Shell Foundation Pilot Programme

for Innovative Financing and Project Solutions for Health Electrification

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Prepared by

ECA | UKaid from the British people | Transforming Energy Access | Power Africa | USAID From the American People | Shell Foundation | Odyssey




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Abbreviations and acronyms

CfP	Call for Proposals
CHAG	Christian Health Association of Ghana
ECA	Economic Consulting Associates
GBE	Green Business Environment
HFE	Healthcare facility electrification
KPI	Key performance indicators
MIGA	Multilateral Investment Guarantee Agency
RBF	Results-based financing
SSA	Sub-Saharan Africa
USAID	United States Agency for International Development

Acknowledgements

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AfrikPoll was responsible for gathering both baseline and endline data for the pilot programme.

The analysis and report were prepared by Elena Adamopoulou, Iro Sala and Adrian Pilco (Economic Consulting Associates), with support from Kathryn Fluehr (Odyssey Energy Solutions).

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1 Introduction

1.1 Objective and value added

Ensuring access to dependable, cost-effective, and contemporary energy services is paramount for the provision of health services and the robustness of health systems. Yet, despite the undeniable significance of energy access, a vast majority of health facilities in Sub-Saharan Africa (SSA) grapple with inconsistent power supply. Currently, approximately 15% of health facilities in SSA are without electricity access, while 41% suffer from unreliable electricity supply. In this context, off-grid solar photovoltaic (PV) systems emerge as a pivotal solution, offering environmentally friendly, steadfast, and economically efficient electricity to health establishments otherwise lacking consistent power. Over the past decade, solar technology has transformed into a technically and economically feasible solution, thanks to substantial cost reductions and technological evolution.

In the wake of increasing global efforts to electrify health facilities, the Shell Foundation and Odyssey Energy Solutions have partnered to address the balance between immediate deployment and sustainable development. As entities spanning renewable energy firms, development finance institutions, governmental bodies, and health agencies have unveiled and advanced initiatives to champion the electrification of health facilities, especially in the post-COVID-19 era, **a pressing challenge persists: finding the equilibrium between swift implementation and long-term sustainability**.

To test which financial strategies can allow for prompt execution, scalability, and enduring project sustainability, the Shell Foundation, in collaboration with Odyssey Energy Solutions, has pioneered the Shell Foundation Pilot Programme for Innovative Financing and Project Solutions ('the pilot programme'). The insights derived from the pilot programme are not just theoretical but anchored in tangible projects that aim to guide the design of future, larger scale health facility electrification programmes. As part of this initiative, 11 projects developed by six renewable energy companies have been commissioned.

One of the primary objectives of the pilot programme is to explore and identify the key factors of innovative financing solutions that can ensure timely deployment, scalability, and long-term sustainability of healthcare electrification projects. By doing so, the programme aims to strike a balance between immediate deployment and ensuring that facilities continue to benefit from reliable power sources in the long run.

Another key objective of the pilot programme is to demonstrate how technology can contribute to the scalability and long-term sustainability of healthcare initiatives. Odyssey manages over $1 billion of financing for distributed renewable energy on its platform, including a significant volume of health-specific projects. Odyssey's Powering Health Platform, developed with support from Shell Foundation, is intended to facilitate the design and implementation of health electrification financing programmes at scale and has played a pivotal role in generating insights for this particular pilot. More specifically, developers answered a Call for Proposals (CfPs) by modelling their projects and submitting due diligence information securely on Odyssey's platform. As sites have been commissioned, on-site energy and consumption data has been collected automatically through Odyssey's remote monitoring and control solutions or through integrations with third-party tools. Broader health and impact metrics, collected through surveys, have also been visualised alongside site data on Odyssey's analytics platform. Such data-driven insights are invaluable to support ongoing operation and maintenance, understand on the ground challenges and successes of the pilot programme, and, importantly, to inform future strategies.

The table and figure below summarise the healthcare electrification projects that were developed as part of the pilot programme.

Table 1 Overview of the healthcare electrification projects in the pilot programme

Developer	Country	Type of facilities	No. of facilities	Names of facilities	Size of facilities[1]
PowerGen	Nigeria	Private	1	• Ijebu Eye Clinic (3.2-7.5kWh/day)	Small-sized health facility (5-10 kWh/day)
Havenhill	Nigeria	Public	1	• Ace Medical Centre (no data)	Medium-sized health facility (10-20 kWh/day)
Nuru	DRC	Public	4	• Faradje Health Centre (1.6kWh/day) • Faradje Paediatric Hospital (no data) • Tadu Medical Centre of Saint Bakhita (2.8 kWh/day) • Grace Medical Centre (no data)	Medium-sized health facilities (10-20 kWh/day)
Zhyphen	Nigeria	Private	1	• Minna Health Facility (14kWh/day)	Medium-sized health facility (10-20 kWh/day)
ARESS	Benin	Private	2	• Saint Bakhita Hospital (4-82kWh/day) • Saint Luc Medical Clinic (8-20kWh/day)	Medium-sized health facilities (10-20 kWh/day)
Stella Futura	Ghana	Private	2	• Holy Family Hospital (1,472 kWh/day) • St Mary's Hospital (772kWh/day)	Large-sized health facilities (> 20 kWh/day)
Total			**11**		

[1] Based on the United States Agency for International Development (USAID) multi-tier framework system for distinguishing healthcare facilities.

Figure 1 Countries of engagement

Source: Odyssey's Analytics Platform. Note: The figure includes sites in Uganda that were not commissioned, as the developer, Equatorial Power, was unable to complete their participation in the pilot.

1.2 Methodology

The pilot programme was designed from the outset to effectively collect data on specific projects, while also distilling useful insights for future, larger scale initiatives. The pilot programme invited various developers to apply for the project through a CfPs. The CfPs was specifically advertised to the extensive developer network of over 2,000 project developers already engaging with the Odyssey platform. Developers used Odyssey's digital application portal, as well as its robust technical and financial project modelling tools, to submit their company and site information. Grantees were short-listed based on their proposed strategies for electrifying health facilities and were selected based on:

- Intended business model and scalability;
- Coordination with key health and energy stakeholders in their respective region or country;
- Structure of their existing electrification contracts and consideration of how those could support health-specific projects;
- Understanding of risks inherent in powering health facilities and potential mitigation strategies;
- Demonstrated ability to collect data about energy usage and broader impact on past health electrification initiatives.

The selected developers targeted health facilities of varying sizes and catchment areas and located in a variety of settings, including rural, peri-urban, and urban communities. As summarised in Table 1, the seven developers selected were: ARESS (Benin), Powergen (Nigeria), Nuru (DRC), Zhyphen (Nigeria), Stella Futura (Ghana), Havenhill (Nigeria), and Equatorial Power (Uganda).

Data was gathered from both the health centres and its patients before and after the pilot's implementation. The objective was to collect baseline data prior to the commissioning of the systems, while endline data were scheduled for collection at least three months post-commissioning. Given the varying commissioning dates across the 11 health facilities, the collection of endline data ranged from three months to a year after the systems were operational. For each set of baseline and endline data, two distinct survey types were conducted: one aimed at gathering information from the health centre, and the other designed to obtain feedback directly from approximately 50 patients at each facility. Challenges and learnings encountered during data collection will be discussed later in this report.

Data pipelines and dashboards were developed to standardise survey data and monitor system performance. Odyssey developed data ingestion pipelines to standardise the collected survey data. Additionally, visualisations were built on the Odyssey platform to effectively monitor key performance indicators (KPIs) and discern trends from the baseline to the endline data. To gather system performance data from various sites, Odyssey closely worked with teams on the ground to define technical requirements and install its remote monitoring and control hardware. With feedback from participating developers, Odyssey built detailed dashboards that aim to track metrics like battery state of charge, energy generated from PV versus diesel generators, and total energy consumption. Furthermore, alongside these technical dashboards, which are pivotal for the operation and maintenance of the systems, Odyssey also created high-level dashboards to provide Shell Foundation and external stakeholders with a concise, overarching view of the systems' performance.

Midway through the pilot programme, an interim report[2] was developed that offered insights into the progress, challenges, and achievements of the electrification projects. This report encompassed various aspects, including health facility categorisation, detailed explanations of business models, financing mechanisms, contract design, and an exhaustive list of KPIs for ongoing tracking. The KPIs developed as part of the mid-term report established a structured framework for the surveys. The report was subsequently presented to a consortium of key stakeholders, followed by a roundtable discussion to gather preliminary feedback on the effectiveness of the pilot programme.

The analysis presented in the final report is based on rigorous quantitative assessment of the health facility data, along with qualitative information and insights provided from stakeholder interviews. All the developers involved in the pilot programme were interviewed to gather insights, feedback, and recommendations. These interviews provided a first-hand account of the challenges faced, the strategies employed, and the outcomes achieved by each developer. Additional interviews were also conducted with financiers, who could offer their perspectives on the financial mechanisms, risk mitigation strategies, and innovative financing structures tailored to the profile of health facilities. The experience of financiers facilitated a deeper understanding of the unique challenges that need to be addressed when it comes to securing the necessary financial support for electrifying health facilities in a manner that is commercially viable and sustainable in the long-term.

It is important to acknowledge that the limited sample size did not allow for conclusive findings to be drawn. Therefore, the quantitative analysis undertaken in this study predominantly serves to supplement and validate the insights obtained from the stakeholder consultations.

[2] The report was prepared by E&K Consulting.

2 Financing for healthcare electrification

2.1 Investment needs

According to recent analysis by WHO[3], 63.5% of the healthcare facilities in SSA require electrification interventions, in the form of either a new connection or a backup power system, as illustrated by Table 2. The majority of facilities needing intervention are **non-hospitals**, such as community clinics and dispensaries, amounting to 110,058, compared to 4,889 hospitals. It is estimated that intervention type is roughly evenly split for non-hospitals, meaning that **new connections and backup off-grid system interventions** are required by similar amounts of non-hospital structures, while hospitals are primarily in need of off-grid system interventions.

Table 2 Breakdown of healthcare facilities, by region, type and intervention level required

Region	Type	Total	New connections			No. facilities that require a backup off-grid system	No. of facilities that require intervention	% of facilities that require intervention
			Total	Grid	Off-Grid			
LAC	Hospital	634	9	9	-	116	123	22.5
	Non-hospital	4,311	279	162	117	774	991	
SAR	Hospital	4,871	173	173	-	634	774	67.1
	Non-hospital	239,442	28,937	26,303	2,634	150,566	163,140	
EAP	Hospital	2,719	313	258	55	763	1,040	46.5
	Non-hospital	26,203	4,334	2,789	1,545	9,045	12,416	
SSA	**Hospital**	**9,679**	**1,368**	**824**	**544**	**3,893**	**4,889**	**63.5**
	Non-hospital	**171,347**	**65,513**	**35,648**	**29,865**	**57,715**	**110,058**	
Total		459,206	100,926	66,166	34,760	223,506	293,431	63.9

Source: WHO et al. 2023. Energising Health: Accelerating Electricity Access in Healthcare Facilities. https://www.who.int/publications/i/item/9789240066960

The countries considered in the analysis are in total 63 covering all world regions.

LAC: Latin America and the Caribbean region; SAR: South Asia region; EAP: East Asia and Pacific region; SSA: Sub-Saharan Africa region.

The total investment needed to close the electrification gap for health facilities in SSA is estimated at USD 2.5 billion, as detailed in Table 3. This includes USD 945 million allocated for hospitals, predominantly for the capex of off-grid systems, and USD 1,593 million for non-hospital facilities, mainly to establish new grid connections. More precisely, approximately 62% of this investment is necessary to provide initial electricity connections to 67,000 health facilities in the region. Additionally, around 62,000 facilities that currently have power will require backup systems due to the unreliable electricity supply from their existing

[3] WHO et al. 2023. Energising Health: Accelerating Electricity Access in Healthcare Facilities. https://www.who.int/publications/i/item/9789240066960

providers. Nigeria, Democratic Republic of the Congo, Kenya, Ethiopia and United Republic of Tanzania rank high in terms of total investment required, as shown in Table 4. In particular, non-hospital facilities are estimated to require larger amounts of investments compared to hospitals.

Table 3 Healthcare electrification investment needs by region and type of intervention needed

Region	Type	New connections CAPEX – grid (million US$)	New connections CAPEX – off-grid (million US$)	New connections OPEX – off-grid (million US$)	Backup system CAPEX – off-grid (million US$)	Backup system OPEX – off-grid (million US$)	Total NPC (million US$)	
							By type	Total
LAC	Hospital	2.7	-	-	13.8	8.0	24.6	33.3
	Non-hospital	1.5	1.2	0.1	3.9	2.0	8.7	
SAR	Hospital	46.9	-	-	89.5	60.0	196.5	1,961.3
	Non-hospital	277.9	32.6	17.4	928.0	508.9	1,764.8	
EAP	Hospital	47.2	16.5	7.7	113.6	55.4	240.4	374.8
	Non-hospital	28.7	20.7	2.6	56.7	25.8	134.4	
SSA	**Hospital**	**327.5**	**44.3**	**2.5**	**530.6**	**40.6**	**945.4**	**2,537.4**
	Non-hospital	**812.2**	**360.7**	**29.2**	**349.4**	**40.5**	**1,592.0**	
Total		1,544.7	475.9	59.5	2,085.5	741.2	4,906.8	

Source: WHO et al. 2023. Energising Health: Accelerating Electricity Access in Healthcare Facilities. https://www.who.int/publications/i/item/9789240066960

LAC: Latin America and the Caribbean region; SAR: South Asia region; EAP: East Asia and Pacific region; SSA: Sub-Saharan Africa region.

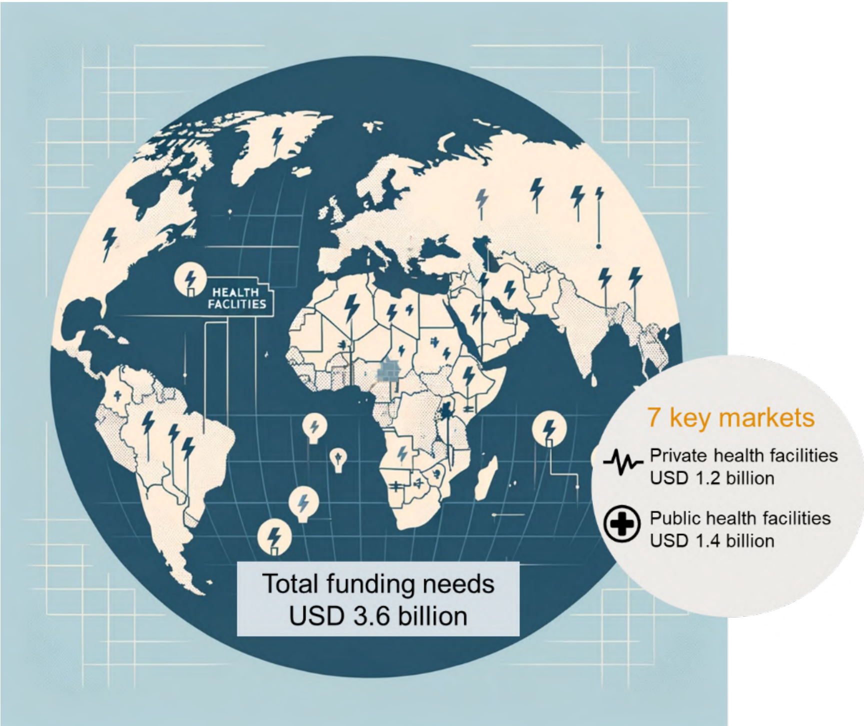
Table 4 Detailed investment needs assessment for key countries by health facility type

Country	Type	Total	New connections CAPEX – grid ($)	New connections CAPEX – off-grid ($)	New connections OPEX – off-grid ($)	Backup system CAPEX – off-grid ($)	Backup system OPEX – off-grid ($)	Total NPC ($)
Nigeria	Hospital	1,726	91,699,052	3,587,408	192,259	68,298,735	3,660,310	**167,437,764**
	Non-hospital	47,603	425,270,778	135,947,047	7,445,720	62,553,608	3,426,015	**634,643,169**
DRC	Hospital	536						
	Non-hospital	14,210	80,328,920	58,706,392	3,091,938	29,615,224	1,559,769	**173,302,242**
Kenya	Hospital	1,721	31,765,075	1,779,096	89,660	104,966,658	5,289,952	**144,890,441**
	Non-hospital	8,814	14,182,035	1,626,164	90,870	17,366,440	970,434	**34,235,944**
Ethiopia	Hospital	412	2,065,189			35,863,735	1,715,973	**39,644,897**
	Non-hospital	21,300	53,322,008	16,867,783	1,203,650	84,583,188	6,035,680	**162,012,309**
Tanzania	Hospital	265	2,856,788			19,271,764	1,063,263	**23,190,814**
	Non-hospital	6,837	27,308,462	8,565,438	1,644,520	6,177,462	1,186,041	**44,881,923**

Source: WHO et al. 2023. Energising Health: Accelerating Electricity Access in Healthcare Facilities. https://www.who.int/publications/i/item/9789240066960

A recent SEforALL report identifies a global funding gap of at least USD 3.6 billion for healthcare facility electrification. A recent report by SEforALL[4], focusing on seven key markets[5], made a clear distinction between public and private health facilities. It determined that the investment needs for healthcare electrification, among the seven markets, amount to USD 2.6 billion, with USD 1.4 billion allocated for public facilities and USD 1.2 billion for private ones. The study also accounted for variations in solar irradiation across countries to accurately estimate the size of the required systems and the corresponding total investment costs. By conservatively extrapolating the estimated funding needs from the countries analysed, the study projects a global funding gap of at least USD 3.6 billion for healthcare facility electrification (HFE), as shown in Figure 2 below.

Figure 2 Healthcare facility electrification funding needs



Source: SEforALL 2023

2.2 Approaches to securing financing

The large investment gaps for healthcare electrification imply that both private and public sector investments are required. Attracting private sector investment requires addressing the fact that both private and public facilities have higher risk profiles and more segmented markets than household electrification. Due to the diverse requirements of the health facilities in terms of energy demand and reliability of supply depending on the tier of healthcare they provide, as well as the different types of facilities (public and private) and associated risk profiles, a one-size-fits-all approach would not be suitable. Instead, it is essential to develop customised financing models to address their specific challenges of healthcare electrification.

[4] SEforALL et al. (2023). Health Facility Electrification Capital Landscape.
[5] Sierra Leone, Nigeria, DRC, Kenya, Malawi, Zambia, India

Health facilities are often viewed as high-risk customers by private energy service companies due to the significant payment risks associated with government transactions. This perception is fuelled by the low levels of government healthcare spending and, combined with insufficient understanding of the need for ongoing O&M, often leads to the failure of government entities to make timely payments. This is further exacerbated by the lengthy payment cycles of governments, sometimes exceeding 270 days, which act as a deterrent to private investment[6]. Concurrently, the heavy dependence on donor funding, traditionally aimed at asset purchase rather than service provision, does not mitigate this risk. Such funding typically addresses only the initial CAPEX without making provisions for O&M, leaving private entities vulnerable to payment uncertainties. Consequently, the private sector is very reluctant to invest in health facilities' electrification, particularly when it involves long-term contracts with governments.

Private facilities, on the other hand, are typically viewed more favourably by the energy service companies, but still pose risks that need to be addressed in order to attract adequate private sector interest. These facilities often struggle to generate sufficient income to cover their operational costs, while the limited energy demand of smaller facilities constrains the bankability of such projects.

Given the payment risk associated with both public and private facilities, public sector funding is typically required in order to catalyse private sector capital, through a blended finance approach. Concessional donor funds are a common component of the financial package used in the healthcare electrification context, with debt and/or equity typically forming the rest of the portfolio. The advantages and disadvantages of the financing instruments are presented in the table below.

Table 5 Key financing mechanisms

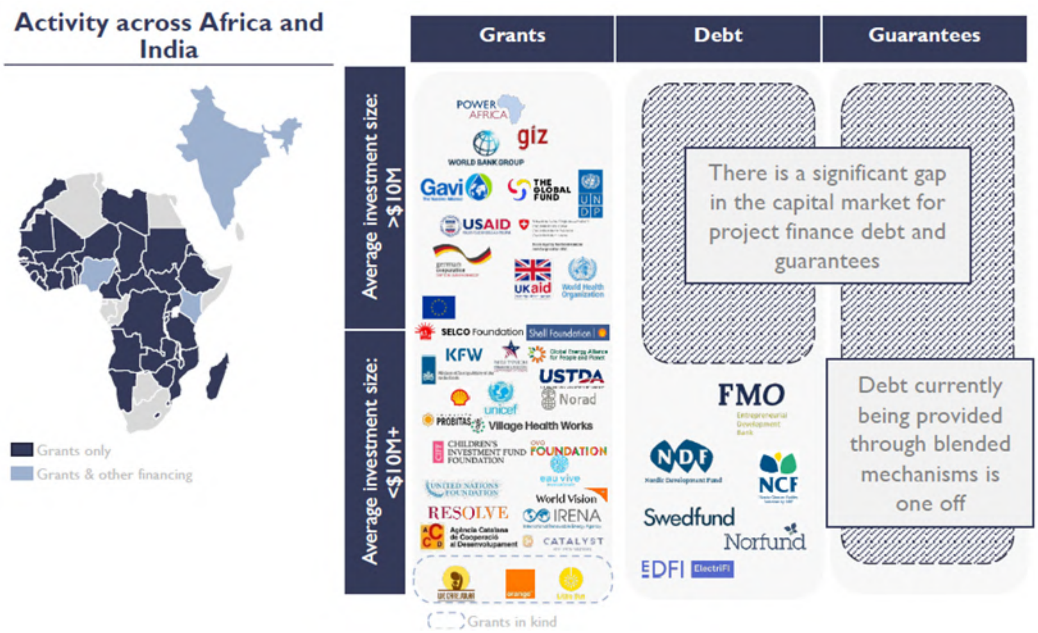
Financing mechanism	Advantages	Disadvantages
Grants	• Reduced financial burden on the health facility by lowering the payment instalments; • Can aid businesses in establishing track records and becoming investment-ready, particularly when paired with technical support or capacity enhancement; • Can motivate companies to engage in the electrification of health facilities which is perceived more risky; • If grants are linked to KPIs - the incentive structure can be tailored to various priorities; • Can generate detailed, frequent data insights if that is required as part of the grant disbursement criteria.	• Can often entail burdensome reporting requirements; • Can skew the market dynamics by favouring certain companies; • Risk of favouring larger companies; • Significant administrative costs associated with numerous small initial grants; • Monitoring validation and reporting processes can be costly for both businesses and donors.
Debt	• When combined with a guarantee facility, the developers' payment can be ensured in case the health facilities default • Offers immediate financing to cover working capital needs unlike results-based financing (RBF) models;	• Health facilities are often required to provide assets as collateral, which can be confiscated in case of default;

[6] SEforALL et al. (2023). Health Facility Electrification Capital Landscape.

Financing mechanism	Advantages	Disadvantages
	• Shifts the market in the direction of sustainable, commercially viable working capital loans; • Can provide liquidity in the banking sector; • Allows commercial banks to choose businesses for investment based on their standard commercial criteria,; • Can be used to improve access to finance in either local or global reserve currency.	• If not meticulously planned, it can overshadow and displace commercial investment; • Debt financing necessitates robust and viable business plans, which decentralised renewable energy companies may not consistently provide.
Equity	• Complete control and ownership of the project; • Reduced financial burden on the developer; • Equity investors share the risk of the project; • Equity investors are typically focused on long-term gains; • A higher equity share makes it easier to attract additional funding.	• Higher return expectations than other mechanisms; • Entails giving up a portion of ownership; • Future profits must be shared with equity investors; • Securing equity investors can take time; • Risk of overvaluing the project to attract investors.
Guarantees	• Can reduce the perceived risk for lenders, making them more willing to extend loans; • Can lower the cost of debt by reducing the risk of the investment; • The are versatile - can be structured in various ways to suit the specific needs of the project; • Can open up a range of financing options; • Can improve the credit rating of a HFE project.	• Obtaining guarantees can often involve navigating complex bureaucratic processes; • Might discourage thorough risk assessment and management; • They typically cover only a share of the loan; • There is limited availability of guarantees.

The majority of HFE initiatives use CAPEX grants for funding as shown in Figure 3. While there are initiatives that have relied on alternative funding options, such as GIZ's Green Business Environment (GBE) programme that experimented with a blended finance approach, the potential of commercial and blended financing solutions in this sector appears to be largely underexplored or underutilised. In nascent and risky markets, like the HFE sector, grant funding is essential. It enables these companies to engage in research and development, enhance their product offerings, fine-tune their business strategies, establish a solid supply chain, accumulate a track record, and prepare for investment. Furthermore, when these grants are paired with technical support and capacity-building initiatives, they can be very effective. This combination not only provides financing support but also significantly contributes to the development of a company's core team, equipping them with the necessary skills and knowledge to expand their operations.

Figure 3 Funding sources for HFE projects



Source: SEforALL 2023

Recent financial commitments to HFE initiatives are significant, yet they represent a small fraction of the total investment needed to effectively bridge the electrification gaps in HFE. Organisations such as the World Bank, USAID/Power Africa, UNDP, GAVI, the IKEA Foundation, and the SELCO Foundation have pledged to electrify approximately 98,000 health facilities in the coming years[7]. These commitments are a positive step forward, but they need to be strategically designed to ensure continuity and extension of programme duration, building on the progress of previous efforts. Despite these advancements, the challenge of electrifying health facilities remains substantial. According to recent analysis conducted by SEforALL, out of the total health facilities requiring new connections, only about 4% of hospitals and 7% of non-hospitals are currently covered by the secured funding for upcoming initiatives[8]. This disparity underscores the urgent need for increased investment and innovative financing solutions.

Mobilising grants and concessional loans is crucial for attracting private capital for funding HFE projects. Public funding, including grants and concessional loans, plays a pivotal role in this context. It not only provides the necessary capital to bridge the affordability gap but also acts as a catalyst in attracting private investments. By reducing the perceived risk and enhancing the feasibility of these projects, public funding can leverage private capital, thereby accelerating the pace of electrification in health facilities. This blend of public and private financing is essential to meet the growing energy demands of health facilities in underserved areas and is a critical component in achieving broader sustainable development goals.

Attracting private capital can also enhance sustainability. Currently only around 5% of projects in SSA included dedicated OPEX financing.[9] This can be the result of short project cycles and donor success metrics that are focused on shorter term outcomes. However,

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[7] SEforALL et al. (2023). Health Facility Electrification Capital Landscape.
[8] SEforALL. Forthcoming. State of the market report for health facility electrification.
[9] SEforALL et al. (2023). Health Facility Electrification Capital Landscape.

donors are increasingly acknowledging the need to transition towards more sustainable electrification efforts, by providing different forms of finance.

Donor agencies are becoming increasingly aware of the limitations of the current financing models for HFE projects. To respond to this challenge, there is a noticeable shift towards more innovative and potentially more effective financing structures. These new approaches include blending traditional grant funding with commercial financing, or tapping into impact investing, which aligns financial returns with positive social outcomes. This evolution in financing strategies reflects a growing understanding that diverse and flexible funding mechanisms are crucial for the sustainable development and expansion of HFE, especially in remote and commercially unattractive areas.

Despite the pivotal role of blended finance in catalysing private capital for healthcare electrification, there is also a need for targeted risk mitigation instruments. While grants are crucial in addressing affordability issues for health facilities, it is often the case that sufficient capital is not the key constraint for developers involved in healthcare electrification sector. Rather, it is the bankability of these projects that remains a challenge, which requires tailored instruments that address payment risk, including:

- **Lockbox mechanisms**: Timeliness of payment can be ensured via dedicated escrow accounts or lockbox mechanisms for ring-fencing government budgets. These mechanisms could help secure a budget to be allocated over the lifetime of the solar PV assets by enabling government prepayment upon budgetary allocation and holding donor-funded reserves.

- **Sovereign credit guarantees**: In the context of public facilities' electrification, these guarantees are crucial for mitigating the risk of the governments defaulting on their obligations, allowing developers to be at least partially covered for any debt obligations.

- **Liquidity pools**: Donors can help provide some certainty to developers regarding the availability of adequate funds to pay for the government's contractual obligations.

- **Protection against local currency devaluation risk**: Local currency debt or hard currency-indexed service agreements can be used to protect energy service providers from fluctuations in local currency. This is a crucial risk because energy service companies often receive payments in local currency but their financing obligations are in hard currencies.

Finally, securing financing for healthcare electrification should ideally integrate broader sustainability considerations. This implies the need to leverage financial mechanisms that go beyond traditional risk mitigation instruments, by opening up new sources of revenue for the health facilities. Not only do these mechanisms improve the commercial viability of such projects, but they also consider the desired outcomes of healthcare electrification through clean energy; increased provision of health services and a broader contribution to the SDGs, including climate change mitigation. Examples of such instruments include:

- **Asset financing**: Small-sized healthcare facilities often lack the necessary medical appliances, which limits their energy demand and prevents revenue growth, because of referrals to other higher-tier facilities. Asset financing can increase the commercial viability of electrifying small health facilities by enabling them to offer more services, thus leading to higher revenues and energy requirements.

- **Distributed Renewable Energy Certificates (D-RECs)**: These can provide a mechanism for healthcare facilities to monetise the environmental benefits of their renewable energy installations. Thus, project developers can access additional revenue streams that can be used to cover a portion of the O&M costs, while contributing to climate change mitigation efforts.

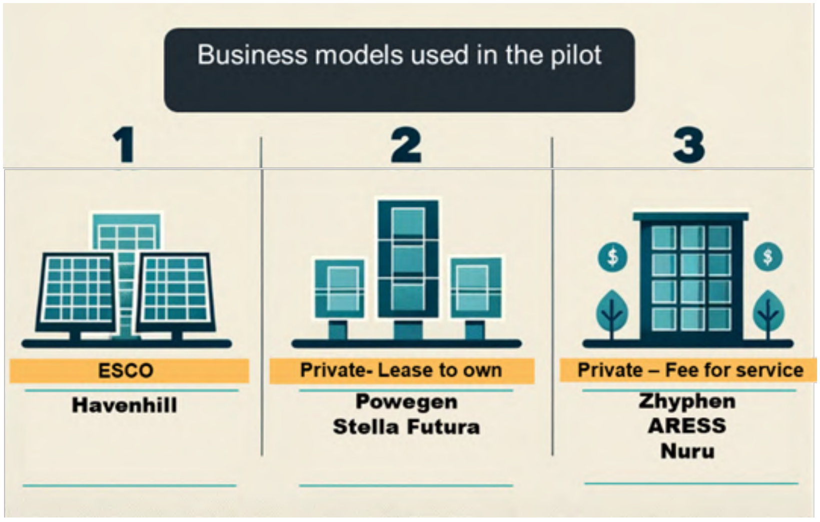
- **Peace Renewable Energy Certificates (P-RECs)**: In a similar way to D-RECs, P-RECs offer a way for developers to access additional revenue streams for their projects, but are applicable in fragile countries, whose unstable political and economic situation often deters investments in the sector, constraining access to finance for developers.

3 The experience of developers and health facilities

3.1 Business models

Three key business models, namely ESCO, lease-to-own, and fee-for-service, were used by developers participating in the pilot programme, presented in the figure below and summarised in the following sections. This categorisation separates the financing and operational aspects, under the assumption that business models reflect the operational aspects of the project (including whether the ownership is transferred or not), without distinguishing between different financing structures.

Figure 4 Categorisation of business models used by developers



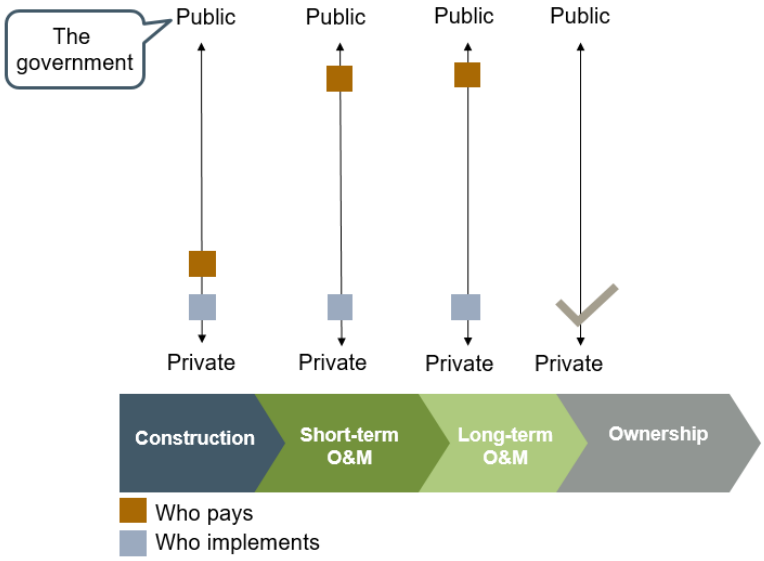
Source: ECA

Irrespective of the business model, developers relied on multiple sources and financial instruments to improve the financial viability and bankability of projects.

3.1.1 ESCO model

Under an ESCO model, a private company designs and installs the solar PV system and provides electricity services to public institutions over the duration of a contract with the public sector (government or donor), usually 10–15 years. In return for their services, companies receive a regular payment from the government or donor. These contracts often include performance indicators such as reliability of system supply, number of institutions connected, and available daily capacity. The figure below provides a schematic of the key features of this model.

Figure 5 ESCO model



Havenhill's experience

A Power Service Agreement was signed between the Oyo State government[10] and the developer. The agreement specifies a fixed amount to be paid, with the facility getting a predetermined amount of energy regularly. To ensure sustainability, a 10-year O&M contract was also signed, which requires the government to make a yearly payment, covering all O&M activities, including the replacement cost of the major components. In other words, rather than a direct agreement with the facility, Havenhill has an agreement with the state government under an Energy-As-A-Service model. Ownership of the assets remains with the developer for the duration of the contract, which can be renewed after the end of the initial 10-year duration. The length of the contract allows Havenhill to recover the costs, which requires approximately 5-7 years depending on the source and type of finance, according to the developer.

Havenhill's model was based on a **long-term performance-based contract**, whereby the yearly payment by the state government is hinged upon the continuous performance of the electrification systems. Thus, Havenhill is responsible for ensuring that KPIs (including target energy available each day to power loads and target availability of solar PV systems over a period of time) are met during the contract period, while the government pays on a regular basis. If the energy needs that are to be met through the installed system are not covered and have to be met through the diesel generator instead, Havenhill pays for **liquidated damages**, ie for the extra cost incurred. This approach ensures sustainability over the lifetime of the assets, given that the private sector can leverage its expertise to deliver long-term good-quality services.

Odyssey's remote monitoring system has been essential for validating performance against the agreed upon KPIs and serve as a trigger for payments by the government to Havenhill. In addition, to avoid oversizing the systems, thus adding an unnecessary financial burden to the facility, Havenhill required the facility to give prior notice in case they planned to acquire new equipment, so that the system size could be increased.

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[10] represented by the Commissioner for Energy and Mineral Resources

Figure 6 Havenhill's solar panel installation

Source: Havenhill

Havenhill's initial plan was to electrify public facilities, which pose idiosyncratic risks related to the government potentially defaulting on its payment obligations. Public facilities are under the general responsibility of the state government for staffing, salaries, and power. As explained in section 2.2, there is a high payment risk associated with governments due to limited budgets dedicated to healthcare, combined with a lack of understanding of the need for recurring O&M expenses. In addition, Havenhill had previously experienced significant delays in terms of payments by the government in another project[11], which led to the developer's reluctance to electrify the public facilities without a guarantee from the state government that would ensure the prompt payment of the service fee. In the absence of such a guarantee, Havenhill had to switch to a private facility.

In this context, Havenhill emphasised the need for guarantees, if public facility electrification were to be scaled up and become a key part of their business strategy. Escrow accounts or lockbox systems designed to ring-fence government budgets could ensure the allocation of funds throughout the lifespan of solar PV assets. These mechanisms enhance transparency regarding payment schedules, allowing the government to prepay upon budget allocation and hold reserves funded by donors.

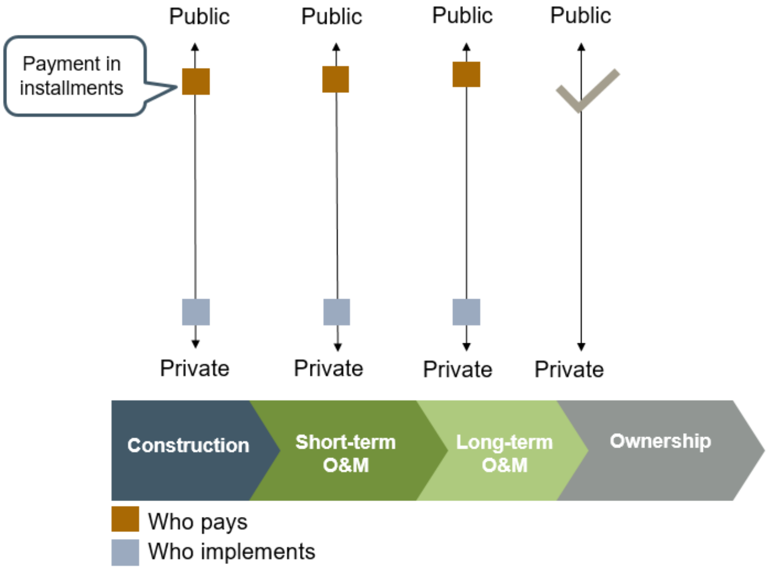
Grant funding was crucial for improving affordability. The grants by the Shell Foundation covered 50% of the CAPEX, which allowed Havenhill to reduce the payments required by the government. No debt financing was required, with the rest of the portfolio consisting of equity.

3.1.2 Fully private model – Lease-to-own

Under this model, beneficiaries (health facilities) pay the entire cost of the system, in small instalments over a period. After all payments are made, ownership of the system is transferred to the beneficiary. The figure below provides a schematic of the key features of this model.

[11] According to the developer, the payment by the government for the 1st year of service as part of a similar project was delayed by 2 years.

Figure 7 Lease-to-own model



Powergen's experience

An offtake and O&M contract was signed between the clinic and Powergen, for a duration of 15 years with potential extension. Payments are made based on the kWh amount consumed and aim to ensure reduced tariffs for the health facility to generate savings, while still maintaining commercially bankable returns. The agreement includes a **minimum generation guarantee and a minimum demand guarantee**. The minimum generation guarantee is particularly important when integrating solar with an existing diesel generator, as it helps to determine the solar power required to offset a significant portion of the health facility's energy needs, leading to a reduced reliance on the diesel generator and overall energy cost savings.[12] The minimum demand guarantee ensures that the health facility will consistently require a certain minimum amount of electricity from the off-grid system, which is crucial for financial planning and system sizing. The system is transferred at the end of the contract for a nominal $1.

Powergen used a combination of grants (42%) and debt (58%). The developer has stressed that a guarantee structure, in the form of a 3-month prepayment security, or a payment insurance guarantee, is crucial for catalysing private sector investment in healthcare electrification projects, which can be replicated in other countries. For instance, a guarantee reserve account ensures that the annual payments are made, as a third-party guarantor would step in to meet the health facility's payment obligations in cases of default. **Guarantee facilities** are key to addressing payment risk for both private and public facilities (also see section 2.2) because it reduces the payment and, thus, provides an incentive for private sector investment, but also enhances the resilience of the financing model when faced with external shocks (such as health or economic shocks). No issues with non-payment have been reported, according to a recent interview with Powergen.

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[12] According to Powergen, the system has typically performed well above the minimum generation guarantee, and when there was a technical failure of the system, the customer was refunded.

Stella Futura's experience

Stella Future has used a pay-as-you-go solution through a 15-year hire-purchase agreement. The monthly repayments over that period recoup the investment cost (in addition to O&M expenses). At the end of the agreement, system ownership can be transferred for $1, in which case training is provided to the facility's staff to be able to perform O&M. The facility also has the option to extend the agreement, so that the developer remains responsible for O&M.

Figure 8 Installation of Stella Futura's system

Source: Stella Futura

A distinctive feature of Stella Futura's approach was the use of climate finance mechanisms. Climate finance is starting to gain traction in the health electrification sector, as it creates significant co-benefits related to reduced greenhouse gas emissions. According to Health Care Without Harm (2019)[13], healthcare's climate footprint is equivalent to 4.4% of global net emissions. Additionally, enhancing the climate resilience of health facilities through the utilisation of low-carbon approaches is key for their adaptability to the impacts of climate change, especially in the context of extreme weather events and temperatures. Thus, leveraging climate finance mechanisms goes beyond addressing the electrification needs of health facilities towards aligning healthcare electrification with broader SDGs.

Apart from the combination of grants and equity, Stella Futura has leveraged **Distributed Renewable Energy Certificates** (D-RECs), which monetise the environmental benefits of the renewable energy installations at the health facilities. This carbon financing solution, in collaboration with Powertrust, helps to ensure financial stability, as well as improve affordability for the facility. In particular, the Shell Foundation grants reduced the hospital's financial burden by 40%, while the D-RECs further reduced it by 15%, resulting in a contract payment made in local currency, amounting to 13 USD cents per kWh.[14] D-RECs could offer a **sustainable, replicable solution** to the lack of funding for O&M once the facilities are electrified, given that the funds obtained by selling D-RECs could be used to cover a part of the O&M costs.

Increasing climate resilience and mitigating the healthcare sector's carbon emissions are complementary objectives and should be at the heart of healthcare electrification initiatives. This can be achieved through defining a set of standardised impact assessment indicators that align such initiatives with the relevant SDGs, namely SDG 3 (Good Health and

[13] Health Care Without Harm (2019). Health Care's Climate Footprint.
[14] Based on the Consultant's interview with Stella Futura

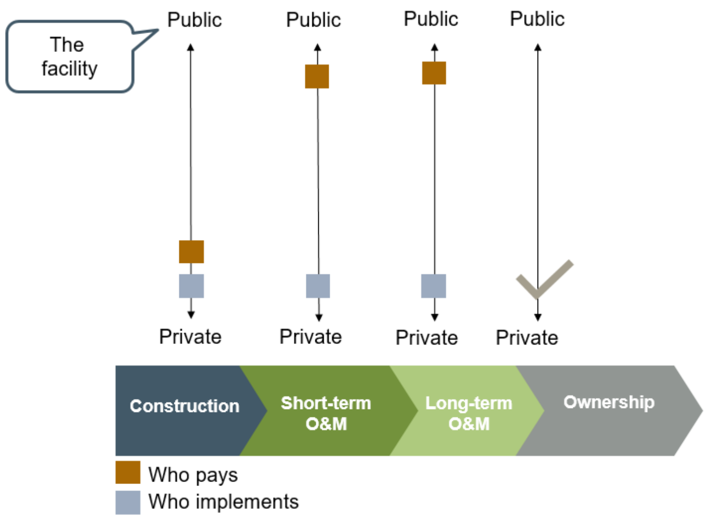
Well-being), SDG 7 (Affordable and Clean Energy), and SDG 13 (Climate Action). Adding climate and environment impact metrics to the list of KPIs typically used in the context of healthcare electrification projects presents a lot of potential for unlocking catalytic financing, which remains, to a large extent, untapped.

Stella Futura is expecting carbon finance mechanisms to play an even larger role in its portfolio going forward, in light of the recent bilateral commercial agreement between Sweden and Ghana targeting carbon credit financing (including for the healthcare segment) in Ghana.[15] Replicating this model in other countries should be made possible through an enabling regulatory framework that incentivises climate-smart investment and facilitates the transition of the healthcare sector towards net zero emissions in alignment with the Paris Agreement.[16]

3.1.3 Fully private model – Fee-for-service

Under this model, beneficiaries pay for electricity supply through a prepaid meter or monthly. If the beneficiary does not pay its monthly bill or the prepaid meter is not loaded, the solar system is turned off and the supply of electricity ceases. Unlike in the lease-to-own model, ownership of the system is never transferred to the customer. The figure below provides a schematic of the key features of this model.

Figure 9 Fee-for-service model



Zhyphen's experience

There is limited experience regarding Zhyphen's selected business model on the ground due to the delayed start of the project. The company was forced to switch from Mozambique to Nigeria (also see section 3.2), where it faced additional challenges due to terrorist activity adjacent to their health facility.

Zhyphen has leveraged a **fixed rate lease** model, with a **five-year agreement** whereby the facility receives a fixed amount of power at 30 pounds per month. Due to the increasing price

[15] Ghana-Sweden Cooperative Approach under Article 6.2 of the Paris Agreement – Carbon Markets Office
[16] The Lancet. (2023). Momentum builds for health-care climate action.

of fuel in Nigeria after the removal of government subsidies, the health facility was struggling to cover the electricity costs. Thus, the main objective of the off-grid system was to reduce the reliance on diesel and achieve significant cost savings for the facility. Zhyphen used a combination of grant and debt and emphasised the importance of grants for covering the upfront cost, in the context of a lease model. The simplicity of this model makes it easily replicable and scalable. At the end of the five-year agreement, the facility can make a final payment to take complete ownership of equipment (potentially using a grant) or can choose to continue paying (increased) monthly payments, in order to keep the equipment on-site. Zhyphen, however, has stressed that they acknowledge their social mission to support medical and educational facilities in gaining sustainable access to electricity, and they are willing to incorporate flexibility in their approach to achieve this goal.

ARESS's experience

ARESS, using a combination of grants and debt, employed a **fee-for-service model, with a** 10-year agreement for operating the system at a fixed monthly fee of $200. Under this model, the company provides energy service to the facility and ensures that the **system remains operational for as long as there is an active contract and the facility pays the monthly fees**. The long-term service provision gives an incentive to the company to ensure that high-quality components are used, enhancing the sustainability of this model. At the end of the contract, the customer is given the choice of **transferring ownership, continuing to rent the system, or terminating the contract**. In case the transfer of ownership is selected, a **'surrender' value** is calculated on the basis of the book value of the assets. The approach used by ARESS is impact-driven, as, according to the developer, the objective is to provide social infrastructures with clean energy to efficiently meet all their needs and enable them to improve the communities' living standards.

Figure 10 Installation of ARESS's system

Source: ARESS

Nuru's experience

Grant funding from the Shell Foundation allowed Nuru to deliver energy services to four health facilities in a fragile and conflict-affected setting like the DRC. According to the developer, grant funding was crucial for the viability of the project because of the remoteness of the sites and the associated high logistical costs; more specifically, Nuru has estimated that similar rural energy infrastructure projects in DRC would require significant grant funding in the short-term (approximately covering 70-85% of the project cost). The implementation of an **RBF approach within a grant funding framework** whereby funding is provided upon the achievement of set milestones, is key for expanding to less commercially viable areas in the context of a private sector-driven approach to healthcare electrification. Private companies naturally prioritise commercially attractive areas in the absence of incentives, leaving less profitable regions underserved. Thus, RBF mechanisms can be vital to ensure a more equitable distribution of electrification efforts, especially in critical sectors like healthcare. Nuru stressed the importance of the RBF structure of the grant for de-risking the project. In particular, Nuru's payments through the Shell Foundation's results-based milestones relied upon connecting and providing energy services to four healthcare facilities, verified via the Odyssey platform, and for delivering internal wiring services to these facilities.[17]

A small component of Nuru's financing approach was Peace Renewable Energy Credits (P-RECs). This instrument is similar to a typical renewable energy certificate, but it also certifies additional peace-building co-benefits. It is applicable in countries that are vulnerable to conflict, climate change and energy poverty. Thus, each P-REC represents one-megawatt hour (MWh) of renewable energy generated by renewable energy projects located in fragile states.[18] The DRC, where Nuru operates, is among the most fragile, climate vulnerable and energy poor countries in the world.[19] P-RECs present a significant opportunity for additional revenue that can cover a portion of the project costs, making it a replicable approach in other fragile countries. Nuru stressed that despite the total value of the P-RECs being relatively small (less than 1% of the overall project CAPEX), it was still of utmost importance given the high project costs.

3.2 Challenges faced by developers

Securing financing for the development of health facility electrification projects is undoubtedly one of the main challenges that developers face. As described in section 2.2, HFE projects are often seen as not bankable or financially viable within a developer's broader portfolios. With macroeconomic factors, such as interest rates soaring to exorbitant levels, as Nuru experienced, attracting investors becomes a challenging task. Depreciating local currencies can also get in the way of making a project financially viable, a dynamic experienced by Stella Futura, as they had initially expected to execute agreements with health facilities through dollar-based contracts. In addition, the heavy reliance on grants for projects, while beneficial, raises concerns about the sustainability and scalability of such endeavours in the absence of grant funding. This reliance on grants has sometimes led health facilities to

[17] Additional RBF financing was obtained through the World Bank for 100 connections of households, businesses, and other public institutions, as well as through the EU (both grant-based and RBF financing).
[18] Climate Finance Lab. P-REC.
[19] Energy Peace Partners.

expect to receive solar power at no cost, which was a hurdle cited by Equatorial Power.[20] Blended finance, combining grants, equity, and other financial instruments, emerges as a potential solution, but the landscape remains fraught with uncertainties.

Another key barrier that developers have faced is navigating the bureaucracy of government and regulatory approvals. As early as the site selection stage, ARESS, operating in Benin, ran into unforeseen limitations with the Ministry of Health's requirements for determining which health facilities to electrify. In particular, the Benin Ministry of Health requires private health centres to have a licence to operate, which requires a baseline level of access to electricity. Thus, ARESS initially selected private health facilities that did not have the appropriate licensure to operate. Furthermore, as seen with Nuru's experience in the DRC, delays in obtaining necessary permissions or in setting up regulatory frameworks can lead to extended periods of free electricity provision, straining the overall financial viability of the project. Moreover, in some regions, the absence of clear policies on renewable energy integration into existing grids can further complicate matters. Companies like Havenhill also highlighted the intricacies of regulatory compliance, emphasising the need for clearer guidelines and streamlined processes. Regulatory complexity played a key role in Havenhill having to shift their initial sites from a set of smaller public health facilities to a single regional private health facility. While Stella Futura was able to avoid delays through proactive engagement with Ghana's Ministry of Health, their choice to focus on health facilities operated by the Christian Health Association of Ghana (CHAG) led to several bureaucratic obstacles. For instance, the developer was required to seek approval in-person for the two projects during preset CHAG Board meeting times, which resulted in numerous delays getting contracts executed.

The geographical remoteness or unstable sociopolitical context of many healthcare facilities pose significant logistical challenges. Importing equipment over large distances, as Nuru experienced, not only introduced delays but also escalated costs. This challenge can be further exacerbated when the infrastructure, such as roads and transportation networks, is underdeveloped, making the transportation of heavy solar panels and batteries even more daunting. Uncertainty and difficulty in communication, as a result of sociopolitical instability and remoteness, led Zhyphen to move sites from their originally planned health facility in Mozambique to Nigeria. Even when switching to a country where they had existing projects and more familiarity, they encountered last mile shipment obstacles due to Boko Haram terrorist activity adjacent to their health facility.

The collection of data for impact assessment purposes also presents considerable challenges, which can lead to additional administrative burdens for developers, especially in programmes involving donor funding. Accurate and comprehensive data on the impact of health electrification projects is key to attract donor or investor interest. However, collecting baseline and endline data on the health facilities' equipment, types and quality of services offered, patient demographics, and general operations is no simple task, as survey implementation involves many different actors who have differing priorities and often requires navigating the complexity inherent in geographically remote sites. Where data collection is required, requirements and deadlines should be communicated to stakeholders early on to avoid confusion on who is actually responsible and when delivery is expected. Furthermore, the data collected needs to be cleaned and standardised so that comparisons can be drawn from pre to post system commissioning, as well as across a portfolio of projects. Surveying

[20] Equatorial Power was initially selected to participate in the pilot programme, but due to commitments from their selected health facilities falling through, were unable to complete their projects.

tools, like Kobo, can be valuable here for data validation purposes, as they allow for preset dropdown options, which improve data standardisation.

On the technical front, integrating renewable energy solutions with existing, often old and sub-standard grid and electrical wiring systems/infrastructure at health facilities presents its own set of challenges. Stella Futura's encounter with low-capacity transformers and inadequate wiring that required replacements and over-haul underscores the need for an electrical assessment and adjustments prior to installing solar systems to avoid delays. Furthermore, the transition from traditional power sources, like diesel generators, to solar solutions requires meticulous planning to ensure that consistent power supply is maintained to support fragile medical equipment at the health facility, a challenge highlighted by Zhyphen.

Beyond the technical and logistical aspects, renewable energy companies must also navigate the delicate balance between electrification and environmental concerns. Nuru's project near a national park highlights the potential conflicts between electrification efforts and environmental conservation. Engaging with local communities, understanding their needs and concerns, and ensuring that projects align with broader environmental and conservation goals is crucial.

3.3 Key trends in operational and financial aspects

Health facilities targeted

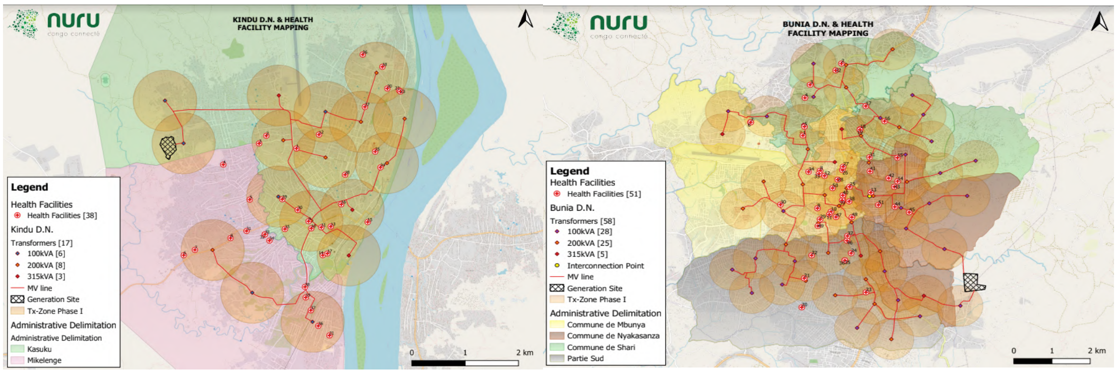
Most developers targeted healthcare facilities in remote or underserved areas, exemplifying the need for reliable electricity in these regions. The projects ranged from small health centres (in the case of Zhyphen, ARESS and Stella Futura) to medium-sized (in the case of Nuru and Havenhill) and large-sized facilities (in the case of Powergen), with some developers also integrating surrounding infrastructure like streetlights.[21] The proximity to conservation areas, as seen in Nuru's project, can introduce additional complexities, requiring a balance between electrification and conservation efforts.

In general, the focus was on remote areas, given the large disparity in access between the urban and the rural areas. In particular, in Sub-Saharan Africa, while the urban electricity access rate stands at 81% (of urban population), the rural access rate is only 29% (of rural population).[22] However, developers have also emphasised that there is still significant need for investing in renewable energy infrastructure to support healthcare facilities in peri-urban and urban areas. Advantages in those areas include the wider patient coverage that can be provided, as well as the larger pool of healthcare professionals to draw from for staffing these facilities.

For some developers, such as Nuru, healthcare electrification forms a core part of their business strategy, by integrating health facilities in their service expansion planning. The figure below provides a snapshot of the health facility mapping developed by Nuru, highlighting the distance of those facilities from the grid.

[21] According to an interview with Nuru.
[22] ESMAP. Tracking SDG7.

Figure 11 Nuru's mapping of health facilities in Kindu and Bunia



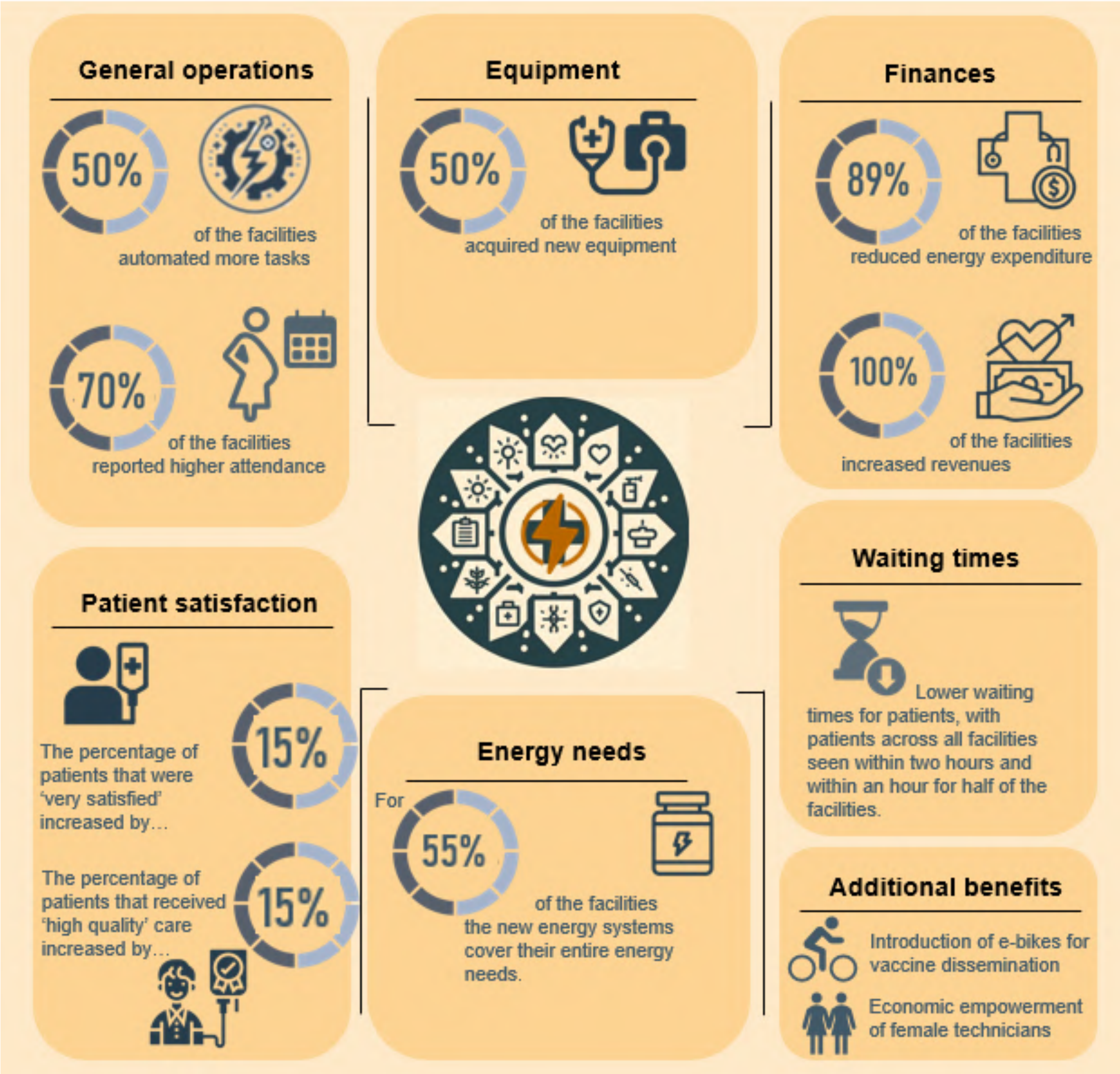
Source: Nuru

Impact on health facilities in the pilot programme

Electrification has markedly improved healthcare services by enabling facilities to extend operational hours, use modern equipment more reliably, and improve overall service quality, as evidenced by increased equipment purchases and reduced service interruptions.

Overall, electrification has had a profound impact on the operational efficiency and service quality of health clinics in the pilot programme. Some of the benefits of electrification through the pilot reported by healthcare facilities include the addition of services and the automation of tasks such as financial reporting, or the usage of electrical equipment to replace mechanical ones. The consistent power supply has enabled clinics to use machines and tools reliably, ensuring that essential services, such as the storage of vaccines, remain uninterrupted. Some facilities, which previously had limited operational hours for power-intensive rooms like theatres, can now run them more frequently, enhancing the quality and range of services offered to patients, which is reflected in patients' increased satisfaction. The impact of the pilot programme is summarised in Figure 12 below.

Figure 12 Summary of impact from the pilot

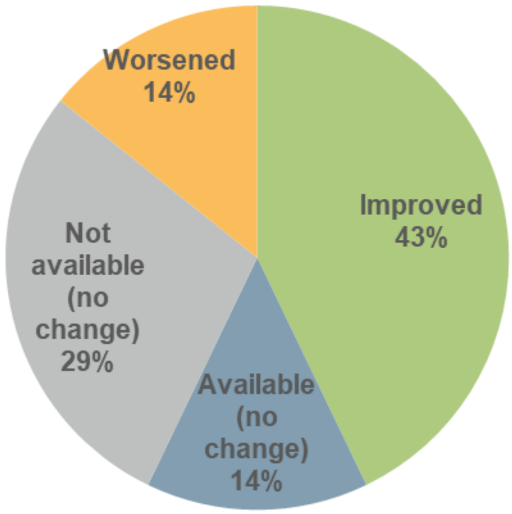


Energy needs

The pilot programme led to significant improvements in the availability of electricity at the facilities, which is crucial for the provision of quality health services and the functioning of medical equipment. The concern with regards to supply interruptions on healthcare delivery is well understood by developers. Zhyphen and Nuru, for instance, have emphasised the importance of system reliability in the context of critical loads of health facilities. Following the implementation of the pilot programme, 43% of the facilities reported an improvement on the availability of electricity during operating hours, as shown in Figure 13.

It is important to note that the facilities were asked regarding electricity availability over a seven-day period preceding each survey. Therefore, their responses should be interpreted alongside other relevant metrics. For example, Ace Medicare Community Hospital indicated no power outages during a randomly selected seven-day period in the baseline survey conducted before the pilot programme. However, they reported experiencing an outage during another randomly selected seven-day period following the pilot's implementation. Despite this, other indicators suggest an enhancement in both reliability and services provided to Ace Medicare Community Hospital. Consequently, this particular data point should be viewed within the larger context of overall improvements.

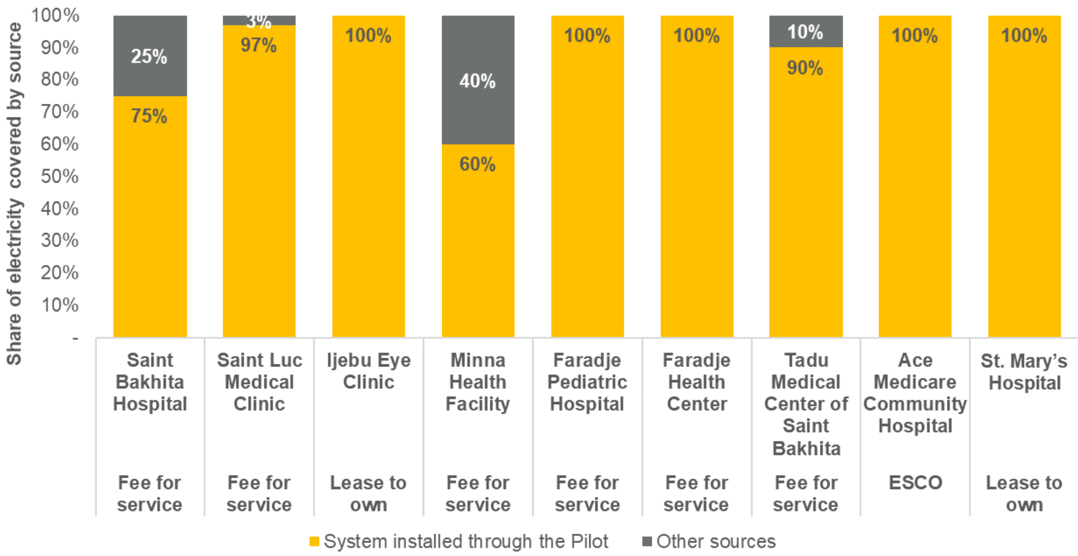
Figure 13 Availability of electricity during operating hours after implementation of pilot programme



Source: ECA, using data collected by AfrikPoll

Not only did the installed systems improve the availability of electricity, but they also covered the majority of the facilities' energy needs. In particular, 55% of the facilities that responded to the survey reported that the system installed through the pilot covers their entire energy needs. For the rest of the facilities, the system covered the majority of their needs, ranging from 60% to 97%, as shown in Figure 14. It is possible that where the fee-for-service business model is implemented, facilities might be more likely to maintain some of their secondary generation, potentially as a result of facilities committing to lower monthly fees in exchange for smaller systems.

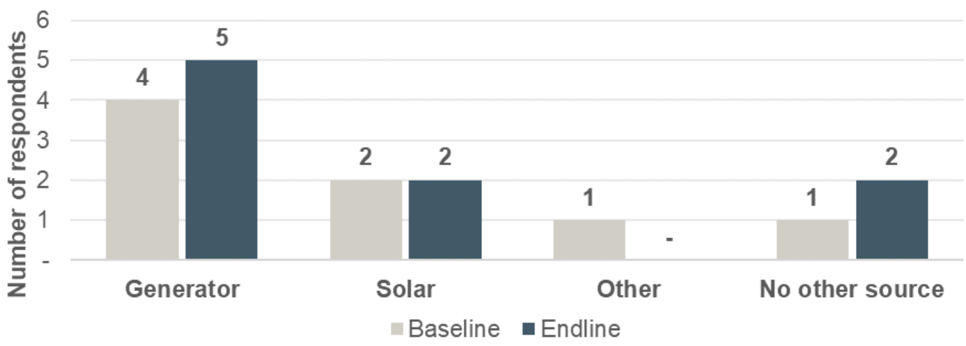
Figure 14 Share of electricity demand covered by source



Source: ECA, using data collected by AfrikPoll

Between the baseline and endline surveys, there was no substantial increase in the use of alternative electricity sources by the facilities, as depicted in Figure 15. This is crucial because it implies that the facilities did not seek auxiliary electricity sources since the installation of the system through the pilot. In addition, reliance on these sources has potentially been reduced significantly due to the pilot programme's system covering most of their electricity needs (see Figure 14 above), leading to notable cost savings and environmental benefits from reduced carbon emissions.

Figure 15 Other sources of electricity (not including grid or the systems installed through the pilot)

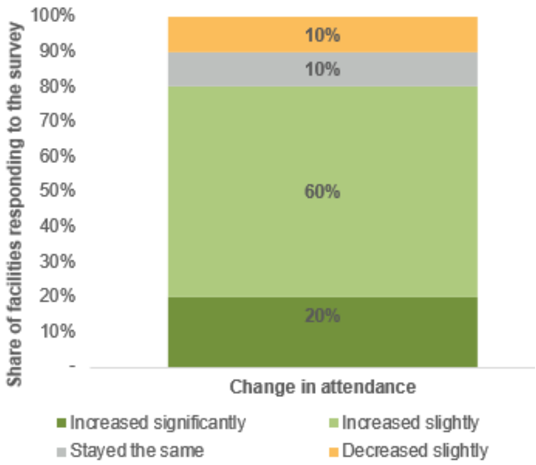


Source: ECA, using data collected by AfrikPoll

General operations

Attendance increased for all healthcare facilities following the pilot programme, with 80% of facilities reporting either a slight increase (60%) or a significant increase in attendance (20%), as shown in Figure 16 below. Of those that reported slightly or significantly higher attendance, 87.5% of the facilities attributed the increase to the electrification through the pilot programme.

Figure 16 Changes in attendance following electrification



Source: ECA, using data collected by AfrikPoll

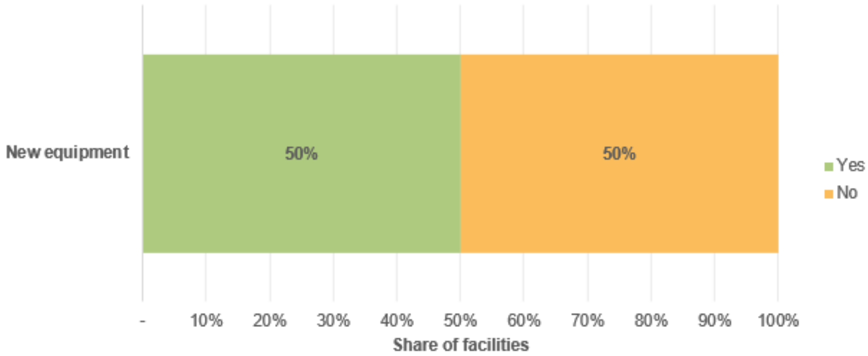
In addition, 60% of the facilities have been able to automate some manual tasks since the pilot's implementation. Tasks that become automated include laboratory analysis, including chemistry analysis, daily financial reports and other records, as well as water pumping.

Beyond powering the essential operations of health facilities, electrification creates opportunities for innovative solutions that extend the benefits of reliable electricity to the communities. The introduction of e-bikes by Stella Futura for vaccine dissemination and remote health care delivery is an example of how electrification can have broader positive impacts for public health. In this case, e-bikes leverage the electrified infrastructure to facilitate the swift and efficient delivery of vaccines to remote or difficult-to-reach areas at lower cost. Finally, some developers, such as Stella Futura, leveraged the opportunity to incorporate gender mainstreaming considerations into their service, by targeting 30% of the team of installers to be female. Stella Futura is also planning to sign an MoU with a female technicians association to strengthen the positive economic impact of electrification on women.

Services and equipment

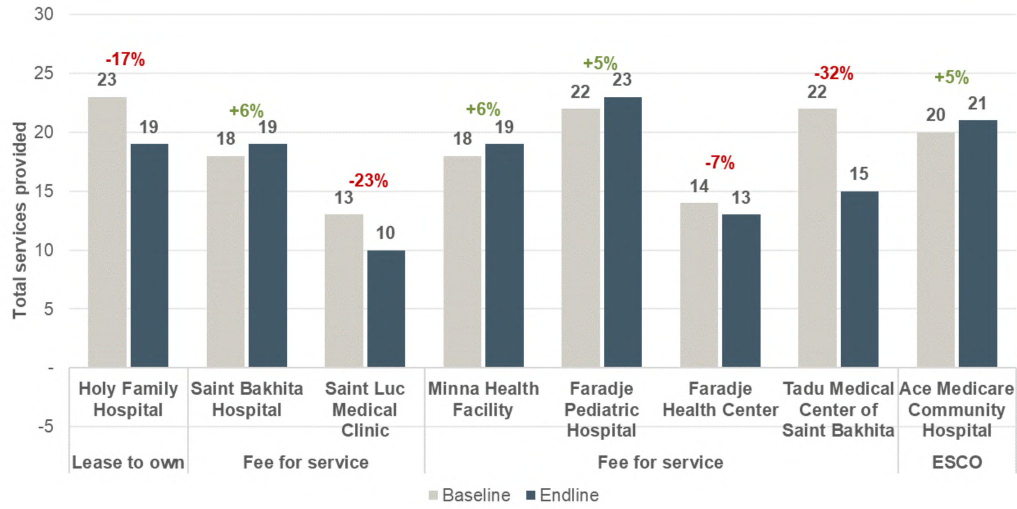
The increased availability of electricity at the facilities has contributed to the purchase of new equipment, with half of the facilities acquiring new appliances since electrification through the pilot, as shown in Figure 17 below. For example, Ijebu Eye Clinic and Faradje Paediatric Hospital reported the purchase of autoclaves, Saint Luc Medical Clinic reported the addition of communication and electronic medical record equipment, while Tadu Medical Centre, Saint Luc Medical Clinic and Faradje Paediatric Hospital reported purchasing cold chain equipment. Faradje Paediatric Hospital also reported purchasing lab testing equipment.

Figure 17 New equipment acquired following electrification



The electrification of facilities has allowed some facilities to expand their offering of services, with half of facilities reporting a higher number of services provided during the endline survey (Figure 18). Two facilities (Minna Health Facility and Tadu Medical Centre) reported that the introduction of chemical analysis and ultrasound services was the result of the electrification through the pilot programme. However, some facilities have experienced reductions in their services, which implies that adding new services may prove difficult for facilities even after improving their electricity supply as these may involve new specialists and adequate infrastructure. Overall, other confounding factors could be contributing to these changes in services provided.

Figure 18 Number of services provided (baseline vs endline)

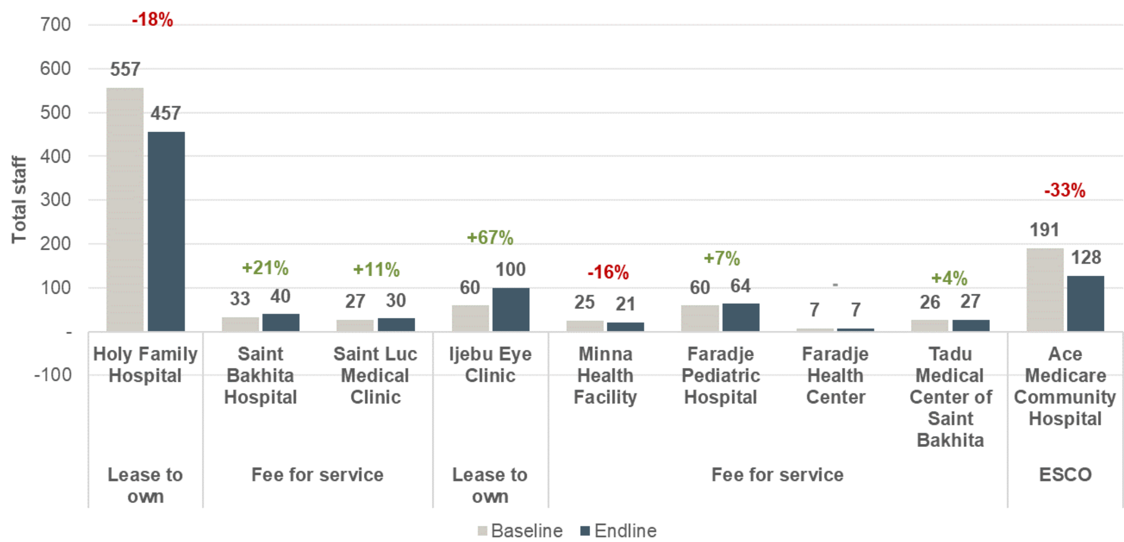


Source: ECA, using data collected by AfrikPoll

Staffing of healthcare facilities

The total number of staff across electrified facilities has increased substantially for 90% of the electrified facilities. Another benefit of electrification is that it has the potential to improve the working conditions of full time and part time staff, both medical and non-medical. Over the six months prior to the endline survey, most facilities reported an increase in the number of staff, with only 10% reporting a decrease. At the facility-level, some facilities reported increases on total staff of up to 67% compared to the baseline survey (see Figure 19). Overall, the increases are driven by the increase in full time staff, ranging from 4% to 69% with respect to the baseline. However, the increase in health facility staff may be influenced by various factors other than electrification, making it challenging to establish a direct causal relationship.

Figure 19 Total staff in healthcare facilities (baseline vs endline)

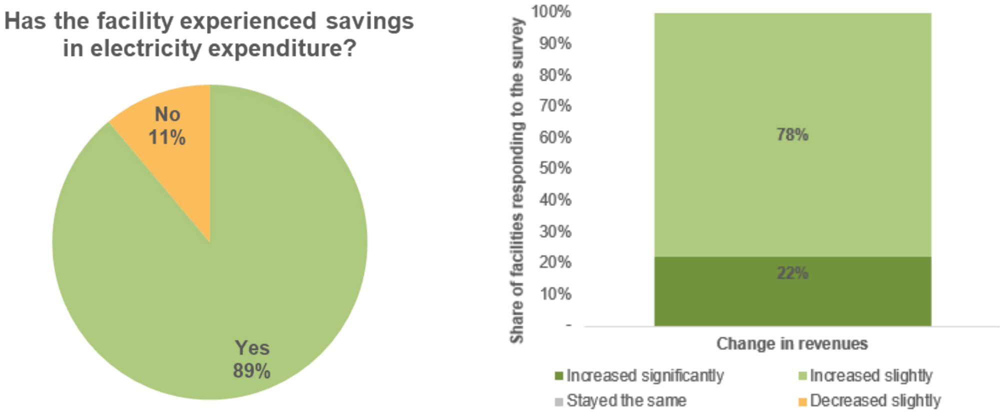


Source: ECA, using data collected by AfrikPoll

Finances

While data on facilities' expenditures and incomes is limited, the health facilities consistently reported savings in electricity expenditure and increases in revenues. The vast majority of facilities (89%) reported reduced energy expenditure since electrification through the pilot programme (see Figure 20). Furthermore, all healthcare facilities responding to the survey reported an increase in their revenues, with 78% of the facilities having significantly increased revenues and 22% slightly increased revenues.

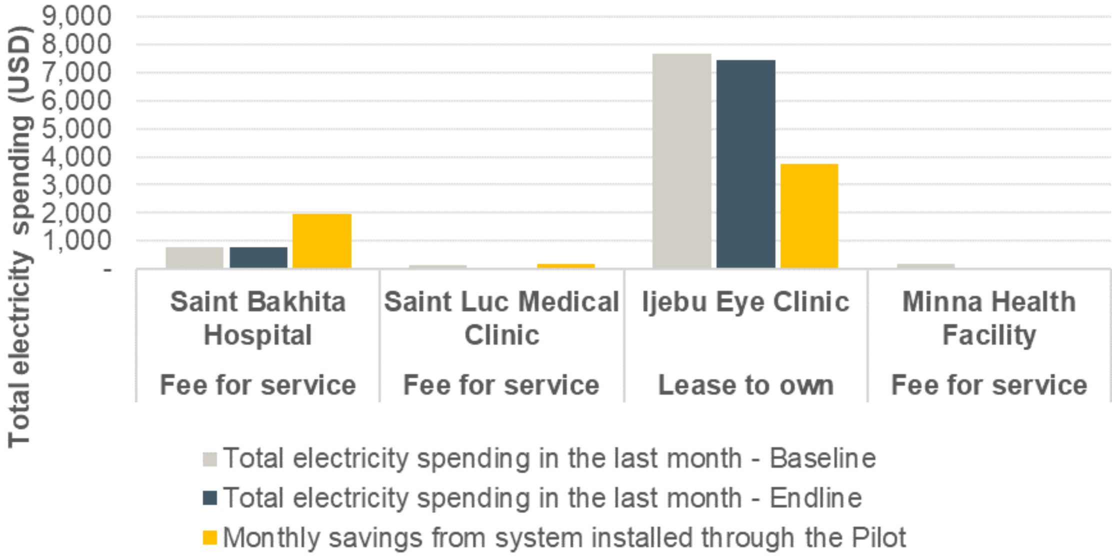
Figure 20 Reduced energy expenditure and increased revenues for the facilities following the implementation of the pilot programme



Source: ECA, using data collected by AfrikPoll

While the exact level of savings is difficult to quantify due to data limitations, the existing data points to substantial savings compared to the facilities' monthly electricity spending. Data from four facilities, shown in Figure 21, provides a rough indication of the monthly savings of each facility compared to their monthly electricity spending. The cost of the system installed through the pilot, on the other hand, is reported to be small compared to the facilities' annual expenditure (see Figure 22). While more data is needed to fully assess the significance of these savings with respect to the facilities' financial sustainability, such savings and reported increases in revenues serve as a good indicator of the financial benefits of the pilot programme for the facilities.

Figure 21 Monthly savings on electricity (baseline vs endline)

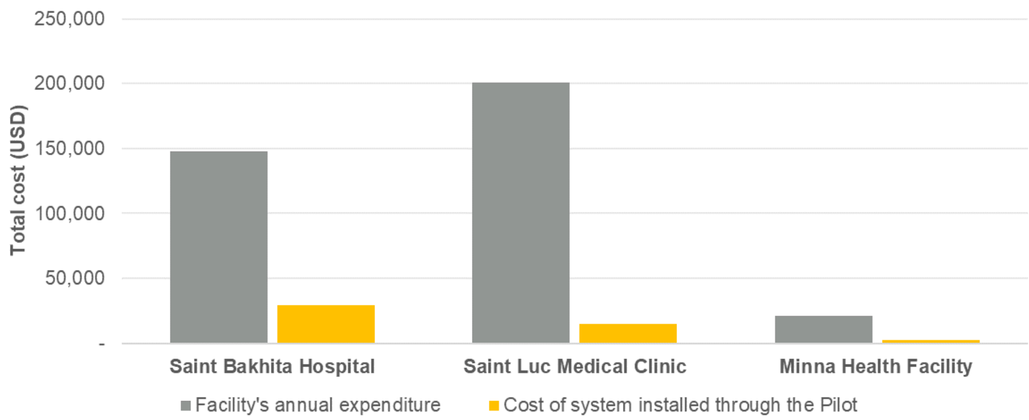


Source: ECA, using data collected by AfrikPoll

Note: The total electricity spending is not an average, but the actual spending in a given month (not necessarily the same in baseline and endline), while the monthly savings is an average.

More data is needed to assess the differences between business models in the savings they create for facilities of different sizes. In the pilot programme, monthly savings are lower in the lease-to-own model when compared against the monthly electricity spending of the facilities; while for the fee-for-service model, the savings are reported to be greater than their monthly electricity spending. However, this may respond to other factors such as the quality of grid service for each facility, their size, and the new investments made in equipment. Nonetheless, Figure 22 points to a low cost of the installed system when compared against the facilities' annual total expenditures, which may result in facilities opting to acquire the equipment at the end of the contract.

Figure 22 Facility's annual total expenditures vs cost of the system installed through the pilot

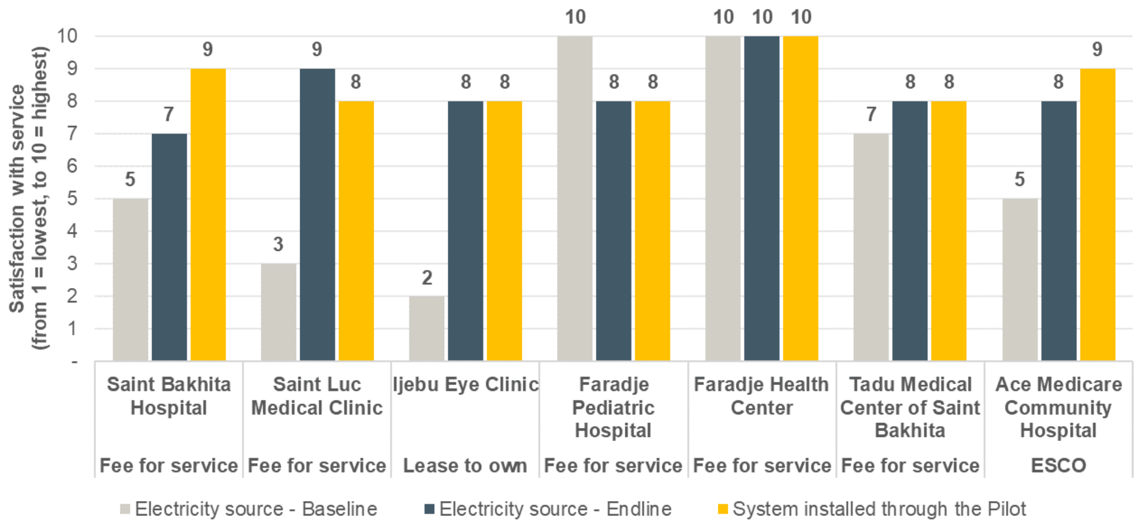


Source: ECA, using data collected by AfrikPoll

Facilities' satisfaction with the systems installed through the pilot programme

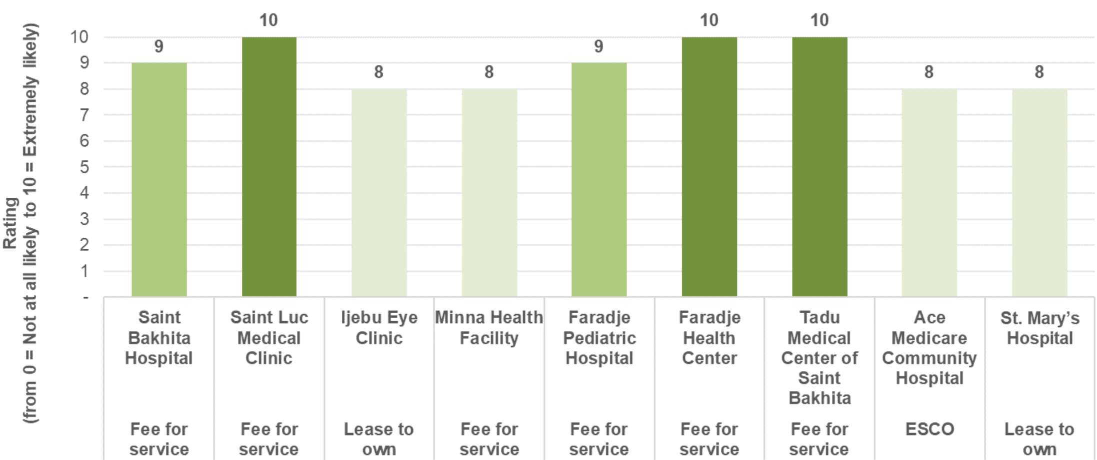
The pilot programme's implementation has garnered significant satisfaction among healthcare facilities, especially regarding their access to electricity. Prior to the pilot programme, some facilities reported unsatisfaction with their electricity supply, with most relying on auxiliary generation to function normally. Following the pilot's implementation, however, the levels of satisfaction when it comes to the electricity service increased, as reported by the facilities under all business models (see Figure 23). Unsurprisingly, all facilities reported a very high likelihood of recommending these systems to other facilities, as shown in Figure 24.

Figure 23 Satisfaction with electricity service – facility-level data



Source: ECA, using data collected by AfrikPoll

Figure 24 Likelihood of recommending the systems installed through the pilot to other facilities



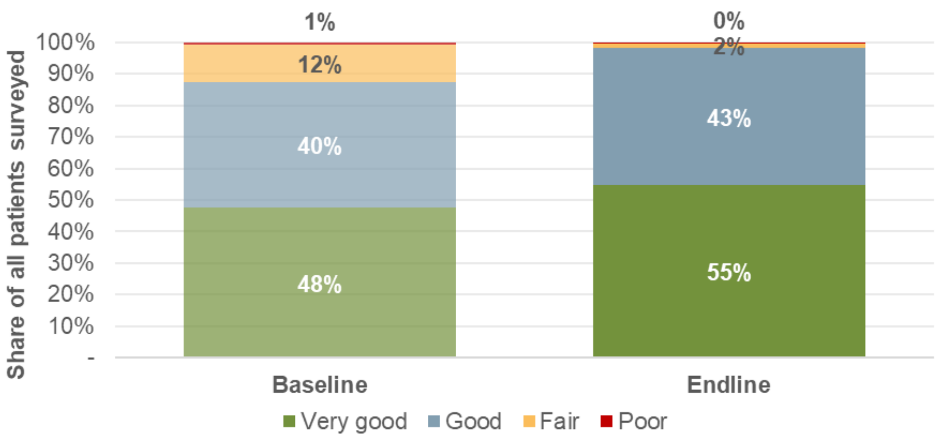
Source: ECA, using data collected by AfrikPoll

Healthcare facilities surveyed also highlighted other notable improvements, such as the timely availability of medical analysis results, improvement of patient comfort, better lighting in the facility, and a decrease of theft.

Patients' satisfaction with the services provided

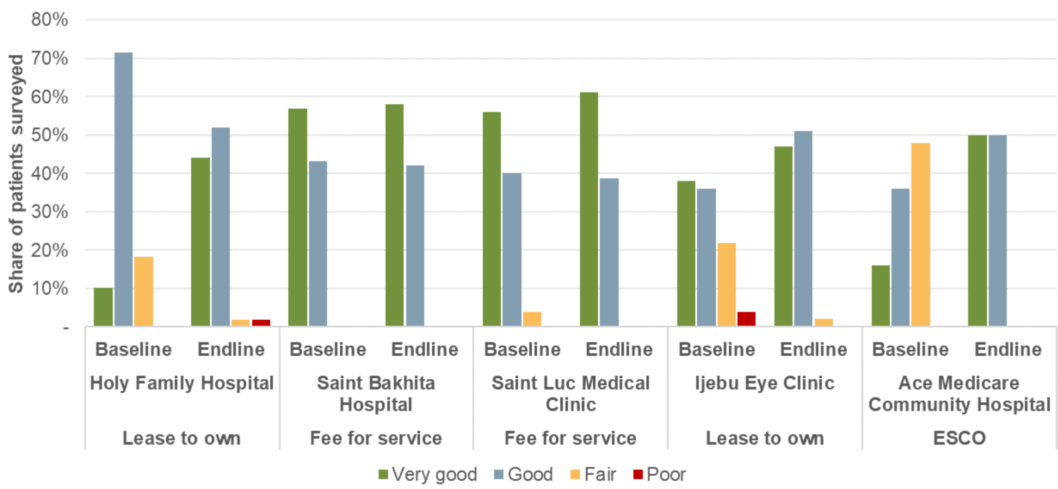
Electrification of healthcare facilities has improved the quality of care provided by the facilities, which is reflected in the patient data. Patients report a clear improvement on the quality of care of these facilities, with 98% rating the quality of care received very good or good, up from 88% in the baseline survey (see Figure 25). This is also reflected at the individual facility-level, with marked decreases of patients rating the quality of care as fair or poor in the Ace Medicare Community Hospital and Ijebu Eye Clinic (see Figure 26).

Figure 25 Quality of care (baseline vs endline) reported by patients



Source: ECA, using data collected by AfrikPoll

Figure 26 Quality of care at each facility (baseline vs endline) reported by patients



Source: ECA, using data collected by AfrikPoll

Reportedly, one aspect of the improved quality of care is reduced waiting times for patients. Patients at all facilities are now seen within two hours, with half of them

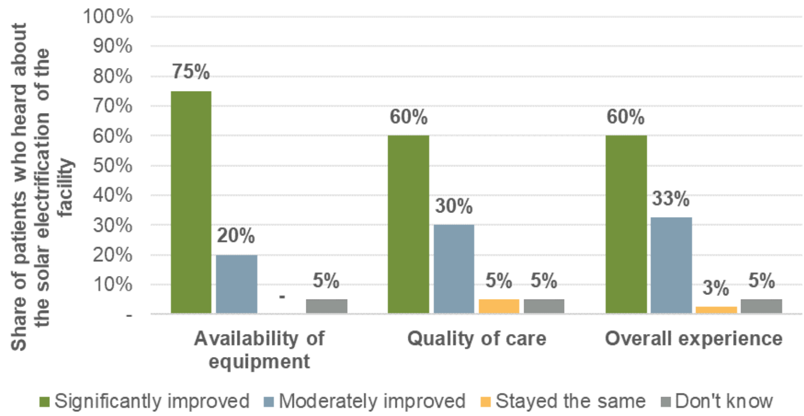
receiving attention within just one hour. Reducing waiting times is vital for patients, as it ensures timely access to medical care, thus minimising discomfort, preventing the exacerbation of health conditions, and improving overall patient satisfaction. In the examples shown in Figure 27, there is a clear improvement on waiting time for patients between the baseline and endline surveys, with the sole exception being Ace Medicare Community Hospital, though improvements are still shown with no patients reporting waiting times of above two hours.

Figure 27 Cumulative share of patients attended within a time period

Source: ECA, using data collected by AfrikPoll

Notably, from the subset of patients who have heard about the electrification of the facility through the pilot programme, the perception is overwhelmingly positive, with a majority perceiving a significant improvement in availability of equipment, quality of care, and overall patient experience, as seen in Figure 28.

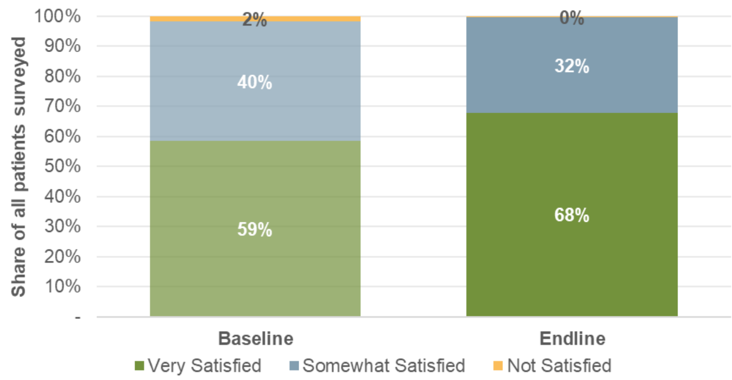
Figure 28 Perception of respondents who heard about electrification of the facility

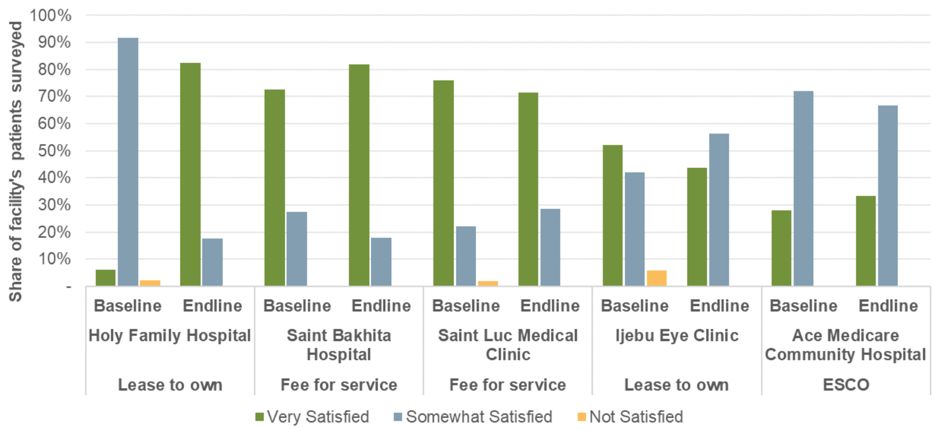


Source: ECA, using data collected by AfrikPoll

The aforementioned improvements in the service provided have led to higher overall satisfaction of patients with the facilities, with almost 70% describing their experience with the facility as very satisfied, an increase of almost 10% compared to the baseline survey, as shown in the figure below.

Figure 29 Reported patient satisfaction with the facilities (baseline vs endline)





Source: ECA, using data collected by AfrikPoll

Scalability

While some developers view health facility electrification as an opportunistic venture, others see it as a potential area of growth. In the case of ARESS, Zhyphen and Havenhill, collaborations with organisations like GIZ and Power Africa have opened doors for further projects, not just in healthcare but also in other social infrastructure categories, like education.

While there's acknowledgement of the positive impact of these projects, concerns about scalability persist. The heavy reliance on grants for health projects raises questions about the viability of scaling without such support. Some developers believe that for the next 5-10 years, such projects will require significant grant funding to be financially viable. However, as the sector matures, there will be a pressing need to transition towards more sustainable financing models.

DFIs play a pivotal role in supporting and financing electrification projects. Their involvement can significantly reduce tariffs, making projects more affordable for health facilities. Some developers emphasised the importance of DFIs providing guarantees against payment risks, especially for public healthcare facilities. Such guarantees can mitigate the challenges posed by potential default scenarios. As elaborated in section 2.2, it is the bankability of health electrification projects that remains a challenge for developers, rather than having sufficient capital, which points to the crucial role of DFIs in offering tailored instruments that address payment risk for both public and private facilities.

The regulatory environment is another important parameter for the scalability of health facility electrification projects. Nuru's interactions with the DRC government regulator, which resulted in them providing electricity free of charge for an entire year, is a testament to the challenges posed by regulatory hurdles. On the flip side, Stella Futura's proactive engagement with the Ministry of Energy in Ghana earlier in the project development phase demonstrates the potential advantages of navigating and collaborating within the regulatory framework.

Infrastructure and logistics also play a pivotal role in the scalability of electrification projects. For instance, Nuru's project in the DRC points to the logistical challenges inherent in the electrification of remote facilities, particularly when it comes to transporting equipment over large distances. Furthermore, the spatial constraints of a location can significantly influence the project's feasibility. Powergen's experience with the Ijebu Eye Clinic in Nigeria highlights how land availability at a site can dictate the size and type of renewable installations.

Long-term sustainability

The importance of O&M arrangements to ensure that systems remain operational and meet the longer-term needs of healthcare facilities was emphasised by all developers. The experience of developers in the pilot programme highlights the importance of the financing model accounting for the recurring O&M costs of the installed systems. While initial funding for the CAPEX is typically covered by grants from donors (with Shell Foundation grants playing a key role in the pilot for reducing the costs to the developers and the health facilities), all developers stressed that sustaining the long-term functionality of these systems requires ongoing financial support. Traditional approaches of electrifying facilities without ongoing O&M arrangements have not only undermined the long-term sustainability of health electrification initiatives, but have also created reputational damage for off-grid solar systems in some facilities, as noted by Powergen.

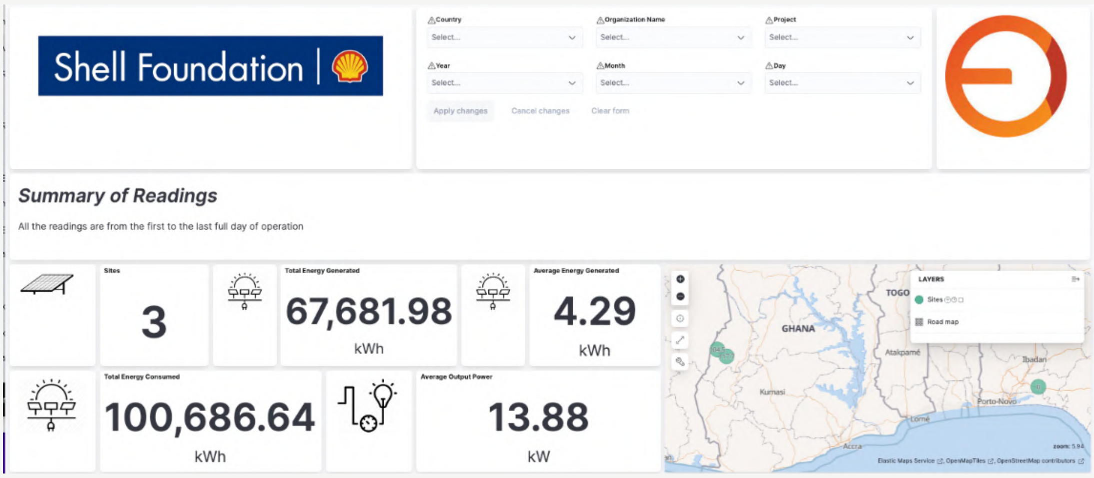
Remote monitoring is key to long-term sustainability as it reduces operational costs (as a result of fewer site visits needed) as well as the risk of theft and vandalism. Crucially, given that health facilities might acquire new appliances and equipment, remote monitoring can track load growth and plan system expansions before existing components are used sub-optimally. This is important for addressing the issue of oversizing the systems, which adds an unnecessary financial burden to the facility. Advanced systems can track metrics for individual appliances in health facilities, such as vaccine fridges.

In addition, remote monitoring technology ensures that any component failures are prevented or corrected through tracking performance metrics. Odyssey's technical dashboards and performance metrics are presented in the box below. Odyssey also directly integrates with third-party tools, like SparkMeter and Victron, so that system data can be easily aggregated regardless of which monitoring system is installed.

Box 1 Odyssey's O&M dashboard

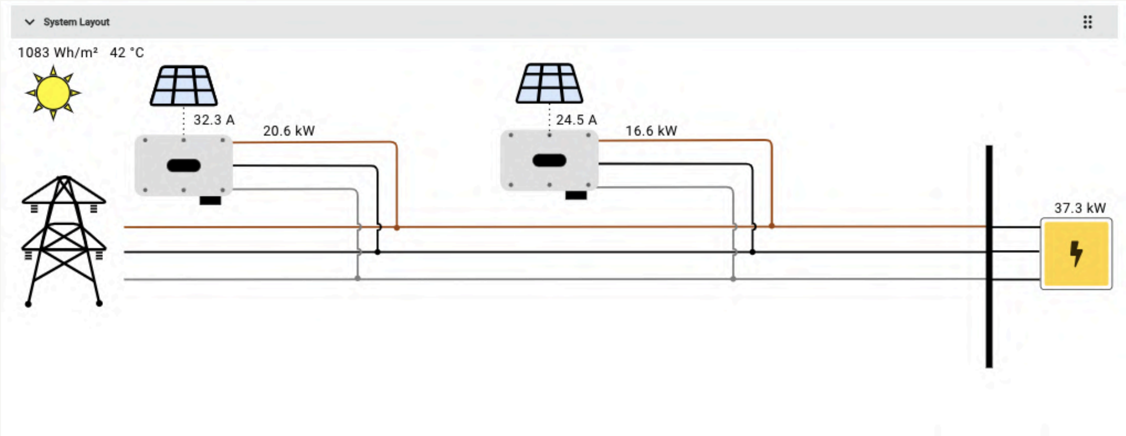
Odyssey's Fern monitoring hardware was installed at the pilot sites where remote monitoring tools were not already in place. The dashboard shown below aggregates and summarises detailed site-specific data to provide Shell Foundation and other external stakeholders with a zoomed-out view of the portfolio of sites. The data can be filtered based on location, developer, or project for further analysis.

Figure 30 Screenshot of dashboard monitoring high-level system data for a subset of the pilot sites



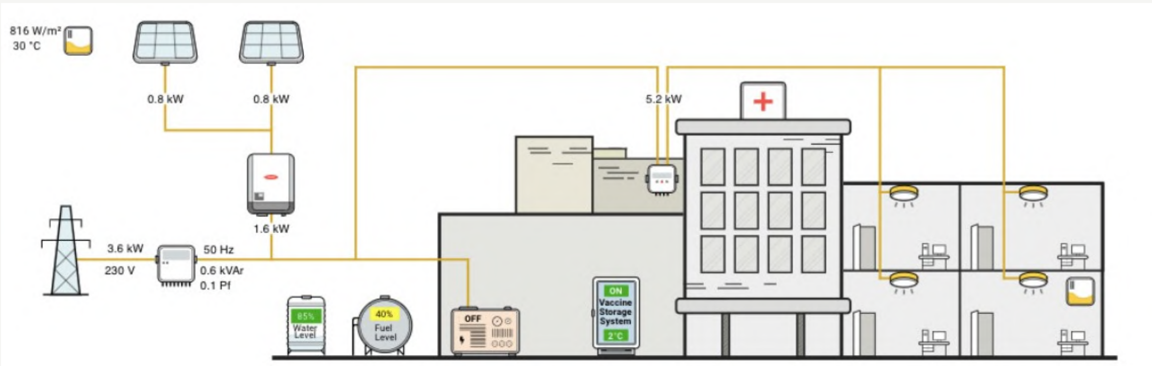
At the same time, granular dashboards give project developers and operators a detailed view of metrics, like battery state of charge, system uptime, and energy produced through PV, shown in the figure below.

Figure 31 Screenshot of layout diagram showing real-time data for Holy Family Hospital



Through communication with on-site sensors, Odyssey's FernHealth monitoring system also allows operators to track the temperature and energy usage of vaccine fridges and provides alerts if the temperature of that fridge goes above or below a certain predetermined threshold (see the figure below).

Figure 32 Screenshot of sample FernHealth dashboard collecting data from equipment on-site



Business models that entail a transfer of ownership (and long-term O&M responsibility) to healthcare facilities might do so at the expense of long-term sustainability, especially because these facilities typically do not have the capacity to manage the installed systems. Zhyphen, having employed a Lease model, has considered this challenge and emphasised the importance of simplicity in the design, so that the health facility staff can easily understand how to use it, given that they are not trained technicians and that managing the system would not necessarily be a priority. In most cases, developers provide some support to the staff while the contract is still active, in order to build capacity regarding key information about the basic maintenance of the installed systems and their efficient use.

Adaptability to the local environment and climate

Tailoring the design of off-grid solutions to local climate and environmental conditions is of paramount importance for ensuring the sustainability of the installed systems. Factors like sunlight exposure, temperature variations, and precipitation patterns, significantly affect the performance of solar panels. Additionally, understanding and adapting to local environmental factors, such as dust, humidity, and potential hazards, enhance the durability and longevity of the system. Zhyphen stressed the importance of tailoring the design to fit the local environmental conditions so that the system is resilient.

The World Bank's guidelines on off-grid solar systems for public facilities[23] also emphasise the importance of considering both the local climate and the specific operating environment of equipment when selecting components. For instance, the choice of battery technology should be based on project-specific considerations; lithium-ion batteries are preferable in terms of price and longevity, and they are less susceptible to degradation in warm temperatures. On the other hand, lead-acid batteries can be easier to fix and replace. Thus, selecting the type of battery technology might depend on the climatic conditions, as well as the availability of a pool of skilled technicians in the vicinity of the facility.

Energy requirements and energy efficiency considerations

Oversizing of the systems can lead to unnecessary upfront expenses and operational inefficiencies, which highlights the need for an accurate determination of the facilities' energy needs prior to the installation of the systems. This is typically done through an energy audit at each of the sites. In the case of the pilot programme, the developers considered the historical consumption patterns of the facilities.[24] Based on these needs, most of the developers installed modular systems, which have building blocks of system sizes that can be added as needed, in case of load growth. This modular system design drives down investment and operational costs, especially because costly retrofits in case of expansion are avoided.

However, it is equally important not to disregard the facilities' future energy needs. As a result of the energy cost savings due to the solar power, the health facilities might be able to acquire new medical appliances, which can lead to increased energy demand. Coordination between the facility and the developer can play a key role in preventing operational inefficiencies or the system falling short of the facility's energy needs. For instance, Havenhill asked to be notified in advance by the facility in case they planned to acquire new equipment, so that the system size could be increased. The developer also noted that new MRI machines that were acquired by the facility but were not yet operational were taken into account before sizing and installing the systems.

Energy efficiency should be prioritised when selecting equipment. Inefficient appliances increase the cost of powering health facilities exponentially, thus increasing their monthly energy expenditures. At the same time, the size of the installed systems might not be able to support the inefficient medical equipment. In the case of Zhyphen, the health facility proactively replaced the inefficient fans that were used with energy-efficient ones prior to the system installation, once they were informed that they would receive a predetermined, fixed amount of power as per the lease agreement.

Security concerns

Developers face a significant risk to the safety of personnel when operating in contexts with security issues, including political instability, terrorism, and violence, making project management and maintenance extremely challenging. The unpredictable nature of these

[23] World Bank (2021). Requirements and Guidelines for Installation of Off-Grid Solar Systems for Public Facilities.
[24] For instance, according to Zhyphen, details regarding the facility's energy profile were obtained through the clinic manager.

issues can disrupt project timelines, jeopardise investments, and hinder the implementation of healthcare electrification projects, which was the experience of Zhyphen in Nigeria.

Moreover, the perceived risk by investors can result in a reluctance to commit resources to projects in such environments. In fragile contexts with significant political uncertainty or security concerns, guarantees can play a crucial role in mitigating some of these risks that discourage private investment. The Multilateral Investment Guarantee Agency (MIGA) is one of key players in providing political insurance, as explained in the box below.

Box 2 MIGA guarantee and economies of scale

MIGA's political risk insurance safeguards investments against non-commercial risks such as war or civil disturbance or currency transfer restrictions, making it more attractive for private sector investors to engage in healthcare electrification projects that are often located in challenging or remote areas with uncertain economic conditions. MIGA is able to provide insurance coverage for 95% of debt and 90% for equity for up to 15 years, with an increase to 20 years in certain circumstances.

Scale is a prerequisite for a MIGA guarantee given the large ticket size of USD 1 million. Although there is no minimum number of facilities that need to be targeted, the ticket size will only be achieved by a large number of facilities (also depending on the cost of each system).

There are two stages at which sustainability is considered by MIGA as part of its due diligence process:

- At the project design stage: MIGA will need to be interacting with the government to ensure that the project is arranged in a way that promotes long-term sustainability;
- Once a developer is selected through a competitive process, the capacity of the developer, as well as the procedures followed (for instance, social and environmental safeguards) are thoroughly assessed.

It becomes evident that this due diligence process might be too burdensome, especially for developers with limited capacity to navigate complex procedural standards set by MIGA. During an interview with MIGA, the need for technical assistance provided by DFIs was emphasised that build the developers' capacity to conform with such standards.

Source: Interview with MIGA

4 Conclusion and recommendations

While it is difficult to draw any conclusions on the comparable suitability of each business model given the small number of developers per business model (and, thus, data points), the general trends with regards to the positive impact on health facilities seem to be consistent. On a qualitative basis, valuable insights can be drawn through the stakeholder consultation conducted as part of the final report. The recommendations provided in this section address the challenges faced by developers, reflect the broader experience of both the developers and the health facilities, and are closely linked to the objective of this pilot programme, as explained in Section 1.1, namely the identification of key financing and operational factors (including technology) that can ensure timely deployment, scalability, and long-term sustainability of healthcare electrification projects.

There's no 'one size fits all' solution

It is important to highlight that no single business model can be used as a solution to the challenge of electrifying healthcare facilities. The ESCO model, for instance, implemented in this pilot programme by Powergen, requires adequate governmental capacity, and technical assistance might be required to catalyse a shift in the common perception that solar power comes at no cost. On the other hand, fully private models, including lease-to-own and fee-for-service models implemented by the rest of the developers, lead to cherry-picking of the most viable sites or customers by developers. Alternative models not adopted in the pilot programme, such as an EPC model with long-term O&M, should not be disregarded, given that depending on the context, the enabling environment might favour it over other models.

Adopting a long-term approach, tailored to the employed business model is crucial. This would entail not just connecting health facilities to power sources but also ensuring the sustainability and reliability of these connections. It includes investing in renewable energy sources, implementing energy-efficient practices, and providing training for local staff on basic maintenance and management of the electrical systems. Such a comprehensive strategy would not only address the immediate need for electricity but also contribute to the long-term sustainability and resilience of health services in these regions.

Innovative strategies should be implemented to effectively address the constraints of public resources.

Given the limited public resources available for health facility electrification it is important to prioritise cost-effective approaches, through focusing on the 'low-hanging fruits'. This involves identifying existing mini-grids within SSA regions where health facilities remain unconnected. Despite the proximity of these facilities to mini-grids, they often lack access to reliable electricity, which is crucial for delivering essential health services. To address this gap, donor institutions and government agencies should conduct a comprehensive survey to pinpoint these locations and facilitate the connection of these health facilities to the existing infrastructure. This can also be done at the developer level; Nuru provides an example of conducting a health facility mapping to guide the developer's expansion of services. This approach not only maximises the potential benefit of utilising current resources but also ensures a quicker and more efficient electrification process.

Climate finance, including D-RECs and P-RECs represent key additional income streams that can partly cover the CAPEX, as well as OPEX through the ongoing sale of credits.[25] As part of the pilot programme, climate finance formed a component of the financial portfolio for Stella Futura (D-RECs) and Nuru (P-RECs), which covered part of the CAPEX. Given the large transaction costs associated with accessing such funds, climate finance would be best suited for projects of a considerable scale, or when developers have a large number of healthcare facilities in their portfolio.

Operating in fragile and conflict-affected countries poses its own unique set of challenges, which need to be factored in when deciding on the financing and operational approach of the developer. Security issues can put investments at risk and hinder project management and maintenance extremely challenging, which was the experience of Zhyphen in Nigeria. Tailored financing solutions, such as political guarantees need to be part of the portfolio in order to mitigate some of these risks and encourage private investment.

A holistic approach, taking into account the entire spectrum of health facility needs, should be adopted instead of focusing exclusively on connections.

Increased attention needs to be given to the ability, or lack thereof, of healthcare facilities to improve healthcare provision through electricity access. It is often the case that small-sized healthcare facilities lack the necessary medical appliances, which limits their ability to provide the necessary services and prevents revenue growth, because of referrals to other higher-tier facilities. A holistic approach to healthcare electrification would need to include asset financing, which enables facilities to offer more services, leading to higher revenues and increased commercial viability of electrifying them.

A detailed demand assessment when designing the systems is crucial for reliability of supply and cost reduction. Continuous power supply is necessary for the effective provision of healthcare services and the functioning of critical medical equipment. An accurate assessment of the energy needs of the facility not only ensures the adequacy of power, but also prevents the oversizing of systems and unnecessary upfront costs.

Energy-efficient appliances (such as lighting and medical equipment), as well as energy-efficient buildings (through natural ventilation and insulation) will have to be a priority in the context of climate change. Reducing energy needs through energy efficiency measures can make healthcare facilities more climate-resilient, by reducing the negative impacts of extreme weather events. An additional benefit, which is crucial in light of the typically tight healthcare facilities' budget is cost reduction; energy efficiency measures for healthcare facilities in India have the estimated potential to reduce required solar panel capacity by 56% and costs by 55%.[26]

Communication and data sharing is key to the sustainability of healthcare electrification efforts.

Remote monitoring technology is an integral component of a sustainable healthcare electrification programme. When it comes to financing solutions, **remote monitoring**

[25] SEforALL (2023). Climate Finance for Powering Healthcare.
[26] SELCO Foundation (2022). SDG7 for primary healthcare infrastructure.

technology plays a crucial role when issuing RECs, discussed above, given that a remote monitoring platform is required to process electricity generation data and push it to the REC platform for the certification to be issued. Remote monitoring also enables the effective implementation of RBF schemes, as it allows for the release of payments to be tied to the achievement of specific measurable outcomes. When it comes to operational aspects, having a mechanism for tracking ongoing O&M is critical for long-term sustainability. Remote monitoring tools can track performance metrics and load growth, ensuring that component failures are promptly detected and addressed by on-site teams, while also reducing operational costs.

Effective collaboration and communication between the developer and the healthcare teams on-site needs to be established early on and maintained throughout a project. Accessing resources in the form of grants or other public funding schemes requires the monitoring and reporting of impact metrics through impact assessments. Data collection processes need to be efficiently managed through close coordination with on-site teams to minimise delays, combined with a clear understanding of the KPIs of interest for which data needs to be collected.

The pilot programme for healthcare facility electrification has demonstrated the transformative impact that healthcare electrification has across multiple dimensions, from operational efficiency to patient satisfaction. This project, targeting health facilities predominantly in remote and underserved areas, has proven the critical importance of reliable electricity in enhancing healthcare delivery. Our analysis underscores that the electrification of these facilities, through various business models, significantly boosts their operational capabilities, enabling the acquisition of new equipment, extension of operational hours, and improvement in the quality of care. Moreover, the project's focus on sustainable and scalable solutions has set a foundation for long-term benefits, not just for the health facilities but also for the communities they serve. The key learnings from this initiative, and the financing models implemented, pave the way for future efforts, highlighting the importance of tailored, context-specific strategies, efficient data management, and strong collaborations to optimise the electrification of healthcare facilities.

Annexes

A1 List of interviewees

Interviewees
Developers
ARESS
Havenhill
Powergen
Nuru
Stella Futura
Zhyphen
Others
Crossboundary
MIGA