availability (facility type)



Average grid availability: **13h/day**

Average # grid outages: **4.6/week**

Findings and analysis

- Every off-grid facility has stand-alone solar, a mini-grid connection, and/or a genset
- Where stand-alone solar has been deployed, it was found to be operational
- Several sites with mini-grid or stand-alone solar power solutions are also grid-connected
- Grid connection reliability and quality is low; facilities suffer both from frequent and long power outages

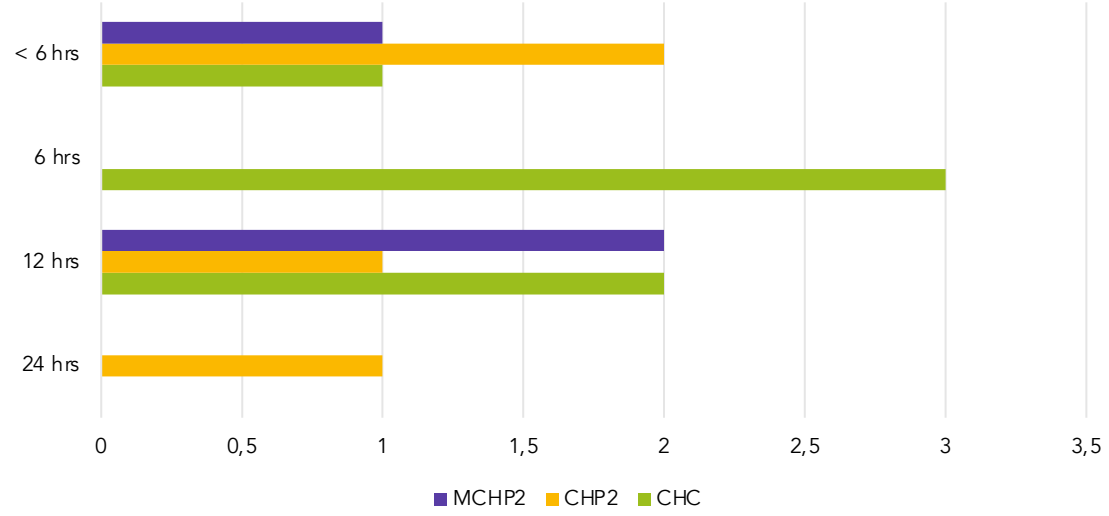
Electrification Status Analysis: TENN/Global SDG7 Hubs, 2020 (13 PHUs)

Overview

District(s): **Kambia**
Sample size: **13 Peripheral Heathcare Units (PHUs)**
Facility type:

- **6 Community Health Centres (CHCs)**
- **4 Community Health Posts (CHPs)**
- **3 Maternal and Child Health Posts (MCHPs)**

Hours of electricity at facilities



Findings and analysis

- All 13 facilities audited in 2020 are off-grid; in general, the whole of Kambia District is not yet connected to the national grid.
- All the facilities visited have a stand-alone solar PV connection as their main (for some the only) source of power.
- Three sites with stand-alone solar power solutions also have a genset as a back-up power source, but there are challenges with finance to buy diesel and/or access to diesel to run them.
- Four facilities visited had 24/7 access to electricity;
- Installed solar PV systems were typically very small systems for powering a refrigerator and/or providing lighting only.
- For some locations, the stand-alone solar PV systems were found to be operational sub-optimally.
- One CHP facility had electricity for <6hrs. Most of the facilities had electricity for only 6-12hrs daily.
- Some facilities had wiring problems whereas for others the batteries were no longer in working order. None of the facilities have an efficient operation and maintenance regime.

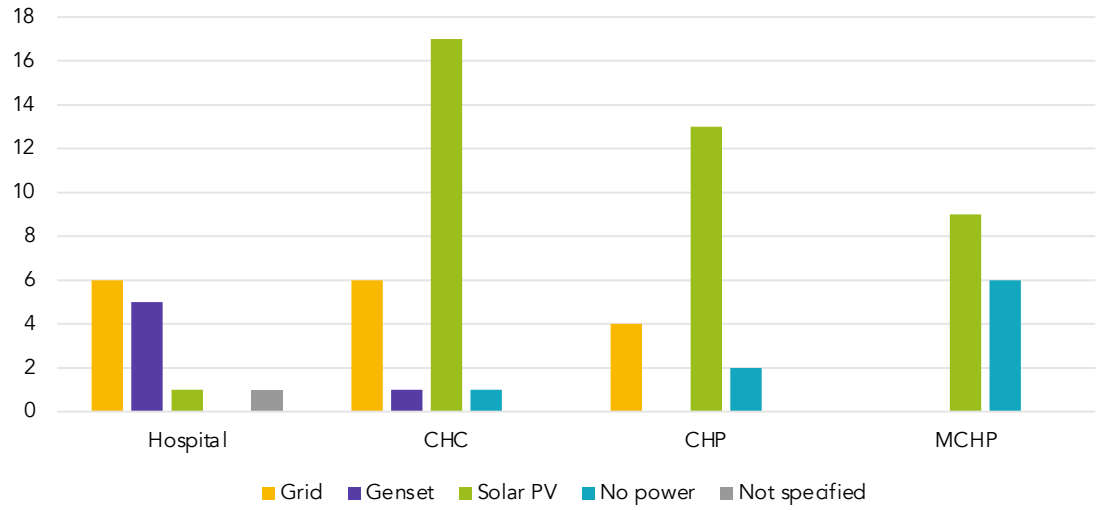
Electrification Status Analysis: national study, 2022 (72 facilities)

Overview

Region: **statistically nationally representative**
Sample size: **72 facilities**
Facility type:

- **13 hospitals**
- **25 Community Health Centres (CHCs)**
- **19 Community Health Posts (CHPs)**
- **15 Maternal and Child Health Posts (MCHPs)**

Power sources per facility type



Findings and analysis

- Out of 13 hospitals assessed, 11 had functional gensets (either as main electricity source or as backup) that were functional. One hospital had a genset that was non-functional and one other hospital did not have a genset as a standby source of electricity.
- Power reliability remains a problem for all levels of healthcare facilities: 80% (48/59) of PHUs do not use the national grid as a primary electricity source, 66% (39/59) of PHUs use solar and 15% (9/59) have no electricity source
- For hospitals, fuel tends to be available when needed (8/11 surveyed). Availability of fuel became a bigger barrier for lower tier health facilities (e.g., CHP and MCHP; 1/6 surveyed).
- O&M was an issue for the 59 PHUs examined with a solar PV system. 9 PHUs had a partially functional solar PV and inverter system.

Source: Chukwu et al., 2022_Electricity Computing Hardware and Internet Infrastructures in HF in SL. JMIR Medical Informatics

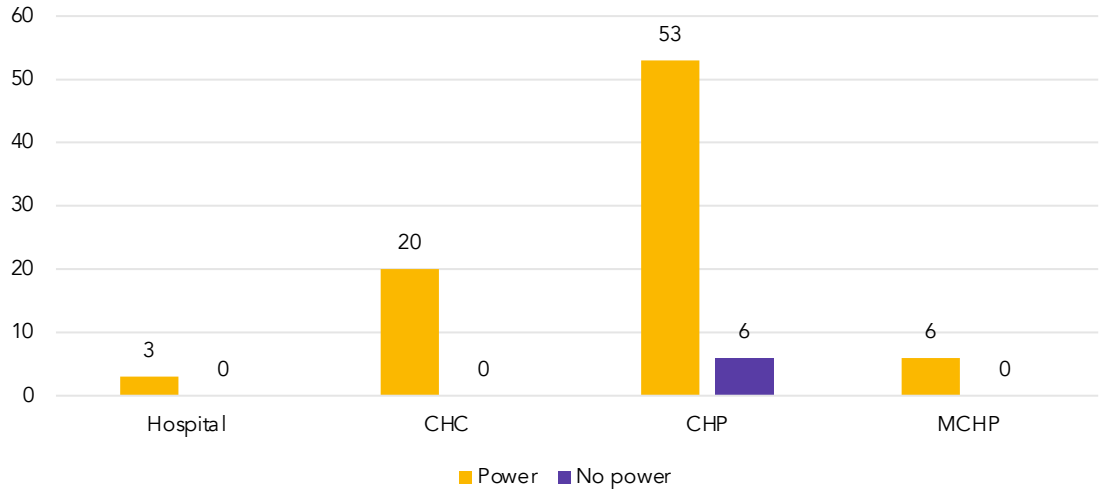
Electrification Status Analysis: Kailahun District, 2022 (88 facilities)

Overview

District: **Kailahun**
Sample size: **88 facilities**
Facility type:

- **3 hospitals**
- **20 Community Health Centres (CHCs)**
- **59 Community Health Posts (CHPs)**
- **6 Maternal and Child Health Posts (MCHPs)**

Availability of electricity



55 facilities have power only for lighting

26 facilities have power only in maternity room

2 facilities have a genset back-up

Findings and analysis

- All healthcare facilities in the district, including three hospitals are not connected to the grid.
- Out of 88 PHUs in the district, 6 PHUs facilities had no access to any form of electricity, while 2 PHUs had stand-alone solar systems but they were not functional.
- The three hospitals in the district were all off-grid. They are powered either by solar or gensets or a combination of the two
- Only 13 PHUs in the district had 'sufficient' electricity, mainly from stand-alone solar PV systems for both lighting and powering equipment.
- Except for one of the hospitals which is owned by an NGO, the source of financing for O&M of installed electricity (solar or genset) was identified as government although none of the facilities have a financing mechanism in place for O&M

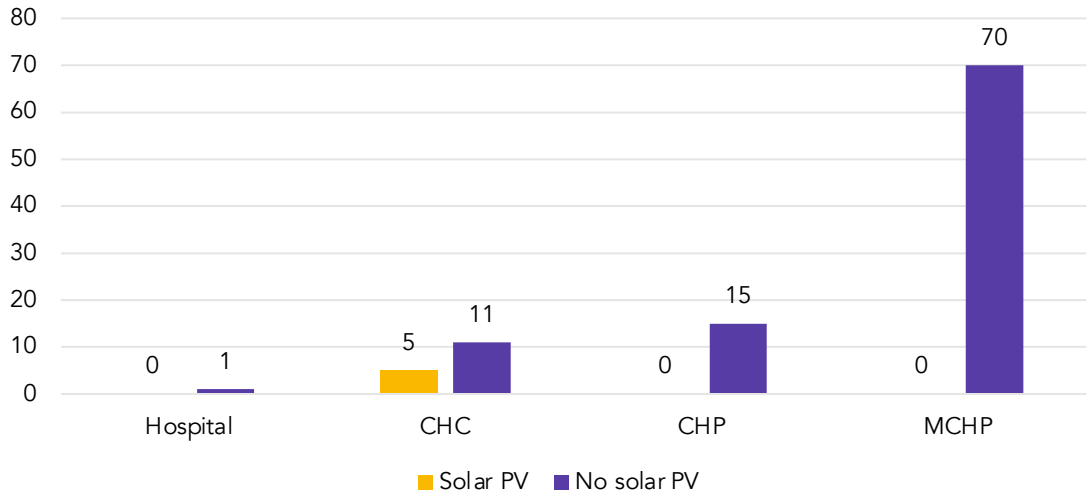
Electrification Status Analysis: Pujehun District, 2022 (102 facilities)

Overview

District: **Pujehun**
Sample size: **102 facilities**
Facility type:

- **1 hospital**
- **16 Community Health Centres (CHCs)**
- **15 Community Health Posts (CHPs)**
- **70 Maternal and Child Health Posts (MCHPs)**

Availability of solar PV mini-grids



Only 5 out of 102 facilities have a solar PV solution; all are mini-grids

Only 2 out of 102 facilities have a generator on the premises

Findings and analysis

- None of the healthcare facilities in the district are connected to the grid. Out of 102 facilities in the district, only 7 facilities have some form of electricity - 4 connected to solar PV mini-grids (+1 under construction) and 2 powered by gensets.
- The only hospital in the district is off-grid. This is a government-owned facility that is powered by a genset. It has no functional solar PV.
- All 5 solar mini-grids were done for CHCs: one is under construction and four are functional. Of the 4 in operation, one only powers lighting and three power both lighting and equipment.
- None of the installed solar systems in any of the facilities have a financing mechanism in place for O&M

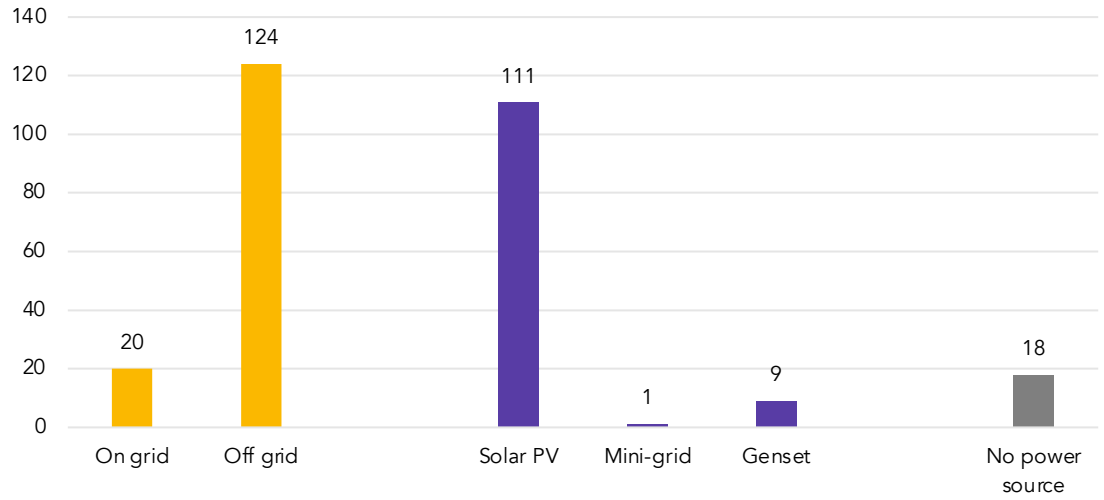
Electrification Status Analysis: Bo District, 2022 (144 facilities)

Overview

District: **Bo**
Sample size: **144 facilities**
Facility type:

- **26 Community Health Centres (CHCs)**
- **39 Community Health Posts (CHPs)**
- **77 Maternal and Child Health Posts (MCHPs)**
- **2 clinics**

Power sources



5 on-grid facilities also have a solar PV solution

4 facilities (out of 9) that have a genset are on-grid

Findings and analysis

- Out of 144 facilities in the district, 18 facilities have no form of electricity; 20 facilities were connected to the grid; 111 had functional stand-alone solar systems; one facility was connected to mini-grid and nine operated gensets as back-up.
- Out of 18 facilities in the district without access to electricity, 2 were CHCs, 8 were MCHPs and another 8 were CHPs, which are usually located in rural last-mile communities
- The government-owned facility in Bo City is connected to the grid and it is in addition powered by solar PV systems and genset.

Electrification Status Analysis: SEforALL, 2022 (17 facilities)

Overview

Region: **national coverage; not nationally representative**
Sample size: **17 facilities**
Facility type:

- **10 PHUs**
- **7 hospitals**

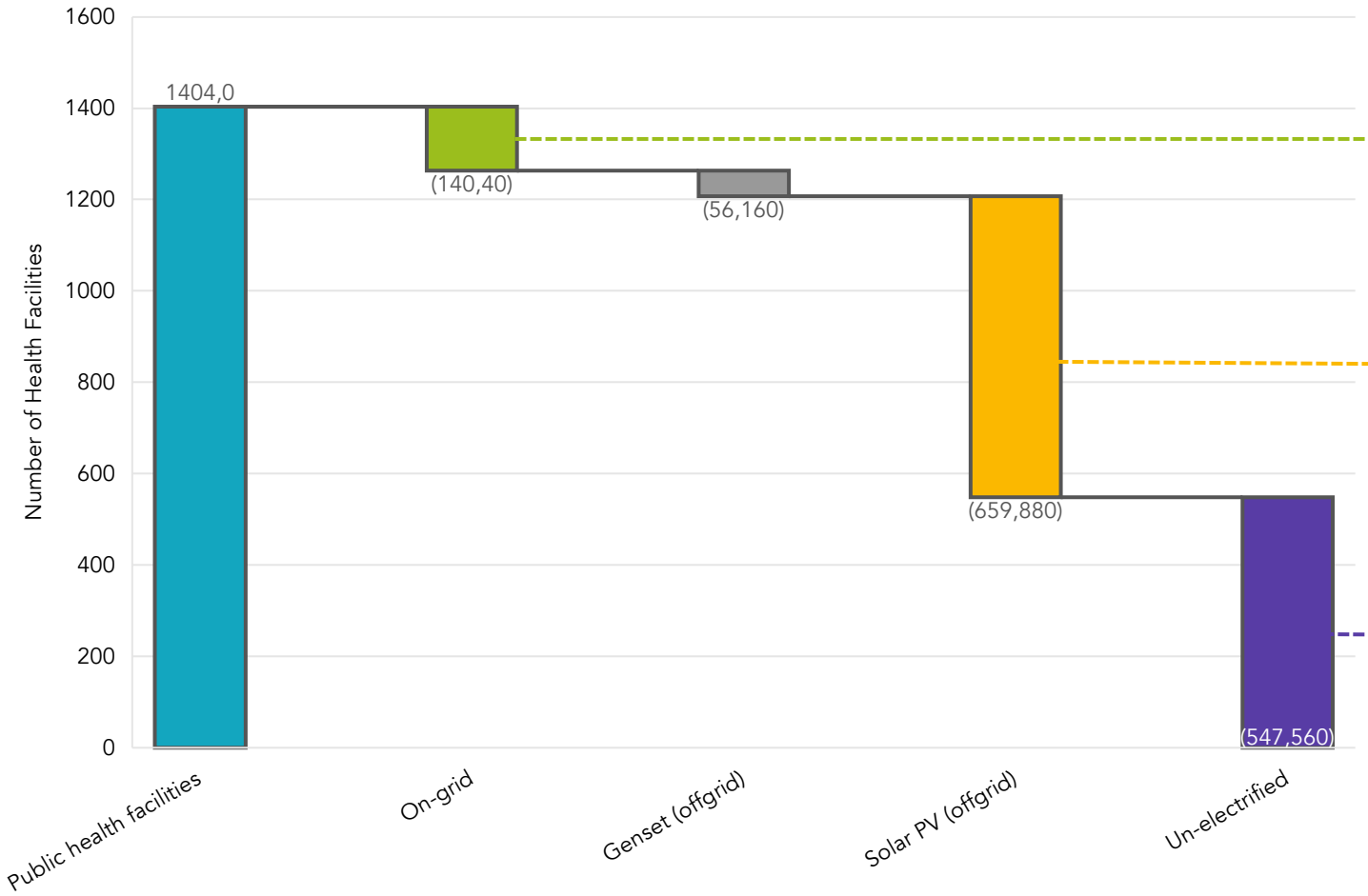
Overview of PHUs

District	Facility Type	Beds	Patients/ month	Staff		Electricity source[1]					Water supply		
				#	Staff quarters	Grid	Genset	PV	Mini grid	Solar kit/lights	Borehole	Well	Pump
Pujehun	CHC	6	900	11	✓	×	×	✓	×	✓	×	✓	✓
Western Area Rural	CHC	12	750	26	×	×	×	✓	×	×	✓	×	✓
Kambia	CHC	4	750	7	✓	×	×	×	✓	×	×	✓	✓
Kenema	CHC	12	750	11	✓	×	×	×	×	✓	×	×	×
Moyamba	CHC	6	900	7	×	×	×	×	✓	×	×	✓	✓
Bo	CHC	8	417	12	✓	×	×	×	✓	×	×	×	×
Moyamba	CHP	6	120	4	×	×	×	×	×	✓	×	×	×
Bonthe	CHP	4	200	3	×	×	✓	×	×	×	×	✓	✓
Bombali	CHP	2	450	8	×	×	×	×	×	✓	✓	×	✓
Tonkolili	MCHP	4	680	6	×	×	×	×	×	✓	×	×	×
Kono	MCHP	4	750	9	×	✓	×	×	×	✓	×	×	×

Findings and analysis of PHUs

- Most of the PHUs have some type of electricity source, especially for lighting. Many facilities have broken energy generation systems and water pumps. The sites showing no water supply rely on local water wells/boreholes and have to collect it and transport it manually while some facilities require other water sources during the dry season
- The PHUs have tiers and recommended offered services
- They often provide additional services to fulfil the local demand due to shortage of health facilities in the region.
- Most of the facilities offer overnight care and are not connected to the grid. Thus, they use solar lanterns and small solar kits to power LEDs at night, especially important for night deliveries.
- None of the visited PHUs have gensets as a power supply and only two had a small PV and battery system.
- Kambia, Tikonko and Moyamba Junction CHCs were connected to mini-grids which provide electricity for at least some portion of the day.

Sizing the access gap - market opportunity for solar PV systems



Solar PV back-up systems can be provided to address frequent outages and quality of access for healthcare facilities **connected to the national grid.**

→ **25% of on-grid and all genset-powered PHUs require solar PV back-up = 91 PHUs**

+

Primary health facilities with solar PV solutions tend to be **under-electrified**, as they mostly only have power for a specific health service (e.g., maternity ward or vaccine refrigerator) and/or lighting.

→ **75% of PV-powered PHUs need additional power = 495 PHUs**

+

Most of the PHUs **without access** to a reliable power source are lower-tiered healthcare facilities in last-mile communities.

→ **All un-electrified PHUs require additional power = 548 PHUs**

Total market opportunity: 1,134 PHUs

Sizing the access gap - GIS tools provide an opportunity

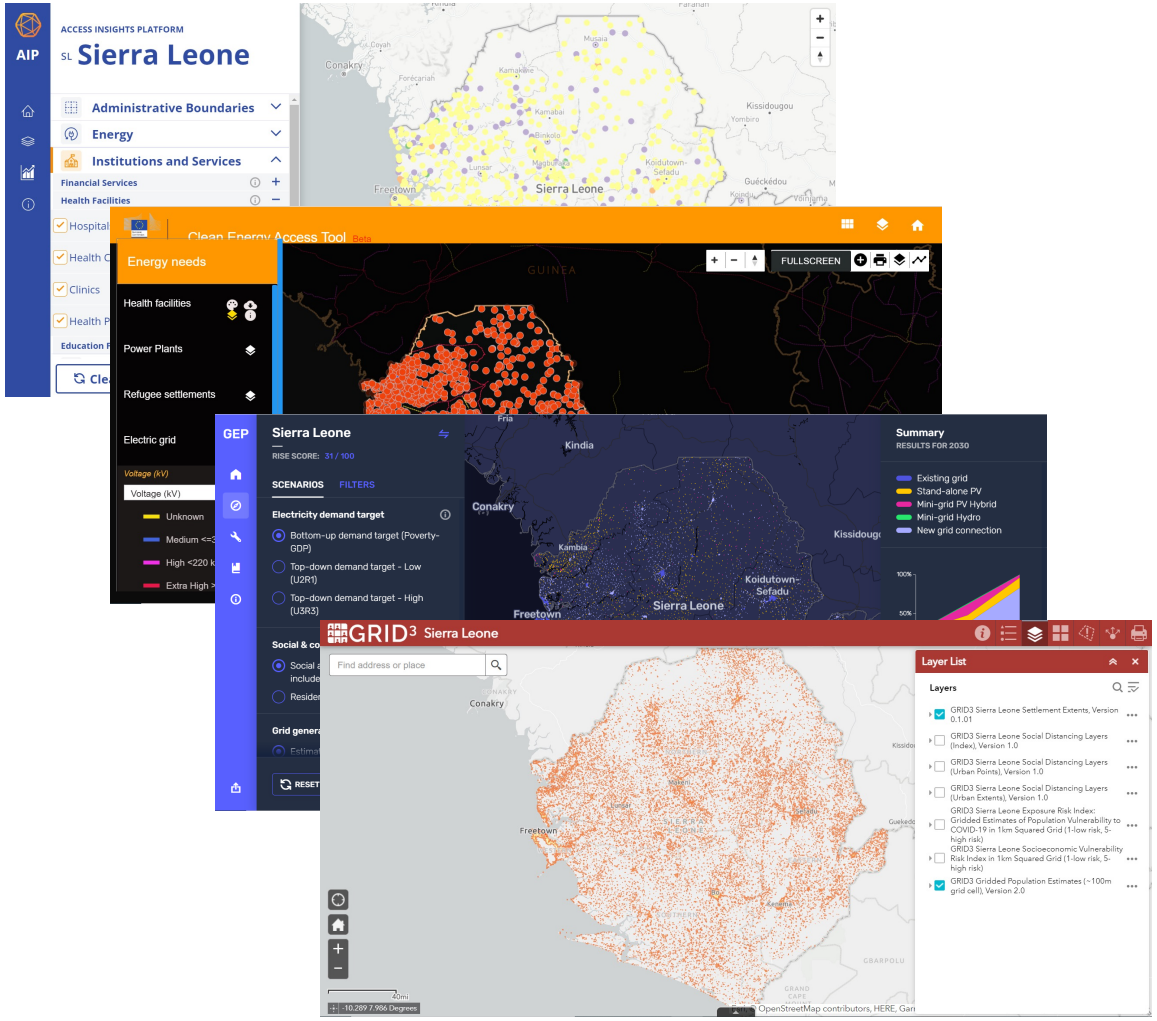
Increasingly, GIS tools are applied for data-driven analysis of energy access potential as well as for project opportunities. This is also the case for mapping out social infrastructure and identifying high-need areas.

Advantages

- Low-cost opportunity to identify potential sites that are far from the existing grid and are not showing any signs of electrification (e.g., through night-light satellite data).
- Potential to add in other socio-economic factors, such as geographic distances for specific communities to social infrastructure or ability to pay at the household level.

Limitations

- The analysis is only as good as the data that underpins it. Where data is outdated or incomplete (e.g., grid only partially mapped, or mini-grids not mapped), this may result in incorrect labelling of sites as being on-grid or off-grid.
- In most cases, the analysis can provide 'an order of magnitude' and identify a group of priority sites. The tools do not take away the need for (at least partial) site-level validation, in particular where there are known data gaps.



Data insights: findings and recommendations

Situation

- Several data collection initiatives and datasets were identified, including updated data from the Ministry of Health and Sanitation (MoHs) international development partners working in the health sector and online portals such as Energy Access Explorer, Clean Energy Access Tool, etc.
- Data is obtained from a variety of sources, including healthcare facility energy assessments, self-reporting systems, and open-source dynamic databases that differ in coverage (location/period) and the methodologies applied.
- Invariably, these studies/surveys/audits have produced varying data points and estimates for different time intervals that can be difficult to harmonize.
- There is a National Health Information System (NHIS) at MoHS that was created to provide a centralized and robust data collection hub on all health facilities, including data on electrification. However, it is currently non-functional (in Oct 2022).

Findings

Size

- The Ministry of Health & Sanitation (MoHS) lists a total of 1404 healthcare facilities in Sierra Leone - including public, private, faith-based facilities and others run by NGOs – at different levels of healthcare (primary, secondary and tertiary).
- The majority (96.2%) of health facilities in the country provide basic and primary healthcare services; 1,286 of which are publicly owned Peripheral Healthcare Units (PHUs) operated by government with different levels of functionality (CHCs, CHPs & MCHPs).

Electricity access

- Nationally, approx. 38% of healthcare facilities at all levels of care combined do not have access to electricity
- Healthcare facilities connected to the national grid (approximately 20%), mostly higher tier healthcare facilities e.g., hospitals, have challenges with duration and quality of electricity access.
- Although an estimated 62% of healthcare facilities have some form of access to electricity, most facilities, especially those operating at the primary care level (PHUs), still have unreliable and insufficient access to electricity from any combination of electricity sources.
- Many PHUs (~66%) have access to solar PV systems that provide power, though in most cases this is primarily for lighting. Many facilities in small towns and villages have power in the maternity ward. A few PHUs (<10% and mostly CHCs) are connected to solar mini-grids.

Data gaps

- Data on the electrification status for healthcare facilities is largely unavailable. For the facilities with data on electrification, the data is either incomplete and/or outdated, and difficult to obtain.
- There are challenges with the granularity of data in terms of:
    - Electrification need, status and duration of electricity supply
    - Source of electricity supply
    - Monthly/annual budget spend on electricity
- Where it exists, data on electrification status is often binary (yes/no), and almost never includes reliability indicators (e.g., outages or quality of power).
- Given that several data collection initiatives and datasets exist with no coordination in data planning and collection, the available data on healthcare electrification from these sources is fragmented with inconsistent data points and profiles.

Recommendations

- The Directorate of Policy, Planning and Information (DPPI) at MoHS is positioned to lead the coordination and planning of data governance arrangements, including data from energy audits and healthcare electrification.
- A fully functional NHIS can be designed to build on existing tools and establish a central dynamic and standardized dataset that captures healthcare facility performance and infrastructure, including their electrification status, O&M regimes and sustainability plans of interventions on healthcare electrification.
- The DPPI can be supported to coordinate a well-functioning NHIS that is designed to provide timely, complete and accurate data and information on the electrification status of healthcare facilities, in addition to collecting data regular data on health system performance and key health outcomes from those facilities.
- Technical assistance may include programmatic support to get the NHIS fully operational and functional through capacity enhancement and financial support to undertake joint energy audits/surveys and validation exercises to update critical baseline inputs that will bridge data gaps and address existing needs.
- The development and adoption of a consistent energy needs assessment methodology will lead to more consistent data that allows for clear comparison between districts, as well as better integration in a national dataset on energy access for health facilities.
- Plans to establish a stakeholder platform/community of practice on powering healthcare in Sierra Leone could function as an advisory body to foster multi-sectoral dialogue and data collection/exchange on healthcare electrification.

CHAPTER 4

Technology

1.5 to 12 kWp

Est. PV power solution required to power different types of health facilities

~ $8.2 / Wp

CapEx cost to deploy power solutions to clinics, including retrofit (rewiring and energy efficiency improvements)

Types of solar PV solutions deployed to date

- Standalone solar PV systems are widely used in Sierra Leone to power both on-grid (back-up) and off-grid (primary) healthcare facilities.
- They range widely in size and design specifications from solar rechargeable pico-lanterns and pico solar solutions (50-200 Wp) to smaller stand-alone PV solutions (500 Wp to 3 kWp), larger stand-alone solar PV solutions (16-36 kWp), and medium-sized and large-sized solar PV community-wide mini-grids
- Recent and upcoming examples of larger-scale solar PV deployment include:
  - RREP led by UNOPS installed a total of 5 MW for 94 communities across Sierra Leone (completed);
  - 1.4 MW solar PV generation capacity in Moyamba District to serve 10 communities (planned).
- Small solar PV stand-alone solutions are primarily used for lighting and powering small/basic equipment and refrigerators at healthcare facilities.
- In other locations, stand-alone solar PV systems have been used to power submersible pumps at many healthcare facilities throughout the country.

Energy needs in health facilities

Energy needs recommendations are based on:

- Energy audit survey data, interviews, and observations during site visits (TTA, 2022)
- SL MoHS Basic Package of Health Services Report (MoHS, 2015)
- WHO multi-tier framework (WHO & World Bank, 2015)
- USAID health facility category guidelines (USAID, 2009)

** Vaccine refrigerators are excluded from this calculation as the majority of facilities have a functional stand-alone power solution for the medical cold chain.*

Quarters

	MCHP		CHP		CHC	
Equipment	Current	Ideal	Current	Ideal	Current	Ideal
Rooms	*0*	*1*	*0*	*1*	*1*	*2*
Light - Interior	0	2	0	2	2	4
Radio	0	1	0	1	0	2
TV small	0	0	0	0	0	0
Phone Charger	0	1	0	1	1	2
Fan	0	1	0	1	1	2
Refrigerator	0	1	0	1	0	2

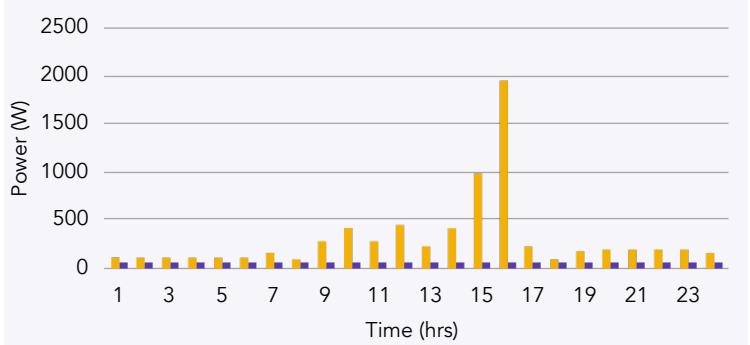
PHU Equipment

	MCHP		CHP		CHC	
Equipment	Current	Ideal	Current	Ideal	Current	Ideal
Rooms	*~3*	-	*~6*	-	*~10*	-
Water pump	0	1	1	1	1	1
UV water purifier	0	1	0	1	0	1
Fire alarm	0	0	0	0	1	1
VHF radio	0	1	0	1	0	1
Phone charger	0	3	0	3	5	5
Printer	0	0	0	0	0	1
Desktop computer	0	0	0	0	0	1
Refrigerator	0	0	0	1	0	1
Refrigerator (vaccine)	0	0	0	0	0	0
Fan	0	3	0	3	6	6
Light - interior	20	20	20	20	24	24
Light - exterior	0	6	1	6	3	6
Jaundice light	0	0	0	1	0	1
Blood analyzer	0	1	0	1	0	1
Centrifuge	0	0	0	0	0	1
Microscope	0	0	0	0	0	1
Small autoclave – 19L	0	1	0	1	0	1
Oxygen concentrator	0	0	0	0	0	1
Baby incubator	0	0	0	0	0	0
Portable ultrasound	0	0	0	0	0	1

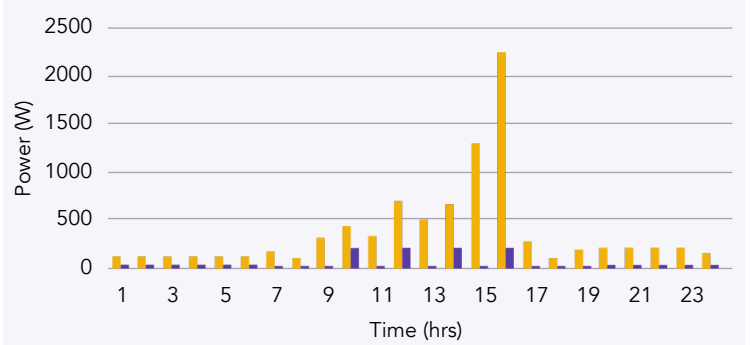
Energy needs in health facilities (useful storage and solar capacity)

MCHP		CHP		CHC	
Current	1,536 Wh	Current	1,731 Wh	Current	6,067 Wh
	64 Wp		215 Wp		571 Wp
Ideal	8,317 Wh	Ideal	9,837 Wh	Ideal	19,166 Wh
	1,958 Wp		2,195 Wp		2,828 Wp

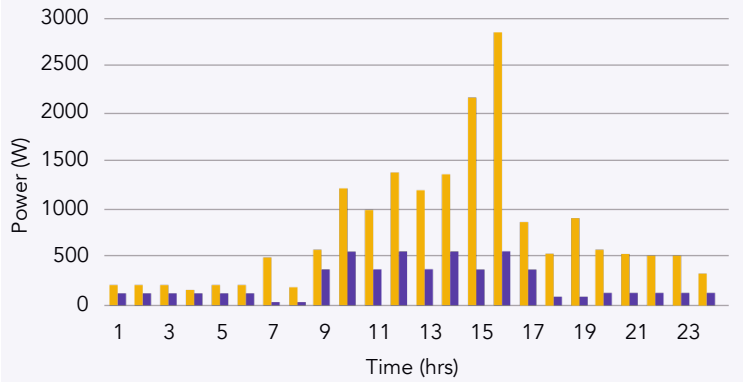
MCHP Load Profile



CHP Load Profile



CHC Load Profile



Ideal Current

Recommended solar PV system sizes for health facilities

		CURRENT LOAD	IDEAL LOAD	CapEx*	OpEx**
1.5 kWp	3 kWh	MCHP		$ 18,200	$ 320 / year $1,120 at year 10
3 kWp	6 kWh	CHP	MCHP	$ 24,700	$ 330 / year $2,240 at year 10
6 kWp	12 kWh	CHC	CHP	$ 39,300	$ 370 / year $4,320 at year 10
12 kWp	24 kWh		CHC	$ 67,200	$ 440 / year $8,640 at year 10

**CapEx costs include: design, PV system components, balance of systems, internal rewiring, energy efficiency improvements, civil works, and transportation*

***OpEx costs include: component maintenance, basic preventative maintenance; battery replacement is not included*

Average CapEx: $ 8.2 / Wp

Additional technology considerations

Infrastructure

- **Rewiring:** the majority of health facilities require rewiring as electric wiring is either (i) not present, (ii) damaged, (iii) or inadequate.
- **Civil works:** In most sites, a separate 'powerhouse' or room needs to be constructed. Most facilities do not have sufficient space to safely house a power bank and other electrical equipment (e.g., inverter, switchboard).
- **Safety:** for ground-mounted PV arrays, fencing is recommended. For roof-mounted PV arrays, external security lights are recommended.

Equipment

- All audited sites were **under-equipped** compared to a list of required and recommended appliances.
- The **opportunity for energy efficiency** exists primarily in the future supply of electricity-dependent medical and non-medical equipment for health facilities

Environmental Standards

- Waste from solar PV products contains toxic materials, such as heavy metals and polychlorinated biphenyls which are harmful to the environment and human health if improperly managed.
- There are currently no stringent regulations for the safe transport, disposal, and handling of e-waste.
- The lack of appropriate collection and recycling infrastructure presents additional challenges.

Technology: findings and recommendation

Situation

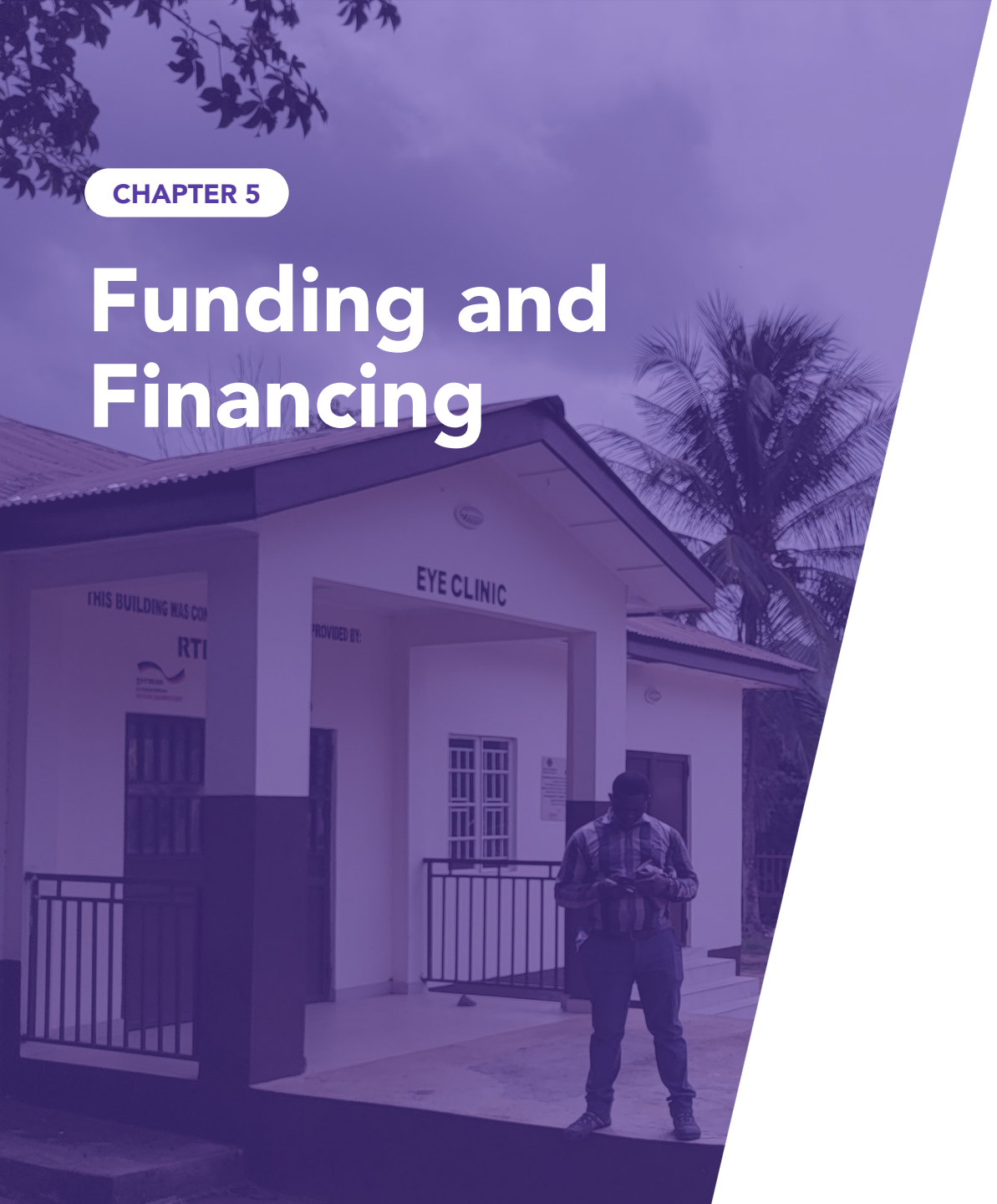
- Solar PV solutions at health facilities in Sierra Leone vary widely in size and design specifications, e.g., rechargeable solar pico-lanterns and pico solar PV systems; small and large standalone solar PV systems; small, medium and large-sized solar PV community-wide mini-grids.
- At some health facilities, multiple solar PV systems have been installed, some of which are non-functional and in need of repairs but often there are no O&M procedures put in place.
- There is no manufacturing base for solar PV products in Sierra Leone. A wide range of solar PV products and accessories are imported into the country.
- There are no national guidelines or standards to guide or manage solar PV products and there are no e-waste recycling facilities, no established battery recycling facilities and no attempt to manage the e-waste.

Findings

- Both current and potential future energy needs at health facilities are much higher than what can currently be met, especially, for those facilities with a pico-solar power solutions which typically only meets lighting needs and/or a specific health service (e.g., lighting for the maternity ward or medical cold chain room of a healthcare facility).
- Recommended system sizes show the need to plan for growth. There is a x2 multiplier for system sizes when comparing current loads with future ideal load profile.
- e-waste management is a growing concern. Sierra Leone is yet to develop the necessary policies, guideline/standards and management strategies to reduce the adverse health and environmental effects of e-waste. Informal handlers try to exploit the economic value contained in e-products (e.g., copper and lead) with rudimental recycling processes and little regard to health and environmental safety.

Recommendations

- Staff at remote healthcare facilities can be trained to monitor and record the performance of installed systems and provided with contact points of trained technicians who can undertake regular maintenance checks and repairs that may be required.
- Develop minimum technical standards and/or minimum quality standards for the importation and installation of solar PV systems. The Ministry of Environment and EPA-SL could take the lead with the support of MoE. EWRC could lead in enforcing e-waste management guidelines/standards. REASL could work with its members to comply to acceptable e-waste guidelines/regulation.



CHAPTER 5

Funding and Financing

10%
Fraction of GoSL expenditure from total health spending

6.5%
GoSL health budget as a percentage of total national budget

44.8%
Household out-of-pocket (OOP) expenditure as a fraction of total health spending

$8.33
Per capita government expenditure on health

3%
Share of GoSL spending on health devoted to primary healthcare

25.9%
Share of Development Partners spending from total health expenditure

Sources of financing healthcare

Healthcare facilities receive little operating budget; GoSL's share of the three sources is less than 10%

The health sector is financed from three main sources:

1. government general revenues;
2. donor financing
3. Domestic private including out-of-pocket payments by patients seeking healthcare.

GoSL's share of all the three sources combined was less than 10% in 2018 (9.71%), which is small compared with the other two sources of finance. Development partners (DPs) support represented over a quarter (25.88%), whereas the majority of health expenditure was covered by domestic private funds (64.41%). 70% of household expenditures go into drugs, with roughly 10% of the population facing the risk of catastrophic spending on health (DPPI, 2020).

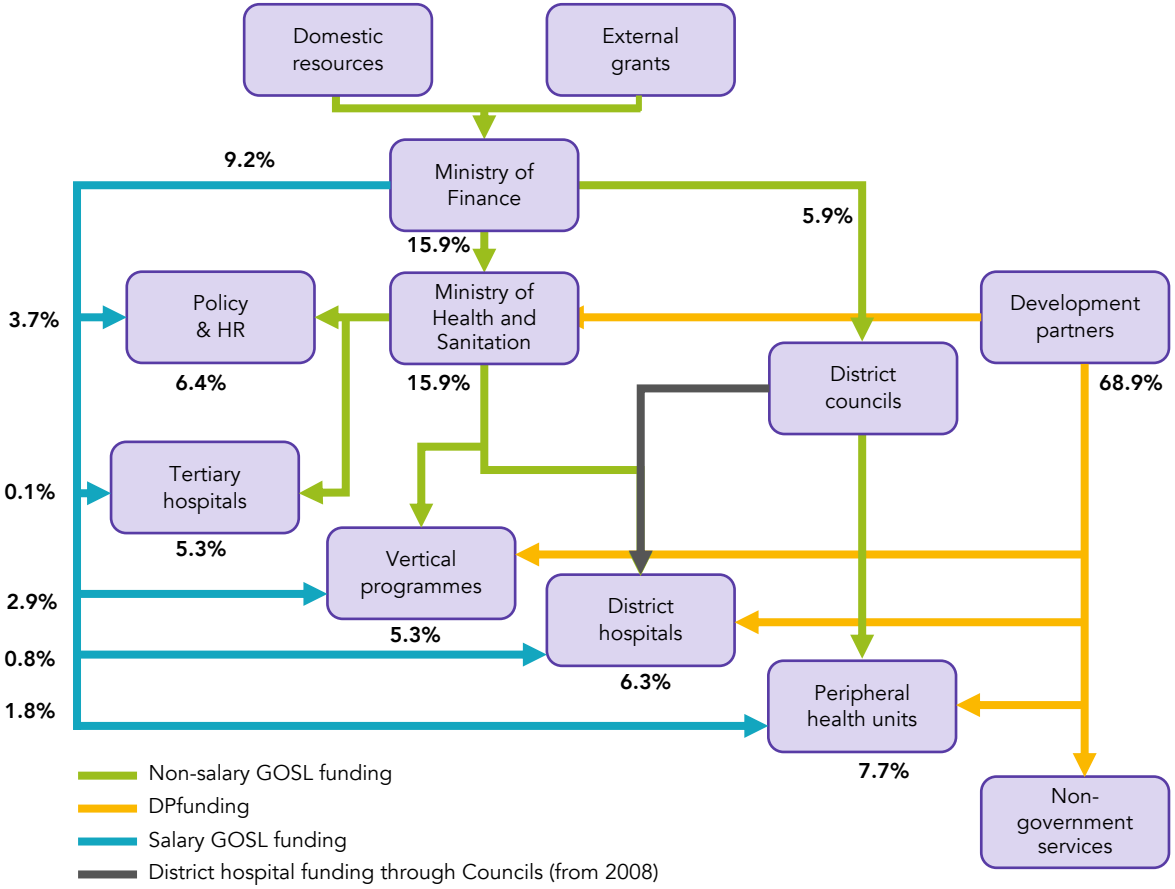
Even with the free healthcare initiative and GoSL's ambitions for Universal Health Coverage (UHC), patients still pay for some the services delivered to them at public health facilities.

Domestic general government health expenditure as a percentage of general government expenditure has remained relatively constant, although it has increased steadily over the years as a percentage of current health expenditure.

GoSL launched the Sierra Leone Social Health Insurance (SLESHI) in 2018 to improve financial accessibility to healthcare. To address financing for health holistically, GoSL has developed a comprehensive health financing strategy.

Development Partners (DPs) complement GoSL efforts in the delivery of health services in Sierra Leone. Support from DPs is largely off-budget in the form of commitments and disbursements through vertical investment projects and technical assistance.

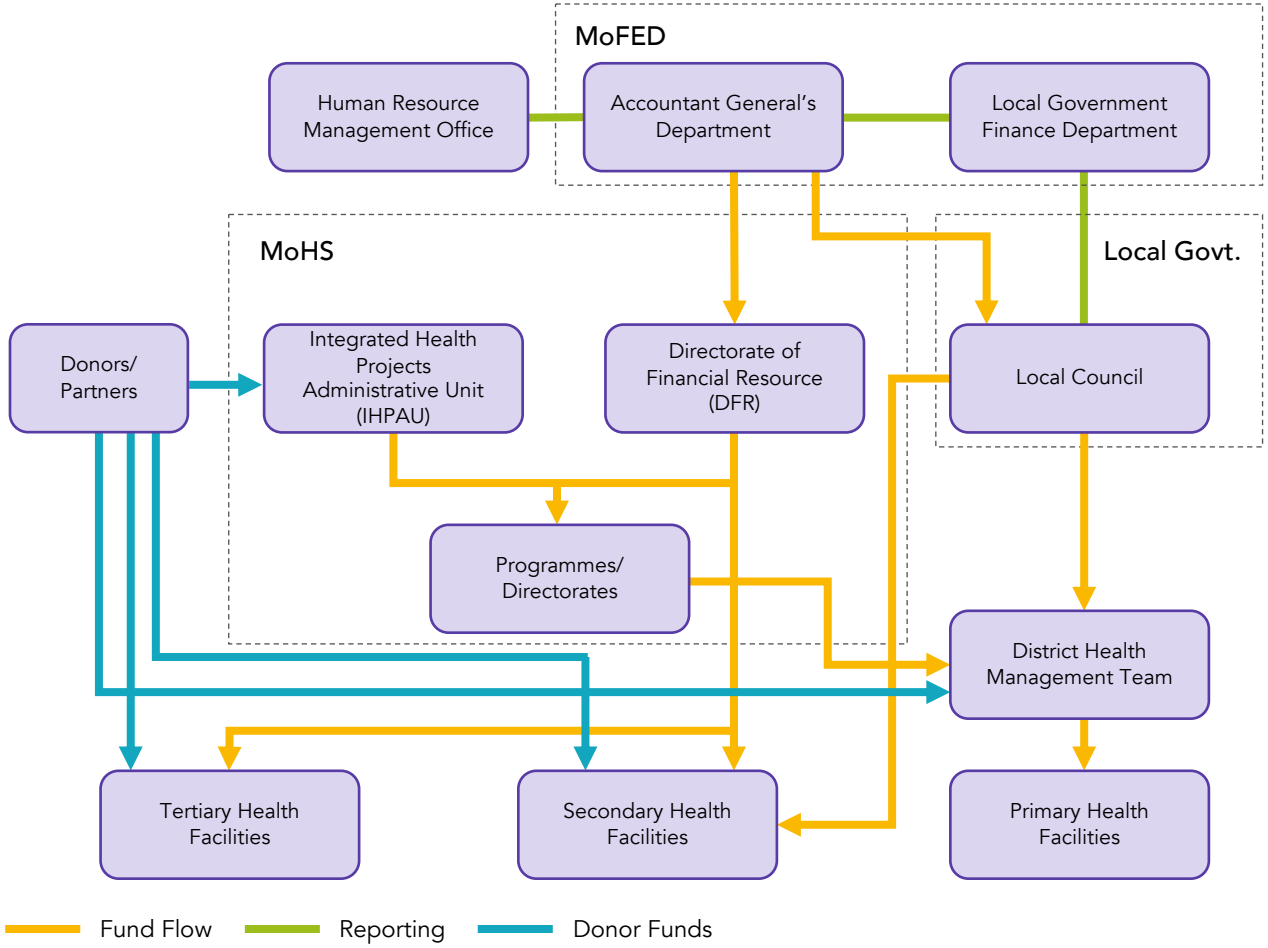
Donor dependence for implementing health projects/programs



Sources: MoHS. National Health Sector Strategic Plan 2017-2021; sierra_leone_nhssp_2017-21_final_sept2017.pdf (who.int); Sierra Leone Public Expenditure Review. Improving Quality of Public Expenditure in Health; https://documents1.worldbank.org/curated/en/329991623665655127/pdf/Sierra-Leone-Public-Expenditure-Review-2021-Improving-Quality-of-Public-Expenditure-in-Health.pdf

- Donor expenditures constitute a significant proportion of the total health sector expenditure in the country, with several Development Partners (DPs), including international NGOs implementing various projects and programs at the national, district and health facility levels.
- DPs complement government efforts in the delivery of health services in Sierra Leone. Gavi, World Bank, WHO, UNICEF, JICA, CDC, Global Fund, and IsDB, together provided over 93% of off-budget financing for critical stand-alone programs
- World Bank is the biggest spender accounting for 39.6%, followed by Global Fund (24.9%), GAVI (14.%), UNICEF (11.1%), WHO (6.1%) and JICA (2.8%) of the total DPs' expenditure.
- Total sector spending excluding out-of-pocket expenditure (OOP) for the period 2015-2019 was $357.2 million (DPs & GoSL only)
- DPs' spending accounted for the lion's share (88.2% compared to GoSL (11.2%) of the total sector expenditure, excluding OOP.
- Donor spending is largely off-budget in the form of commitments and disbursements through the implementation of vertical investment projects and technical assistance.
- Although donor spending provides the GoSL with more resources, it does not guarantee sustainability of sector projects/programs as most of these donors' programs/projects are implemented within a certain period.

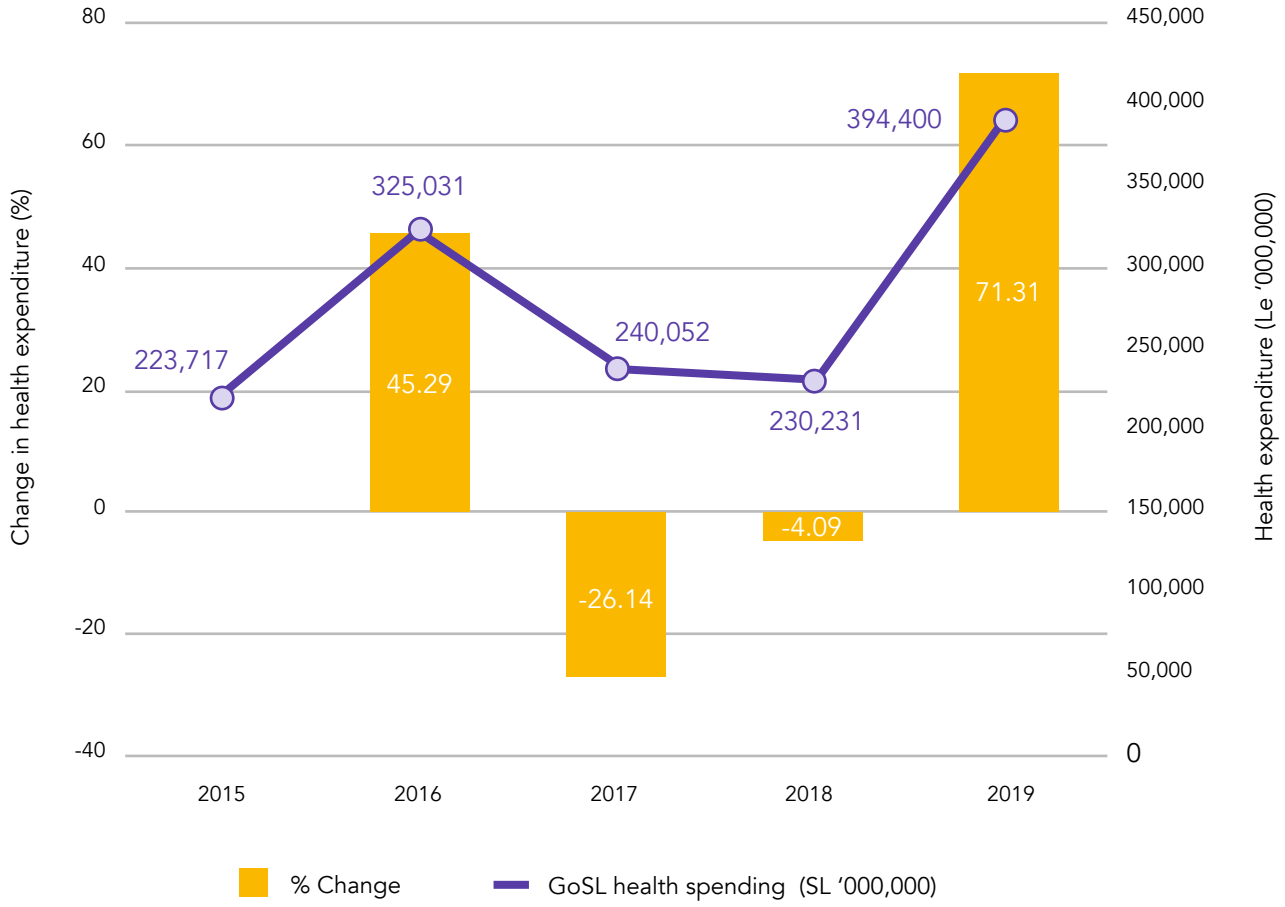
Public funding cash flow for financing healthcare services



- Public sector allocation is largely based on a line budget system. Non staff funding is channeled through the MoHS for vertical programmes, tertiary, secondary and primary care.
- The payroll is still operated centrally by the Ministry of Finance. However, DHMTs generally report that decentralization of budget responsibility has improved their access to resources.
- Similarly, DMOs can speak directly with the district officials responsible for the budget allocation and receive speedy information on why allocations may be held up.
- Allocations are a little bit more flexible than in the past although disbursements are still made according to the budgets developed prior to the start of the year.
- There is little or no relationship between allocation of funding and performance at any level of the system. User fees largely represent the only direct payment for results element of the system.

Source: MoHS. National Health Sector Strategic Plan 2017-2021 sierra_leone_nhssp_2017-21_final_sept2017.pdf (who.int)

Public funding cash flow for financing healthcare services



- Relatively high total health expenditure (US$66.4 per capita as compared to the average of low-income countries at US$44.81 per capita in 2017)
- For the period 2015-2019, public health expenditure (both capital and recurrent, including personnel emolument) grew at an average annual rate of 14.17%
- Public health spending demonstrates a fluctuating, peak-and-trough pattern. For example, public spending increased in 2016. It dropped in 2017 and 2018, rising considerably in 2019. The highest decrease of 26.16% was recorded in 2017, while the maximum increase of 71.31% was in 2019
- This spending volatility and unpredictability weakens informed decision-making and undermines systematic planning and performance.

Sources: Government of Sierra Leone Human Capital Development Project Report https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.394.7144&rep=rep1&type=pdf; Sierra Leone Public Expenditure Review. Improving Quality of Public Expenditure in Health https://documents1.worldbank.org/curated/en/329991623665655127/pdf/Sierra-Leone-Public-Expenditure-Review-2021-Improving-Quality-of-Public-Expenditure-in-Health.pdf

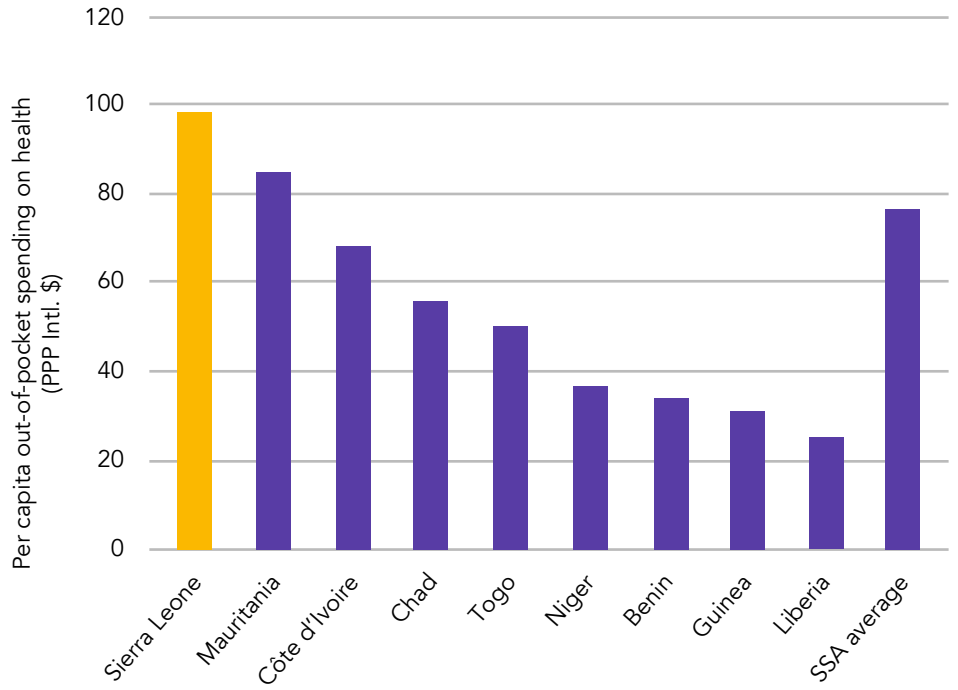
Health spending in Sierra Leone compared to West African Sub-Regional Countries

- Public and private spending on health in Sierra Leone is higher compared to other neighboring countries in West Africa, but health outcomes are lower.
- Total health expenditure was equivalent to over 5 (5.72) percent of GDP in 2018 when comparable data are available.
- It is higher than the West African sub-regional average (4.85%), LIC average (5.34%) and Sub-Sahara Africa (SSA) regional average (5.08%) respectively.
- Similarly, Sierra Leone dedicates 7.25% of its own domestic public resources to general government health expenditure (GGHE), which is higher than the sub-regional average (5.65%).
- GGHE as a percentage of GDP is 1.56% for Sierra Leone, which is higher than the West African regional average of 1.37%.
- Sierra Leone's relatively poor health outcomes suggest that there is scope for the GoSL to improve the efficiency of spending.
- Funding from GoSL sources, on a per capita basis, is more evenly spread, which is reflected in actual government spending patterns.
- Funding from development partners per capita is extremely uneven across districts. But GoSL allocations to district councils for primary health care are based on formula that gives greatest weight to size of population.

Sources: Sierra Leone Public Expenditure Review. Improving Quality of Public Expenditure in Health https://documents1.worldbank.org/curated/en/329991623665655127/pdf/Sierra-Leone-Public-Expenditure-Review-2021-Improving-Quality-of-Public-Expenditure-in-Health.pdf ; Government of Sierra Leone Human Capital Development Project Report https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.394.7144&rep=rep1&type=pdf

Out-of-pocket expenditure on health compared to other countries in sub-Saharan Africa

- It is extremely difficult to assess the total volume of resources spent by patients at public facilities. The Sierra Leone Integrated Household Survey (SLIHS) estimates spending on health care which can be disaggregated both by item of spending (medicines, facilities etc.) and type of facility.
- Even with the FHCI, user surveys suggest that a large User charges paid by individuals out of pocket expenses represent a significant source of funding for healthcare services in Sierra Leone.
- There is no nationally available estimates of user charges collected by facilities. However, a proportion of groups that should be exempt from paying for healthcare are still paying charges.
- Spending for government services alone amount to around Le 44 bn, which is considerably more than the entire government budget for health care.
- Compared to development partners (DPs) spending, which represented just over a quarter (25.9%) of total expenditure on health, household out-of-pocket (OOP) payments made up 44.8%. 17% of such household expenditures go into payments for medicaments, where structural inefficiencies has been reported due to irrational prescription and sale of counterfeit drugs.

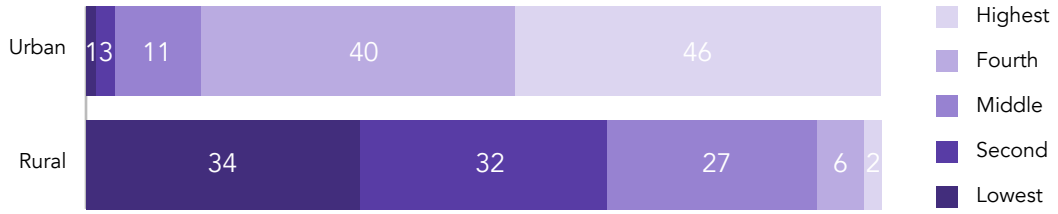


Sources: Government of Sierra Leone Human Capital Development Project Report https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.394.7144&rep=rep1&type=pdf; Sierra Leone Public Expenditure Review. Improving Quality of Public Expenditure in Health https://documents1.worldbank.org/curated/en/329991623665655127/pdf/Sierra-Leone-Public-Expenditure-Review-2021-Improving-Quality-of-Public-Expenditure-in-Health.pdf

Household wealth by residence and under-five mortality by wealth quintile

Household wealth by residence

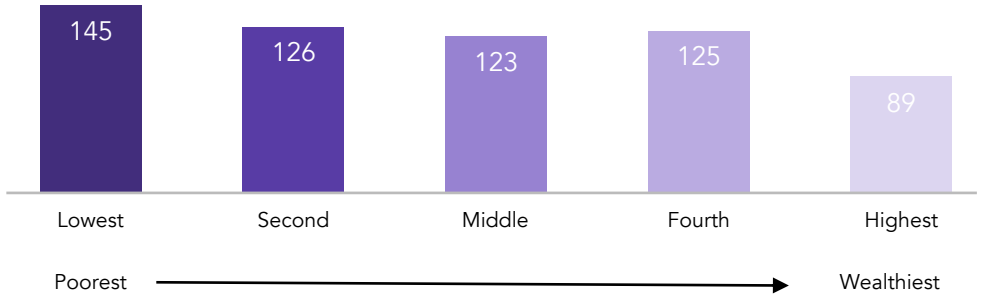
Percent distribution of de jure population by wealth quintiles



Note: May not add to 100% due to rounding

Under-5 mortality by wealth quintile

Deaths per 1000 live births for the 10-year period before the survey



- There is huge disparity in household wealth between urban and rural residence.
- More than 60% of rural residents are grouped in the first (lowest) and second wealth quintiles compared to urban areas where >85% of the population is grouped in the fourth and fifth (highest) wealth quintiles.
- This means that rural populations are less likely to be able to pay for healthcare services in addition to challenges of accessing a nearby healthcare facility in their area of domicile.
- Overall health insurance coverage is extremely low across background characteristics categories.
- 96% of women and 79% of men aged 15-49 do not have health insurance coverage.
- 14% of women and 12% of men with more than a secondary school education have some form of health insurance.

Source: 2019 SL Demographic and Health Survey; https://dhsprogram.com/data/dataset/Sierra-Leone_Standard-DHS_2019.cfm?flag=0

Financing need to electrify all PHUs

1,134 (88%) PHUs
in need of a reliable energy solution

567 MCHPs
requiring av. 3 kWp

340 CHPs
requiring av. 6 kWp

227 CHCs
requiring av. 12 kWp

$14m in CapEx
$4m in OpEx

$16.7m in CapEx
$3.3m in OpEx

$22m in CapEx
$3.4m in OpEx

- *OpEx costs include regular O&M for 15 years + battery replacement after 10 years*
- *A 50-30-20 split is used for MCHPs, CHPs, and CHCs that require an energy solution*

Total CapEx required: $53m

Total OpEx required: $11m

Installed Capacity to be added: $6.4 MWp

Funding and Financing: findings and recommendation

Situation

- Most PHU facilities are owned by the GoSL, with limited budget to pay for operational activities or investing and maintaining critical infrastructure like access to electricity supply.
- Sierra Leone's general government expenditure on health (GGHE) as a percentage of GDP is 1.56%. This is higher than the West African sub-regional average of 1.37%. However, government expenditure on health is still far below the Abuja declaration of 15% in terms of the share of total government spending in 2019 (6.45% of total national budget).
- Although out-of-pocket (OOP) expenditure as a fraction of total health expenditure declined with the introduction of the FHCI in April 2010, it is still the highest source of healthcare financing, accounting for approximately 45% of total health expenditure in 2018 (compared to ~ 70% in 2006) followed by donor spending of about 26% and 10% from GoSL sources.
- The bulk of OOP expenditures (70%) is used for drugs. User fees are now widely acknowledged as both an inequitable and inefficient means of funding health services but an estimated 40–60% of funds raised are lost through administration costs.
- Donor expenditures constitute a significant proportion of the total health sector expenditure in the country (25.88%). But the unpredictable nature of donor spending undermines systematic planning and sustainability.

Findings

- Budgetary allocations for health care delivery is coordinated centrally by the MoHS although the DHMTs and the local councils play a significant role, especially in overseeing primary and secondary healthcare at the district level across the country.
- An average total of Le282.69 billion was spent on the key functions to address healthcare needs for the period 2015–2019 by GoSL. The bulk of this expenditure Le207.09 billion (73%) went to administrative services whereas a combined average of 12% (Le35.79 billion) was directed towards secondary and tertiary care services.
- Only Le9.21 billion (3% of GoSL spending) was devoted to primary health care (PHC) notwithstanding the key role these facilities play in achieving Universal Health Coverage (UHC).
- Recurrent expenditure consistently surpasses capital expenditure. Recurrent and capital spending combined was Le1.43 trillion (~101,743 USD) for the period 2015–2019. This corresponds to ~Le187 (~0.013 USD) PHC expenditure per capita. 90% (Le1.28 trillion) of the total GoSL expenditure on health was devoted to recurrent expenses, while 10% (Le147.71 billion) was spent on capital investments.
- Low capital expenditure has led to inadequate availability of healthcare infrastructure, including electrification, which has a serious impact on the efficient delivery of health services.

Gaps and Opportunities

- 1,134 out of 1,287 PHUs (88%) at all levels of primary healthcare need a reliable energy solution. Out of which an estimated 46.9%, 33.4%, 19.7% are MCHPs, CHPs and CHCs respectively.
- MoHS short-term ambition to electrify all PHUs provides an investment opportunity of $64 million for approximately 1,134 PHUs without access to reliable electricity. Many of those facilities are MCHPs, the focus of GoSL plans to significantly improve the poor health outcomes on maternal and child healthcare.
- Given that GoSL's share of funding healthcare is less than 10% of the three main sources of funding, plans for the electrification of healthcare facilities cannot solely depend on anticipated government funding.
- International development partners could step up funding specifically for healthcare facility electrification given that donor expenditures constitute a significant proportion of the total health sector expenditure to improve health outcomes.

Investment Considerations and Recommendations

- With approximately 1,134 PHUs at all three levels of primary care needing electrification, an estimated $64 million ($53m CAPEX and $11m OPEX cost) is required to provide 6.4 MWp of installed solar PV systems.
- GoSL and DPs can target all approx. 548 PHUs without access to any form of electricity in the short-term to address urgent electrification needs. This would require $15-20m in CapEx to achieve the overall MoHS PHU electrification ambition.
- In the medium-term, GoSL and DPs could focus on addressing the electrification needs of PHUs having challenges associated with electricity duration, reliability and loads requirement to meet existing needs. To achieve this, an additional 586 PHUs would require an estimated $35-40m in CapEx investment.
- For the long-term, attention could focus on extending grid connectivity where possible and expanding off-grid connectivity to new facilities in last-mile communities.
- In addition to investing in energy generating equipment, donor grants and subsidies can facilitate the purchase of energy efficient appliances and retrofits for health facilities to reduce overall energy needs.
- Meanwhile, GoSL could work with DPs towards mitigating financial risks by providing blended financing options including performance-based grants, subsidies, equity and debt financing for private sector energy services companies. Long-term concessionary loans from impact investors are required to encourage private sector energy service companies to participate in health facilities electrification.

CHAPTER 6

Delivery Models & Financing Mechanisms

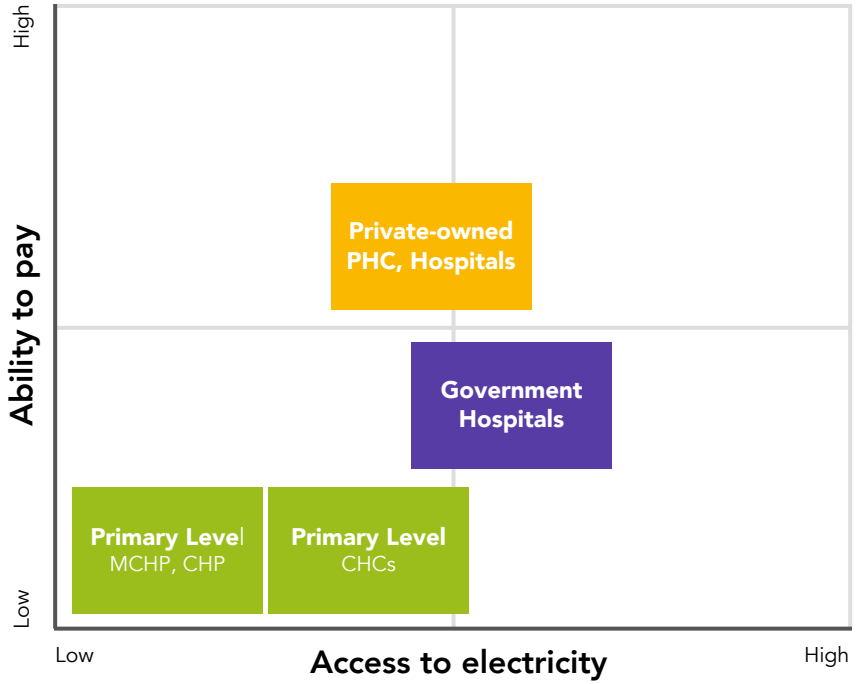
Access to and ability to pay for electricity

Access to Electricity is gauged on connectivity to the grid or having an alternative source that provides at least 8 hours reliable electricity per day.

- An estimated 38% of all types of HFs have no access to electricity due to being off-grid, in remote locations or having no alternative. Additionally, a significant number of health facilities suffer from unreliable power connections or are under-electrified. The ability to pay for MCHP,CHP and CHCs present little or no economic incentive for private energy service companies to set up fully commercially driven operations. Primary level facilities have lower access to electricity as they are located in rural areas, while secondary level facilities such as hospitals typically have better access being located in grid-connected urban locations or having access to alternatives such as fuel generators.
- The majority of primary (and secondary) level HFs are publicly owned with limited budgets for utility or alternative energy financing and repayments. At the primary level, access to electricity is even lower for MCHPs and CHPs.

Ability to pay is gauged on whether the facility is private or publicly owned, availability of funds for utility payments, and the ability to repay commercial private energy service companies to provide electrification.

- Primary level health facilities have lower capacity to afford utility repayments as majority of revenue (70%) is from OOPE charged to patients, lower ability to invest in or afford renewable energy systems and lower levels of funds to enable repayments to commercial private energy service companies. This is also by nature of the primary level facilities being majority public owned.
- Majority of secondary level health facilities are also government owned and located in more urban/semi-urban grid connected locations. Hence these have slightly better access to electricity.



- Private-owned health facilities are a combination of mostly primary health centers operating from off-grid rural locations, and hospitals. The PHCs still face similar affordability challenges. Generally, private-owned facilities are thought to have better ability to pay for electricity and afford alternatives.

Different delivery models have been deployed to date

The traditional equipment ownership model: describes a model where a donor agency either directly provides grant funding and commissions an NGO or private sector actor or grants a public agency funding to commission an NGO or private sector actor to design, purchase and install solar PV systems at a public institution e.g., health facility. The asset is owned by the public institution or agency. This has been the predominant model for most HFE interventions implemented in Sierra Leone. The main strength of this model is that it makes deployments easier and quicker, as funds are usually readily available from donors, reducing the burden of having to raise funds for private sector or waiting for government allocations. Its main weakness is that there is limited scope for O&M or provisions for replacements, making it difficult to sustain deployed systems beyond the project timelines. These constraints are mitigated if the public agency allocates dedicated funds for repairs, maintenance and replacements. The traditional equipment ownership model is well suited for MCHPs and CHPs, since they require smaller sized stand-alone PV systems with minimal O&M requirements.

The service-based model: describes a model where a public agency selects a service provider (private sector or NGO) to provide electricity services (design, procure, install, operate and maintain solar PV systems) to public institutions e.g. health facility, typically over a 10- to 15-year period. The service provider raises investment capital (debt or equity) from investors and may also get subsidies and guarantees from donors. The service provider ensures that service levels are met for the contract period. The government pays the provider on a regular basis, as it would with other utilities directly or through a financial institution once a 3rd party verifies that the services are rendered accordingly. Depending on the operating model, assets are either owned by the public institution or the private service provider for a pre-defined period. This model is suitable in instances where public sector financial management, compliance management and procurement management capacities are strong, with effective regulatory frameworks, long-term financing supported by local banks, active off-grid industry and institutional trust for government to fulfil its fiduciary and legal agreements. This is not entirely the case in the Sierra Leonian context. Secondary level government hospitals, private owned PHCs and hospitals are more suited to this commercial service-based model or its hybrid variants as they tend to have better management capacity as well as ability and willingness to pay for electricity services from a private developer. While multiple financing mechanisms can be implemented across different business models, overall, some of the identified credit enhancement instruments that can enhance the viability of service based and hybrid models include guarantee mechanisms, grant subsidies, concessional funding, and renewable energy credits.

The hybrid model: combines elements of the traditional equipment ownership model and the service-based model, where it is not fully commercially market driven and yet not fully dependent on donor funding and public agency ownership and management. The role of donors here could be to provide grant funds for aggregated procurement of energy efficiency upgrades for the health facilities such as lights, fans, electrical wiring and the likes, as well as supply side subsidies to cover portions of the RE system CAPEX or in form of RBFs to the private sector ESCO. The private sector ESCO raises concessional funding through impact investors, DFIs, corporates or philanthropies. Hybrid model is more suited to CHCs and large hospitals. In the case of Sierra Leone, a hybrid model for CHCs should consider a community/ecosystem approach whereby the CHC is not the main anchor client upon which OPEX and revenues will be generated. For smaller MCHPs and CHPs, standalone solar systems can be provided on an energy-as-a-service model with some incentives for the ESCOs.

Traditional equipment ownership approach – model

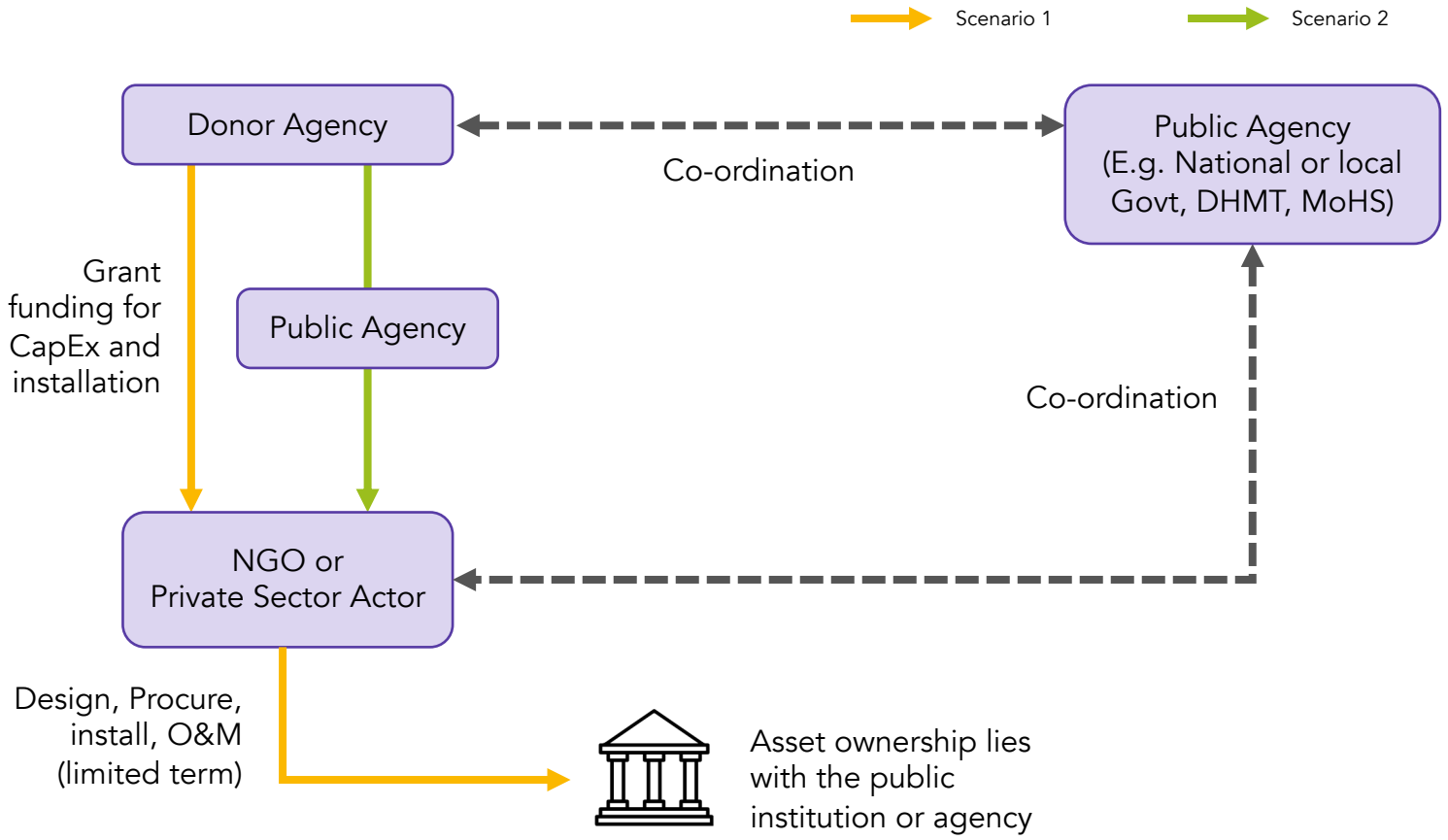
Scenario 1

A donor(s) directly provides grant funding and commissions an NGO or Private sector developer to design, purchase and install RE systems at a health facility.

Scenario 2

A donor(s) provides grant funding directly to an implementing public agency who commissions an NGO or Private sector developer to design, procure and install RE systems to a health facility.

In both instances, a public agency plays a co-ordination role, and the asset is owned by the public institution or agency



Note: illustration from SEforALL, WB, ESMAP (2021) 'From Procurement to Performance'.

Traditional equipment ownership approach – SWOT

Strengths

- Targeted funds making it easier for quick deployment
- Removes or lessens burden of raising finance for public and private stakeholders

Weaknesses

- Short-term scope
- Limited term and funds for O&M
- No or unclear provision for replacements, repairs
- Lack of institutional capacity to manage and maintain systems limited

Opportunities

- Aggregation of procurement and implementation

Threats

- Free donations tend to be viewed as 'nobody's property'

Traditional equipment ownership approach – applied examples

Technology considerations:

- Small sized Solar Standalone Systems 100W-500W minimum range (Tier 2)

Preconditions:

- Potential selection of prioritized MCHP,CHP locations by population density, health/electrification indices
- Ground-truthing; verification of status of MCHP,CHP as functional, establish energy needs assessment and categorization to generate list of potential locations
- Sustainability; public agency, government commitment to putting aside funds for replacements beyond installations.
- Training of facility manager(s)/ technicians on first level troubleshooting and O&M

Funding Mechanisms:

- Donor grants for CAPEX and Installation
- NGO grants/contributions for limited O&M
- Government contributions for replacement of systems beyond end-of-life period

Traditional Equipment Ownership Models

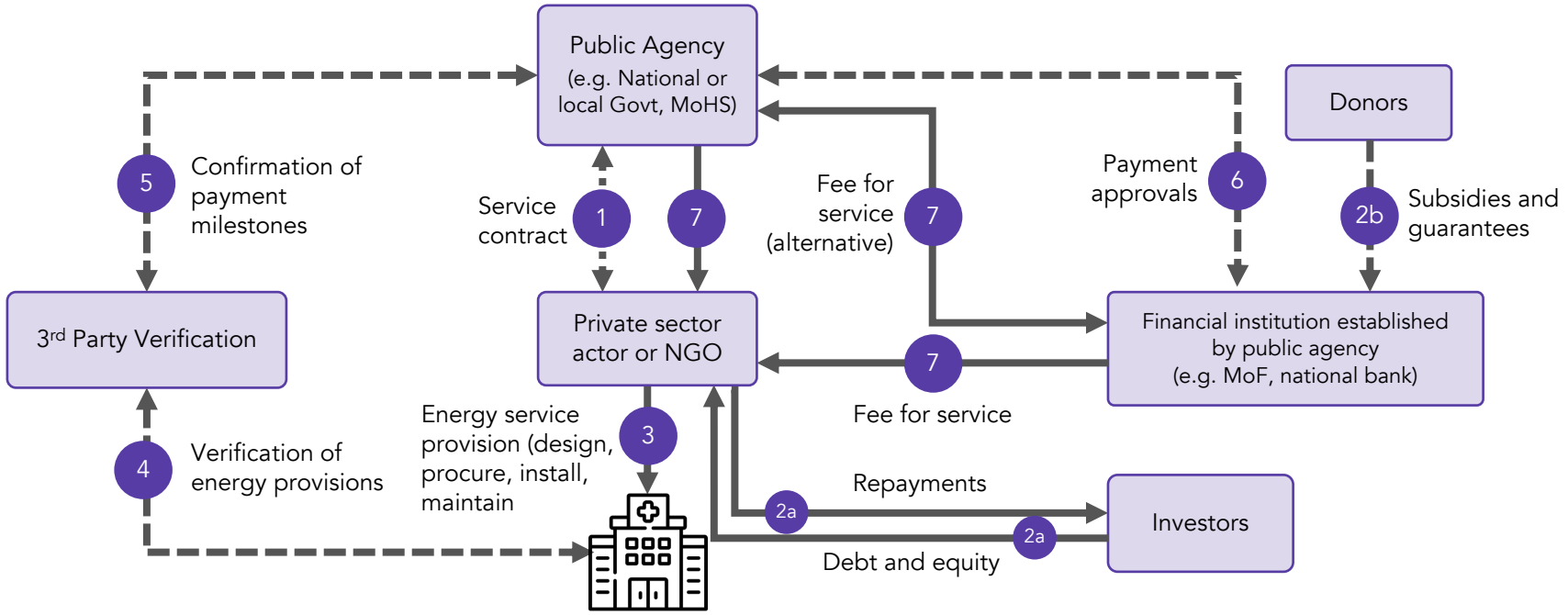
Operating Model	Stakeholders	Funding Type	Asset Ownership	Examples
Donation/ Equipment Ownership Model	Donor	Fully donor funded	MOH&S	UNICEF Solar Refrigerators
	NGO, Govt.	Fully donor funded	MOE	OXFAM IBIS, PRESSD-SL Solar for secondary schools
	NGO, Philantrophists	Donation	BO Government hospital	Project Bo
	Donor, NGO	Fully donor funded	unclear	Pilot Projects solaring healthcare facilities and livelihood streams in Kambia District- Building Resilient Energy Ecosystems Around Decentralized Renewable Energy
	Donor, NGO/Porject/ fund manager, Govt.	Fully donor funded	unclear	USAID- funded project; **Advancing Partners & Communities** in collaboration with Govt. of Sierra Leone – Ministry of Health & Sanitation
	Donor, NGO	Fully donor funded	NGO	PRESSD-SL
	Donor, Govt.	Fully donor funded	MOH&S	We Care Solar, UNFPA, MoHS, Friends of PCMH, Medical Research Centre, Friends of Maternity and CUAMM
EPC Model	Pool of Donors, Govt., Private Sector	Grants, O&M sustainability fund	Public Agency (MOHS)	HealthGrid

Service-based approach – model

01 A service contract is signed between the service provider and the public agency

2a The service provider raises capital from investors; direct grants to the investors (for e.g., RBF) are not included in this figure

2b Subsidies and guarantees are deployed; these are in addition to existing funds and finance going to public spending (e.g., health, education, etc.). Alternatively, the health facility pays for energy services provided



03 An energy solution is deployed, and the health facility starts using power as a service

04 A third party verifies that energy is being provided and consumed, including through remote monitoring technologies

05 The third-party verifier sends confirmation that payment milestones have been met to the public agency

06 The public agency sends payment approval to the financial institution

07 The financial institution (e.g., fund manager) issues payment in accordance with the contract and the service delivered

7 alt The financial institution releases funds, which the public agency uses to pay the service provider. Note: these funds can be provided up front.

→ Funding/ Finance

◄- - -► Information

Service-based approach - SWOT

- The Service Based Model seen in Sierra Leone is bilateral in the sense that the health facility contracts an energy service provider directly
- The service provider funds the CAPEX and ensures that contractual agreements are met.
- The health facility pays the service provider on a regular basis, as it would with other utilities

Strengths

- Service provider has technical capacity to manage systems post-implementation
- Generation assets can be subsidized
- Revenue generation from service provision, O&M
- Ownership and responsibilities clearly defined

Weaknesses

- High risk of non-repayment for electricity by public institutions
- Not enough incentive exist to make PHCs entry points/anchors for community electrification

Opportunities

- Entry point to communities to provide other energy-related/ ecosystem services
- Opportunity for aggregation of clusters

Threats

- For Standalone SHS systems, may become irrelevant when MGs arrive
- Highly dependent on agreements with government agencies
- Authoritative dynamics fluid

Service-based approach – applied examples

Technology considerations:

- Large sized Solar Standalone Systems serving Tier 3 energy needs

Preconditions:

- Size of opportunity large enough for multiple players (limited in the case of Sierra Leone)
- Active off-grid industry in the country/region, ideally already involved in investing in service-based models (limited in the case of Sierra Leone)
- There should be lenders and local banks supporting access to longer-term financing, ideally with precedents for lending to similar projects (limited in the case of Sierra Leone)
- Regulatory frameworks or tested agreements in place around operations of service-based models or mini-grids

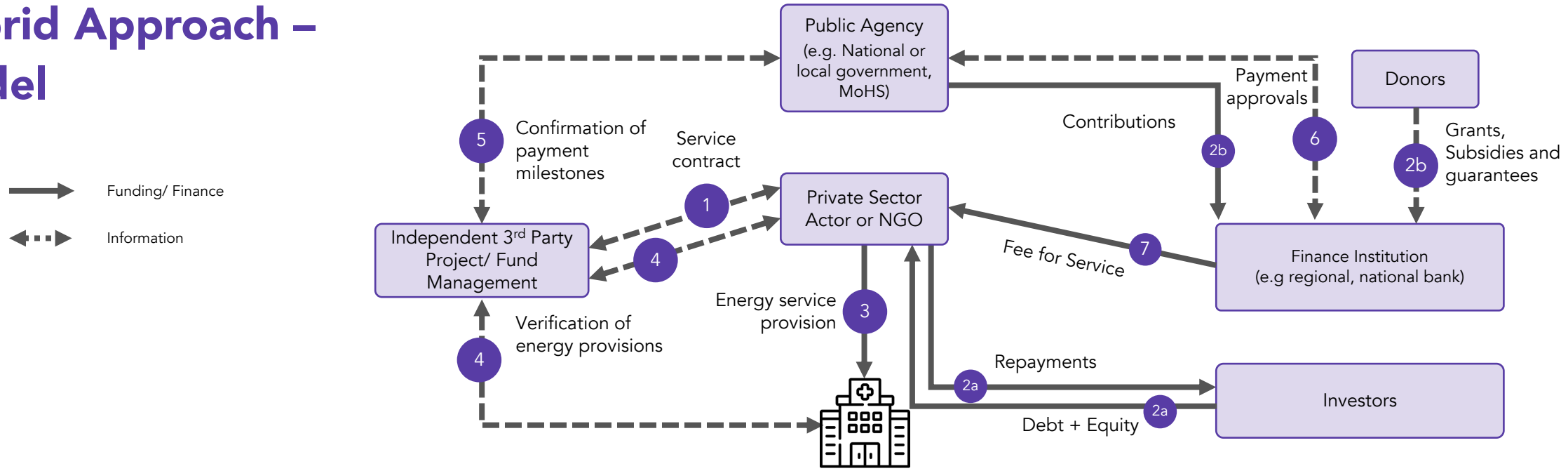
Funding Mechanisms:

- Commercial investors debt and equity (size still small)

Service-Based Models

Operating Model	Stakeholders	Funding Type	Asset Ownership	Examples
Outright purchase or lease models	Private Sector	Private sector funds	Private sector, end user	Easy solar

Hybrid Approach – model



01 A service contract is signed between the service provider and the public agency e.g. MoHS SLA Unit, PPP Unit

2a The service provider raises capital from investors; direct grants to the investors (for e.g., RBF) are not included in this figure

2b Public health and education electrification specific subsidies, guarantees and contributions from donors and government

03 An energy solution is deployed, and the health facility starts using power as a service

04 A third party manages the project contract, verifies that energy is being provided and consumed, including through remote monitoring technologies

05 The third-party verifier sends confirmation that payment milestones have been met to the public agency and financial institution

06 The public agency sends payment approval to the financial institution

07 The financial institution issues payment in accordance with the contract and the service delivered

Hybrid approach – SWOT

Strengths

- Ideally, private sector ESCO dependence on contracts with public agency limited, reduced risk of failed contracts in case of change of administration
- Oversight of funds and repayments managed by dedicated project management entity

Weaknesses

- Challenges with capacity to design, procure, install, operate and maintain systems, may require long-term technical assistance and skills transfer for MGs

Opportunities

- Aggregation of locations by districts
- Aggregation of procurement of assets, energy efficient and productive use appliances as part of demand side interventions
- Opportunities for bundled services provision e.g., solar water pumps, internet access with a laptops for record keeping/ business center services, 2/3-wheeler electric motorcycles/tricycles charging of the installed solar system, in accordance with WHO definition of basic amenities for health facilities to include improved water source, sanitation facilities, room with privacy, communication equipment, computer with internet/email, emergency transportation.

Threats

- Consistency of contributions from public agency required for sustainability and building confidence of private sector ESCOs and investors
- Highly dependent on agreements with government agencies and independence of project management entity

Hybrid approach – applied examples

Technology considerations:

- Mini-grids serving Tier 3 and above energy needs

Preconditions:

- Government / customer- demonstrate willingness to pay for energy service, and energy services must be prioritized appropriately in the budget planning for the health sector
- Public-sector finance management and procurement should be capable of long-term service contracting consistent with the lifetime of solar PV assets during transition
- An independent non-financial PM Entity is required to manage, donor funding, oversight and verification of program implementation for government and ESCOs.
- Buy-in from government and donor stakeholders to operate through a PM Entity. This has been demonstrated successfully in Bangladesh with IDCOL, in Nigeria with the likes of USADF operating funds through Diamond Development Initiatives (DDI), and WB-REA through NEP PMU, and UNOPS in Sierra Leone.
- Strong commitment from government to follow through with contributions to payments for electricity services provided. Must be prioritized appropriately in the budget planning for the health sector

Funding Mechanisms:

- Donor grants, subsidies,
- Donor and government guarantees
- Debt and equity from impact investors

Hybrid Models

Operating Model	Stakeholders	Funding Type	Asset Ownership	Examples
Build-Own-Transfer, Build-Own-Operate-Transfer models	Government, Private, Donor	Public funds, Private equity/debt, Grants and/or subsidies	Private, Public institution	RREP Split Asset Model

Main findings and recommendations

Planning

- Operational sustainability needs to be enshrined in project planning and budgets
- Due to the small size of the market opportunity and private sector players, an aggregated approach with possible concessions can be considered either for Private ESCOs with subsidies and/or CAPEX grants.

Capacity

- Better harmonization between MoE and MoHS interventions can create the basis for building capacity of public operational capabilities, public fund availability and planning to finance and sustainably maintain HF electricity assets.
- Technical assistance would still be required for project/portfolio management assisting government and private sector to navigate the ecosystem as the sector takes shape

Standards

- Minimum standards and service levels have to be set for technologies to be deployed to health facilities

03 | Roadmap: Powering Healthcare Facilities

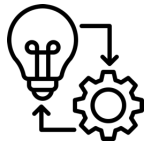
SUSTAINABLE ENERGY FOR ALL

Global Energy Alliance for People and Planet

Foreign, Commonwealth & Development Office

Proposed implementation phases for sustainable electrification of all PHUs by 2030

	Phase 1: Structuring and feasibility 2023 – 2024	**Phase 2:** Development and demonstration 2024 – 2026	**Phase 3:** Scale up 2026 – 2029
Key activities	• Consultations initiated between MoHS, MoE, IPs and other stakeholders and set-up programme management structures on powering social infrastructure. • Undertaking a comprehensive assessment of the energy-health ecosystem; energy audits/assessment of healthcare facilities. • Technical assistance and programmatic support to MoHS & MoE for developing proof-of-concept for i) healthcare electrification; ii) developing a central and dynamic database with real time applications for MoHS and partners.	• Implementation plans and delivery models on financing and ownership defined. • Investment plans (standardised system design and costing) developed for different categories of PHUs. • Funding sources identified and structured to electrify an initial 300 PHUs. • O&M and MEL performance management framework developed and tested.	• Scale-up plans developed, and funding partnerships established. • Implementation plans and delivery models on financing and ownership models refined based on MEL from Phase 2. • Investment plans developed and funding secured for additional electrification of 834 PHUs. • O&M and MEL performance management framework completely developed and fully operational.
Key outputs	• Central and dynamic database on health facility electrification (HFE) with real time application • Report on energy-health ecosystem mapping, energy audits/assessments; proof-of-concept for healthcare electrification	• Pilot HFE implementations and demonstration of delivery models on financing, ownership and O&M. • 300 PHUs electrified and associated O&M and MEL procedures established.	• Investment plans developed and funding secured for additional electrification of 834 PHUs. • O&M and MEL performance management framework completely developed and fully operational.



Proposed next steps for phased implementation

Phase 1: Structuring and feasibility (2023 - 2024)

- Engagements initiated between GoSL, IPs and other stakeholders to plan framework for coordination and support for projects on powering social infrastructure (PSI), including the establishment of a dedicated Project Management Unit (PMU) for PSI.
- Commit and provide funds to: i) establish PMU; ii) undertake energy-health ecosystem mapping and energy audits/assessment.
- Establish a fully staffed and equipped PMU that takes the lead on the comprehensive energy-health ecosystem mapping, energy audits/assessments of healthcare facilities countrywide.
- Commit and provide resources for technical assistance and programmatic support to MoHS & MoE for developing proof-of-concept for healthcare electrification.
- Development of central and dynamic database with real time application at MoHS commences.
- PMU commences and begin to provide technical assistance, leads healthcare electrification plans and engage all stakeholders, including GoSL, IPs, private sector, etc.

Phase 2: Development and demonstration (2024 – 2026)

- Implement pilots on healthcare electrification with different financing, ownership and operating models/practices; gather and analyze lessons learnt.
- PMU use initial MEL outputs to refine investment and aggregation of health facility electrification plans, as well as MEL plans.
- Launch large-scale health facility electrification programme and engage donors, GoSL, IPs and the private sector (EPCs) to activate health facility electrification programme.
- Funding and financing mechanisms are secured and electrification (design, procurement and installation) of an initial 300 PHUs commences in partnership with relevant parties (GoSL, donors, private sector and IPs and impact investors.
- MEL performance management framework developed and activated on ownership and operation and maintenance regimes .

Phase 3: Scale up (2026 – 2029)

- Refine and elaborate on implementation plans and delivery models on financing and ownership models from Phase 2.
- Scale-up and complete electrification of additional 834 PHUs, including a complete and functional MEL framework on O&M.
- Data on O&M/MEL framework feeding directly into central and dynamic database in real time for impact evaluation.

Recommendations, roles and actions

Challenges	Recommendations	Proposed actions	Stakeholders
01 **Data collection, digitalization and visualization**	Undertake comprehensive energy audits/assessments on electrification status, including information on current expenditure on electricity, current O&M regimes, funding and financing, as well as ownership and governance arrangements.	Commission comprehensive energy audit/assessment and data gathering for health facilities, including electrification status.	MoHS (DPPI, DPHC, DHMT, HFE advisory team), MoE, IPs, HFE programme donors
	Invest in data gathering on health facilities, build a central and dynamic national database that captures, aggregates and presents real time information on health facility infrastructure, including heatmaps on electrification status.	Upgrade DPPI health facility database if possible. Otherwise, develop new digital database with real time visualization that is accessible to key stakeholders.	HFE programme donors, DPPI, DPHC, DHMT.
	Digitalization of health facilities to facilitate record keeping, data collection, remote monitoring of deployed RE systems, monitoring and reporting of impacts.	Invest in computers and internet access across all health facilities.	HFE programmes, private sector, civil society, IPs, donors.
02 **Funding, financing and ownership**	Mitigate financial risks for private sector energy services companies by providing blended financing options and instruments including performance-based grants, subsidies, guarantees, equity and debt financing.	Develop and pilot HFE projects with blended financing options and instruments targeted at HFE.	HFE programme donors, DFIs, investors.
	Long-term concessionary loans from impact investors are required to encourage private sector energy service companies to participate in health facilities electrification.	Provide access to concessionary loans to private sector.	DFIs, investors.
	Explore funding opportunities with the BHCPF and community-based funding models to supplement operational maintenance and retrofit costs.	Allocate percentage of GoSL budget on healthcare/local government finance for O&M at healthcare facilities.	GoSL, local government councils

Challenges	Recommendations	Proposed actions	Stakeholders
03 **Technology, standards and energy efficiency**	Technology choice of standalone solar PV systems (serving single user) or mini-grids (serving multiple users) should be guided by both functionality and least-cost burden for the type and level of health facility.	Support standard high quality and appropriate technology products and choices.	Health facility electrification programme, either donors or government-led, private sector, Ministry of Environment, EPA-SL, REASL.
	Factor in minimum standards for health care electrification in terms of critical and non-critical equipment, appliances and staff accommodation when sizing renewable energy systems.		
	Invest in use of energy efficient appliances and equipment for health facilities.		
	Commit to adhering to acceptable international standards and guidelines at programme level, e.g., internationally approved quality standards for solar PV components, and the environmental guidelines of the Ministry of Environment/EPA-SL throughout project lifecycle and especially for handling e-waste and disposal of used batteries.		
04 **Sustainability and delivery approach**	Strongly consider preconditions when selecting delivery models, such as organizational capacity, financial and technical robustness during design and implementation of 'fit for purpose' delivery models for the electrification of various levels of health facilities. Ownership, funds availability or sources, energy service delivery levels must be clearly and realistically defined.	Invest in pilots of outlined delivery models for the various types and level of health facilities.	HFE programmes, either donors or government-led.
	Leverage on O&M guidelines being developed locally by REASL-EnDev and other similar initiatives for powering social infrastructure and ensure that proper safeguards are in place to ensure sustainability. The ability to operate, maintain, replace electricity supply systems is paramount to long-term sustainability and performance.	Adhere to sustainability guidelines.	HFE programmes, either donors or government-led, private sector, investors.
	Support and build capacity of existing efforts to create cluster networks, Community of Practice (CoP) and community champions, to enhance community participation, physically monitor system performance and provide accountability for O&M requirements and procedures with private sector actors.	Invest in technical capacity building programmes.	HFE programmes, either donors or government-led, private sector actors, REASL.

Challenges	Recommendations	Proposed Actions	Stakeholders
05 **Coordination and information exchange**	Leverage existing coalition and relations between MoHS, other GoSL ministries and agencies, IPs, donors, local government and civil society to foster dialogue, information exchange, bridge gap between health and energy stakeholders and get buy-in for creating a policy framework that is conducive for O&M and the sustainability of HFE.	Strengthen role and structure of coalition to provide a framework for engagement.	HFE programme donors, MoHS, local government, civil society
	Provide technical assistance and programmatic support to MoHS/MoE at pre-implementation, implementation and post implementation stages.	Establish and invest in technical assistance through proposed HFE PMU.	HFE programme donors
	Support capacity development and build on existing skill development initiatives of REASL/EnDev and other stakeholders for a strong and responsive technical, commercial, legal, institutional capacity for public agencies supporting HFE interventions.	Invest in technical capacity building programmes.	HFE programme, either donors GoSL-driven, capacity building institutions REASL
	Develop or align and implement healthcare electrification programs in consonance with existing health and energy sector plans e.g., GoSL plans to increase renewable energy contribution in the national energy mix to 65% by 2023 and transforming the health sector into a well resourced and functioning national health-care delivery system.	Adopt a phased approach to delivery in line with GoSL energy access plans and strategy.	HFE programmes, either donors or GoSL-driven, private sector, investors

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Vienna (Headquarters)
Andromeda Tower, 15th Floor
Donau City Strasse 6
1220, Vienna, Austria
Telephone: +43 676 846 727 200

Washington, DC
1750 Pennsylvania Ave. NW
Washington, DC 20006 USA
Telephone: +1 202 390 0078

About SEforALL

Sustainable Energy for All (SEforALL) is an international organization that works in partnership with the United Nations and leaders in government, the private sector, financial institutions, civil society and philanthropies to drive faster action towards the achievement of Sustainable Development Goal 7 (SDG7) – access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement on climate.

We work to ensure a clean energy transition that leaves no one behind and brings new opportunities for everyone to fulfil their potential.

Contact us to learn more

PoweringHealthcare@seforall.org

SUSTAINABLE ENERGY FOR ALL

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