

Sierra Leone Healthcare Electrification Project: Developmental Evaluation

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CATALYST
ENERGY ADVISORS

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SEforALL point of contact:

Quinn Reifmesser, Head, MEL
Andromeda Tower 15th floor
Donau-City Strasse 6, Vienna, 1220
email: Quinn.Reifmesser@seforall.org

Catalyst point of contact:

[Dan Murphy](#), Managing Director
1831 Solano Ave, Suite 7442
Berkeley, CA 94707
email: dan@catalyst-advisors.com

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Acronyms

CAPEX	Capital Expenditures	MW	Megawatt
CHC	Community Health Centre	O&M	Operation & Maintenance
CHP	Community Health Post	ODCH	Ola During Children’s Hospital
DE	Developmental Evaluation	OPEX	Operational Expenditures
EPC	Engineering, procurement, and construction	PCMH	Princess Christian Maternity Hospital
EWRC	Electricity and Water Regulation Commission	PHU	Peripheral Health Units
FCDO	UK's Foreign, Commonwealth & Development Office	PIH	Partners in Health
GHG	Greenhouse gases	PPP	Public-Private Partnership
GoSL	Government of Sierra Leone	PV	Photovoltaic
IA	Impact Assessment	RMS	Remote Monitoring Sensors
kW	Kilowatt	SCBU	Special Care Baby Unit
kWh	Kilowatt-hour	SL-HEP	Sierra Leone Healthcare Electrification Project
kWp	Kilowatt peak	SLA	Service Level Agreement
MCHP	Maternal and Child Health Posts	SEforALL	Sustainable Energy for All
MoE	Ministry of Energy	TBA	Traditional Birth Attendants
MoH	Ministry of Health	VfM	Value for Money
		WASH	Water, Sanitation and Hygiene

1. Executive Summary

The Sierra Leone Healthcare Electrification Project (SL-HEP) was launched to address one of the most persistent barriers to quality healthcare in the country: unreliable or non-existent electricity in public health facilities. Led by Sustainable Energy for All (SEforALL), in collaboration with the Government of Sierra Leone (GoSL), the UK's Foreign, Commonwealth & Development Office (FCDO), and technical partners, the programme installed solar PV and battery systems across hospitals and Peripheral Health Units (PHUs) in multiple phases between 2021 and 2025. Figure 1 gives an overview of intervention sites, the size of renewable energy systems, and the scope of evaluation.

The DE provides a forward-looking assessment of Phases 2 and 3 of the project, building on the evidence base established through the Phase 1 Impact Assessment (IA). While the IA focused on measuring outcomes and related impacts to date, from the installation and operation of solar photovoltaic (PV) systems in six hospitals under Phase 1, the DE is designed to inform future programming by identifying key lessons, strategic adaptations, and pathways for replication and scale-up.

This DE covers site visits to 18 healthcare facilities—6 Phase 1 hospitals, PHUs under Phase 2, and 4 hospitals under Phase 3—alongside interviews with stakeholders from the Ministry of Health (MoH), Ministry of Energy (MoE), Electricity and Water Regulatory Commission (EWRC), SEforALL, CEMMATS, and the Engineering, Procurement and Commissioning (EPC) contractor EM-ONE. Field observations and learnings from the Phase 1 hospital visits, originally conducted for the Impact Assessment, played a foundational role in shaping this DE, offering a performance baseline, insights into adaptive system design, and critical lessons on sustainability and maintenance challenges that directly informed the evaluation of Phases 2 and 3. Reports, including the *Monitoring Evaluation and Learning Baseline Report* and the *Electrification of 6 hospitals in Sierra Leone Solar Panel Post Installation Report*, elaborated by Crown Agents, offered valuable insight about the project's baseline. Additional documents, including the *Core Impact Indicators, Results Framework*, and *Revised Logframe*, provided by SEforALL, were fundamental to determining relevant KPIs for both assessments. A collaboration was established with Tetra Tech, the Project Management firm responsible for verification and confirmation of EPC milestones, and EM-ONE, the EPC contractor, during the elaboration of the IA. Drawing from these sources, the evaluation examines operational integration, institutional coordination, design evolution, and early indicators of sustainability.

A key distinction between the IA and the DE lies in their temporal focus and use. While the IA measured post-installation outcomes such as diesel reduction, energy reliability, service delivery and health outcome improvements, the DE captures learning during implementation, particularly the adaptive choices and institutional dynamics that enabled SEforALL to deliver Phases 2 and 3 on an accelerated timeline. Phase 1 findings, gathered via a utility-focused evaluation conducted by ITP Energised, directly informed refinements in technical design, procurement processes,

stakeholder engagement, and sizing methodologies in subsequent phases. Notably, the DE also integrates insights from Phase 1 hospitals where expansion works were ongoing, further enriching the evidence base for scale-up.

Findings from the DE affirm the programme's strong alignment with national healthcare priorities and growing government interest in sustainable public infrastructure electrification. Facilities across Phases 2 and 3 have shown early gains in energy reliability, staff motivation, and community trust in health services. Persistent gaps, however, such as lack of medical equipment, uneven training, and uncertainty over long-term operations and maintenance (O&M), highlight the need for systemic improvements. These challenges are not unique to Sierra Leone and offer globally relevant insights for similar health-energy programmes in other contexts.

To guide replication, institutional strengthening, and future programming, the evaluation outlines the following recommendations:

1. **Leverage and document adaptive design for replication:** Codify effective adaptive practices from Phases 2 and 3 into internal playbooks, including engineering templates, procurement strategies, and stakeholder engagement protocols to support replication in other sectors or countries.
2. **Enhance facility-level operational integration:** Strengthen alignment among medical, technical, and administrative staff at the facility level. Develop onboarding materials and coordination tools to ensure shared understanding of system capabilities and responsibilities.
3. **Build structured demand forecasting into project design:** Develop scalable energy demand forecasting models to anticipate clinical and non-clinical energy needs, guide system sizing, and inform long-term O&M planning.
4. **Formalise long-term O&M mechanisms:** Finalise and institutionalise a national O&M framework with clear responsibilities, sustainable financing (e.g., bundled contracts or hybrid PPP models), and regulatory oversight to ensure system sustainability beyond the donor funding window.
5. **Enhance monitoring and community co-benefits:** Improve remote monitoring systems and local reporting. Track social co-benefits such as community safety and education gains and formalise pathways for community-led stewardship of electrified facilities.
6. **Strengthen VfM Monitoring and Cost-Effectiveness Analysis:** Link financial inputs to tangible outputs and outcomes. Track capital and operational costs at the site level and develop metrics such as \$/kWp installed or \$/additional patient visit to inform scale-up decisions.
7. **Expand Cross-Sector and Cross-Country Replication of the SL-HEP Model:** Consolidate lessons across phases and support replication of the SL-HEP model in other public service sectors (e.g., education, WASH, public safety). This includes institutional coordination, system modularity, and alignment with national energy and health

strategies. Further South–South learning and peer exchanges are encouraged to build a global evidence base.

These recommendations are supported by a *Replication and Adaptation Matrix* included at the end of this report, which distils transferable elements and contextual considerations for implementing the SL-HEP model in other settings. While the matrix provides a useful starting point, it is not intended to be exhaustive. Adaptation will necessarily vary by country, sector, and institutional context, and further tailoring will be required to reflect local needs, infrastructure capacity, and governance arrangements.

Overall, this DE affirms the viability and replicability of SL-HEP’s approach while underscoring the importance of long-term planning, institutional ownership, and evidence-informed adaptation to achieve sustainable impact.

2. Introduction

The Sierra Leone Healthcare Electrification Project (SL-HEP) was initiated to address chronic energy deficits across the country's public health system through the deployment of reliable, solar-powered energy solutions with battery storage. Sierra Leone continues to face some of the lowest electricity access rates globally. As of October 2023, only 36% of the population had access to electricity, with an installed generation capacity of just 160 MW as of 2021.¹² The national power system is marked by high technical, commercial, and collection losses, estimated at nearly 40%, alongside ageing infrastructure, chronic supply unreliability, and heavy dependence on polluting diesel generators. These constraints impact not only household energy use and communication but also significantly undermine the delivery of essential public services, particularly in sectors like healthcare and education.³

The programme launched with the approval of £4.95 million in July 2022, which funded Phase 1. This phase successfully installed clean energy systems at three regional hospitals—Kabala, Kambia, and Bonthe—along with a backup system for the Ola During Children's Hospital (ODCH) and Princess Christian Maternity Hospital (PCMH) in Freetown, and an expanded system at Masanga Hospital. By the end of the 2023–24 financial year, approximately 627 kWp of solar capacity had been installed under Phase 1, meeting its initial objectives on schedule and within budget. This initial phase underwent a utility-focused evaluation by ITP Energised, of which the findings were integrated into phases 2 and 3, as well as leveraged for this DE's comparative analysis with the initial findings during ongoing deployment.

With Phase 1 meeting its targets on schedule and the evaluation insights in hand, the programme advanced to a much broader scope thanks to further grant extensions. The original GBP 4.95 million grant, signed in August 2022, supported installations at six hospitals and was later supplemented by a GBP 2.8 million extension in August 2023 and a further GBP 12.2 million extension in April 2024, bringing the total programme budget to nearly GBP 20 million. An Addendum to the original grant agreement formalised these successive extensions, enabling Phase 2—which targeted Kailahun District Hospital and 25 Peripheral Health Units (PHUs)⁴ – and Phase 3, which focuses on solar installations at 11 additional hospitals across the country, including several major facilities in Freetown. While formal operations and maintenance (O&M) contracts are currently in place only for Phase 1 through March 2025, O&M for Phases 2 and 3 is

¹ [Statement by His Excellency Dr. Julius Maada Bio, President of the Republic of Sierra Leone, on the occasion of the launch of the National Dialogue on Developing a Just and Inclusive Energy Transition," State House of Sierra Leone.](#)

² <https://www.seforall.org/our-work/country-engagement/country-work-sierra-leone>

³ Independent Evaluation of SEforALL Projects in Sierra Leone: Powering Sierra Leone's Hospitals Programme (March 2024), p. 16

⁴ PHUs are the primary delivery points for community-based healthcare, and include Community Health Centres (CHCs), Community Health Posts (CHPs) and Maternal and Child Health Posts (MCHPs)

being actively discussed and integrated into ongoing sustainability planning. At the time of writing, all Phase 1 and 2 installations are complete and operational, while Phase 3 installations are in progress, with detailed site-level status provided in Figure 1.

The Addendum also tasked SEforALL with supporting the Ministry of Health in developing a sector-wide strategy for the long-term sustainability of energy infrastructure across public health facilities. This includes efforts to institutionalise O&M systems and identify sustainable financing models.

The following Developmental Evaluation (DE) of the SL-HEP builds on insights from the Phase 1 Impact Assessment (IA), as well as the *Independent Evaluation of SEforALL Projects in Sierra Leone: Powering Sierra Leone's Hospitals Programme*, shifting focus to Phases 2 and 3 to assess implementation, sustainability, and scalability. While DEs are typically designed to support real-time learning and adaptation during implementation, this DE was conducted in the final stages of programme delivery to capture emerging lessons and support strategic reflection for future design. In line with the Terms of Reference, it aims to consolidate operational insights, identify enabling and limiting factors for scale-up, and inform the development of future programmes in Sierra Leone and similar contexts. This evaluation examines the following key areas: a) the long-term sustainability of hospital electrification, b) the financing mechanisms needed for ongoing operations and maintenance, c) innovation in system design and implementation, and d) the scalability of the model both within Sierra Leone and in other country contexts. Findings explore the potential for further expansion in Sierra Leone, as well as replication in other countries or other sectors (e.g., education).

The assessment draws from output data analysis, field observations, stakeholder interviews, and document reviews. By analysing project performance, this evaluation provides key learnings for future electrification initiatives, supporting long-term impact and strategic alignment with national policies and donor priorities.

3. Programme Context & Phases 2 and 3 Overview

How We Got Here – Programme Design and Lessons for Future Expansion

The design of SL-HEP evolved in response to both logistical constraints and strategic learning from Phase 1. Initial electrification efforts focused on hospitals, demonstrating the feasibility of solar-powered systems in improving healthcare service delivery and reducing reliance on diesel generators. However, limitations in system capacity, maintenance planning, and the exclusion of critical infrastructure, such as staff quarters, informed adjustments in subsequent phases. A separate IA was conducted for Phase 1 and is available as a standalone document, providing detailed findings on post-installation performance and health system outcomes. Phase 2 expanded the scope to include twenty-five (25) Peripheral Health Units (PHUs) and one hospital, prioritising first-time electrification in remote areas where no alternative power sources existed. This phase introduced standardised system sizes (6.6 kWp and 13.2 kWp), streamlining procurement and deployment while balancing cost efficiency with impact.

Phase 3 marked the most extensive scale-up, incorporating lessons from prior phases to refine technical design, accelerate procurement, and introduce more structured stakeholder coordination. By incorporating recent energy audits to better align system capacity with actual hospital energy needs, Phase 3 aimed to improve system sustainability and adaptability. These iterative adjustments provide a foundation for scaling the model to additional health facilities within Sierra Leone, while also offering practical insights for adapting and replicating similar electrification initiatives in other public service sectors, such as education, water and sanitation, or local government infrastructure, both in Sierra Leone and comparable country contexts.

Where We Are – Implementation Progress in Phases 2 and 3

Implementation of Phases 2 and 3 has progressed under compressed timelines, requiring adaptive management strategies to navigate procurement, logistics, and government engagement. Field observations and stakeholder interviews confirmed that solar systems have been successfully deployed to community health centres in Phase 2, addressing critical service gaps in remote areas.

Phase 3, which targeted hospitals, was implemented with a mix of on-grid and off-grid facilities, focusing on reliability improvements and diesel displacement. While the solar installations have significantly reduced generator dependency, some hospitals reported energy demand outpacing system capacity due to facility growth. The rapid procurement and installation process, while essential to meeting project deadlines, also presented challenges in adapting to changing site conditions.

Where We Are Headed – Scalability and Sustainability Challenges

Looking ahead, the long-term sustainability of these electrified health facilities remains a primary concern. While the project successfully installed systems and trained hospital staff in basic

operations, the absence of a structured financing model for long-term operation and maintenance (O&M) poses a risk to system reliability & sustainability. Interviews with stakeholders highlighted ongoing discussions between SEforALL, the UK Government’s Foreign, Commonwealth & Development Office (FCDO), and Sierra Leone’s Ministry of Health (MoH) on potential O&M financing models, including public sector funding allocations, donor-supported maintenance contracts, and private-sector partnerships.

Scalability remains an open question, with significant interest in expanding existing interventions and extending the model to additional facilities; however, constraints in financial and institutional capacity exist. Future iterations may require adjustments in financing mechanisms, technical design flexibility, and clearer government ownership structures.

Strategic Fit and Policy Alignment

SL-HEP aligns with Sierra Leone’s national energy and health strategies by supporting electrification efforts in critical public institutions. The project contributes to broader sectoral goals, including MoH’s initiative to strengthen healthcare infrastructure and the government’s commitment to expanding energy access under the National Renewable Energy Action Plan. Regulatory gaps do, however, persist, particularly concerning long-term asset ownership and integration of solar solutions into public-sector energy planning. Though the *National Asset and Government Property Commission Act (1990)* establishes a public asset registry, it does not clarify who retains responsibility for the operation and maintenance of clean energy installations once project funding concludes. The Electricity and Water Regulatory Commission (EWRC) has yet to adopt standardised model Power Purchase Agreements (PPAs) specifically for solar or mini-grid projects. Instead, project developers negotiate bespoke agreements with the Ministry of Energy, subject only to regulatory approval. A patchwork of policies—including the *Public Financial Management Act (2016)*, the *Environment Protection Agency Act (2022)*, and the *Disaster Management Act (2020)*—touch on public investment in climate-related infrastructure, but no comprehensive framework exists to streamline the inclusion of solar assets in public budgeting. From a donor perspective, SL-HEP aligns with the UK Government’s priorities on climate resilience, health systems strengthening, and energy access, while also supporting SEforALL’s mission to accelerate sustainable energy solutions in alignment with a just and equitable energy transition for all. The project’s approach—balancing rapid implementation with adaptive learning—offers insights for future donor-funded electrification initiatives, both in Sierra Leone and in similar contexts.

The following figure provides a summary overview of solar PV system capacity and commissioning status across all phases of the SL-HEP. It details the implementation phase, site locations, installed solar and battery capacities, and the current operational status of each system as of April 2025. It also highlights planned capacity expansions and their progress where applicable. The scope column details the reach of the evaluation process for each facility, including whether

it was part of the field visits and if Remote Monitoring Sensor (RMS) data was analysed; as well as if the facility was evaluated as part of the Impact Assessment (IA) or the Developmental Evaluation (DE). The facilities in Phases 1 and 3 were comprised of hospitals exclusively, while Phase 2 includes Community Health Centres (CHCs), Community Health Posts (CHPs), and Maternal and Child Health Posts (MCHPs).

Figure 1. Overview of solar PV systems capacity and commissioning status for all phases of SL-HEP

Imp. Phase	Sites	Solar Capacity (kWp)	Battery Capacity (kWh)	Status	Solar Cap. Exp. (kWp)	Expansion Status	Scope ⁵
1	Bonthe Hospital	70.4	217	Commissioned	26.5	Commissioned	IA - field visit & RMS
1	PCMH	300.8	547	Commissioned	120	Ongoing ⁶	IA - field visit & RMS
1	ODCH						
1	Masanga Hospital						
1	Kabala Hospital	90.8	290	Commissioned	49.5	Commissioned	IA - field visit & RMS
1	Kambia Hospital	59.4	217	Commissioned	35.2	Commissioned	IA - field visit & RMS
2	Kailahun Government Hospital	114.4	290.3	Commissioned			DE
2	Jenner Wright CHC	13.2	20	Commissioned			DE - field visit
2	Cline Town CHC	13.2	20	Commissioned			DE - field visit
2	Bayama Lela CHP	6.6	10	Commissioned			DE
2	Ngelehun Govuhun CHC	6.6	10	Commissioned			DE
2	Bo School Clinic CHC	6.6	10	Commissioned			DE
2	Torwama MCHP	6.6	10	Commissioned			DE
2	Yele Community CHC	6.6	10	Commissioned			DE
2	Makali CHC	13.2	20	Commissioned			DE - field visit
2	Mamosasanka CHC	6.6	10	Commissioned			DE - field visit
2	Kameindor CHC	6.6	10	Commissioned			DE
2	Kindoya CHC	13.2	20	Commissioned			DE
2	Mokotawa CHP	6.6	10	Commissioned			DE
2	Moriba Town CHP	6.6	10	Commissioned			DE - field visit
2	Foya CHP	6.6	10	Ongoing			DE
2	Taigbe CHP	6.6	10	Commissioned			DE
2	Bonthe Under Five MCHP	6.6	10	Commissioned			DE - field visit
2	Mindohun CHP	6.6	10	Commissioned			DE
2	York Island MCHP	6.6	10	Commissioned			DE
2	Torma Bum CHP	6.6	10	Commissioned			DE
2	Taiama Trauma CHC	6.6	10	Commissioned			DE
2	York Peripheral Village CHC	6.6	10	Commissioned			DE - field visit
2	Newton CHC	6.6	10	Commissioned			DE
2	Kent CHP	6.6	10	Commissioned			DE

⁵ Identifies if key findings inform primarily the IA or DE and data sources, i.e., if data was gather through field visits and/or RMS

⁶ SEforALL is executing the expansion of the newly installed 300.8 kWp solar PV system by an additional 120 kWp, expected to be commissioned by March 31, 2025. In parallel, the components are being installed for a 150 kWp solar PV system with a 290 kWh battery capacity to supply the oxygen gas plant. Commissioning is subject to the installation of the oxygen plant. The project has an estimated completion date of December 2025.

Imp. Phase	Sites	Solar Capacity (kWp)	Battery Capacity (kWh)	Status	Solar Cap. Exp. (kWp)	Expansion Status	Scope ⁵
2	Tombi CHC	13.2	20	Commissioned			DE
2	Khalimat Shahed Hospital	6.6	10	Commissioned			DE - field visit
3	Connaught Hospital	759.9	1225	Ongoing			DE
3	King Harman Road Hospital	94.4	190	Ongoing			DE
3	Rokupa Hospital	94.4	292	Ongoing			DE
3	Lakka Government Hospital	99.7	190	Ongoing			DE - field visit
3	Port Loko Hospital	181.7	394	Ongoing			DE - field visit
3	Makeni Hospital	247.8	496	Ongoing			DE - field visit
3	Magburaka Hospital	189.0	350	Ongoing			DE
3	Koidu Government Hospital	667.7	860	Not started			DE
3	Moyamba Government Hospital	235.4	262	Ongoing			DE - field visit
3	Kenema Hospital	190.0	204	Ongoing			DE
3	Pujehun Hospital	165.2	634	Ongoing			DE

4. Key Findings and Analysis

This section presents an evidence-based analysis of the SL-HEP based on field visits, stakeholder interviews, and monitoring data. It assesses the project's relevance, sustainability, and opportunities for scaling or replication, with a view to informing future programmatic phases and sectoral expansion.

4.1. Relevance and Coherence

Assessment:

- **The SL-HEP was clearly aligned with the Government of Sierra Leone's strategic objectives around health system strengthening, energy access, and rural infrastructure development.**
- **Cross-ministerial coordination with the Ministry of Energy was more limited, and site selection prioritised geographic equity and catchment population over needs-based or off-grid criteria.**

The SL-HEP was clearly aligned with the Government of Sierra Leone's strategic objectives around health system strengthening, energy access, and rural infrastructure development. At the design level, SEforALL worked closely with MoH to identify healthcare facilities for electrification, emphasising geographic equity and regional representation. The approach sought to address urgent maternal and neonatal health needs while ensuring coverage across the country. While this lens reflected government priorities and helped provide political and geographic balance, SEforALL staff interviews indicated that the process was not guided by a formal, published framework using consistent metrics, such as energy access status, facility ownership, or criticality of service. As such, some facility choices, such as the inclusion of a private, grid-connected facility in Phase 2, prompted reflection among stakeholders on how equity, need, and infrastructure readiness were balanced during the selection process.

These limitations must also be viewed in the context of SL-HEP's unusually accelerated delivery timeline. The entire programme, from design to multi-phase implementation, was executed far more quickly than is typical for infrastructure projects of this scale. Under such time constraints, the decision to prioritise geographic representation over more granular metrics was a pragmatic trade-off to avoid delays. Nonetheless, future phases or replicable models with longer lead times could benefit from a more transparent, criteria-based site selection methodology.

The project's implementation further reinforced its relevance. As observed during field visits and noted in interviews with hospital staff, electrification significantly improved care in operating theatres, maternity wards, and special care baby units. Several facilities reported an increase in patient confidence and service utilisation, with one hospital administrator recalling that patients *"used to avoid staying overnight because the hospital was dark,"* whereas now, *"they are more willing to remain under observation."*

Within SEforALL's scope, deliberate efforts were also made to link the programme with national planning structures. The establishment of the Health Facility Electrification Working Group in 2023, involving MoH and development partners, created a space for ongoing policy dialogue. Separately, SEforALL's support to the Electricity and Water Regulatory Commission (EWRC) on tariff regulation for mini-grids, funded under the same UK Government umbrella, complements SL-HEP by addressing regulatory gaps that affect the long-term sustainability of health sector electrification.

While coordination with MoH was a notable strength, collaboration with the Ministry of Energy (MoE) was more limited, narrowing the project's potential for alignment with national energy planning. As acknowledged in SEforALL staff interviews, this was a missed opportunity that may limit the integration of technical standards, sector oversight, and long-term ownership. Staff expressed that the project would have benefited from earlier involvement of MoE, particularly in defining O&M roles and aligning with broader rural energy strategies. Nonetheless, MoE did participate in coordination structures, including chairing the weekly solar electrification committee, and shared a focal point with the World Bank's schools and hospitals electrification project, indicating some level of ongoing engagement. Future replication and scale-up efforts would benefit from more formalised and sustained cross-ministerial mechanisms to strengthen coherence across public infrastructure electrification programmes.

4.2. Scalability and Replicability

Assessment: High potential for scale, but institutional readiness and sustainability remain limiting factors.

Stakeholders consistently identified the SL-HEP as a scalable and adaptable model, particularly in the case of Peripheral Health Units (PHUs). In these settings, standardised solar photovoltaic (PV) packages have proven to be technically appropriate and operationally effective, offering a blueprint for replication in similarly-sized and structured facilities across Sierra Leone and potentially in comparable contexts. The success of these installations, validated through site visits and staff interviews, was attributed to their relatively low complexity, strong community acceptance, and compatibility with available local maintenance support.

Moreover, the programme's modular approach, use of pre-developed designs, and centralised procurement strategy helped streamline implementation. Notably, the use of FIDIC procurement and contract templates during Phase 3 (recognised and well-understood by bidders) further improved process efficiency and supported smoother implementation. These design and delivery features make the SL-HEP model particularly well suited to scale-up in other public service sectors, including education and WASH (water, sanitation, and hygiene), where electrification gaps remain acute. In interviews, SEforALL staff and health officials pointed to growing demand from other ministries for similar interventions, noting the project's visibility and demonstrable health service impacts as strong enablers of cross-sectoral interest.

By contrast, scaling the SL-HEP model to larger secondary and tertiary hospitals, as targeted in Phase 3, requires more customised design, stakeholder coordination, and sustained technical support. These sites demand tailored energy solutions, integration with multiple power sources, robust maintenance frameworks, and must also contend with space limitations that constrain PV system size, particularly in urban environments. The groundwork laid by SL-HEP does, however, provide a strong platform for future success. Detailed energy audits conducted during Phase 3, for example, offer replicable methodologies that can inform future sizing and infrastructure planning. The use of pre-qualified engineering, procurement, and construction (EPC) contractors and independent project management firms has also established a procurement and delivery model that can be adapted for future phases. One limitation noted by project staff is the use of AlphaESS centralised power conversion units (50 kW, 100 kW, or 500 kW), which restrict the maximum capacity of inverters, PV arrays, and batteries that can be installed. For future implementation, more modular and expandable system designs are recommended to improve scalability and system flexibility.

To enable successful replication, future initiatives could build on several concrete practices piloted in SL-HEP: early engagement with hospital leadership and technical staff; incorporation of buffer capacity to accommodate growing energy needs; and use of standardised yet adaptable design templates. Strengthening local O&M ecosystems, through training, certification, and partnerships with national institutions, will further support long-term viability.

As sector coordination improves through platforms like the Health Facility Electrification Working Group and regulatory engagement with the EWRC, the institutional foundations for scale-up are becoming stronger. With these elements in place, the SL-HEP model offers a credible, tested pathway for expanding sustainable electrification to additional public facilities in Sierra Leone and potentially across similar low-resource settings.

4.3. Innovation and Technology

Assessment: Notable process and design innovations accelerated delivery, however, system monitoring and data utilisation remain underdeveloped.

The SL-HEP introduced a number of delivery innovations that enabled rapid and adaptive implementation. Notably, the use of standardised EPC tender templates and pre-engineered system designs for smaller facilities allowed SEforALL to complete Phase 2 and 3 procurements in an unusually short timeframe. Staff highlighted that these innovations, combined with strong internal prioritisation and legal-procurement coordination, enabled contracts for 11 large hospitals in Phase 3 to be finalised within months. For PHUs, modular PV-battery packages were deployed with minimal customisation, improving installation efficiency and simplifying future replication.

At the technical level, newly installed solar systems were designed with embedded AlphaESS RMS. Additional RMS were installed in the facilities prior to the solar system intervention to measure

existing system performance. The figure below details the scope, the reliability, and the specific indicators each sensor is tracking.

Sensor	System Scope	Specific Indicators	Data Reliability
Alpha ESS	SEforALL solar PV installations	Daily solar generation, daily load, battery SoC, PV system uptime, number of outages (inferred).	High
nLine	Room-level quality of electricity service	Daily duration of outages, Daily frequency of outages, Average length of outages, Voltage, Frequency, Time outside nominal voltage range.	High ⁷
Prospect	Electricity generation by source	Electricity generation from gensets, solar PV systems, and the grid (where applicable).	Low

Figure 2. Summary of RMS deployed at Phase 1 hospitals

Field visits revealed however that in many facilities, real-time data monitoring was often not functional due to weak mobile network connectivity. Desk analysis of RMS data from Phase 1 hospitals conducted during the Impact Assessment revealed suboptimal sensor configurations and significant RMS data gaps for Prospect sensors, with less than half of them being operational at any given moment. Current system configuration permits data retrieval only from sensors that are online during the download process. Consequently, data from offline sensors is inaccessible, leading to gaps in the dataset. Moreover, Phase 1 analysis of Prospect data revealed that when data is missing for a particular sensor, it is impossible to ascertain whether this is due to the genset being offline or simply not generating electricity. As a result, the programme has not yet been able to fully leverage system performance data for operations oversight, troubleshooting, or adaptive management. Hospital staff in several locations were unaware of how to access system-level diagnostics, and in some sites, the data loggers had never been connected to the internet.

SEforALL staff noted the importance of developing more sustainable operations and maintenance models for future phases or replication efforts. One proposed approach is to bundle multiple sites under a single long-term maintenance contract, supported by public financing and potentially complemented by private sector involvement. While this model has not yet been piloted under SL-HEP, SEforALL’s parallel work with the EWRC on mini-grid tariff regulation could help lay the groundwork for such innovations. These types of delivery models may offer a pathway to reduce

⁷ While nLine sensors provide reliable data, their system-level calculation methodology introduces complexities that may portray indicators as worse than they are in reality.

donor dependence and improve long-term system performance through performance-based incentives.

4.4. Sustainability and Maintenance

Assessment: Progress on interim O&M arrangements; however, long-term ownership model still evolving.

Temporary O&M contracts were embedded in EPC agreements only for Phase 1, covering basic troubleshooting and periodic servicing through to March 2025. However, there is no finalised institutional model or financing framework for long-term O&M.

SEforALL is working with the UK Government and MoH to design a national-level solution. Options under consideration include fixed-term performance-based contracts, cost-sharing with government budgets, or centralised service provision through a new rural electrification agency. Staff stressed the importance of clearly assigning institutional responsibility, whether to MoH, MoE, or a dedicated agency, and ensuring that technicians are available at the facility level to support sustainability.

4.5. Value-for-money (VfM) Assessment

Assessment: Implementation was rapid and resource-efficient, however lack of detailed cost data limits VfM conclusions.

SEforALL's procurement process benefited from the UK Government's flexible fixed-amount funding model, which enabled rapid adjustments to scope and budget without triggering lengthy donor approvals. Legal and procurement advisors helped streamline tenders and ensure compliance with international standards. The use of standardised templates, including FIDIC-based procurement and contracts in Phase 3, further supported transparency and bidder confidence.

While the project demonstrated strong economy and efficiency, core elements of the UK Government's VfM framework, particularly 'effectiveness' and 'cost-effectiveness', are difficult to assess without more granular expenditure data. No comprehensive financial model or cost breakdowns were available at the time of this review. While diesel generator usage has declined in most hospitals, and solar systems are reducing operational downtime, there is insufficient expenditure data to quantify cost savings or calculate unit costs across sites. SEforALL staff noted the time savings were invaluable given urgent health facility needs, but emphasised the need for improved financial monitoring in future phases. To better align with the VfM framework, future programming should incorporate systematic tracking of capital and operational expenditures, unit installation costs (e.g. \$/kW installed), and cost savings (e.g. diesel and maintenance reduction per site). Disaggregating costs by site and system type (e.g. off-grid vs. grid-tied, hospitals vs. clinics) would further enable comparative analysis of value-for-money.

More detailed measures to strengthen VfM assessment, including the development of standardised financial monitoring tools, site-level expenditure tracking templates, and integrated dashboards to link cost and performance data, are outlined in Section 6: Recommendations.

4.6. Social and Gender Inclusion

Assessment: Strong gender and community engagement, with additional co-benefits extending beyond healthcare.

The SL-HEP incorporated deliberate gender inclusion elements, including the recruitment and training of women as STEM interns during the implementation of Phases 1 and 2. Hospital staff interviews also indicated improved working conditions for female healthcare workers, who can now safely provide services at night in well-lit facilities. Healthcare staff and community members also reported increased trust in public hospitals due to reliable electricity, with visible benefits in maternity services, neonatal care, and night-time safety. Field visits confirmed that patients are more willing to remain overnight and that facilities are less reliant on referral systems.

In addition to these core health impacts, the programme has produced several unanticipated social benefits at the community level. In some areas, children now use the light from solar-powered health centres to study at night, indirectly contributing to educational outcomes. As one community member in Moriba Town noted, “The children in the neighbourhood sit by the hospital in the evening and at night to do their homework and to study.” In Mamosasanka, local residents organised themselves to repaint the facility after electrification, reflecting an increase in community ownership and pride. These examples suggest that reliable electricity in public health infrastructure can serve as a broader catalyst for social cohesion and local empowerment, particularly in underserved areas.

4.7. Climate Co-benefits

Assessment: Clear reductions in diesel use and emissions.

The transition from diesel generators to solar PV systems under SL-HEP has clear implications for climate co-benefits. Modelling conducted during the Phase 1 Impact Assessment estimated that the installed systems could reduce approximately 72 metric tonnes of CO₂ annually, primarily through avoided diesel consumption. Field visits and staff interviews during this evaluation confirmed that many hospitals now use gensets only as a backup, typically during extended cloudy periods or in the rainy season, while most PHUs operate entirely on solar power year-round.

These patterns suggest ongoing reductions in both greenhouse gas emissions and local air and noise pollution. SL-HEP’s current monitoring framework does not, however, include real-time tracking of diesel displacement or formal Greenhouse Gas (GHG) accounting. This is consistent with the DE’s focus on output-level performance rather than impact-level quantification. This does represent a missed opportunity to credibly capture and communicate the programme’s climate

mitigation co-benefit, especially in a context where electrification is directly displacing diesel use in critical public services.

In the absence of automated tracking systems, several practical modalities could still be employed. Site visits, which occurred regularly throughout implementation, can be leveraged to collect retrospective estimates of diesel consumption before and after solar installation, either through fuel logbooks, generator runtime data, or structured interviews with facility managers. However, field visits revealed that maintenance officers rarely maintain fuel logs, and finance departments often combine fuel costs across multiple uses (e.g., gensets, ambulances, and staff vehicles), making attribution difficult. Future projects should implement a protocol requiring technicians to record the exact fuel amount at each refill. Even partial data from a sample of facilities could support indicative estimates of litres of diesel displaced, which, when combined with standard emissions factors (e.g., IPCC default values), would enable approximate GHG emissions reductions to be calculated. These estimates could also inform broader reporting on co-benefits and potentially support access to results-based climate finance in future phases.

Incorporating simple, low-cost tools for fuel-use tracking, such as monthly reporting templates or integration into maintenance logs, could further strengthen future monitoring frameworks without imposing an excessive burden.

4.8. Overall Programme Design

Assessment: The programme demonstrated an adaptive and responsive design, supported by strong internal learning. Future iterations would, however, benefit from more deliberate planning for demand growth.

As SL-HEP continues to evolve and potentially inform similar efforts in other sectors, such as education or WASH, future programmes would benefit from more deliberate integration of design-phase planning tools without losing the delivery agility that enabled SL-HEP's success.

A critical area is the early identification and engagement of key stakeholders during site assessments and energy audits. Experience from implementation shows that some important actors, such as facility-based partners like Partners in Health (PIH), who support diesel supply or infrastructure upgrades, were not fully consulted early on, despite their direct influence on energy usage and future demand. Overlooking these stakeholders may limit alignment on technical specifications and create missed opportunities for coordination.

In addition, hospital leadership and facility managers should be meaningfully involved in design decisions, including energy system sizing, load prioritisation, and operational responsibilities. Some Phase 3 hospital administrators and maintenance officers expressed uncertainty about what services the solar system would cover exactly or about the autonomy of the solar system, leading to potentially misaligned expectations regarding system reliability and capacity, which could affect operational planning and satisfaction post-installation. The administration in one hospital reported

that he was not contacted by the EPC company prior to installation, although the company denied this claim. This underscores the need for better documentation and clarity in stakeholder engagement processes throughout project implementation.

Additionally, while energy audits informed the initial site designs, there remains no standardised process for forecasting future energy demand based on population growth, service expansion, or medical equipment acquisition. Embedding scalable demand forecasting models, co-developed with health authorities and other development partners, such as Partners in Health (PIH), would allow future solar PV systems to accommodate anticipated increases in load and reduce the risk of underperformance.

SL-HEP's design has a significant shortcoming regarding the MEL framework: rather than being developed up-front and in-house, it was built in parallel during project execution by an external firm. This approach led to persistent challenges throughout the project due to the limited capacity of the external MEL providers. For future frameworks, priority should be given to in-house development. If outsourcing is necessary, the Head of MEL must be involved from the outset, participating in both the design of the TOR and the selection process. The modular approach used for smaller PV systems effectively streamlined implementation across PHUs. To account for future energy demand growth, SL-HEP should extend this principle of technical modularity and scalability to larger, customised PV systems in hospitals. Technical designs must be forward-looking and adaptable, capable of expansion and integration of additional capacity as healthcare service delivery scales, new medical equipment is introduced, and energy demands increase. Simultaneously, challenges such as space limitation for PV expansions should be considered and accounted for when assessing modularity. This will help future-proof investments and avoid costly retrofits.

The programme's adaptive sequencing across phases allowed for important midstream corrections, such as incorporating staff quarters into system designs and improving sizing methodologies. These iterative gains could now be captured in formalised technical guidelines and site selection criteria for future implementation. Similarly, while procurement was executed swiftly, replicating this speed under new institutional arrangements (e.g. SEforALL's transition under UNOPS) will require proactive planning and advocacy for contracting flexibilities.

Finally, to maximise both long-term sustainability and cross-sectoral impact, SL-HEP's legacy should include continued contributions to national-level frameworks, whether through support to the proposed rural energy agency, alignment with EWRC's regulatory work, or development of standard operating models for solar O&M in public institutions. Scaling what works will require embedding the "learning-by-doing" ethos of SL-HEP within more structured systems and policies, enabling sustained gains in public service delivery powered by clean energy.

5. Field Visit and Stakeholder Interview Findings and Takeaways

This section summarises direct observations from field visits to hospitals and PHUs as well as stakeholder interviews with institutional partners and SEforALL staff.

Site visits were conducted across 18 health facilities under the SL-HEP, covering:

- Phase 1: 6 hospitals; PV systems commissioned
- Phase 2: 8 Peripheral Health Units (PHUs); PV systems commissioned
- Phase 3: 4 hospitals; PV systems commissioning ongoing

Facilities were selected to reflect a diversity of geographic locations, system sizes, and implementation stages, offering valuable insights into system performance, sustainability, and community-level impact.

The evaluation also draws on interviews with representatives from the Ministry of Health (MoH), Ministry of Energy (MoE), the Electricity and Water Regulatory Commission (EWRC), EM-ONE, and SEforALL. These discussions provided critical perspectives on the implementation, institutional coordination, sustainability, and scalability of the SL-HEP.

Each thematic area in this evaluation was assessed based on evidence gathered through field visits, stakeholder interviews, monitoring data, and document reviews. Assessments reflect both observed performance and systemic readiness, considering implementation to date as well as risks to long-term sustainability and impact.

A traffic light system was used to summarise findings:

- **Green – Positive:** Strong outcome or performance with minimal concerns. Systems or processes are functioning well or show high potential for sustainability and replication.
- **Yellow – Moderate Concern:** Notable progress, but with gaps, risks, or inconsistencies that could undermine long-term success if unaddressed.
- **Red – High Concern:** Significant weaknesses or barriers that threaten the effectiveness, sustainability, or equity of the intervention, requiring urgent attention.

This approach allows for a quick visual reference while maintaining nuance through accompanying narrative analysis.

5.1. Phase 1 hospitals - Key learnings from field visits⁸

The primary focus of these visits was on the Impact Assessment, specifically evaluating the outcomes of electrification interventions in terms of improved healthcare delivery, operational

⁸ This DE incorporates several findings, quotes, and thematic takeaways that were originally gathered during field visits and interviews conducted as part of the Phase 1 IA. These include data and insights from all six hospitals commissioned under Phase 1. While the IA focused primarily on measuring outcome-level results, the DE reinterprets selected findings through a forward-looking lens to inform sustainability, scale-

efficiency, increased reliability and availability of services and expansion of operational machinery, community perception of safety, reliability, and increase in health-seeking behaviours, and energy reliability. While the findings from these visits were primarily gathered for the Impact Assessment, they also offer valuable insights for this Developmental Evaluation.

A selection of relevant findings is summarised below; however, this list is not exhaustive and does not capture the full range of observations from Phase 1 hospital visits. For a more comprehensive context and analysis, please refer to the Impact Assessment report.

At the time of the visits, all PV systems had been commissioned and operational for approximately one year. Following the initial commissioning, the solar generation capacity of several systems was subsequently expanded to better meet facility demands. By the time of the field visits, expansion works had been completed in four hospitals, with commissioning ongoing at PCMH/ODCH. Figure 3 shows an overview of the status and capacity of solar systems in Phase 1 facilities.

Figure 3. Overview of visited health facilities under Phase 1

Sites	Solar Capacity (kWp)	Battery Capacity (kWh)	Status	Solar Cap ⁹ . Exp ¹⁰ . (kWp)	Expansion Status
Bonthe Hospital	70.4	217	Commissioned	26.5	Commissioned
PCMH & ODCH	300.8	547	Commissioned	120 150 + 290 kWh battery	Ongoing ¹¹ Ongoing ¹²
Masanga Hospital	105.6	290	Commissioned	52.8	Commissioned
Kabala Hospital	90.8	290	Commissioned	49.5	Commissioned
Kambia Hospital	59.4	217	Commissioned	35.2	Commissioned

5.1.1. Use of medical equipment and reporting

Takeaway: The installation of solar systems has significantly improved the functionality and utilisation of existing medical equipment, particularly in critical units. However, healthcare staff consistently report shortages of medical equipment and challenges in acquiring new equipment, limiting the full potential of the improved electricity supply.

Assessment:

up, and cross-sector replication. Where relevant, DE sections clearly reference Phase 1 learnings while introducing new analysis from subsequent stakeholder engagements and expanded fieldwork under Phases 2 and 3. A more comprehensive analysis of Phase 1 facilities, including monitoring data and KPI trends, can be found in the full Impact Assessment report.

⁹ Capacity

¹⁰ Expansion

¹¹ Commissioning expected by March 31st, 2025

¹² Expansion to supply an oxygen plant. Commissioning is subject to the installation of the plant with estimated completion date of December 2025.

● **Moderate Concern (YELLOW)** – While improved electricity has significantly enhanced medical equipment use and reporting, the shortage of essential medical devices and limited access to new equipment constrain the full potential impact on healthcare service delivery and patient outcomes.

5.1.2. Healthcare service availability

Takeaway: The solarisation of hospitals has significantly enhanced healthcare services, leading to better emergency response, better maternal and neonatal care, safer surgical conditions, and better patient diagnosis. However, critical challenges remain, including insufficient oxygen supply, lack of medical equipment, and limited solar system capacity, which restricts the full impact potential.

Assessment:

● **Positive (GREEN)** – The solarisation of hospitals has significantly improved healthcare service delivery, ensuring more reliable emergency response, safer surgical conditions, and better patient monitoring. Power stability has led to improved maternal and neonatal care, enhanced laboratory capabilities, and expanded vaccine storage capacity.

5.1.3. Electricity uptime

Takeaway: Field observations and hospital staff interviews indicate consistent power availability in critical units, but seasonal variations (e.g., rainy-season challenges) and storage capacity affect uptime.

Overall improvement in electricity reliability:

- Fieldwork findings confirm that all hospitals now have stable and reliable electricity throughout the day, particularly in critical units such as operating rooms, neonatal care, and emergency wards.
- Findings indicate reduced reliance on gensets, leading to fewer outages and lower operating costs. While solarisation has played a key role in this improvement, other factors have also contributed. For instance, at ODCH and PCMH, improved grid reliability has significantly impacted overall electricity service uptime, further reducing dependence on backup gensets.
- RMS findings show that solar systems are operational an average of 23 hours/day in off-grid hospitals.

Reported challenges in ensuring system uptime:

- **Seasonality:** All hospitals report more frequent and longer outages during the rainy season.
- **Storage capacity:** Hospitals in Phase 1 Impact Assessment reported insufficient storage capacity to ensure 24-hour uptime, and most hospitals preventively use diesel gensets in the evening to postpone usage of solar batteries until later at night.

- **Rationing power:** Hospitals have to manage electricity demand by dividing loads into critical and non-critical, ensuring priority power supply to essential medical services. To maintain electricity uptime, non-critical loads are switched off after sunset, optimising battery storage.

Assessment:

● **Moderate Concern (YELLOW)** – While field reports confirm improved electricity reliability, analysis of RMS data reveals that the hospitals are just shy of achieving 24 hours of electricity uptime in all buildings and throughout the year. Annually, diesel generators supply about 9% of total uptime, with most genset use occurring in the evening because battery backups in some facilities can't sustain overnight loads. Usage is also seasonal with genset dependence dropping significantly during the dry season.

5.1.4. Quality of electricity service

Takeaway: The solarisation of hospitals has improved the quality and stability of electricity, ensuring that voltage remains within the acceptable range across all facilities. This has led to more reliable operation of medical equipment and reduced risks of damage due to power fluctuations. However, further optimisations can be carried out to ensure that solar inverters always stabilise voltage fluctuations.

Qualitative feedback from maintenance officer interviews at hospitals confirms that the quality of electricity has significantly improved after the installation of the PV systems:

"Before solarisation, there were instances whereby we would have power, but the voltage would be so low that we couldn't use a lot of our equipment. There were several instances when the power would come back [after a power outage], but voltage fluctuations would spoil equipment. Wall sockets would stop working, so we couldn't administer oxygen to and monitor our patients. The situation today is much better." – Dr. Sahr Gborie, Resident Paediatrician, ODCH

However, further optimisations are possible. For instance, at ODCH and PCMH, the grid is frequently used in bypass mode, meaning electricity does not pass through the solar inverter. As a result, voltage fluctuations from the grid persist, whereas routing power through the inverter could help regulate and stabilise voltage levels, improving overall power quality.

Assessment:

● **Positive (GREEN)** – Strong improvement in voltage stability, leading to better equipment reliability and reduced risks of power-related malfunctions.

5.1.5. Reliance on gensets & grid

Takeaway: Although hospitals have significantly reduced their reliance on gensets following the installation of solar PV systems, they still depend on both gensets and

the national grid (where available) to maintain a consistent electricity supply. Genset usage varies depending on solar system capacity, seasonal fluctuations in solar generation, and financial constraints.

Feedback from maintenance staff indicates that reliance on gensets has decreased overall, improving system resilience and reducing the burden of fuel procurement. However, the extent of genset usage depends on hospital type, seasonal factors, and financial resources.

- Off-grid hospitals (Kabala, Masanga, Bonthe, and Kambia):
 - With the exception of Kabala, off-grid hospitals didn't use gensets during the first 4 months post-solarisation. Later, as the rainy season approached, gensets were used in the evenings to prevent early depletion of battery storage systems, ensuring sufficient power availability overnight for critical loads. Even so, genset use, in terms of uptime, has decreased by about 46% at these hospitals.
 - It is important to note that total electricity consumption at these hospitals more than doubled post-solarisation, so the use of gensets is no longer a necessity, but a means of complementing an already robust and reliable electricity supply.
- On-grid hospitals (ODCH and PCMH):
 - Grid usage: The national grid remains the primary power source, with solar serving as a backup.
 - Genset usage: Gensets are activated when the grid is down for extended periods (typically over four to five hours) and when solar battery storage is depleted.

Key factors influencing genset reliance:

- **Budget availability:** At PCMH, diesel consumption actually increased post-solarisation (2024) compared to pre-solarisation (2023). This was due to better availability of funds—50% of the forecasted fuel budget was received in 2024, compared to just 25% in 2023, as reported by the hospital's accountant.
- **Seasonal variations:** Hospitals like Bonthe report no change in genset usage (relative to the baseline) during the rainy season, as battery charging is less efficient due to reduced solar input. However, pre-solarisation, overall electricity uptime was much lower, and dependence on a single genset presented a significant risk.
- **Solar system battery capacity:** All hospitals report that gensets are still being used because solar battery capacity is not sufficient to ensure 24-hour electricity uptime.

"The maintenance team used to work tirelessly to fix the genset, but sometimes we couldn't repair it in time, and patients would not survive. Now, I'm grateful that we no longer face those issues" – Francis J. Lahai, Maintenance Officer at Bonthe Hospital

Assessment:

● **Moderate Concern (YELLOW)** – While solarisation has reduced genset reliance and improved electricity uptime, continued use of gensets presents cost and sustainability challenges and an opportunity to increase PV and battery capacity.

5.1.6. Routine maintenance protocols

Takeaway: Hospital staff effectively carry out routine maintenance tasks, but a weak maintenance culture poses a risk to long-term system performance.

Assessment:

● **Moderate Concern (YELLOW)** – While hospitals are performing routine maintenance, gaps in broader infrastructure management indicate a risk to the long-term functionality of solar systems.

5.1.7. Feedback on O&M service provider

Takeaway: EM-ONE's responsive O&M support is praised for its timely and professional resolution, but further digitalisation of O&M services could improve transparency for all stakeholders and contribute to long-term sustainability.

Assessment:

● **Positive (GREEN)** – Reliable and timely O&M services contribute to system uptime and functionality, but a lack of structured tracking mechanisms and a broader lack of an O&M strategy may hinder long-term planning and accountability.

5.1.8. Hospital Energy Management & Energy Efficiency

Takeaway: While hospitals reported improved reliability in electricity supply, inefficient energy use, particularly overnight overconsumption, has affected system performance in some hospitals.

Assessment:

● **Moderate Concern (YELLOW)** – Positive impact on energy reliability, but lack of structured energy use guidelines poses risks to long-term efficiency.

5.1.9. Long-term O&M strategy

Takeaway: Uncertainty over long-term O&M responsibilities and funding poses a major risk to the project's sustainability.

Assessment:

● **High Concern (RED)** – The lack of a long-term O&M strategy presents a major risk to the project's sustainability, impact, and effectiveness.

5.1.10. Spare part provision of essential components

Takeaway: The limited provision of spare parts for essential components, such as light bulbs, tubes, and fans, poses a risk to system functionality and hospital operations.

Assessment: ● **Moderate Concern (YELLOW)** – The lack of a robust spare parts provision system presents a medium-level risk to the reliability and longevity of the installed systems. While some basic components like bulbs and tubes were included in limited quantities, their replenishment process remains unclear to facility staff, leading to delays and avoidable outages. The absence of spare fans in the original scope further exacerbates the risk, particularly given their intensive daily use in hospital wards. Although there is a plan to address spare part provision at the end of the project, this should be done much earlier in the procurement process to prevent service disruptions. Future procurement should require a clear spare parts strategy from EPC contractors, including specification of components that can be sourced locally and those that need to be imported.

5.1.11. Commissioning training & capacity of maintenance staff

Takeaway: EM-ONE's hands-on commissioning training was highly valued for its practical approach, enabling maintenance officers to better understand system functionality and troubleshooting. However, skill gaps among maintenance staff, particularly in certain hospitals, pose a risk to long-term system sustainability.

Assessment:

● **Positive (GREEN)** – Strong training outcomes, but technical capacity gaps and lack of structured refresher training require attention to ensure long-term sustainability.

5.1.12. Training of STEM trainees

Takeaway: The Women in STEM training successfully equipped participants with technical skills and professional networking opportunities, empowering them to enter the renewable energy sector. However, strengthening post-training employment pathways is crucial to retain female talent, sustain engagement in the field, and maximise long-term impact.

Assessment:

● **Positive (GREEN)** – The Women in STEM training successfully provided technical skills, confidence, and networking opportunities for female trainees, equipping them for careers in the renewable energy sector. The project has empowered participants, with some pursuing further education or securing internships in the field. However, a lack of structured career pathways and job placement support poses a risk, as some trainees struggle to find employment in the sector.

5.1.13. Battery storage capacity

Takeaway: While solar systems adequately meet energy demands during the day, battery storage capacity remains insufficient to sustain hospital operations throughout the night. As a result, hospitals must rely on diesel gensets in the evening and strict energy rationing to prevent

early battery depletion. Hospitals report insufficient storage capacity to ensure 24-hour uptime, and most hospitals preventively use diesel gensets in the evening to postpone usage of solar batteries until later at night.

Assessment:

● **High Concern (RED)** – Battery capacity constraints have been identified as a challenge in all six Phase 1 hospitals, limiting the effectiveness and sustainability of solar electrification efforts. It is recommended to increase battery storage capacity and improving automated switching between PV and alternative electricity sources (gensets and grid) to optimise existing storage capacity.

5.1.14. Security lighting for ground-mounted PV plants

Takeaway: Insufficient lighting around ground-mounted PV plants increases their vulnerability to theft, vandalism, and unauthorised access.

Assessment:

● **Moderate Concern (YELLOW)** – The lack of adequate security lighting around ground-mounted PV installations poses a tangible risk to the safety and integrity of the solar infrastructure. These systems are often placed in isolated areas within hospital compounds, making them vulnerable to tampering or theft, particularly during the night. While no major incidents were reported during field visits, the risk remains present and could compromise system reliability if left unaddressed.

5.1.15. Standardised containerised powerhouse

Takeaway: Inconsistent storage conditions for battery and inverter systems pose risks to equipment integrity and system reliability.

Assessment:

● **Moderate Concern (YELLOW)** – Variability in storage conditions poses a risk to system integrity and sustainability. While some hospitals (e.g., ODCH/PCMH, Masanga) benefit from standardised EPC-supplied containers, others (e.g., Kabala) rely on existing infrastructure with limited safeguards. These sites face risks such as inadequate security (e.g., weak doors, exposed roofs) and poor environmental conditions (e.g., roof leaks, dust, insufficient ventilation), increasing the likelihood of theft, equipment degradation, and system failures. Standardising storage solutions can impact consistent system performance and protection.

5.1.16. Healthcare staff's motivation to work at hospitals

Takeaway: Improved electricity access in hospitals has significantly enhanced staff motivation, creating a better working and living environment for healthcare professionals. Reliable power enables a better work-life balance, increased job satisfaction, and improved efficiency, making hospitals more attractive workplaces.

Assessment:

● **Positive (GREEN)** – The availability of reliable electricity has been a major driver of improved staff morale, engagement, and retention in hospitals. Staff now perceive their workplace as safer, more functional, and better suited for delivering quality care. This shift has transformed perceptions of remote or previously under-resourced facilities, making them more attractive postings. The increased motivation of maintenance personnel and healthcare workers alike translates into better service continuity, reduced absenteeism, and improved performance across departments.

5.1.17. Living conditions of healthcare staff

Takeaway: Improved electricity access has enhanced safety, comfort, and overall living conditions for healthcare workers, leading to higher motivation and job satisfaction. However, inconsistencies in power availability across staff quarters present challenges.

Assessment:

● **Moderate Concern (YELLOW)** – While access to reliable electricity has positively influenced the living conditions of healthcare staff in many hospitals, important gaps remain. In several facilities, only selected staff quarters (e.g., for medical officers or midwives) benefit from 24/7 electricity, while others are left without power. This uneven access has implications for staff satisfaction, retention, and equity. In facilities where staff quarters remain unelectrified, healthcare workers feel less safe at night and face challenges in carrying out their duties during off-hours. It should be noted that plans are in place to expand the solar PV systems to meet this important load.

5.1.18. Safety in the hospital

Takeaway: Hospital staff perceive the facility as significantly safer than before due to improved night-time lighting, which has enhanced security, reduced risks of attacks and theft, and created a safer working environment for night-shift staff. However, outdoor lighting remains insufficient in some areas, particularly along pathways between staff quarters and hospital buildings, leaving staff vulnerable when walking at night.

Assessment:

● **Positive (GREEN)** – Strong improvement in staff safety and security, though outdoor lighting gaps require further attention.

5.1.19. Job creation & Improvement

Takeaway: While the installation of solar systems did not generate significant new full-time employment opportunities, it greatly improved working conditions for existing hospital staff by ensuring a more stable and efficient work environment.

Assessment:

● **Positive (GREEN)** – Although job creation was not significant, staff in all hospitals report significant improvement in working conditions.

5.1.20. Patient and community perceptions

Insights from patient and staff interviews on how electrification has impacted healthcare quality, trust, and hospital utilisation.

Takeaway 1: Electrification has helped improve medical services.

“The quality of care we provide to patients now has improved significantly compared to before. Before the solar installation, we had a very hard time providing quality care, because there is only so much you can do without electricity. Sometimes, we would take the patients to the Special Care Baby Unit (SCBU) for them to be treated there because the SCBU had constant light. It was difficult back then; we had to get very creative to provide care for our patients.” – Healthcare staff focus group discussion at Kabala Government Hospital

Takeaway 2: Communities have more trust in the hospitals thanks to improved electrification.

“The community has been very happy since the installation of the solar system. Because of this intervention, they have made several radio programs on the district radio stations praising the hospital. In the past, they used to refer to the hospital as a cemetery because of how dark it used to be. Patients didn’t want to spend the night here, they didn’t want to be admitted here, but now they say it’s an actual hospital. The community is very satisfied, the relatives are able to stay with their patients who are admitted here longer now.” – Healthcare staff focus group discussion at Kabala Government Hospital

Takeaway 3: More patients visit and stay in the facility because there is light at night.

“Since the solar was installed, this place gets full. Patients even sit on the property just waiting to be attended. Now they can wait until night-time because there is electricity. In the past, this place didn’t get full, and right before it started getting dark, patients would start leaving.” – Ma Patience

● **Positive (GREEN)** – The qualitative evidence from focus groups and interviews consistently indicates that electrification has had a transformative effect on community trust, healthcare utilisation, and patient experience.

5.2. Phase 2 PHUs – Key learnings from field visits

Site visits to Phase 2 facilities included a diverse mix of Community Health Centres (CHCs), Community Health Posts (CHPs), and Maternal and Child Health Units (MCHUs), spread across various geographic regions. All systems visited had been commissioned and operational for several months at the time of the visits, providing a solid basis to assess early performance and user experiences.

The systems installed under Phase 2 featured standardised PV configurations of 6.6 kWp or 13.2 kWp, each paired with appropriately sized battery storage. Figure 4 details an overview of the commissioned facilities under Phase 2.

Figure 4. Overview of visited health facilities under Phase 2

Sites	Solar Capacity (kWp)	Battery Capacity (kWh)	Status
Jenner Wright CHC	13.2	20	Commissioned
Cline Town CHC	13.2	20	Commissioned
Makali CHC	13.2	20	Commissioned
Mamosasanka CHC	6.6	10	Commissioned
Moriba Town CHP	6.6	10	Commissioned
Bonthe Under Five MCHP	6.6	10	Commissioned
York Peripheral Village CHC	6.6	10	Commissioned
Khalimat Shahed Hospital	6.6	10	Commissioned

5.2.1. Electricity uptime

Takeaway: Field observations and staff interviews indicate consistent power availability in all PHUs. All PHUs reported 24 hours availability of uninterrupted electricity.

Assessment:

● **Positive (GREEN)** – PHUs have sufficient installed PV system capacity to ensure 24 hours of electricity supply throughout the year.

5.2.2. Use of medical equipment

Takeaway: While solar electrification has improved healthcare service delivery, a persistent lack of medical equipment at PHUs continues to limit the full potential of the intervention.

Interviews across PHUs revealed a widespread lack of electricity-dependent medical equipment. Several facilities reported that they had no functional clinical devices at all. In multiple cases, staff mentioned that equipment such as oxygen concentrators or baby warmers had been donated in the past, but were later removed and transferred to other facilities due to the absence of power at the time, or remained damaged or unused due to a lack of training or spare parts. One facility reported that staff did not know how to operate the baby warmer, which had become non-functional.

Where equipment was present, it was often not suited to the level of care the facility was expected to provide. In one facility, an oxygen concentrator was broken, and in another, staff were still using a charcoal-based autoclave, despite requesting an electric model. No facility reported receiving new clinical equipment since electrification, though many expressed hope that the improved energy supply would make them eligible for future investments. Requests for blood

pressure machines, diagnostic devices, neonatal resuscitation kits, foetal monitors, electric autoclaves, oxygen concentrators, and baby warmers were common, but most facilities reported no clear communication from district medical officers (DMOs) about when or whether these would be delivered.

The lack of equipment not only limits service delivery but also contributes to continued patient referrals, particularly for maternal and neonatal complications that could otherwise be managed locally. It also contributes to frustration among healthcare workers, who feel unable to deliver on the potential offered by 24/7 electricity access.

With regard to energy-efficient equipment, most facilities received only the basic LED bulbs and fans that came with the solar installations. No other efficient devices, such as LED surgical lights or energy-saving diagnostic tools, were introduced.

- **Impact on healthcare delivery:** The unavailability of critical medical equipment significantly hinders the quality of care, particularly in maternal and neonatal health. Facilities with reliable power but without functional medical devices still struggle to provide lifesaving interventions, leading to continued referrals to distant hospitals.
- **Underutilization of solar capacity:** Many facilities operate below their full potential due to the lack of compatible equipment. The solar infrastructure is capable of supporting more advanced medical services, but the absence of necessary appliances prevents full utilisation.
- **Overutilisation in select facilities:** While not observed during field visits, SEforALL staff noted that in some locations (e.g., Kent CHP), staff were connecting non-medical appliances to PV systems as the only available power source in the area. This highlights the need for clear O&M protocols and usage guidelines to ensure systems are used optimally for healthcare delivery.
- **Healthcare worker frustration and adaptation:** Staff have adapted by continuing to work within their resource limitations, but many have expressed frustration over their inability to maximise patient care despite having stable electricity.

Assessment:

● **High Concern (RED)** – Critical barrier to achieving intended health outcomes. While solar electrification has successfully provided reliable energy across PHUs, the absence of essential medical equipment—including oxygen concentrators, neonatal devices, and sterilisation tools—severely limits the intervention’s impact.

5.2.3. Patient and community perception

Takeaway 1: Electrification benefits communities in other ways besides improved healthcare access, for example, allowing kids to study at night.

“At night, there is electricity, which wasn’t the case before. In this neighbourhood, only the facility has electricity. So, at night we are lucky because we live nearby and can benefit from this light.”

The children in the neighbourhood sit by the hospital in the evening and at night to do their homework and to study.” – Fati, community member at Moriba Town CHP

Takeaway 2: Some communities take better care of facilities and actively contribute to their maintenance.

“After the solar system was installed, the community was so happy that they got organised to buy paint and paint the building” - Nurse at Mamosasanka CHC

Takeaway 3: Lack of medical equipment is still a challenge, especially in CHCs.

Although PHCs now have a reliable and constant electricity supply, the lack of medical equipment and trained personnel to use the equipment remains a challenge.

“The facility is better equipped to handle a lot of the needs of the community, but not all of them. For example, if a woman delivers a pre-term baby, we have to refer them to ODCH/PCMH [Hospitals], which are really far away. If we had the equipment and staff, we could do all of that here because the catchment population of this facility is very big.” – Focus Group at York Peripheral Village CHC

Assessment:

● **Moderate Concern (YELLOW)** – Positive community response but limited by service delivery constraints. Electrification at PHUs has generated meaningful community-level benefits that extend beyond healthcare, including educational co-benefits and stronger community ownership. However, these positive outcomes are tempered by systemic gaps in health service capacity, particularly persistent equipment shortages.

5.2.4. Operation & Maintenance

Takeaway: While EM-ONE has maintained strong communication and rapid response for O&M support, the lack of on-site technical capacity, structured training, and basic spare parts at PHUs poses serious challenges to the long-term sustainability of the systems.

EM-ONE, the EPC contractor responsible for O&M, has been praised by PHU staff for its responsive service and clear communication. Each PHU has a dedicated WhatsApp group with EM-ONE, which facilitates fast responses to maintenance requests. Staff consistently reported that the company is quick to respond when issues are raised.

However, the lack of dedicated technical staff at PHUs presents a critical challenge for long-term system sustainability. Most PHUs are staffed by healthcare workers with little to no technical training, and staff rotation further compounds this issue. For instance, at Makali CHC, none of the current staff were present during the system’s installation, resulting in limited knowledge of its operation and maintenance.

There are no training manuals or user guides available at most PHUs, leaving staff without clear instructions on basic troubleshooting or preventive care. Unlike hospitals, routine maintenance is rarely performed by PHU staff. A few facilities, such as Cline Town CHC and Mamosasanka CHC, reported cleaning PV panels regularly, but this was self-initiated and done without formal guidance or appropriate tools. SEforALL team confirms training manuals and user guides will be provided before the end of the project. In future projects, this should ideally be provided earlier, during the commissioning of the PV systems.

Additionally, a shortage of basic spare parts, such as light bulbs and fans, was noted. EM-ONE did not supply extra components but instructed staff to contact them when replacements are needed. In several cases, minor equipment failures had already occurred. For example, at Newton CHC, the fan and light bulb in the maternity ward were no longer functioning.

In Cline Town CHC, an urban, grid-connected facility with 13.2 kWp capacity, one of the solar PV systems consistently fails when an AC is connected, leaving the facility with only 6.6 kWp. Although EM-ONE has dispatched technicians multiple times and staff praised their response speed, the issue remained unresolved since the system's commissioning.

Assessment:

● **Moderate Concern (YELLOW)** – EM-ONE provides responsive support and maintains open communication, but the lack of trained on-site personnel, manuals, and spare parts jeopardises the long-term functionality of PV systems at PHUs.

5.2.5. Training on solar system use and maintenance

Takeaway: Training on solar system operation and maintenance has been inconsistent and often insufficient across PHUs. While a few facilities received basic orientation, most lack formally trained staff, and in many cases, those originally trained have been reassigned. The absence of technical staff at the PHU level makes it particularly challenging to deliver and retain solar-related knowledge.

Only a handful of facilities, such as Khalimat Shahad hospital, confirmed that a maintenance technician had received some training, though even there, the scope was limited. In Makali CHC, all current staff had been transferred after the installation and were unfamiliar with the system, while York Peripheral Village CHC and Mamosasanka CHC claimed that they had not received any training at all. In Moriba Town CHP, a community health service (CHS) assistant supported the installation but was not formally trained. Newton CHC staff were unsure whether any training had taken place.

These findings reflect a broader challenge: PHUs typically do not have dedicated technical or maintenance personnel, which makes it difficult to offer and sustain technical training. Even where training occurs, staff rotation and lack of training manuals or system user guides undermine knowledge retention. As a result, many staff members are unable to troubleshoot basic issues.

To mitigate this, future projects should incorporate simplified training formats suitable for non-technical health workers, provide visual guides or manuals, and build in follow-up support mechanisms. This should be part of a broader O&M scheme that should be designed at the project inception.

Assessment:

● **Moderate Concern (YELLOW)** – The lack of consistent, structured training poses a risk to long-term system functionality and sustainability. In most facilities, either no training occurred or knowledge has been lost due to staff turnover and the absence of technically qualified personnel. Addressing this gap will require tailored, easy-to-understand training for non-technical staff, as well as refresher sessions and better documentation. In the future, the training requirements should be specified by SEforALL during EPC contractor procurement, The EPC contractor should be responsible for conducting trainings during solar PV system commissioning.

5.2.6. Healthcare staff working conditions

Takeaway: Reliable electricity has transformed the working environment for healthcare staff by improving lighting, ventilation, and overall safety, especially during night shifts. This has enabled more efficient service delivery and contributed to improved staff morale and performance.

Before solar electrification, healthcare workers reported having to use mobile phone torches during night deliveries, creating unsafe and inefficient working conditions. Since the installation of the solar PV systems, staff now benefit from well-lit wards and fans that improve thermal comfort, particularly in maternity units. Staff at York Peripheral Village and Newton CHCs highlighted how lighting enables them to attend emergencies at any hour, and fans help reduce the physical strain of attending to patients in hot conditions. However, limitations persist: in some facilities, fans and lighting were only installed in administrative rooms, leaving critical service areas under-equipped. Maximising the benefits of electrification will require more consistent deployment of essential electrical infrastructure across all clinical zones.

Assessment:

● **Positive (GREEN)** – Across all facilities, access to reliable electricity has greatly improved staff working conditions, especially during night shifts. Healthcare workers now feel safer and more confident performing deliveries and attending emergencies after dark, which was previously hindered by the lack of lighting. Fans have also made working environments more comfortable, particularly in maternity wards. However, staff still report limited or poorly distributed equipment.

5.2.7. Staff quarters and healthcare workers' living conditions

Takeaway: The impact of solar electrification on staff living conditions has been uneven. While some healthcare workers benefit from improved safety and comfort in electrified quarters, many staff quarters remain unelectrified or lack basic amenities, undermining morale and retention.

For example, in Newton CHC, staff quarters for community health officers and midwives are connected to the solar system, contributing to a greater sense of safety and availability for emergency night-time care. In York Peripheral Village CHC, staff receive lighting from a different solar system installed in 2024, further supporting service delivery and retention. In Mamossanka CHC and Newton CHC there are staff quarters, but they don't have any electricity access.

Assessment:

● **Moderate Concern (YELLOW)** – While the solar installations have improved living conditions in some staff quarters, there are notable inconsistencies across facilities, with many staff quarters either not electrified or inadequately served. This creates disparities in comfort and perceived security, potentially undermining staff morale and retention.

5.3. Phase 3 hospitals – Key learnings from field visits

All Phase 3 facilities visited were in the process of PV solar system installation. The visits focused on assessing readiness for implementation, stakeholder collaboration, and scalability. Interviews explored how these facilities were preparing for electrification, the anticipated benefits, and any potential barriers to successful implementation. Interviews also explored perceptions from facility leadership and staff regarding the programme's design and potential for long-term sustainability. Figure 5 details an overview of the health facilities visited under Phase 3.

Figure 5. Overview of visited health facilities under Phase 3

Sites	Solar Capacity (kWp)	Battery Capacity (kWh)	Status (at time of field visit)	Date of visit
Lakka Government Hospital	99.7	190	Ongoing - groundwork for installation of PV panels ongoing;	Jan 27th, 2025
Port Loko Hospital	181.7	394	Ongoing – groundwork for installation of PV panels ongoing; electrical installation retrofitting ongoing	Jan 25th, 2025
Makeni Hospital	247.8	496	Ongoing – PV panels onsite; roofs ready for installation; electrical installation retrofitting ongoing	Jan 23rd, 2025
Moyamba Government Hospital	235.4	262	Ongoing – improving roof condition for installation; electrical installation retrofitting ongoing	Jan 25th, 2025

5.3.1. Readiness of maintenance staff

Takeaway: In all visited hospitals with dedicated maintenance officers, the EPC contractor actively engaged these teams throughout the solar PV system planning and preparation phases, strengthening local ownership and technical familiarity. However, the absence of dedicated

maintenance team at one site raised concerns about long-term system maintenance and loss of institutional knowledge.

They praised EM-ONE's inclusive approach, which engaged them from the initial energy needs assessments through to site preparation activities such as groundworks, electrical retrofitting, and roof reinforcement where required. Maintenance staff also expressed enthusiasm about participating in the installation process itself, noting that this hands-on experience has helped them better understand the PV systems and will likely enhance their ability to perform routine maintenance and troubleshooting in the future.

However, one hospital (Lakka) currently lacks a maintenance officer formally assigned by the MoH. Instead, facility maintenance—including oversight of the solar PV system—is managed by Partners in Health (PIH), who have designated a staff member for this role. While this arrangement provides short-term support, it could pose a significant risk to the long-term functionality and sustainability of the system should PIH's involvement end. The absence of a dedicated, government-assigned technician during the installation phase also limits opportunities for knowledge transfer and system familiarisation, which are critical for effective ongoing maintenance. Without designated personnel to be part of the system installation and oversee system operation, routine maintenance and troubleshooting could be neglected, leading to system degradation over time. The MoH should prioritise the deployment of qualified technical personnel to such facilities prior to commissioning.

Assessment:

● **Positive (GREEN)** – Maintenance officers and their teams were actively engaged throughout the planning and installation process in most Phase 3 hospitals, reflecting strong collaboration and ownership. Their hands-on involvement is likely to enhance long-term system performance. The absence of a dedicated maintenance officer at Lakka remains a concern, underscoring the need for MoH to ensure qualified technical staff are deployed at all facilities prior to commissioning.

5.3.2. Hospital management engagement

Takeaway: At 3 out of 4 of the Phase 3 hospitals visited, Medical Superintendents (MSs) reported being actively engaged by EM-ONE from the outset, including participation in the energy needs assessment. They also expressed a clear understanding of the PV system's capabilities and what the solar installation is expected to power.

However, at Port Loko Government Hospital, while the Maintenance Officer confirmed active involvement during site preparation and needs assessment, the MS reported limited engagement and stated they had not interacted directly with the EM-ONE team. In contrast, EM-ONE staff indicated that the MS had been kept informed and had even introduced key personnel to the survey team. This discrepancy suggests a communication gap or misalignment in stakeholder

expectations, underscoring the need for better documentation and clarity in stakeholder engagement processes throughout project implementation.

Communication on system capabilities: MSs and maintenance officers generally demonstrated a solid understanding of the overall capabilities of the planned PV systems. EM-ONE communicated that the systems would support most of the hospital's operations and that the autonomy would mostly depend on usage behaviour, which helped set broad expectations. Some hospital administrators and maintenance officers expressed uncertainty about what services the solar system would cover or about the autonomy of the solar system, leading to potentially misaligned expectations regarding system reliability and capacity, which could affect operational planning and satisfaction post-installation.

Assessment:

● **Moderate Concern (YELLOW)** – While most hospital management teams were engaged and had a good understanding of system capabilities, inconsistencies in stakeholder engagement were observed, particularly at Port Loko Government Hospital. In that case, a communication gap between EM-ONE and the Medical Superintendent (MS) created misaligned expectations. The MS reported limited involvement despite EM-ONE staff claiming the MS had been informed and introduced to the survey team. This highlights the need for clearer, documented communication during project rollout. Clearer protocols are needed to ensure expectations around system performance, coverage, and autonomy are aligned and verified.

5.3.3. Assessing future demand

Takeaway: While the SL-HEP effectively tailored system sizing to meet immediate energy needs through detailed assessments, the absence of a structured approach to forecast future demand risks undermining long-term system adequacy.

A comprehensive assessment of current hospital energy needs was carried out using a combination of data loggers, interviews, and an inventory of existing equipment, with clear roles and safeguards in place to ensure robustness. Crown Agents, the initial Project Management firm, led the assessments. EM-ONE during their visits. validated these findings during their site visits, while Tetra Tech and CEMMATS provided final approval before EM-ONE proceeded with procurement. This approach helped tailor solar PV system specifications to immediate hospital requirements.

However, there is currently no systematic process in place to assess or plan for future energy demand at the hospital level. Forecasting energy needs is inherently complex, as it requires input from multiple stakeholders and coordination across departments. Hospital management often anticipates receiving new medical equipment, such as larger autoclaves, oxygen plants, cold storage for blood banks, and diagnostic machines, but are rarely certain about what will be delivered or when. Much of this equipment is donated by external partners, and such contributions are typically not planned or tracked by the MoH. Without mechanisms to incorporate projected

demand growth into system design, there is a significant risk that installed solar PV systems may become undersized sooner than expected, leading to system strain, increased reliance on gensets, or costly retrofits. Demand growth should also be proactively integrated into the O&M strategy. This includes not only routine maintenance but also planning for system scalability, such as modular PV expansions, potential genset upgrades, or future grid integration where feasible. An effective O&M framework should enable facilities to respond flexibly to evolving energy needs, guided by clear protocols for system upgrades, equipment additions, and infrastructure modifications.

Assessment:

● **Moderate Concern (YELLOW)** – While current energy needs were thoroughly assessed, there is no systematic process to forecast future demand. This poses a risk of system undersizing as facilities expand or receive new equipment. Integrating demand growth planning into system design and O&M strategies is essential to ensure long-term system adequacy and avoid reliance on gensets or costly upgrades.

5.4. Key learnings from stakeholder interviews

The stakeholder interviews with the MoH, MoE, EWRC, EM-ONE, and SEforALL Staff reveal several critical insights regarding the implementation, sustainability, and scalability of the SL-HEP as well as the operational, strategic, and policy-level dimensions of the SL-HEP. These interviews illuminated the challenges and innovations driving the scale-up and implementation of Phases 2 and 3. It is, however, important to note that a greater number of representatives were interviewed from the MoE than from the MoH, the project's primary institutional stakeholder. Despite multiple outreach attempts, the DE team was unable to interview the designated point of contact (PoC) at the MoH, which may have limited the completeness of health sector-specific insights. It is also of note that, given time constraints, only four SEforALL staff members were interviewed.

The findings summarised below reflect the perspectives of those interviewed and highlight recurring themes across discussions. While informative, they should not be considered fully comprehensive and may omit important viewpoints, particularly those of the MoH PoC. Nonetheless, the interviews offer critical takeaways that help illuminate key opportunities and challenges for the SL-HEP moving forward.

5.4.1. Design Evolution and Adaptive Delivery

Takeaway: The SL-HEP's phased implementation model showcased a strong commitment to adaptive learning. Through iterative improvements in design, procurement, and project management, the programme was able to scale quickly while responding to on-the-ground realities. This flexibility not only ensured continued progress under challenging conditions but also positioned the model for successful replication in other sectors and countries.

The design of the SL-HEP has evolved substantially across its three phases, reflecting an intentional learning-by-doing approach. Phase 1 served as a testing ground for key assumptions about hospital energy demand, installation feasibility, and coordination with health authorities. One of the clear lessons from that phase was the underestimation of power needs due to slightly outdated energy audits and expansion of hospital facilities between assessment and installation. This prompted SEforALL and its partners to update their sizing methodologies for Phase 3, incorporating newer data, built-in buffer capacity, and design provisions for anticipated expansion, particularly for staff quarters, which were not initially electrified.

Another major adjustment was the streamlining of procurement. With tight timelines and increased scope, SEforALL moved quickly to standardise tender documents and clarify technical specifications. A team member described it as “*writing the playbook while running the game,*” highlighting the pressure to deliver against fixed deadlines while simultaneously refining internal systems. Procurement for Phase 3, which included 11 large hospitals, was completed within months, a pace rarely achieved in infrastructure projects of this scale. This was possible in part due to increased internal prioritisation at SEforALL, flexible donor arrangements, and support from legal and technical advisors.

The project also demonstrated adaptability in its contracting and implementation arrangements. For instance, when a previous project management firm exited unexpectedly, SEforALL rapidly onboarded new contractors and adjusted work plans without significant disruption. Similarly, in Phase 2, field teams responded to real-time implementation challenges, such as changes in site conditions or ownership disputes, by modifying designs and adjusting delivery plans as needed. As one staff member noted, “*nothing went exactly as planned, but we always found a way to keep the project moving forward.*”

These adaptive management practices, paired with strategic use of existing designs and early preparation, enabled SL-HEP to accelerate delivery without compromising system quality. The approach has laid the groundwork for potential replication in other sectors or geographies, particularly where speed and scale are critical and implementation environments are similarly complex.

Assessment:

● **Positive (GREEN)** – The SL-HEP demonstrated strong adaptive capacity, with each phase building on lessons learned to improve system design, sizing, and delivery. Rapid procurement, flexible contracting, and responsive problem-solving allowed the project to stay on track despite tight timelines. This agile, learning-by-doing approach provides a solid foundation for replication in similarly complex contexts.

5.4.2. Long-Term Sustainability: Institutional, Technical, and Financial Considerations

Takeaway: The long-term sustainability of SL-HEP solar PV systems remains a critical risk. While short-term maintenance is covered, the absence of a clear institutional lead, sustainable financing, technical capacity, and real-time monitoring systems jeopardises future performance. A structured O&M framework must be urgently established to avoid system degradation post-donor support.

A consistent concern raised in interviews with SEforALL staff was the long-term sustainability of the solar systems, particularly once donor funding ends in March 2025. While temporary operations and maintenance (O&M) coverage has been included in EPC (Engineering, Procurement, and Construction) contracts for Phase 1, a structured national approach is still under development. SEforALL has been working directly with the UK Government and the Ministry of Health to design a sustainable O&M model across all public health solar installations.

Multiple models are currently under consideration, including fixed-term maintenance contracts, pay-for-performance arrangements, and government-supported budget allocations. As one SEforALL team member noted, “We’re trying to define a model that won’t rely indefinitely on donor support—it needs to be something the government can eventually take over, even if gradually.” The challenge, however, remains the lack of dedicated public financing for energy system maintenance and uncertainty around which institution—the Ministry of Health, the Ministry of Energy, or a proposed centralised rural electrification agency—will ultimately lead long-term implementation.

In parallel, SEforALL is supporting the Electricity and Water Regulatory Commission (EWRC) to develop a national tariff framework for mini-grids, including those servicing the health sector. Though separate from SL-HEP, this work reflects recognition that financial sustainability also depends on coherent regulation and cost-recovery mechanisms. According to one team member, these regulatory reforms could help inform new models for public-private maintenance partnerships or structured cost-sharing systems in the future.

At a systems level, staff interviews also reinforced several persistent operational gaps that must be addressed to support any sustainable O&M strategy. While the Ministry of Health is broadly expected to assume oversight, there is no formalised framework for doing so, and roles remain unclear. There is also a pressing need for a centralised monitoring platform to track the real-time performance of installed solar systems across hospitals. The lack of such a system makes it difficult to detect failures, plan preventive maintenance, or benchmark outcomes. Moreover, without allocated government funding for O&M, hospitals face a significant risk of system degradation once donor support lapses.

These financial and institutional constraints are compounded by a shortage of technical capacity within both the Ministry of Health and the Ministry of Energy. Staff emphasised the need for

structured, ongoing training for government technicians and hospital-based maintenance personnel. As one team member observed, “These aren’t plug-and-play systems—hospitals need trained staff to monitor performance, troubleshoot issues, and know who to call. Right now, that’s still too dependent on a handful of people.” Until a more formal national system is in place, the programme relies heavily on SEforALL’s in-country field presence and its network of implementing partners.

Assessment:

● **High Concern (RED)** – Despite ongoing efforts to develop a national O&M strategy, long-term sustainability is at risk due to unclear institutional ownership, lack of financing, limited technical capacity, and the absence of a centralised monitoring system. Without concrete commitments and structures in place, system performance and reliability may deteriorate once SEforALL’s support ends.

5.4.3. Procurement and Implementation efficiency and challenges

Takeaway: Procurement under SL-HEP Phase 3 was executed with speed, structure, and adaptability; thanks to standardised templates, flexible donor funding, and strong internal legal and technical support. While coordination with the Ministry of Energy could have been stronger, the process overall demonstrated how agile procurement can accelerate delivery in complex infrastructure programmes.

Phase 2 of SL-HEP was delivered through an extension of EM-ONE’s original contract from Phase 1, enabling a seamless transition and rapid scale-up using already validated tools and procedures. In contrast, Phase 3 was launched through a new tender process, drawing on lessons learned to further streamline implementation. SEforALL leveraged standardised tender templates, including adaptations of FIDIC¹³-based contract structures, to streamline procurement, promote fair risk allocation, and ensure legal and technical consistency. The fixed-amount funding agreement with the UK Government was widely viewed as a key enabler, providing SEforALL with significant flexibility to adjust scope and timelines without waiting for lengthy donor approvals. This flexibility proved particularly critical when unforeseen issues emerged, such as the need to reassign project management functions or adapt technical specifications in response to site-level constraints.

SEforALL’s internal legal and procurement advisors played a critical role in facilitating the rapid rollout. As one team member put it, “*We had to finalise procurement for Phase 3 in a matter of months—not years—and that was only possible because we had the right systems in place and the freedom to move fast.*” Coordination with external legal consultants also helped include procurement packages that were legally sound, technically robust, and aligned with international standards, earning positive feedback from multiple bidders during the tendering process.

¹³ Fédération Internationale Des Ingénieurs-Conseils, or International Federation of Consulting Engineers.

Looking ahead, one team member noted that SEforALL's transition to operating under UNOPS may affect the level of agility seen in earlier phases of the project. As they remarked, " *This project was unique because it had just the right mix of urgency, internal prioritisation, and contracting flexibility—but under UNOPS, we may not have that same ability to fast-track decisions or adapt contracts quickly.*" With more formalised and centralised procurement and HR protocols under UNOPS, SEforALL may encounter longer lead times, less flexibility in certain operational processes, and higher transaction costs, which could influence the pace of implementation in future large-scale infrastructure programmes.

While SEforALL's internal project management was widely praised by interviewees as a key success factor, particularly in responding to shifting implementation realities, the Ministry of Energy (MoE) raised concerns about coordination gaps during the procurement process. Specifically, the MoE mentioned they were not involved in equipment procurement or the development of technical specifications, leading to questions about long-term standardisation and the establishment of nationally consistent benchmarks. MoE stakeholders also noted they would have expected earlier and more active involvement, both to support alignment across public sector electrification programmes and to help institutionalise procurement standards for future projects.

Assessment:

● **Positive (GREEN)** – Procurement under Phase 3 was impressively fast, well-structured, and adaptive. SEforALL's use of standardised templates, legal support, and flexibility enabled fast, compliant contracting even under tight timelines. This efficiency was widely praised by stakeholders and contributed to timely implementation. While some feedback suggested opportunities for deeper coordination with MoE, the overall process set a strong precedent for future infrastructure programmes.

5.4.4. Site selection process & criteria

Takeaway: While SEforALL's nationwide roadmap study clearly outlined the process for identifying healthcare facilities for solar electrification, the specific HFE selection criteria remain unclear, particularly for PHUs.

The selection of health facilities under SL-HEP was informed by SEforALL's nationwide roadmap study, *Powering Social Infrastructure in Sierra Leone: Market Assessment and Roadmap for Health Facilities (2023)*. This assessment mapped health facilities across the country, identifying energy access gaps and prioritising electrification needs based on facility type, service level, and population coverage. Site selection was then carried out by the MoH and verified by the Project Manager, Crown Agents. According to MoH, site selection prioritised geographic representation to ensure equitable distribution of electrified facilities across the country. While this approach may help mitigate social and political tensions, it does not necessarily align with an objective, needs-based assessment. Other potential selection criteria, such as urban vs. rural location, on-

grid vs. off-grid or the presence of pre-existing PV systems, were not clearly defined or consistently applied.

Private vs. public facilities

For instance, in Phase 2, Khalimat Shahad hospital, a private facility in an on-grid area, was included in the program, raising concerns about whether the selection process prioritised facilities with the greatest need. The ownership of the facilities was not a criterion according to SEforALL team, and private facilities had no reason to be excluded. At the same time, the project could benefit from greater impact and transparency if criterion is clearly defined and a reasoning for including each facility proposed by the MoH is included in the project documentation.

Facilities with existing PV systems

Some selected facilities had already received solar PV systems through other partners:

- York CHC was equipped with a 3.5 kWp standalone PV system in June 2024, installed by Felicity Solar. While it's possible that Crown Agents verified the facility prior to this installation and found no power access, another donor may have intervened between the verification and commissioning of the SL-HEP system.
- Makali CHC already had an older PV system with 24 kWh battery capacity (PV generation capacity unclear). Under SL-HEP, a new system was installed, and the previous one was repurposed to supply staff quarters only.

In both cases, the new SL-HEP systems were not redundant. At York CHC, the original system frequently ran out of power, especially during the rainy season. At Makali CHC, the existing system offered only a few hours of power autonomy during daylight. However, these cases raise questions about opportunity cost—whether other facilities with no existing electricity access at all might have derived greater benefit from solar PV installation.

Off-grid vs. on-grid facilities

Among the eight Phase 2 facilities visited, two were grid-connected: Khalimat Shahad hospital and Cline Town CHC. While grid-connected sites may still benefit from backup and stabilisation through solar PV systems, their inclusion suggests that grid status was not a consistently applied selection criterion, and the rationale for their prioritisation remains unclear.

However, it is important to recognise that developing a detailed, transparent selection methodology takes time, particularly in a context with limited national data and evolving programmatic priorities. In this case, the project team had to strike a balance between analytical rigour and speed of implementation. A highly technical and exhaustive selection model could have delayed deployment. Instead, the simpler approach adopted enabled rapid rollout of Phases 2

and 3, helping commission PV systems with minimal delay. While this may have come at the expense of clearly documented criteria, it supported faster action in a critical service sector.

Assessment:

● **Moderate Concern (YELLOW)** – While the roadmap study provided a solid foundation for site selection, the specific criteria applied, particularly for PHUs, remain unclear. Cases involving grid-connected, private, or already-electrified facilities raise valid questions about prioritisation. However, given the urgency and data limitations, the approach enabled fast deployment, even if at the expense of transparency and needs-based rigour. Clearer selection frameworks will be essential for future phases.

5.4.5. Sector Alignment and Strategic Value

Takeaway: SL-HEP has strengthened alignment between energy and health sector priorities in Sierra Leone, serving as a catalyst for improved institutional coordination and policy dialogue. While not yet linked to formal policy reform, it has laid important groundwork for national standardisation and future cross-sector replication.

The SL-HEP aligns with the Government of Sierra Leone’s broader objectives around health-systems strengthening, renewable energy access, and rural development. While no formal legislation or policy reform has yet been directly triggered by the project, SEforALL staff emphasised that SL-HEP has contributed to broader momentum on sector coordination and institutional awareness. The Solar Facility Electrification Working Group, established in 2023 and involving SEforALL, the Ministry of Energy, Health, Education, Mining, Agriculture, Water Resources, Public Private Partnerships Unit and other development partners, has emerged as a key platform for advancing dialogue on roles, responsibilities, and regulatory gaps in the electrification of public facilities.

In parallel, SEforALL is supporting the EWRC through a separate but related initiative focused on mini-grid tariff regulation. Though not directly tied to SL-HEP, this work is funded under the same UK Government programme and is seen as part of the wider enabling environment for sustainable public-sector electrification. Interviewees noted that regulatory clarity on tariffs, technical standards, and operator models will be critical for future scale-up and integration of health-sector electrification efforts into national systems.

The project’s implementation experience has also highlighted the absence of harmonised technical standards across electrification initiatives. For instance, discrepancies between system specifications in SL-HEP and those used in the World Bank’s Energy Access Project demonstrate the need for common national guidelines. SEforALL staff identified this as a key policy gap that SL-HEP indirectly brings to light.

Finally, there is strong recognition among SEforALL team members that while SL-HEP offers a viable model for replication in other public sectors such as education, public safety, water supply

and sanitation (WASH), scale-up will depend on resolving sustainability bottlenecks, particularly around long-term operations and maintenance, and availability of CAPEX and OPEX funding.

Assessment:

● **Positive (GREEN)** – SL-HEP is well aligned with national development priorities and has catalysed greater sector coordination through platforms like the Solar Facility Electrification Working Group. While no direct policy reforms have emerged yet, the project has contributed to momentum on regulatory and institutional frameworks. Its model shows strong potential for cross-sector replication, especially if sustainability challenges are addressed.

5.4.6. Government Ownership and Institutional Coordination

Takeaway: The strong involvement of the Ministry of Health was critical to the success of SL-HEP, enabling effective coordination and rapid implementation. While engagement with the Ministry of Energy was more limited, the emergence of inter-ministerial coordination platforms offers a promising path toward more integrated, sustainable governance for public facility electrification.

The Ministry of Health played an instrumental role in the successful implementation of SL-HEP, demonstrating strong ownership and leadership throughout. SEforALL actively engaged the MoH from the outset and worked closely with its technical teams to ensure alignment on key decisions—from site selection and contractor coordination to addressing implementation challenges. SEforALL’s collaborative approach, paired with the MoH’s commitment, enabled rapid troubleshooting and responsive project delivery. This collaboration was widely praised by stakeholders and is considered a strong example of how deep engagement with line ministries can accelerate impact and drive sustainable energy access in the health sector.

While the MoH was actively engaged and had a designated technical focal point who played a vital role throughout implementation, coordination with the Ministry of Energy was more limited. Several SEforALL interviewees reflected on this as a missed opportunity, noting that stronger institutional links between MoH and MoE remain important, not necessarily for technical implementation, given current capacity gaps at MoE, but for strategic alignment, planning, and eventual integration of health facility electrification into national energy systems. One staff member remarked, *"It's an energy project in a health facility, so the fact that the Ministry of Energy wasn't more involved is something we'd do differently next time."* Another noted that, *"We've had great collaboration from Health, but building a bridge to Energy is essential if we want real sustainability"*.

The emergence of an inter-ministerial energy access working group was cited as a positive development, and the proposal to establish a centralised rural energy agency was seen as a promising institutional solution. Such a body could help streamline donor engagement, oversee technical quality, and centralise long-term operations and maintenance planning for electrified public facilities across sectors.

Assessment:

● **Positive (GREEN)** – The Ministry of Health demonstrated strong ownership and played a central role in project implementation, contributing to rapid and effective delivery. While coordination with the Ministry of Energy was more limited, the establishment of an inter-ministerial working group and proposals for a rural energy agency show positive momentum toward stronger institutional alignment for long-term sustainability.

6. Recommendations

The Developmental Evaluation of the SL-HEP highlights a number of operational strengths, adaptive practices, and critical lessons for future implementation and scale-up. This section consolidates key learnings and provides evidence-based recommendations aimed at improving long-term sustainability, strengthening institutional ownership, and supporting potential replication in other sectors or geographies.

6.1. Leverage and document adaptive design for replication

Learning: The modular design, pre-developed engineering templates, and fast-tracked procurement process used in Phase 3 offer a replicable delivery model for other sectors, including education and water, sanitation, and hygiene (WASH). However, these adaptive practices were not always systematically documented.

Recommendation: Codify key adaptive delivery practices into internal guidance tools or playbooks for future projects. This includes pre-design templates, stakeholder engagement protocols, and procurement pacing strategies that proved effective under tight timelines.

6.2. Enhance facility-level operational integration

Learning: Phase 3 findings show strong collaboration during installation and commissioning, particularly with hospital maintenance teams. However, in a few facilities, there were gaps in internal alignment, such as differing understandings of system functionality or a lack of clarity on roles during installation.

Recommendation: Future phases should place greater emphasis on aligning roles and responsibilities across all key actors within each facility, including medical, technical, and administrative staff. Clear briefings, onboarding materials, and internal coordination protocols can ensure a shared understanding of system capabilities, improve coordination, and promote more effective day-to-day use and maintenance of the systems.

6.3. Training manuals and user guides

Learning: Some of the facilities that were visited did not provide the staff with training manuals or user guides for the newly installed solar PV systems.

Recommendation: Training manuals and user guides should be distributed to facility staff during the commissioning of the solar PV systems to ensure the workers fully understand the operation of the newly installed systems.

6.4. Build structured demand forecasting into project design

Learning: Energy audits and sizing methodologies evolved across phases, yet most installations did not incorporate systematic projections of future demand. Unanticipated



growth in energy needs, due to new equipment, infrastructure expansion, or higher patient load, risks outpacing current system capacity.

Recommendation: Develop and apply a scalable energy demand forecasting model to guide both initial system design and long-term O&M planning. While some level of demand growth should be anticipated and factored into design (e.g., through system modularity and structured consultations with hospital management, national health authorities, and development partners to forecast demand), a robust O&M framework should take the lead in accommodating dynamic, long-term changes, including those driven by service expansion, new technologies, or staff needs. This model should also account for the diverse sources of demand growth, including not only clinical services and medical equipment, but also non-clinical uses, such as staff appliances and community use in some facilities.

6.5. Formalise long-term O&M mechanisms

Learning: SEforALL made notable progress in extending O&M coverage during implementation, but sustainability remains uncertain beyond the donor funding window. Responsibility for long-term operations and maintenance is not yet anchored within a specific government entity or financing structure.

Recommendation: Finalise and institutionalise a national O&M framework, building on current work with MoH, MoE, the UK Government, and EWRC. Options may include bundled facility contracts, hybrid public-private models, and performance-based contracting, all linked to dedicated budget lines or donor support. Capacities must also be built within the government and private sector to manage and oversee such systems.

6.6. Enhance monitoring and community co-benefits

Learning: PV system monitoring remains inconsistent, limiting real-time performance management. At the same time, field visits revealed unanticipated social benefits, such as community children using hospital lighting to study and community-led maintenance activities.

Recommendation: Strengthen remote monitoring infrastructure and local reporting systems to support evidence-based decision-making. Consider tracking social co-benefits and promoting community-led stewardship activities as part of broader sustainability and accountability strategies.

6.7. Strengthen VfM Monitoring and Cost-Effectiveness Analysis

Learning: While implementation under SL-HEP was rapid, adaptive, and broadly resource-efficient, the absence of detailed cost data and financial modelling limited the evaluation's ability to assess cost-effectiveness across sites. Existing financial



documentation did not consistently track capital and operational expenditures by facility, nor were outcome-linked cost metrics available to assess performance relative to investment.

Recommendation: To establish a more systematic approach to value-for-money tracking, future projects should link financial inputs to tangible outcomes. This might include disaggregated tracking of capital expenditures (e.g., procurement, installation, commissioning), operational costs (e.g., O&M, spare parts, training), and site-level performance metrics such as uptime, patient throughput, or diesel offset. Developing standardised cost-efficiency indicators, such as \$/kWp installed, \$/ton CO₂ avoided, and \$/additional patient visit, will enable more robust VfM analysis and benchmarking across facility types (e.g., hospitals vs. PHUs, grid-tied vs. off-grid systems). Integrating these metrics into future project monitoring and reporting systems can also support adaptive resource allocation and inform scale-up decisions.

6.8. Expand Cross-Sector and Cross-Country Replication of the SL-HEP Model

Learning: The success of SL-HEP, particularly in PHUs, demonstrates the viability of standardised solar electrification in public infrastructure where reliable energy access is lacking. Community-level benefits, such as improved trust in services, increased facility utilisation, and even indirect educational gains, highlight the potential for broader development impact.

Recommendation: SEforALL and its partners should explore replicating the SL-HEP model in other essential public service sectors in Sierra Leone (e.g. education, WASH, and public safety) where similar gaps in energy access exist. Any replication effort should be underpinned by a comprehensive consolidation of lessons learned across the programme. This includes documenting adaptive system design, procurement processes, and stakeholder engagement strategies, with particular attention to the roles and coordination between key institutions such as the Ministry of Health, the Ministry of Energy, the Electricity and Water Regulatory Commission, and other development partners. Future iterations must also address critical cross-cutting issues identified during implementation, including energy efficiency, equipment compatibility, safety standards, staff capacity constraints, and the adequacy of training and technical support mechanisms. Furthermore, SEforALL should support the development of national frameworks that integrate energy planning into broader public service delivery strategies, ensuring long-term alignment and institutional ownership. Strengthening operational sustainability, through clearer O&M responsibilities, budgetary provisions, and regulatory oversight, will be essential. Replication should also be informed by peer learning and South–South collaboration with countries facing comparable electrification challenges, contributing to a growing global evidence base on sustainable, resilient energy solutions for public infrastructure.

7. Conclusion and Next Steps

As SL-HEP draws to a close, a key priority is identifying how its most effective elements can be replicated and adapted in future programmes. While the project demonstrated the feasibility of delivering solar electrification at scale in remote health settings, its implementation also surfaced important lessons on the need for contextual flexibility, cross-sector coordination, and design adaptability. The following Replication and Adaptation Framework distils which aspects of SL-HEP can be standardised across sectors and regions, and which require customisation based on site-level conditions, stakeholder dynamics, and infrastructure constraints. This framework is intended to inform future programme design, guide donor investments, and support government efforts to scale up sustainable energy access across public infrastructure in Sierra Leone and beyond.

7.1. Replication and Adaptation Framework

This section synthesises the key elements required to replicate and adapt the SL-HEP model to other countries and public service sectors. The components outlined below are drawn from the core findings and recommendations of the DE and should serve as a practical foundation for future implementation efforts.

While this framework highlights key areas for replication and contextual adaptation, it is not intended as an exhaustive account of all operational and strategic insights from the project. Rather, it offers a structured synthesis of relevant findings to support informed decision-making for future planning and implementation in similar low-resource settings.

7.1.1. Key Elements for Replication

The SL-HEP model has demonstrated considerable potential for replication in other low-resource settings, particularly for electrifying PHUs) and community health centres. Several design and delivery features offer a reliable blueprint for future implementation:

- ***Standardised, Modular System Design:*** Phase 2 successfully applied standardised solar PV systems for PHUs, balancing scale and simplicity for broad applicability.
- ***Centralised Procurement Using FIDIC Templates:*** The adoption of FIDIC-standard procurement and contracting documents in Phase 3 ensured transparency and familiarity among bidders, improving process efficiency and mitigating procurement delays.
- ***Management and EPC Oversight:*** The combined use of Engineering, Procurement and Construction (EPC) contractors with independent Project Management Consultants (PMC) ensured quality control, risk mitigation, and performance tracking.
- ***Engagement and Demand for Services:*** The visibility of the electrified facilities and their impact on service utilisation and staff motivation contributed to widespread community acceptance, a critical enabler for replication.



- **Adaptive, Phased Implementation:** SL-HEP applied a learning-by-doing approach across phases, with Phase 1 informing system improvements in later stages. Midstream adaptations—such as sizing corrections and improved staff quarter integration—highlighted the value of iterative programme delivery.
- **Monitoring, Evaluation, and Learning (MEL) Framework:** The MEL framework, while ultimately a valuable outcome of the SL-HEP, reflects one of the project’s key process-level challenges and learnings. Rather than being designed at inception, the framework was developed in parallel with implementation, largely by external partners. This approach, outsourcing MEL to actors without the same level of in-house expertise, resulted in persistent challenges, including delays in indicator finalization, limited integration with implementation workflows, and gaps in data consistency. While the final MEL framework has improved significantly and can be replicated, future initiatives should prioritize early, in-house development of MEL systems. If outsourcing is necessary, SEforALL’s internal MEL experts (particularly the Head of MEL) should be centrally involved in drafting terms of reference, selecting MEL providers, and overseeing framework design. This would ensure alignment with implementation needs and leverage institutional knowledge, while enabling real-time learning throughout the programme cycle. Replication of the SL-HEP model should therefore treat the MEL framework not only as a transferable asset, but as a lesson in the importance of ownership and early-stage design.

7.1.2. Elements Requiring Contextual Adaptation

While SL-HEP’s model is broadly replicable, several key aspects require customisation to ensure effective deployment across different facility types, geographies, and institutional ecosystems:

- **System Modularity and Expandability:** Although modular in concept, the AlphaESS central power conversion units (50kW, 100kW, 500kW) limit inverter, PV, and battery expansion. This constrains responsiveness to growing energy needs.
Adaptation Need: Future projects should prioritise truly modular, decentralised architectures that allow for scalable upgrades over time.
- **Spatial Constraints in Urban or Dense Facilities:** Limited roof or ground space in urban health facilities restricts PV installation capacity.
Adaptation Need: Early-stage assessments should integrate spatial feasibility analyses and explore vertical or hybrid solutions (e.g. solar canopies or battery-dominant systems).
- **Stakeholder Mapping During Site Assessments:** During implementation, coordination gaps with actors like Partners in Health (PIH), who were simultaneously renovating facilities or providing diesel, led to missed synergies.
Adaptation Need: Include comprehensive stakeholder identification and engagement during site selection, audits, and system design to align with ongoing infrastructure or energy supply interventions.

- **Facility-Level Planning and Forecasting:** While design templates worked well, they occasionally overlooked evolving operational plans at the facility level. Adaptation Need: Conduct structured consultations with hospital leadership and technical staff to capture both immediate and future energy needs, including use of electricity for residential, medical, and administrative purposes.
- **Ongoing Operations and Maintenance (O&M):** A major risk to long-term sustainability remains the absence of clear national O&M frameworks, disaggregated maintenance budgets, and sustained technical support. Need: Replication efforts must embed a comprehensive O&M strategy from the outset. This includes defining institutional roles (e.g., MoH vs. MoE), securing recurrent funding, developing standard O&M protocols, training in-country technicians, and introducing digital tools for maintenance tracking.
- **Grid Integration and Hybrid System Management (where applicable):** In partially electrified or urban grid-connected hospitals, hybrid system optimisation remains a challenge. Facilities such as PCMH and ODCH continue to rely heavily on the grid and gensets and underutilise PV systems. Need: Develop smart load management protocols and plan for hybrid operation scenarios where solar, grid, and diesel interact through automatic switchovers. Technical training and usage guidelines should reflect these hybrid contexts.

7.1.3. Opportunities for Cross-Sectoral and Regional Scaling

Beyond health, the core SL-HEP model, particularly its approach to small-scale public infrastructure electrification, could be adapted to other sectors such as **education, WASH (water, sanitation and hygiene), and public safety facilities**. Standardised solar packages, modular contracting, and bundled O&M models could be piloted in schools, police posts, or administrative centres with high public service needs.

In countries such as **Nigeria**, with more complex energy markets and stronger private sector engagement, the SL-HEP approach could be integrated with **existing mini-grid regulations**, layered with climate finance instruments, or bundled into larger rural electrification programs. Importantly, early engagement with local governments and regulatory bodies will be key to replicating SL-HEP's success.

The figure below highlights elements of the SL-HEP model that lend themselves to replication, as well as components that may require adaptation based on local context. It is intended to inform future efforts in scaling and tailoring the model across sectors and geographies.

Figure 6. SL-HEP Replication and Adaptation Framework

<i>Design Element</i>	Sierra Leone Approach	Adaptation Considerations for New Countries	Notes
<i>Site selection</i>	MoH-led, geographic equity focus	Add needs-based prioritisation (e.g., no backup power, high maternal mortality)	Include local health data review
<i>System design</i>	Standardised solar + battery packages	Match to national equipment availability and future load forecasts	Plan for equipment scale-up
<i>System design</i>	Mix of standardised power houses and using existing hospital infrastructure	Design all systems with standardised powerhouses.	
<i>System design</i>	Lack of security measures in some ground-mounted PV installations	Design ground-mounted PV installations with adequate lighting and security measures.	
<i>System design</i>	Staff quarters with limited access to electricity	Include staff quarters in system energy demand planning	
<i>Demand forecasting</i>	Limited forecasting; little integration into design	Build scalable demand forecasting into both design & O&M frameworks	Include future medical equipment, residential load, and population growth
<i>Institutional roles</i>	MoH-led, limited MoE involvement	Define clear roles across ministries, including MoE and regulators early	Use stakeholder mapping
<i>Procurement</i>	EPC + PM firm split; standard templates	Assess local procurement regulations and EPC capacity	Leverage SEforALL templates
<i>O&M arrangements</i>	Included in EPC; future model in development	Test hybrid public-private or agency-led models	Link with the energy regulator or the PPP unit
<i>Monitoring</i>	Data loggers, RMS (inconsistent access)	Upgrade to real-time dashboards where connectivity allows	Include telecom assessment

<i>Design Element</i>	Sierra Leone Approach	Adaptation Considerations for New Countries	Notes
<i>Hybrid system integration</i>	Limited in hybrid systems to change between grid, genset and solar	Plan for hybrid (solar-grid-genset) operation with automatic switch over	Develop protocols for load shifting and source prioritisation
<i>Capacity building</i>	Project-based, ad hoc training	Build national-level training programs into the project	Use local vocational institutions
<i>Training & Handover</i>	Limited documentation; training varies by site	Ensure systematic training and system handover at commissioning	Include manuals, fault logs, and refreshers
<i>Regulatory support</i>	Separate mini-grid tariff project	Integrate policy support into the electrification program	Combine energy + health sector planning
<i>Community benefits</i>	Lighting spillover, increased trust	Leverage for school study spaces, vaccine storage, etc.	Track co-benefits

Annexe I: List of stakeholders interviewed

Interviewee	Organisation	Position
Benjamin Kamara	Ministry of Energy	Chief Director of Energy
Cyril Grant	Ministry of Energy	Executive Technical Adviser
Dr. Caulker	Ministry of Energy	Head of Planning Unit
Dr. Jalikatu Mustapha	Ministry of Health	Deputy Minister 2
Nelson Fofana	Ministry of Health	Acting M&E Specialist for Health
Emmanuel Mannah	SL Electricity Water Reg. Commission	Director General
Marilena Lazopoulou	SEforALL	Current Project Manager – SL-HEP
Madhusagar Singh	SEforALL	Former Project Manager - SL-HEP
Ngozi Beckley-Lines	SEforALL	Country Manager
Luc Severi	SEforALL	Programme Manager
Mohammed Absar Sidi	EM-ONE	Project Manager
Sidi Sowa	CEMMATS	Manager of Engineering Services

Annexe II: Interview Guide – Phase 1 Health Facilities

1. General information		
#	Question	Answers options
1.1	Facility Name	<i>Free text</i>
1.2	Name & position of interviewee(s)	<i>Free text</i>
1.3	Date	<i>Date</i>
1.4	Date of solar system installation	<i>Date</i>

2. Operational efficiency / Energy KPIs			
#	Question	Evaluation dimension	Related KPI
Electricity Uptime			
2.1	Since the installation of the solar PV system, on average, how many hours per day is electricity available at this facility? How does this compare to the situation before the installation?	Effectiveness	Uptime of electricity services (Target: 23 hrs/day).
2.2	Have there been any significant changes in the frequency or duration of power outages?	Effectiveness	Average outage frequency and duration
2.3	When power outages occur, how often do they disrupt essential medical equipment usage?	Effectiveness	Impact on electricity-dependent medical devices.
2.4	Do outages occur more frequently during specific seasons or times of the year?	Effectiveness	Seasonal reliability trends and service readiness.
2.5	During prolonged grid outages (i.e. over 24 hours), does the solar PV system provide sufficient power for critical facility needs?	Effectiveness	System performance during grid outages
Quality of electricity service			

2. Operational efficiency / Energy KPIs			
#	Question	Evaluation dimension	Related KPI
2.6	How has the quality of electricity (e.g., voltage stability, frequency) improved since the installation?	Effectiveness	Improved quality of electricity service
2.7	Have you encountered any power fluctuations or equipment damage since the solar system was installed?	Sustainability	Operational efficiency and equipment safety
Reliance on generators & grid			
2.8	Under what specific conditions (e.g., grid failures, emergencies) do you still rely on diesel generators?	Efficiency	Reduction of CO ₂ emissions from generators Share of facility electricity supplied by on-site RE
2.9	Can you estimate the reduction in diesel consumption and electricity costs since the system was installed? (how much diesel was used before vs. now)	Efficiency	Cost savings and energy efficiency
Solar system utilization & design			
2.10	How well does the solar PV system meet the specific energy needs of this facility?	Relevance	N/A
2.11	Was the facility involved in determining the design or capacity of the solar PV system? If not, would more involvement have helped?	Relevance	N/A
2.12	Is there any specific equipment that you cannot use on the solar system?	Relevance	N/A
2.13	Are you using the solar system as the main power source or is it used as a backup when the grid fails?	Impact	System utilization rate and reliability
2.14	Have any energy-efficient equipment or measures been adopted since the solar system installation? If so, what are they?"	Impact	Energy-efficient behaviour and equipment adoption

3. Improved healthcare delivery (Health KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
Maternal and infant health outcomes				
3.1	How has the availability of energy impacted the quality of patient care you provide, particularly for maternal health and infant health	Impact	Health	Number of births supported by improved power supply in targeted facilities
3.2	Have there been observable changes in maternal and infant mortality rates since the installation?	Impact	Health	Average number of maternal and infant deaths across targeted facilities per month.
3.3	Can you share examples of how reliable energy has helped in treating patients, especially during emergencies and births/deliveries?	Impact	Health	Qualitative evidence of improved health outcomes.
Use of medical equipment and reporting				
3.4	Has the use of electricity-dependent medical devices increased (e.g., imaging equipment, incubators)?	Effectiveness	Health/ Energy	Increased use of electricity-dependent medical device
3.5	Has improved energy access led to the acquisition of new medical equipment, either provided by external donors, government programmes, or purchased by the facility? If so, what types of equipment have been acquired, and how has their use impacted patient care?	Effectiveness	Health/ Energy	Qualitative evidence of improved health services

3. Improved healthcare delivery (Health KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
3.6	Are you using more digital reporting tools or software for patient management? If yes, what impact has this had on efficiency and service delivery?	Efficiency	Health	Number of targeted facilities with increased use of digital reporting/ electricity-dependent medical devices
Service availability				
3.7	Have new healthcare services been introduced due to improved electricity access (e.g., night-time surgeries)?	Effectiveness	Health/ Social	Number of target facilities with reported improvement in availability of health services provided.
3.8	Have existing services expanded in terms of hours or capacity?	Effectiveness	Health/ Social	Improved availability and capacity of healthcare services.
3.9	Have you observed a reduction in power-related health service interruptions?	Effectiveness	Health	Improvements in health outcomes

4. Solar System usage & training (Social & Economic KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
4.1	Has anyone in the facility been trained on the usage and maintenance of the solar system?	<i>Effectiveness</i>	Social/ Economic	Number of staff trained on solar energy in healthcare facilities (Target: 29).

4. Solar System usage & training (Social & Economic KPIs)				
4.2	How many facility staff were trained? How many of those were women?	Equity	Social	Number of staff trained on solar energy in healthcare facilities (Target: 29).
4.3	Can you describe the format of the training, such as its duration and balance between theory and practice?	Efficiency	Social	Quality of training provided
4.4	What specific topics were covered during the training? Were they relevant to your facility's needs?"	Effectiveness	Social	Training relevance and coverage
4.5	Did the trainers leave any training materials with staff? If yes, can we review those?	Sustainability	Social	Training relevance and coverage
4.6	Has the training impacted the ability to manage the solar system?	Effectiveness	Social/ Economic	Enhanced capacity for PV system management

5. System maintenance (Operational KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
5.1	How often is the solar system maintained and what protocols are in place for routine maintenance?	<i>Efficiency/ Sustainability</i>	Operational	Uptime of electricity services
5.2	Have there been any technical issues or breakdowns since the installation of the solar system?	Effectiveness	Operational	Reliability of PV system performance
5.3	If yes, have the issues been resolved? How? How long did it take to resolve them?	Efficiency	Operational	Reliability of PV system performance

5. System maintenance (Operational KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
5.4	<p>Are there specific maintenance tasks or protocols that you feel could be streamlined to improve efficiency?</p> <p>How does the performance of the solar PV system compare to the costs of maintaining and operating it</p>	Efficiency/ Sustainability	Operational	Reliability of PV system performance

6. Staff motivation and retention (Social & Economic KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
6.1	Have you noticed any changes in staff motivation or retention since the facility became electrified? If yes, what is the reason for the change in motivation/retention?	<i>Impact</i>	Social/ Economic	Higher motivation or greater ability for healthcare workers to perform their work.
6.2	Do staff members feel safer or more efficient working here now? Why? (e.g., no generator noise, improved air quality, improved lighting at night, improved electrical installation, etc.)	Impact	Social	Improved safety and efficiency for healthcare workers
6.3	Does staff live on the facility's compound, and if so, has the solar installation improved their living conditions?	Impact	Social/ Economic	Improved livelihoods through electrification
6.4	Have there been any jobs created in the facility due to increased electrification?	Impact	Social/ Economic	Improvements in social impact

7. Community perception and health seeking behaviour (Social & Economic KPIs)				
#	Question	Evaluation dimension	Impact category	Related KPI
7.1	Do you think that the community's perception regarding the facility changed since the installation of the solar system? How?	<i>Impact</i>	Social	Community perception of improved services.
7.2	Have you observed an increase in patient visits or health-seeking behaviour? If so, do you believe it has anything to do with the solar system?	<i>Effectiveness</i>	Social/ Economic	Increased health-seeking behaviour
7.3	Have you observed any other unintended impacts on the community? (e.g., economic spillover effects)	<i>Impact</i>	Social/ Economic	Unintended economic or social impacts

8. Challenges / recommendations			
#	Question	Impact category	Related KPI
8.1	Have you faced any challenges using or maintaining the solar system?	Effectiveness	Operational challenges and gaps
8.2	Are there any areas where you feel additional support is needed?	Sustainability	Enhanced capacity for PV system management
8.3	Do you have any recommendations for improving the solar system or scaling the intervention to other facilities?	Sustainability	N/A
8.4	Has there been any other unexpected impact (positive or negative) from the solar system? E.g., reduction in noise from generator	Impact	Unexpected impacts

Annexe III: Interview Guide – Phase 2 PHUs

1. General information		
#	Question	Answers options
1.1	Facility Name	<i>Free text</i>
1.2	Name & position of interviewee(s)	<i>Free text</i>
1.3	Date	<i>Date</i>
1.4	Date of solar system installation	<i>Date</i>

2. Operational efficiency / Energy KPIs	
#	Question
Electricity Uptime	
2.1	On average, how many hours per day is electricity available at this facility since the installation of the solar PV system?
2.2	Have there been any significant changes in the frequency or duration of power outages?
2.3	Since the installation of the solar PV system, how often do power outages disrupt your ability to use essential medical equipment? What impact does this have on patient care?
2.4	Have there been any seasonal patterns in power outages, and how does the solar system perform during those times?
Quality of electricity service	
2.5	How has the quality of electricity (e.g., voltage stability, frequency) changed since the installation? (e.g., did equipment used to get damaged in the past due to voltage fluctuations?)
2.6	Have you encountered any challenges related to power fluctuations or system performance?
Reliance on generators & grid	

2. Operational efficiency / Energy KPIs	
#	Question
2.7	How often do you use diesel generators now compared to before the installation of the solar PV system?
2.8	Can you estimate the reduction in diesel consumption since the system was installed?
2.9	Can you estimate the reduction in electricity costs from the grid now compared to before the installation of the PV system?
Solar system utilization	
2.10	Does the solar system provide all the energy needed in the facility or are you still using the grid/generator?
2.11	Is there any specific equipment that you cannot use on the solar system?
2.12	Are you using the solar system as the main power source or is it used as a backup when the grid fails?
2.13	Did you get any efficient equipment/appliances as a result of the solar system installation? (e.g., replacement of bulbs and fans with efficient ones)

3. Improved healthcare delivery (Health KPIs)	
#	Question
Maternal and infant health outcomes	
3.1	How has the availability of reliable energy influenced the delivery of healthcare services, particularly maternal and infant care?
3.2	Have there been observable changes in maternal and infant mortality rates since the installation?
3.3	Can you share examples of how reliable energy has helped in treating patients, especially during emergencies and births/deliveries?
Use of medical equipment and reporting	
3.4	What types of electricity-dependent medical devices are currently in use? Are there any challenges or limitations in using these devices due to energy reliability?

3. Improved healthcare delivery (Health KPIs)	
#	Question
3.5	Has the availability of reliable power enabled you to introduce new medical equipment or expand the use of digital tools for patient care and reporting?
Service availability	
3.6	Have new healthcare services been introduced due to improved electricity access (e.g., night-time surgeries)?
3.7	Have the operating hours or capacity of existing services expanded as a result of improved electricity access? If so, how?

4. Solar System usage & training (Social & Economic KPIs)	
#	Question
4.1	Who in the facility has been trained on the usage and maintenance of the solar system? Were any of those trained women?
4.2	What was the structure of the training provided (e.g., duration, balance of theory vs. practical sessions)? How effective did the trainees find the format?
4.3	What specific topics were covered during the training (e.g., routine maintenance, troubleshooting)? Were they sufficient to meet the facility's needs?
4.4	Did the trainers leave any training materials with staff? If yes, can we review those?
4.5	How has the training impacted the ability to manage the solar system? Are there any areas where additional training or support is needed?

5. System maintenance (Operational KPIs)	
#	Question
5.1	What is the routine schedule for solar system maintenance? Are there protocols in place, and are they being followed consistently?
5.2	Have there been any technical issues or breakdowns since the system was installed? How were these issues resolved, and how long did it take?

6. Staff motivation and retention (Social & Economic KPIs)	
#	Question
6.1	Have you noticed any changes in staff motivation or retention since the facility became electrified? If yes, what factors have contributed to these changes??
6.2	Do staff members feel safer or more efficient working here now? Can you provide examples? (e.g., no generator noise, improved air quality, improved lighting at night, improved electrical installation, etc.)
6.3	If staff live on-site, how has solar system installation affected their living conditions (e.g., reliable power in staff quarters)?

7. Community perception and health seeking behaviour (Social & Economic KPIs)	
#	Question
7.1	Do you think that the community's perception regarding the facility changed since the installation of the solar system? Can you provide specific examples?
7.2	Have you observed an increase in patient visits or health-seeking behaviour? If yes, what do you think has contributed to this change?
7.3	Have you observed any other unintended impacts on the community? (e.g., economic spillover effects)

8. Challenges / recommendations	
#	Question
8.1	Have you faced any challenges using or maintaining the solar system?
8.2	What additional support or resources would be helpful for improving system performance and sustainability?
8.3	Do you have any recommendations for improving the solar system, replicating or scaling the intervention to other facilities?
8.4	Has there been any other unexpected impact (positive or negative) from the solar system? E.g., reduction in noise from generator

Annexe IV: Interview Guide – Phase 3 Hospitals

1. General information		
#	Question	Answers options
1.1	Facility Name	<i>Free text</i>
1.2	Name & position of interviewee(s)	<i>Free text</i>
1.3	Date	<i>Date</i>

2. Pre-intervention context and readiness for intervention	
#	Question
Pre-intervention context	
2.1	What are the main challenges your facility faces in accessing reliable electricity and how do these impact critical services?
2.2	How often do power outages occur and how long do they typically last? ?
Anticipated benefits of solar	
2.3	What specific improvements do you anticipate with the installation of the solar PV system (e.g., reduced outages, better support for emergency services)?
Staff readiness	
2.4	Have staff members been informed or trained about the upcoming installation and use of the solar PV system?
2.5	What additional training or resources would help prepare your staff for this transition?
Infrastructure	
2.6	Do you anticipate any infrastructure-related challenges with integrating the solar PV system (e.g., space, wiring, roof)?
2.7	Are there any specific upgrades or preparations required before installation?

3. Scalability	
#	Question
3.1	Are there any new healthcare services or technologies you plan to introduce or expand once the solar PV system is operational?
3.2	How do you see this intervention contributing to long-term improvements in healthcare delivery at your facility?

4. Aligning with developmental goals	
#	Question
4.1	How do you anticipate the surrounding community will react to the installation of the solar PV system?
4.2	Are there any anticipated negative impacts due to the solar system installation in the facility? (e.g., surrounding population doesn't have access to electricity)
4.3	Do you foresee changes in patient behaviour, such as increased visits or reliance on clinic services, after the installation?

5. Sustainability and maintenance	
#	Question
5.1	What concerns do you have regarding the long-term maintenance and sustainability of the solar PV system?
5.2	What role will your staff play in maintaining the system's functionality and are there gaps in capacity that need to be addressed?

6. Anticipated challenges / Support needs			
#	Question	Answers options	Evaluation dimension
6.1	What challenges do you anticipate during or after the installation of the solar PV system?		
6.2	Are there specific barriers (e.g., technical, financial, or logistical) that need to be addressed to ensure successful implementation?		
6.3	What type of support would you like to receive from the implementing organisations during and after installation?		

Annexe V: Interview Guide – Institutional Stakeholders

Ministry of Energy Interview Guide

1. Relevance of project and integration within national policy	
#	Question
1.1	What was the role of the Ministry of Energy in the project?
1.2	How does this project align with your ministry's strategic priorities in energy access? Are there any priorities that are missing or should have been included?
1.3	How has the project influenced or been influenced by evolving national policies or international commitments (e.g., SDGs, Paris Agreement)?
1.4	How effectively have your ministry and other stakeholders collaborated on this project and are there areas where alignment or coordination could be improved?
1.5	Are there any other projects in Sierra Leone working on electrification of healthcare facilities? If yes, how well does SL-HEP align with the other projects?

2. Efficiency	
#	Question
2.1	Were there any significant challenges in coordinating between ministries, implementing partners, and other stakeholders? How were these addressed?
2.2	How effective and transparent were procurement processes for equipment and services?
2.3	Were you involved in the procurement process of the equipment? Do you think you should have been involved?

3. Perceived programme sustainability	
#	Question
3.1	What is the ministry's role in ensuring long-term sustainability of installed systems?
3.2	What measures have been taken to ensure the sustainability of installed systems?
3.3	Are maintenance protocols and budgets sufficient to support long-term operations?
3.4	How are the impacts of this project being integrated into broader health and energy policies?

3. Perceived programme sustainability	
#	Question
3.5	Whose responsibility is it to operate and maintain the systems?
3.6	Does the Ministry have any resources to fund operation and maintenance of these systems?
3.7	Does the Ministry have a good understanding of the costs involved in operating and maintaining these systems?
3.8	Does the Ministry have the technical expertise to operate and maintain these systems?
3.9	Are there plans to reduce reliance on external funding for maintaining the systems in the long term?

4. Cross-cutting and closing	
#	Question
4.1	What were the most significant risks encountered during implementation, and how were they mitigated?
4.2	What lessons have been learned that could inform future projects?
4.3	Do you see potential for scalability or replicability of this intervention in other regions or facilities?
4.4	What do you see as the main challenges to replicating this model in other regions or countries?
4.5	Is there anything else you'd like to add or emphasise about the project's implementation or impacts?

Ministry of Health Interview Guide

1. Relevance of project and integration within national policy	
#	Question
1.1	What was the role of the Ministry of Health in the project?
1.2	How does this project align with your ministry's strategic priorities? Are there any priorities that are missing or should have been included?

1. Relevance of project and integration within national policy	
#	Question
1.3	How has the project influenced or been influenced by evolving national policies or international commitments?
1.4	How effectively have your ministry and other stakeholders collaborated on this project and are there areas where alignment or coordination could be improved?
1.5	Are there any other projects in Sierra Leone working on electrification of healthcare facilities? If yes, how well does SL-HEP align with the other projects?

2. Efficiency	
#	Question
2.1	Were there any significant challenges in coordinating between ministries, implementing partners, and other stakeholders? How were these addressed?
2.2	Were you involved in the procurement process of the equipment? Do you think you should have been involved? Why?

3. Perceived programme sustainability	
#	Question
3.1	What measures have been taken to ensure the sustainability of installed systems?
3.2	Whose responsibility do you think should it be to operate and maintain the solar systems?
3.3	What should be the ministry's role in ensuring long-term sustainability of installed systems?
3.4	What other challenges do you see to ensure long-term sustainability of installed systems?

4. Cross-cutting and closing	
#	Question
4.1	What lessons have been learned that could inform future projects?



4. Cross-cutting and closing	
#	Question
4.2	Do you see potential for scalability or replicability of this intervention in other regions or facilities?
4.3	What do you see as the main challenges to replicating this model in other regions or countries?
4.4	Is there anything else you'd like to add or emphasise about the project's implementation or impacts?

Annexe VI: Interview Guide – SEforALL Stakeholders

1. Strategic Vision and Role	
#	Question
1.1	What was SEforALL’s primary role in the design and delivery of SL-HEP, and how did this evolve across Phases 1–3?
1.2	How did SEforALL ensure alignment with the Government of Sierra Leone’s health and energy priorities throughout the project?
1.3	Were there key trade-offs or strategic decisions that influenced the overall programme approach (e.g., prioritizing scale vs. customization)?

2. Implementation and Procurement	
#	Question
2.1	What worked well in terms of procurement, contractor management, and delivery timelines? What would you change?
2.2	How did SEforALL manage risks or delays during implementation, particularly under tight timelines?
2.3	Were there specific innovations (technical or managerial) introduced in Phase 2 or 3 that improved delivery compared to Phase 1?

3. Partnerships and Coordination	
#	Question
3.1	How would you describe the collaboration with the government (i.e. MoH)?
3.2	What worked well in terms of coordination—and what challenges did you encounter?
3.3	To what extent were national policies, regulations, and institutional frameworks taken into account during design and implementation?
3.4	Were there any gaps or misalignments with existing government procedures or priorities that affected project delivery or sustainability?

4. Monitoring, Learning, and Adaptation

#	Question
4.1	How did SEforALL integrate learning from Phase 1 into Phases 2 and 3?
4.2	Were changes to technical design, procurement, or stakeholder engagement informed by real-time learning or evaluation?

5. Sustainability and Ownership

#	Question
5.1	What are the current plans for long-term O&M of the installed systems?
5.2	What institutional models are being explored for long-term O&M?
5.3	What steps are needed to strengthen government ownership and ensure financial sustainability?

6. Cross-cutting and Closing

#	Question
6.1	In your view, what are the most transferable elements of the SL-HEP model?
6.2	Were there any unanticipated outcomes or insights from the project?
6.3	Is there anything else you'd like to highlight regarding the implementation, impact or potential of the SL-HEP model?