



Solar for Health (S4H) innovative financing feasibility study: Liberia summary report

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1. Energy demand and financing need

Many healthcare facilities in Liberia struggle with unreliable access to electricity, and off-grid solutions have yet to scale

The Government of Liberia (GoL) targets 35% access to electricity by 2030 with an intermediate target of all county capitals, healthcare facilities and schools electrified by 2025. Currently, the national electrification rate stands at 12%, though dropping to only 3% in rural areas. The national grid is almost exclusively in Montserrado County (i.e., within the immediate surroundings of the capital city, Monrovia). Although Liberia has benefitted from a number of electrification initiatives over the years (e.g., refurbishment of the Mount Coffee Hydropower Plant funded by a consortium of international donors, the World Bank's Renewable Energy Access Project, the African Development Bank's Liberia Renewable Energy Access Project, a new EU-funded mini-grid electrification project in the southeast of the country), GoL remains far from achieving its energy targets.

GoL has made a push in recent years to strengthen its national electrification plans: in 2016, an independent GoL agency, Rural & Renewable Energy Agency (RREA), launched its 'Rural Energy Strategy and Master Plan' (RESM) to electrify the country, though these efforts have primarily focused on geographically-limited on-grid investments (e.g., grid extension beyond Montserrado County, cross-border interconnector with the Ivory Coast for electrification of three adjacent counties). Similarly, the Ministry of Lands, Mines and Energy (MLME) has recently developed its own off-grid strategy, but this has focused on larger-scale energy solutions such as mini-grids that target large towns or communities. Off-grid standalone solar PV systems may be more relevant for many rural communities far from Liberia's main counties, but this thinking has not been incorporated into national strategies. Moreover, legislation provides little support to renewable energy technologies, with incentives limited to ad-hoc import duty waivers on solar and battery technologies.

In the healthcare sector, specifically, achieving universal and reliable energy access remains an ever-present challenge. In spite of absence of a reliable database, it is estimated that only a fraction of Liberia's 464 public healthcare facilities (excluding health posts) is connected to the grid (only available around the capital). While some donors provide solar PV systems to healthcare facilities in Liberia, they typically focus on those managed by non-governmental organisations (NGOs) or faith-based organisations (FBOs), leaving government-owned facilities largely neglected. Furthermore, with small rural health clinics (i.e., Level 1 and Level 2 clinics) far from the capital accounting for over 87% of public healthcare facilities, providing energy access to the marginal unconnected rural facility becomes increasingly costly. Even the quality of service provided by the few 'electrified' public healthcare facilities can be significantly compromised by underlying electricity problems, such as unstable and insufficient grid power, suboptimal solar PV sizing for facility needs (i.e., only covering refrigeration and basic lighting), and premature system failures due to lack of proper maintenance being the norm rather than the exception.

UNDP's Solar for Health (S4H) programme aims to address these issues and bring reliable and clean energy to healthcare facilities across Liberia. By strengthening access to reliable solar energy, the S4H programme can significantly impact the quality of public healthcare, particularly for the most disadvantaged and remote populations, whilst also supporting local green growth and climate action. Specifically, S4H directly contributes to the following social, economic, and environmental Sustainable Development Goal (SDG) outcomes in Liberia:

- Social: SDG3 (Good Health and Well-being); SDG10 (Reduced Inequalities);
- Economic: SDG8 (Decent Work and Economic Growth); SDG9 (Industry, Innovation, and Infrastructure); and
- Environmental: SDG7 (Affordable and Clean Energy); SDG13 (Climate Action).

An estimated US\$23m in financing is urgently needed to provide reliable solar energy access to healthcare facilities

An estimated US\$23m in investment capital is needed in Liberia to finance the capital expenditures required to provide energy access to healthcare facilities, over an initial 7-year investment timeline.

The investment sizing assumes the following:

- Healthcare facilities within scope: all public on-grid and off-grid healthcare facilities are considered in scope, as just a small fraction is currently connected to the grid. And even these few facilities connected to the grid depend on diesel generators most of the time due to limited grid reliability. Facilities with existing off-grid solutions should be excluded, though in absence of a database of such facilities, a further assessment should be conducted by the Ministry of Health (MOH) prior to programme implementation to identify these facilities and determine if additional capacity is needed. Finally, small health posts were assumed to be out of scope for solar PV systems, given their small size and limited range of healthcare services. For these facilities, solar lanterns may be relevant and sufficient, though these are not included within the S4H programme;
- Energy needs, O&M, and autonomy assessment: an average energy needs and O&M assessment is assumed for different categories of healthcare facilities (from rural clinics to large hospitals) based on regional usage benchmarks. The exact needs assessment of each target facility will need to be conducted by MOH in collaboration with local energy service providers (ESPs) to determine exact solar PV system sizing and investment need. Additionally, autonomy (i.e., through lithium batteries) is estimated at two days for all facilities in the scope. Incorporating a hybrid solution with a diesel generator as a back-up solution, where financially relevant, can reduce total investment need;
- Diesel versus off-grid solar for energy needs: although the estimated levelised cost of energy (LCOE) of solar PV systems (US\$0.95/kWh) is greater than that of diesel generation (US\$0.53/kWh) over the initial contract period, the investment sizing assumes the social and environmental benefits from providing off-grid solar energy to all public healthcare facilities within scope outweigh this unit cost difference. Furthermore, this conservative costing analysis: (i) is based on benchmark retail prices for diesel in urban centres and does not factor in transportation and other middlemen costs that may increase transaction costs to rural healthcare facilities, (ii) does not incorporate CAPEX costs for generators (as it is assumed many healthcare facilities may already have the relevant systems; this, however, is often not the case), and (iii) estimates unit cost based on 7-years of operation (given minimal marginal operations cost, unit cost should decline further as solar PV systems are used past this initial investment timeline and as replacement battery costs decline). Finally, diesel value chains may also experience other unreliability/unavailability supply issues that can generally hinder reliable energy access. Consequently, this can make any costing analysis an unfair comparison as off-grid solar costs are typically greater given the inherent systems needed to ensure continuous and reliable energy access; and
- Investment timeline: an initial 7-year timeline covering initial capital expenditures and long-term O&M. A properly maintained solar PV panel can last up to 25-30 years; a lithium-ion battery lifetime ranges between 5-15 years. Investment financing is structured on an 7-year timeline, though this may be extended if investors show a preference/appetite for longer

investment horizons (i.e., in which case a new battery might have to be purchased prior to a new financing cycle).

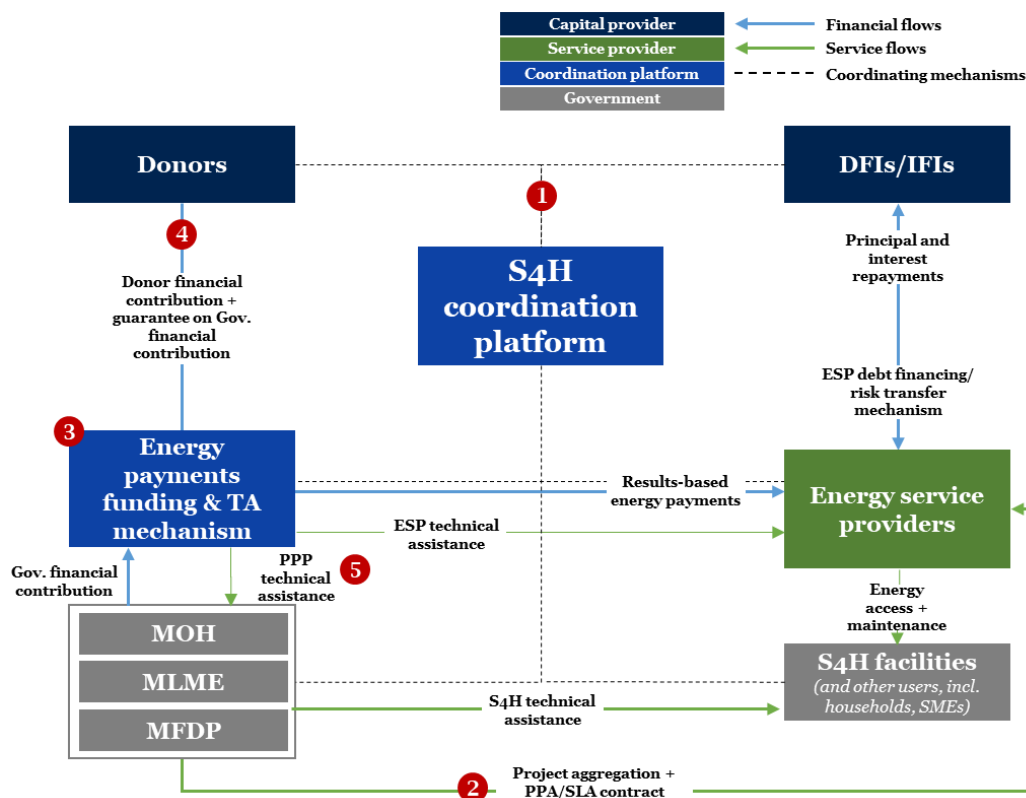
	Level 1 clinic	Level 2 clinic	Health centre	Hospital	TOTAL
Initial investment outlay (unit)	US\$32,266	US\$61,219	US\$117,378	US\$289,349	
Annual O&M cost (unit)	US\$1,510	US\$1,968	US\$2,725	US\$5,313	
Number of facilities	201	205	35	23	464
Total hardware cost	US\$4.9m	US\$9.8m	US\$3.2m	US\$5.3m	US\$23.2m
Total turnkey cost	US\$6.5m	US\$12.5m	US\$4.1m	US\$6.7m	US\$29.8m

Unlocking the quantum of investment capital needed to scale-up the S4H programme remains challenging given inherent financing and operational challenges in Liberia

- Low MOH ability-to-pay: high levels of public debt, inflation, and budgetary mismanagement have resulted in decreasing allocations for healthcare spending. Additionally, past cases of budgetary leakage from government accounts have reduced donor appetite in providing direct financial support to MOH. Against this constrained budgetary backdrop, MOH necessarily prioritises payment of staff salaries and medicines over other ancillary expenses, including energy access. Consequently, low MOH ability-to-pay and creditworthiness creates high payment default and public counterparty risk for potential S4H investors;
- Lack of access to local financing to develop local markets: traditional commercial off-grid energy investors have expressed little appetite for undertaking public counterparty risk in Sub-Saharan Africa. This has significantly limited access to affordable capital for local ESPs, let alone those that may focus on public health infrastructure. Where local financing may be available, it can come at prohibitively onerous terms (typically only offering rates >20%). High inflation (23.5% in 2018 and 27% in 2019) and steady currency depreciation (-6% since the beginning of 2020) further reduce investor appetite;
- Poor incentives for long-term operational and environmental sustainability: existing grant-financing models fail to incentivise long-term sustainability. Due to donor programmatic timelines (typically 3-5 years), specific priority mandates and funding processes, and shorter-term impact metrics, many donor-funded projects prioritise disbursing funding upfront to cover initial capital expenditures (CAPEX) versus financing longer-term annual commitments. This often results in premature failure of solar PV systems within the first few years and reduces potential for impact. Importantly, from a donor perspective, this CAPEX-only financing represents low value-for-money: it can often be the case that a revolving set of donors will finance new off-grid solar initiatives for the same healthcare facility every few years; and
- Lack of coordination and technical capacity to support project development: short-term donor mandates and preference for direct financing of technical assistance (TA) and/or discrete projects outside of government development plans can often create ad-hoc and short-term focused initiatives that fail to deliver long-term impact. This lack of coordination between different government ministries, donor agencies, and project implementers (in this case, often large international players with limited local presence) prevents effective implementation of national off-grid electrification strategies and increases transaction costs related to project procurement, aggregation, due diligence, and delivery.

2. Solar for Health coordination platform financing model

A holistic approach bringing together stakeholder coordination, long-term de-risked financing, and technical assistance can be instrumental in scaling the S4H programme



1. A S4H coordination platform will support MOH with procurement and tendering to aggregate projects that can attract development finance institution (DFI) financing

The S4H coordination platform will coordinate a partnership between MOH, GoL’s Public Procurement and Concessions Commission (PPCC), MLME, local representatives, commercial investors, and local ESPs. UNDP, through its facilitation role, will supervise and support the entire investment process from procurement through to investment monitoring to ensure proper quality standards and successful implementation of the programme.

- PPP procurement and tendering to support project development:
 - o *Coordination with PPCC:* GoL has established PPCC as an independent commission to work closely with Ministry of Finance and Development Planning (MFDP) on implementation of PPP contracts (i.e., currently conducted under the Concessions Act, in the absence of a dedicated PPP framework). Although these initiatives have predominantly targeted on-grid generation in the past, there are opportunities for MOH and other S4H coordination platform stakeholders to leverage PPCC’s and MFDP’s experience with PPPs and adapt relevant best practices for procurement and tendering;
 - o *Coordination with MLME:* the S4H coordination platform will coordinate with RREA, MLME’s Department of Energy (DOE), and MOH to ensure alignment between the national electrification master plan, existing and planned power investments, and priority healthcare facilities that may overlap with other ministries’ development plans. Additionally, MOH can leverage RREA’s and DOE’s expertise and technical knowledge, including experience with private power investments, independent power producer (IPP) contract negotiations, and energy project management;
 - o *Coordination with local representatives:* project selection, energy needs assessment, project preparation, and community engagement will be conducted in close collaboration with community leaders and MOH national and county representatives to ensure buy-in, adapt projects to local context and needs, and allocate budgets to the programme;

- Project aggregation to create investable portfolios: although investment in S4H and the public sector is a non-starter for most commercial investors, DFIs have explicit development mandates (often coupled with an appetite for public sector exposure) and large balance sheets for investment in larger-scale infrastructure and energy projects. The investment needs of an individual healthcare facility, however, cannot meet the minimum investment ticket sizes for DFIs (>US\$10-100m versus typical individual healthcare facility investment needs of US\$40-320k). By aggregating a portfolio of projects through a coordination platform, the S4H programme can create larger investment ticket sizes of sufficient relevance for DFI capital.

There are promising examples of other financing initiatives that have similarly leveraged DFI capital (in the form of concessional loans, equity, or grants) for the renewable energy sector in Liberia. For example, the Renewable Energy for Electrification in Liberia (REEL)—a partnership between the African Development Fund (ADF), USAID’s Scaling Up Renewable Energy Program in Low Income Countries (SREP), and the African Development Bank’s Transition Support Facility (TSF)—committed US\$25m to develop several hydro power plants in various locations across the country. Similarly, the Beyond the Grid Fund for Africa uses innovative finance (such as results-based finance) to build market for off-grid energy in rural and peri-urban areas of Liberia; and

- Mobilisation of private capital to finance local ESPs: the S4H coordination platform will also be responsible for coordinating the financing and investment due diligence processes with different GoL stakeholders, DFIs, and local ESPs. Specifically, the S4H coordination platform will develop investment due diligence criteria as part of its support to MOH during the procurement and tendering process to local ESPs, as well as explicitly coordinating with different DFIs and incorporating respective investor considerations. DFIs may still run separate investment due diligence processes as part of their own organisational processes in parallel to the S4H coordination platform. But already incorporating their investment considerations as part of the PPP procurement can (i) help streamline the investment process for both DFIs and local ESPs and (ii) ensure linkages between the tendering process and investor capital mobilisation. For example, by making S4H tenders contingent on a satisfactory DFI investor due diligence of the project bid and of the local ESP, the S4H coordination platform ensures that winning bidders necessarily also receive access to affordable financing.

2. A power purchase agreement (PPA) and leasing mechanism will align financial incentives and smooth payments over time to ensure long-term financial, operational, and environmental sustainability

A PPP/PPA and leasing mechanism will set out the contractual and financial obligations between DFIs, MOH, and the local ESP over the 7-year contract lifetime to ensure long-term sustainability:

- Financial sustainability and local market development:
 - o *Investor returns matching respective risk-return appetites*: the financing capital structure is expected to blend senior debt at USD-denominated market returns (i.e., DFI capital) with concessional climate finance funds and/or donor grant capital. This blended finance approach will match interest rate returns to the respective risk-return appetites of different capital providers, whilst ensuring that access to financing remains affordable for local ESPs (versus current local financing rates >20%). The interest rate returns will depend on the expectations of committed capital providers identified during financial structuring negotiations, as well as the degree of blending between commercial and concessional financing;
 - o *MOH and donor affordability/value-for-money*: as the contracted off-taker for energy access to public healthcare facilities, MOH will be liable for payment obligations under the PPP. Currently, high upfront CAPEX can be prohibitively expensive and reduce the number of healthcare facilities that can be targeted. By spreading the total energy access costs across a series of smaller leasing payments, MOH and/or donor funders can reduce their monthly costs and improve affordability. Additionally, financial incentives for long-term operational sustainability will support increased impact and value-for-money. Donor mandates focused only on upfront CAPEX funding, however, will need to be adapted to support these recurring payments;
 - o *Local ESP market development*: monthly leasing payments will be paid to the local ESP by a coordinated energy payments funding mechanism comprised of donors and MOH

over the 7-year contract duration. These leasing payments will be priced to include capital expenditure, long-term O&M, cost of capital, and local ESP commercial margins to support local market development. Additionally, access to affordable blended financing through the S4H coordination platform will enable solar PV asset ownership to remain with the local ESP throughout the PPP contract duration (before ownership transfer to MOH). By bearing this financing risk, the local ESP will also benefit from earnings on leasing financing margins. This can support the financial sustainability of local ESPs, as well as strengthen their track record and ability to access capital markets in the future;

- Operational and environmental sustainability:

- *Long-term local ESP operational performance obligations:* under the current grant-based model, donors typically only finance the upfront cost of solar PV panels and initial installation. Long-term O&M (and proper disposal) is often not priced into contracts. Although GoL's RREA has relevant expertise to provide training to on-site healthcare staff on solar PV maintenance, its operating capacity is largely hampered due to severe underfunding. Consequently, both RREA and MOH have limited capacity to manage O&M across a larger portfolio.

Under the S4H coordination platform model, the local ESP (in collaboration with MOH) will conduct an energy load needs assessment across its project portfolio and provide appropriately-sized solar PV systems and installation services. The local ESP will then be responsible for long-term O&M and will need to ensure solar PV system availability and achievement of minimum-service level operational performance criteria, as defined under an SLA. Additionally, given the potential geographic spread of project portfolios, local ESPs may need to train healthcare staff or community-based technicians for more frequent and basic maintenance (e.g., cleaning panels).

The PPP/PPA will specifically aim to incentivise long-term operational sustainability by pricing in O&M into the contract over its 7-year term. Monthly leasing payments will be conditional on achieving the SLA operational performance standards to provide financial incentives for high-quality service over the full life of the PPP/PPA contract. In the event solar PV systems fail to meet minimum service-level performance standards required by the healthcare facility, for example, payments to the local ESP may be reduced and/or withheld. As the S4H coordination platform envisions an initial 7-year investment timeline, the PPP/PPA contract will need to be extended with a new long-term O&M contract (including coverage of any replacement parts) after this investment horizon to maintain on-going sustainability after the 7 years; and

- *Local ESP environmental sustainability and disposal obligations:* the PPP contract might additionally price in disposal costs as part of the local ESP's long-term sustainability obligations. From a technical perspective of disposal, however, there are no standardised best-in-practice guidelines and little practical experience with disposal and recycling of components from medium- to large-scale solar energy systems. There are no hazardous materials in silicon PV panels and lithium batteries (as opposed to lead acid batteries) that should present an environmental concern. The details of where and how it should be disposed (as well as the existence and/or capabilities of relevant ecosystem players), however, need to be further developed. Encouragingly, recycling PV panels and battery components can have economic value and is of relatively low complexity. The market for local recycling value chain actors is expected to grow as these technologies further develop.

3. An energy payment funding mechanism will coordinate healthcare energy contributions from donors and MOH to support ability-to-pay on payment obligations under the PPP

The energy payments funding mechanism will coordinate financial contributions from international donor agencies and local public institutions (i.e., MOH), including incorporating existing budgetary allocations for healthcare energy spending. These monthly energy payments will remunerate the local ESPs through monthly leasing payments as part of the PPP/PPA contractual frameworks and are fundamental to mitigating MOH payment default risk (in order to attract DFI investor capital):

- Support for MOH ability-to-pay through coordinated donor funding: donor contributions within the energy payments funding mechanism will cover a pre-defined proportion of the monthly leasing payments to local ESPs. MOH will be contractually obligated to finance the remaining balance, with covenants in place in the event of default. These can include removing defaulting healthcare facilities from the S4H programme and/or reduced future donor funding to MOH as penalties.

Currently, healthcare facilities do not receive any direct cash allocations; instead, their expenditures are either paid directly by MOH (such as staff salaries or water bills) or received in-kind from MOH and its county subdivisions (including, medicines and diesel for generators). Theoretically, MOH could reallocate these existing sources of energy financing to cover its financial obligations under the PPP/PPA contracts. As budgetary allocations, however, often do not cover full energy access (i.e., amount of diesel received is often not sufficient; and in some instances, no diesel is provided due to GoL budget shortfall), potential budget reallocations from switching to off-grid solar solutions may not be sufficient to cover monthly leasing payments of full energy access. This existing funding amount is nonetheless not negligible: US\$15.7m, or 45% of the total funding need in Liberia.

The proportion of donor funding versus MOH contributions to the leasing payments will thus need to be negotiated amongst relevant stakeholders during structuring of the PPP to ensure ability-to-pay. In Liberia, it is expected that MOH's share will remain quite minimal given the state of government budgets. Donor commitments are an essential component needed to balance MOH's low ability-to-pay and should be sufficient in size to reduce payment default risk (and attract investor financing). This coordinated funding mechanism, however, can still face a funding shortfall: as donor programmatic mandates are typically shorter-term (i.e., 3-5 years), many donor agencies are unable to commit to the full 7-year investment horizon and can only conditionally commit to funding in later years if programmatic mandates are renewed. This risk can be partially addressed by (i) putting MOH contributions into escrow during the first years of a secured donor mandate and using only donor capital during this period for PPP payments (if applicable), with MOH funding from escrow released in later years and/or (ii) using guarantee mechanisms (though these can be costly) and donor first-loss capital;

- Potential additional revenue streams to minimise MOH liabilities: MOH, with implementation support from local ESPs, TA providers, and UNDP can explore additional revenue streams to help off-set payment obligations, including selling excess energy generation to local communities, and/or carbon credits in global carbon markets. For example, the S4H programme can reduce carbon emissions by an estimated 9.3k tCO_{2e} per annum (assuming full off-grid solar energy access for target facilities versus equivalent diesel usage). Under Article 6 of the Paris Agreement, there may be potential for these internationally transferred mitigation outcomes (ITMO) carbon credits to be sold in global carbon markets: at benchmark prices of \$10-\$15 per tCO_{2e}, MOH can potentially reduce its payment obligations by up to \$93-140k per annum. Although these additional revenue streams will likely remain small and unable to cover full payment obligations, they are nonetheless welcome upsides to help offset MOH liabilities;
- Partial foreign exchange risk mitigation: as international donor contributions are typically denominated in hard currencies (e.g., USD, EUR), such funding will partially mitigate foreign exchange risk (up until the proportion of its share of the energy payments) on financing liabilities (i.e., repayments to investors) that are also denominated in hard currencies;
- Reduced budgetary leakage: donor contributions through UNDP will minimise risk of leakage into GoZ's general budgetary allocations and spending outside of the S4H programme. Ensuring a direct link between financial contributions and repayment to investors will additionally reduce investor perception of public counterparty risk; and
- MOH buy-in and long-term asset ownership: although MOH's partial financial contributions to the leasing payments will expose investors to a measured level of public counterparty risk, it is also important to ensure MOH has financial obligations as part of the PPP financing. This skin-in-the-game will incentivise MOH's commitment to the long-term sustainability of the solar PV systems (versus often-limited buy-in under the current grant-based funding model).

4. Guarantees will be necessary to backstop MOH contributions to the leasing payments and further mitigate GoL public counterparty risk for DFI capital

Despite donor contributions to the leasing payments through the energy payments funding mechanism, a complementary guarantee mechanism will still be required to de-risk investor capital against significant MOH public counterparty exposure and short-term donor commitments. Specifically:

- MOH public counterparty risk: guarantees and/or donor first-loss capital to backstop energy payment obligations can mitigate partial exposure to MoH defaults on its payment obligation under the PPP and provide credit enhancements to investors. As guarantee mechanisms can be costly and the donor contributions do not fully mitigate investor risk, a structured combination of both financial tools will be more effective at attracting DFI capital. These guarantees can be structured to either backstop payments to the ESP or directly on payment obligations to investors. The specific terms and payment coverage will depend on the cost and availability of guarantee mechanisms and donor capital; and
- Short-term donor commitments: guarantees can play an additional role at temporarily backstopping donor commitments to energy leasing payments in later years of the PPA. This risk that a potential donor may fail to renew its commitment in later years may need to be covered by a partial guarantee to attract longer-term investor capital.

5. Technical assistance and capacity-building will support GoL's regulatory and PPP framework development and strengthen procurement, project development, investment due diligence, and project delivery and monitoring capabilities

MOH, given its limited expertise with PPP and energy procurement tenders, will require technical assistance (TA) and capacity-building from procurement through project management. Additionally, an undeveloped local off-grid ecosystem will depend on international/regional partnerships and S4H coordination platform support to strengthen local market capabilities. Specifically, a TA provider financed through a TA facility/grant capital can support MOH and local ESPs with the following:

- Project preparation support: healthcare facility selection and prioritisation, specific energy needs assessment, scope of work definition, and investment sizing across hundreds of potential facilities will need to be completed in an initial phase of S4H implementation;
- Procurement and tendering process: although MOH can leverage on the initial learnings from the S4H programme pilot (i.e., 12 healthcare facilities equipped with solar PV installations in 2020 and a few other energy PPP initiatives), additional TA is still essential to adapt best practices to scaling S4H (i.e., tendering aggregated portfolios of healthcare facilities in large procurement contracts);
- Contract and project management: TA can additionally be provided to support PPP contractual and term sheet negotiations with DFIs and local ESPs, PPP governance, and portfolio management; and
- Local ESP project delivery capabilities: the local market ecosystem is still nascent in Liberia (currently <15 locally-licensed solar companies), mostly consisting of small-size providers of solar home systems. Larger local players (e.g., West Coast Energy, EcoPower or LIB Solar) also primarily focus on urban markets for solar home systems. As most local ESPs are small enterprises, they lack sufficient size and/or technical capability to be able to bid for large public procurement tenders. Consequently, the few larger off-grid projects can only be implemented in cooperation with large international actors. TA financing will encourage development of the local market by supporting business plan development, contract procurement, and technical project delivery capabilities (including the upskilling of local and community-based O&M technicians). A large regional player or international joint venture may be relevant in an initial phase to bring in necessary technical expertise; RREA can also support capacity-building given existing support in other energy initiatives.

3. S4H social, economic, and environmental impact

Scaling up the S4H programme in Liberia is expected to deliver better healthcare quality, strengthen local economic green growth, and support climate action

1. Improved energy access and healthcare quality (especially for patients in rural areas)

- Improved healthcare quality for 2.85m patients across 464 facilities: S4H is estimated to provide access to reliable energy to 464 healthcare facilities with a total catchment population of 2.85m individuals. This improved availability and strengthened resilience of healthcare facilities are expected to significantly improve health outcomes across the board, from quantitative indicators (e.g., better response to local outbreaks of infectious diseases such as Ebola or Covid-19) to softer qualitative indicators (e.g., improved patient comfort); and
- Reduced inequalities in health services: lack of access to reliable energy disproportionately affects rural healthcare facilities located in areas where the poorest populations live. Bringing reliable energy access to rural areas can reduce the healthcare quality gap between rural and urban communities in terms of healthcare quality.

2. Economic green growth and job creation

- Local economic development through green growth: S4H can catalyse foreign direct investment inflows (an estimated US\$23m for this programme alone), develop the local energy ecosystem, and create green jobs (particularly in rural communities);
- Renewable energy sector capacity-building: technical assistance and capacity-building of government ministries and local ESPs will contribute to further market transformation and national implementation of off-grid solar technologies; and
- Creation of new value chains: the recycling and disposal of solar PV systems can create demand for new value chains and develop new local green enterprises.

3. Cleaner energy and environmental benefit

Moving from providing full energy access to public healthcare facilities through off-grid solar (versus equivalent diesel usage) will reduce carbon emissions by approximately 9.3k tCO₂e per annum:

	Total	Level 1 clinics	Level 2 clinics	Health centres	Hospitals
Diesel efficiency	21%	15%	20%	20%	30%
Diesel MWh	6,826	1,467	2,993	1,022	1,343
Grid MWh	336	-	-	-	336
tCO ₂ /year	9,321	2,602	3,981	1,359	1,379

4. UNDP role and implementation roadmap

UNDP can play three key roles to support implementation of the S4H coordination platform in Liberia

- Create a convening platform for stakeholder coordination and buy-in: given its networks and track record in Sub-Saharan Africa, UNDP is uniquely-positioned to play a convening role through the S4H coordination platform with all relevant public (i.e., MFDP, MLME, RREA, MOH, community leaders, donors) and private (i.e., DFIs, local ESPs) stakeholders; ensure stakeholder buy-in and alignment of respective mandates and incentives with S4H objectives; and provide oversight of roles and responsibilities for successful collaboration;
- Support capacity-building and strengthening of regulatory frameworks:
 - o *Off-grid/renewable energy regulatory frameworks*: although a number of large-scale energy initiatives exist in Liberia, these have predominantly targeted on-grid generation and transmission. UNDP can support MLME and RREA in strengthening their off-grid development strategies and incorporating clearer targets and timelines into DOE's national electrification master plan. As part of these development strategies, UNDP can further strengthen incentives and favourable policies for the renewable energy sector based on global best practices (including, for example, developing policies for feed-in tariffs). And through off-grid initiatives like S4H, UNDP can support GoL in developing new off-grid/distributed energy models that could be scaled up under the relevant national master plans;

- *PPP regulatory framework and management*: UNDP can support PPCC and MFDP to leverage its previous experience from PPP projects and create a dedicated PPP unit within MFDP. By supporting capacity-building of GoL's PPP framework (including healthcare off-grid energy infrastructure), UNDP can strengthen MOH's PPP and contractual frameworks, increase private sector investor appetite through budgetary allocation ringfencing, and reduce transaction costs on PPP procurement and management;
- *Local ESP capabilities*: the local ESP ecosystem is still nascent in Liberia, and as such will require support to help local solar energy players gain the necessary expertise (which can be achieved by cooperation with large international off-grid solar actors, to the extent that it does not lead to overdependence), as well as to provide much needed seed capital. Through UNDP-supported TA providers, UNDP can encourage development of the local market and its project procurement and delivery capabilities (including the upskilling of local and community-based O&M technicians outside major urban areas); and
- Align and mobilise donor and investor capital to S4H objectives: UNDP can leverage its partnerships development and fundraising platforms to mobilise global development capital providers (i.e., donors, DFIs, climate funds, guarantees providers) to provide grant, guarantees, and investor capital for the S4H innovative financing facility.

Additionally, UNDP may also play a key role in coordinating with international donor agencies to align existing and future off-grid energy programmatic initiatives with S4H objectives (including coordinating the energy leasing payments and TA grants and/or incorporating flexibility into short-term funding timelines and mandates).

Finally, UNDP can support global alignment around the development of ITMO carbon markets under Article 6 of the Paris Agreement, to mobilise climate finance as a potential additional revenue stream for S4H healthcare facilities.

Initial feedback from a consultative workshop with GoL stakeholders indicate interest in further developing the S4H programme

The representatives of GoL have confirmed preliminary interest in pursuing discussions to investigate how the scale-up of the S4H programme could be implemented in Liberia based on the proposed mechanism. As an immediate next step, the participants to the workshop will seek an internal validation to officially engage in the S4H programme at their respective ministries. Subsequently, a more detailed ecosystem analysis that will identify the key stakeholders and further define their roles and responsibilities for the implementation phase.

The workshop participants underscored that it is essential to collaborate with relevant public agencies and further develop their previously launched energy initiatives. It would be desirable to extend the programme to a wider scope of public facilities, therefore achieving improved energy access and economies of scale.

UNDP has identified the Green Climate Fund (GCF) as a potential donor to support the leasing payments and Liberia is particularly well placed to benefit from GCF support for this programme given the GCF primary focus on least developed countries and Africa. UNDP has been working on a concept note for the GCF that shall be validated by the GoL to launch the programme implementation.

UNDP will be organising a set of follow-up calls with relevant ministries to continue engagement and align on next steps.

Based on these learnings, the following are recommended next steps and an implementation roadmap

- Draft and execute a Letter of Interest for the Green Climate Fund (GCF): as a concrete outcome of the country consultative workshop, UNDP is to coordinate with relevant government ministries to execute a Letter of Interest supporting a proposal request for funding from the GCF and its Project Preparation Facility (PPF);

- Develop memorandums of understanding between GoL and UNDP: UNDP will formalise partnership with relevant GoL stakeholders (including MOH, MLME, MFDP) setting out guiding principles for engagement on S4H innovative financing programme;
- Define S4H programme scope: MOH will conduct a comprehensive energy needs assessment, project selection and prioritisation, and budget sizing across its portfolio of healthcare facilities, in collaboration with UNDP and RREA; and
- Engage with donors, DFIs, and other capital providers: UNDP, relevant GoL stakeholders, and its financial transaction advisor will engage with donors and investors to mobilise early interest and/or commitments for the S4H programme; and
- Design and structure the S4H coordination platform financing model: based on the initial design of the PPP model in this feasibility study and MOH's operational design requirements, UNDP and its financial transaction advisor will develop a financial model and investment term sheet to fundraise with donors, DFIs, and other investors. The full design and launch of an S4H innovative financing facility in Liberia is expected to take 1-1.5 years.

