Briefing on
Healthcare Electrification
in Humanitarian Settings

United Nations Institute for Training and Research

GPA GLOBAL PLATFORM FOR ACTION

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AUTHORS

Jonathan Archimi, Shahaab Javeri, Katherine Patterson

PEER REVIEWERS

Salvatore Vinci, Hajar Al-Kaddo, Lama Gharaibeh, Marilena Lazopoulou, Aimee Jenks

DESIGN

Élise Taponier

GPA COORDINATION UNIT SUPPORT

Aimee Jenks, Paola Acevedo, Mariana Soto, Sadiq Zafrullah, Mark Gibson

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Reliable electricity access enables better monitoring of maternal health

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Acronyms and Abbreviations

BOT	*Build-Own-Transfer*
DRE	*Distributed Renewable Energy*
EPC	*Engineering, Procurement, and Commissioning*
ESCO	*Energy Service Company*
GEAPP	*Global Energy Alliance for People and Planet*
GPA	*Global Platform for Action on Sustainable Energy in Displacement Settings*
HEPA	*Health and Energy Platform of Action*
HETA	*Health and Energy Telecommunications Alliance*
HHF	*Humanitarian Healthcare Facility*
ICRC	*International Committee of the Red Cross*
IDP	*Internally Displaced Person*
INGO	*International Nongovernmental Organization*
IOM	*International Organisation for Migration*
IRENA	*International Renewable Energy Agency*
kWp	*Kilowatt Peak*
kWh	*Kilowatt Hour*
MMR	*Maternal Mortality Rate*
MSF	*Médecins Sans Frontières*
NRC	*National Red Cross*
O&M	*Operations And Maintenance*
PPA	*Power Purchase Agreement*
PPP	*Public-Private Partnership*
S4H	*Solar 4 Health*
SDG	*Sustainable Development Goal*
SEforALL	*Sustainable Energy for All*
SIDS	*Small Island Developing States*
TENN	*The Energy Nexus Network*
UNDP	*United Nations Development Programme*
UNHCR	*United Nations High Commissioner for Refugees*
UNICEF	*United Nations Children's Fund*
USAID	*United States Agency for International Development*
WHO	*World Health Organisation*

Executive Summary

In the wake of the COVID-19 pandemic, there has been growing momentum to improve healthcare services globally and achieve SDG 3: Good Health and Well-Being for All. Energy access represents a significant barrier to effective healthcare delivery, and it is estimated that globally, 1 billion people seek care from facilities that have unreliable electricity or none at all. The issue is particularly acute in sub-Saharan Africa, where only 28% of healthcare facilities have reliable electricity supply. Development partners in the energy access and healthcare spaces have sought to tackle this challenge by launching several large-scale partnerships to close the global healthcare electrification gap, in many cases by leveraging the potential of distributed renewable energy sources, and in particular, solar technology.

The healthcare electrification gap is particularly acute in fragile and displacement settings, where many facilities are underpowered or completely without electricity. These facilities are commonly funded and installed by humanitarian organisations leading emergency response activities, often in partnership with government health authorities. Yet ensuring long-term operation and maintenance (O&M) of these systems has proven to be a persistent issue. There is also limited funding available from the humanitarian sector to expand these systems to meet higher demand, and they are more likely to be excluded from national electrification planning.

The present report led by the Global Platform for Action (GPA) on Sustainable Energy in Displacement Settings with the support of NORCAP defines the humanitarian healthcare electrification gap and identifies its causes. In particular, challenges that hinder the maintenance and expansion of the electricity supply to these facilities include short-term humanitarian budget cycles, a lack of financial and management capacity among government partners responsible for long-term stewardship, or difficulty in operationalising available capacity.

Through interviews and two qualitative surveys distributed to partners, the GPA has also identified a pipeline of 175 facilities across 81 sites located in 12 countries serving fragile and displaced communities that require reliable electricity supply. Partnerships between humanitarian, development, government, private sector, and community stakeholders will be needed to move these potential projects forward.

Lessons on potential strategies for closing the humanitarian healthcare electrification gap are drawn from 11 case studies of healthcare electrification projects in sub-Saharan Africa. Four **humanitarian organisation-led case studies** covering Mauritania, Tanzania, Ethiopia, and Uganda demonstrate approaches humanitarian actors are employing today to achieve sustainable healthcare electrification in fragile and displacement settings.

Three **development organisation-led case studies** covering Somalia, Sierra Leone, and India, provide insights on new approaches that have been piloted outside the humanitarian space in recent years. They also illustrate how facilities in displacement settings could benefit from inclusion in large-scale healthcare electrification programmes.

Finally, four **healthcare electrification investment cases** covering Kenya, Sao Tome and Principe, Madagascar, and a multi-country programme showcase innovative financing and management models for healthcare facility solarisation and O&M, with a focus on energy service company models and public-private partnerships.

The report concludes by calling for multi-stakeholder collaboration to close the humanitarian healthcare electrification gap. Learnings from ▶

Executive Summary

the case studies indicate that successful partnerships should leverage the complementary expertise of different stakeholders, appoint effective leadership to move activities forward, and incorporate appropriate incentives to keep all parties engaged over the long term.

Six recommendations for partnerships are also identified. In particular, collaboration is needed to integrate humanitarian healthcare facilities into national and regional electrification programmes, as well as national healthcare systems. Partners must also work together to expand the financing options available for overcoming the CAPEX cost barriers to adopting solar technology in humanitarian healthcare settings as well as to design appropriate strategies for ensuring long-term O&M of systems installed. It is also essential to build holistic solutions focused on enabling healthcare services by including medical equipment and future load expectations in project design and procurement.

Collaboration on data collection and sharing is also needed in order to better understand the healthcare experiences of fragile and displaced people. To truly ensure the sustainability of projects and maximise impacts, it is also essential to build the capacity of local actors and include them in the decision-making and implementation process. The report concludes with a call to action for donors and investors, hosting governments, development partners, humanitarian organisations, the private sector, and local community members.

A solar mini-grid providing reliable, clean energy access

©UNHCR

About this Report

The Global Platform for Action (GPA) is a global initiative committed to bringing sustainable energy access solutions to humanitarian and displacement settings, ensuring that no one is left behind in the pursuit of SDG 7: Clean and Affordable Energy Access for All. The GPA Coordination Unit provides the global supportive ecosystem for accelerating this mission by collaborating with partners to deliver collective progress in its five thematic working areas of coordination, policy and advocacy, innovative finance, technical advisory, and data and research. Working closely at the global, national, and local levels with humanitarian and development delivery partners, governments, funders and financiers, the private sector, and local communities, the GPA advocates for mainstreaming displaced communities into wider development planning and funding, and provides foundational research to inform impact in policy and practice.

Following the COVID-19 pandemic, the importance of reliable electricity supply to enable the delivery of essential healthcare services in developing countries has only become clearer. With the present report, the GPA aims to contribute to the growing body of research on healthcare electrification being developed by partners such as SEforALL via its Powering Healthcare programme and the WHO under its Health and Energy Platform for Action (HEPA). In particular, this report provides ground-level, practical insights on the challenges to and effective strategies for delivering reliable, clean electricity supply to healthcare facilities specifically in humanitarian contexts, by analysing the lessons from ongoing projects serving people living in fragile and displacement settings. The report's geographic focus is on sub-Saharan Africa, where 45 million people[1] are currently living in displacement settings, accounting for roughly 35% of displaced people globally. While this report specifically highlights contexts of fragility and displacement, many of the practical realities are similar to wider institutional electrification in last mile and hard-to-reach locations.

A solarised rural health clinic

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About this Report

REPORT OBJECTIVES

This *Briefing on Healthcare Electrification in Humanitarian Settings*, led by the GPA with support from NORCAP, aims to demonstrate the critical role of energy in providing life-saving healthcare support in humanitarian contexts, identify concrete healthcare electrification needs and project opportunities in humanitarian contexts, and explore various lessons learned and recommendations for decision makers and practitioners in the health and energy sectors. The sections and objectives of the report are structured as follows:

- ***Section 1:*** Demonstrates the crucial role of reliable electricity supply in enabling the delivery of quality, life-saving healthcare to vulnerable communities who mostly fall outside of national and international development planning.
- ***Section 2:*** Maps the current landscape of energy access for healthcare facilities in fragile and displacement settings and defines the humanitarian healthcare electrification gap.
- ***Section 3:*** Identifies healthcare facilities serving vulnerable communities to prioritise for solarisation, which can feed into the project pipeline being developed by SEforALL and the WHO under HEPA, as well as national and regional healthcare electrification planning, and other large-scale healthcare electrification initiatives.
- ***Section 4:*** Extracts lessons on the challenges to electrifying healthcare facilities in fragile and displacement settings as well as solutions being explored through the presentation of 11 case studies of ongoing projects and emerging investment cases.
- ***Section 5:*** Identifies areas where collaboration is needed to close the humanitarian healthcare electrification gap and identify the way forward for humanitarian agencies, development organisations, healthcare stakeholders, government actors, the private sector, and local partners.

METHODOLOGY

The research process began with a review of the existing literature produced by academia, development organisations, and practitioners on the current state of healthcare electrification in sub-Saharan Africa, approaches being employed, and lessons learned. Major healthcare electrification initiatives and the key stakeholders involved in addressing the interrelated challenges of SDG 3 and SDG 7 were also identified.

To gain deeper insight into the specific challenges surrounding the electrification of healthcare facilities serving fragile and displaced communities, semi-structured interviews were conducted with 15 practitioners working on this issue from organisations including NORCAP, UNHCR, UNICEF, USAID, WHO, and SELCO Foundation. These interviews were supplemented with a qualitative survey conducted in 2024 and distributed to 13 practitioners from 10 organisations to gather additional information to produce the case studies presented in this report. A second questionnaire was distributed to 14 NORCAP experts on assignment with various humanitarian agencies across 12 sub-Sahara African countries to gather data on specific healthcare facilities serving fragile and displaced communities, with the aim of selecting sites for inclusion in the project pipeline developed for this report.

A solar refrigerator preventing vaccine wastage

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CHAPTER 1 ◆

The Energy-Healthcare Nexus

The right to the highest attainable standards of physical and mental health is recognised as a fundamental human right and enshrined in international law.[2] Yet today there are millions of people globally living without adequate access to healthcare, which contributes to overall worse health outcomes, reduced lifespans, and increased disease burdens at the country level. Inequities in healthcare access persist around the globe, but they are most severe in Africa, where only 48% of people receive the healthcare services that they need, including the right health outcomes, equity in services, and health system efficiency.[3] This means that approximately 615 million people in Africa are without access to adequate healthcare.

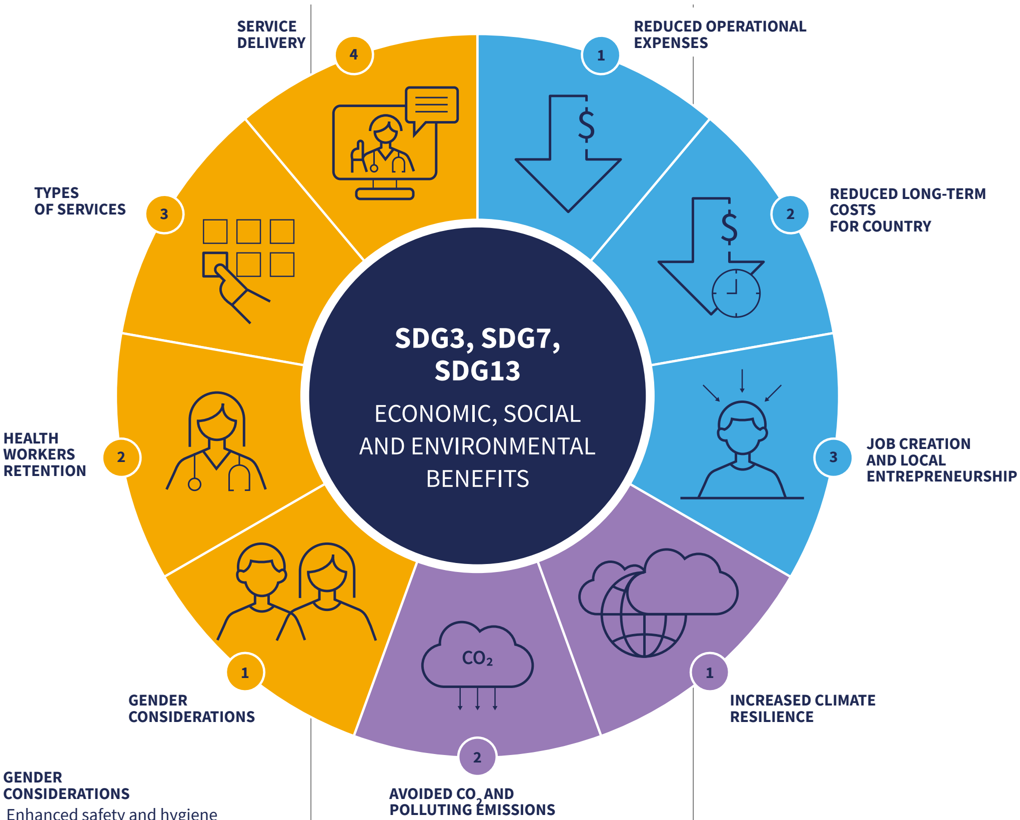
Healthcare inequities are also often more severe for people living in situations of fragility and displacement. Displaced people often undertake physically and mentally arduous journeys to seek safety in response to war, conflict, and natural and environmental disasters.[4] Refugees and internally displaced people (IDPs) often require significant support to recover from injuries, disease, trauma, and exhaustion experienced while fleeing their homes. Yet, at their new destination, the healthcare system available may be under resourced, overburdened, and unequipped to support an influx of new people requiring care. Refugees may also face barriers in accessing healthcare in their host country due to restrictive policies as well as language and cultural barriers. Today, there are around 45 million displaced people living in sub-Saharan Africa, around 35% of the global total.[5]

Sustainable Development Goal 3: Good Health and Wellbeing challenges the global community to guarantee the right to health for all people and close the gap in universal access to quality healthcare. Yet success in achieving SDG 3 will be highly dependent on progress made around several other SDGs, such as those tackling poverty reduction (SDG 1), provision of quality education (SDG 4), clean water and sanitation (SDG 6), and affordable and clean energy (SDG 7).[6]

Access to reliable electricity and clean cooking is crucial to enabling healthcare facilities to deliver quality and timely care. Even basic levels of electricity access provide lighting, power refrigerators for vaccine storage, and supply hot water for sterilisation, for example. Electricity is also essential for running laboratory tests and powering life-saving medical devices.[7] Clean cooking too plays a role in the provision of care, as it enables staff to cook safe, nutritious meals for recovering patients. Figure 1 illustrates the myriad roles of affordable, reliable, and modern energy supply in enabling healthcare delivery. ◆

Rooftop solar can reduce the need for diesel back-up power at health clinics

Figure 1: Sustainable Energy and Health Nexus Developed by WHO, World Bank, IRENA and SEforALL[8]



1 GENDER CONSIDERATIONS
- Enhanced safety and hygiene
- Increased confidence in access to health care
- Reduced risk for women accessing maternal care

2 HEALTH WORKERS RETENTION
- Enhanced safety and hygiene
- Greater comfort in providing health care
- Improved accommodation and well-being (in staff quarters adjacent to the facility)
- Functional systems -> increased motivation and better morale among health-care workers

3 TYPES OF SERVICES
- Immunization and cold chain facilities
- Maternal care and safer deliveries
- Neonatal care
- Laboratory and diagnostics
- Digitization and better administration etc

4 SERVICE DELIVERY
- Prolonged hours of operation
- Reduced "out of pocket" expenses for patients
- Wider range of services
- Better utilization of medical devices
- Telemedicine and remote care

1 INCREASED CLIMATE RESILIENCE
- Independence from fuel supply for generators
- Reduced downtime on energy systems in disaster contexts (flood/cyclones) – ability to repair and maintain locally
- Increased use of active and passive cooling to reduce health complications due to heat stress

2 AVOIDED CO_2 AND POLLUTING EMISSIONS
- Offset the use of fossil fuel based generators
- Reduced energy consumption with efficiency increase
- Avoided need for future fossil fuels as health services grow

1 REDUCED OPERATIONAL EXPENSES
- Reduced electricity bills (efficiency + renewable energy sources)
- Avoided costs of diesel fuel and generator
- Reduced damage to equipment due to voltage fluctuations

2 REDUCED LONG-TERM COSTS FOR COUNTRY
- Avoided diesel use bringing reduction to the health/energy system costs as a whole in the long run
- Improved health outcomes and well-being of population

3 JOB CREATION AND LOCAL ENTREPRENEURSHIP
- Involvement of local individuals, technicians and enterprises in design, installation, operation and maintainance
- Opportunity to strengthen local manufacturing and entrepreneurship on energy-health nexus needs

Sub-Saharan Africa's Healthcare Electrification Gap

It is estimated that globally, 1 billion people are served by healthcare facilities which lack reliable access to electricity or that have no electricity supply at all.[9] The challenge is particularly acute in sub-Saharan Africa, where as of 2021, only 28% of healthcare facilities had access to reliable electricity.[10] This gap contributes to poor health outcomes in the region. For example, today 70% of maternity-related deaths in low- and middle-income countries occur in sub-Saharan Africa.[11] It is also the region with the highest mortality rate globally for children under five and is among the least equipped to deal with infection and disease control.[12]

Bringing energy solutions to healthcare facilities can play a transformative role in the lives of millions of people, including those living in displacement settings. Adequate health infrastructure, including well-powered equipment, lighting, and cold chain storage could help mitigate the spread of infections, viruses, and disease, as well as avoid many easily preventable deaths. For example, providing healthcare facilities with reliable access to electricity and other essential resources would enable better monitoring of women's health during pregnancy as well as a wider range of interventions to respond to emergencies during and immediately after childbirth. Adequate lighting can aid nighttime deliveries, while energy for a baby warmer can help fight neonatal hypothermia. Functional laboratories can support quick diagnoses and timely treatment.

Closing sub-Saharan Africa's stark electricity access gap remains a formidable challenge. Yet, cost declines in solar and distributed renewable energy (DRE) technology, as well as other technological advancements, such as mobile money, have enabled significant progress on this front in the last decade. DRE also makes it possible to electrify healthcare facilities in remote and rural communities more quickly and cheaply than through traditional grid expansion. While the upfront costs are higher, over the long-term, DRE technologies also provide cheaper and more reliable electricity than the diesel generators traditionally used in off-grid settings.[13]

In response to the lessons of the COVID-19 pandemic and the nearing 2030 deadline for achieving the SDGs, stakeholders in the SDG 3 and SDG 7 communities have launched several ambitious programmes to leverage the power of DRE to accelerate progress on both goals simultaneously. The most sweeping initiatives in terms of scale are summarised below. ◆

Women queuing for care at a rural health post

©The Energy Nexus Network

Sub-Saharan Africa's Healthcare Electrification Gap

A solar-powered primary health centre

©SELCO Foundation

*Table 1: **Large-Scale Healthcare Electrification Platforms***

Health and Energy Platform of Action (HEPA)	Launched in 2019 by WHO, UNDP, UNDESA, and the World Bank in cooperation with IRENA, HEPA aims to accelerate access to clean cooking and electricity access in healthcare contexts. Hosted by WHO, HEPA convenes 20 international partners to promote an interdisciplinary approach to tackling the healthcare electrification challenge.[14]
Powering Healthcare	SEforALL's Powering Healthcare programme is equipping governments and their development partners with the evidence and solutions necessary to drive the agenda of achieving universal electrification of health facilities, with the support of the UK Government through the Transforming Energy Access programme, GEAPP, Power Africa and UNICEF. As part of the broader Powering Healthcare programme, in 2021, SEforALL and Power Africa launched the Multilateral Energy Compact for Health Facility Electrification, which aims to power 35,000 health facilities in sub-Saharan Africa with clean energy by 2026.[15]
Health Electrification and Telecommunications Alliance (HETA)	Hosted by USAID's Power Africa initiative, HETA is a development alliance simultaneously addressing healthcare electrification and digital connectivity in sub-Saharan Africa. Seeded with $47 million in initial funding from USAID, the platform convenes global partners to develop market-based approaches and sustainable business models to power healthcare facilities and productive uses of energy.[16]

Health facility staff prepare a baby warmer for an infant patient

CHAPTER 2 ◆

Energy in Humanitarian Healthcare Facilities

Displaced people living in camp settings and within the scope of a humanitarian response receive health services mainly from dedicated humanitarian healthcare facilities (HHF) serving these communities. The exact structure employed to fund and operate these facilities depends on the healthcare and migration policy framework of the host country and the capacity of the local and international actors involved.

Most HHF are small health posts or clinics providing basic healthcare services. They are comparable in terms of size and services provided to a primary healthcare facility as defined by WHO.[17] Some camp settings include hospitals, though these facilities are largely beyond the scope of the current report, as they are few in number. Additionally, due to their size and complexity, hospitals in displacement settings generally receive more support from both government and humanitarian partners. They are also more likely to be integrated into countries' national energy and healthcare planning.

HHF are commonly funded and overseen by national healthcare services, humanitarian agencies, or development agencies. These facilities are operated by UN agencies with a humanitarian mandate, such as UNHCR, IOM and UNICEF; international NGOs (INGOs) specialised in healthcare, such as Médecins Sans Frontières (MSF); or local NGOs. Across sub-Saharan Africa, UNHCR operates 371 HHF across 16 countries. IOM currently operates about 70 migrant health assessment centres globally, of which 35 are already solarised or are planed for solar installation. In addition, IOM works with other humanitarian partners to establish HHF as part of crisis response or in local displacement settings. The International Committee of the Red Cross (ICRC) operates 149 facilities across six countries,[18] and many countries have National Red Cross (NRC) chapters also working on humanitarian response. MSF operates across 17 countries in the region, though the number of facilities it has established in each is not known. ▶

Table 2: Summary of Stakeholder Groups Delivering Healthcare in Humanitarian and Displacement Contexts

STAKEHOLDER TYPE	EXAMPLES OF ORGANISATIONS INCLUDED
Humanitarian emergency response organisations funding and operating dedicated HHF in emergency and displacement contexts	◆ UNHCR ◆ IOM* ◆ Médecins Sans Frontières ◆ Norwegian Refugee Council ◆ International Committee of the Red Cross and National Red Cross chapters
Development organisations providing healthcare services in host communities and building capacity of national healthcare services	◆ WHO ◆ UNICEF** ◆ UNDP ◆ USAID ◆ SELCO Foundation
National and local actors operating country healthcare systems, implementing healthcare services on behalf of international actors, or providing healthcare in areas where there are gaps in official services.	◆ Ministries of Health ◆ Local NGOs and charities ◆ Local private healthcare companies

* While IOM is also a development organization, it is listed as a humanitarian organisation in the chart because IOM is involved in the Cluster Approach to humanitarian response employed by the Inter-Agency Standing Committee, particularly in disaster-related displacement settings. For information on IOM's role in the Cluster Approach, see: https://emergencymanual.iom.int/cluster-approach.

** UNICEF also acts as an emergency response partner leading on WASH, nutrition, and education in emergency settings. They also receive emergency unearmarked funding and may operate in some humanitarian and displacement contexts depending on needs.

A solar system powering healthcare services in Tanzania

In some cases, people living in camp settings will also seek healthcare from facilities located in host communities, which are typically operated by national healthcare services, or local NGOs and charities. Many vulnerable and displaced people also live outside of camp settings and seek healthcare from whatever facilities are available to them.

The scale of the healthcare infrastructure operated by national healthcare authorities and development organisations in sub-Saharan Africa is much larger than the small number of facilities operated by humanitarian actors, as detailed above. UNICEF, for example, has a pipeline of 3,694 facilities for which solarisation is currently planned or completed, and its total number under operation is significantly larger.

An important finding of this research is that it is currently difficult in most cases to measure the extent to which displaced people are seeking healthcare from facilities other than HHF, due primarily to a lack of data. Across many countries, neither government healthcare authorities nor development organisations providing healthcare collect data on services provided to people living in fragile and displacement contexts. This lack of data makes it difficult to develop a holistic understanding of the healthcare experiences of fragile and displaced people and how it can be improved by reliable electricity access. ◆

Energy Supply to HHF

The data collected for this study indicates that there is a gap in both electricity supply to and electrification planning for HHF. Among the facilities examined in the surveys and case studies, HHF which do have access to electricity have an average load and size (in terms of number of beds or physical area) comparable to that of an off-grid rural clinic. However, they often see higher levels of patient traffic and are called on to provide a wider range of medical services than clinics due to being the only healthcare facilities available. Power may be procured from the national grid, but as these facilities are often located in remote areas, they are more likely to be electrified via diesel generators, DRE, or some combination of the two. Further details on the features of HHF are described in Section 3.

Electricity supply to HHF is commonly funded and implemented by UN agencies and INGOs that are well-equipped to deliver basic healthcare services quickly within short- or medium-term emergency contexts, often based on funding available in short-term one-year emergency aid budgeting cycles. Government authorities can also manage electricity supply to HHF, particularly in situations where they are responsible for overall management of the facilities. In other contexts, responsibility for electricity supply may be shared between NGOs in the region, their offices, and other public institutions. Models which outsource electricity supply to energy service companies (ESCO) are also being explored in some contexts. ◆

Workers supporting the installation and maintenance of a solar mini-grid in Ethiopia

Delivery and Financing Models for HHF

So far, HHF are commonly developed under a build-own-transfer (BOT) model in which a UN agency or other humanitarian partner manages implementation, with installation and operation in the short-term tendered out to a private company. The humanitarian partner may immediately transfer ownership to national healthcare authorities or local NGOs, or manage the facility for a period of time before doing so, oftentimes in partnership with the government. This approach allows for quick installation of facilities in emergency settings, but to date, ensuring long-term O&M under this approach has proven difficult because of a lack of long-term budget capacity within humanitarian organisations, a lack of financial and management capacity among other partners responsible for long-term stewardship, or difficulty in operationalising available capacity.

As the case studies illustrate, humanitarian partners have started using various strategies to address the O&M issue. One approach involves incorporating one to five-year periods of O&M and results-based payment conditions into installation contracts with engineering, procurement and construction (EPC) companies. Additionally, partners in these projects have provided technical support and capacity building for EPC companies, government partners, healthcare facility staff, and community members to help them better manage O&M throughout the project lifecycle.

Another approach being trialled is utilising a private sector-led ESCO model to deliver electricity. In this model, commonly used in the commercial and industrial solar sector, the solar installation company retains ownership of the system, sells power to the customer (in this case, a healthcare facility) under a long-term power purchase agreement (PPA), and uses a portion of the sales revenue to cover O&M costs. In contexts where national policies favour public ownership of healthcare infrastructure, alternative approaches have been proposed, such as the government entity retaining ownership of the solar asset, collecting tariffs into a designated fund, and paying the solar installation company for O&M under a long-term contract.

While the ESCO model provides greater certainty in managing long-term O&M, it can be challenging to implement when serving fragile and displaced communities. These communities are often located in remote areas which are expensive to serve. It is difficult to incentivise private companies' engagement, and their need to cover high operating costs as well as the added risk of working in these areas can lead to tariffs which are well above what their customers – healthcare facilities which are often already struggling to cover their own operating costs – can afford.

Though this approach is not featured in the case studies in the present report, it should be noted that the use of digital tools such as data Monitoring, Reporting and Verification (dMRV) systems to support the O&M process also creates opportunities to leverage innovative financing tools to cover system maintenance costs. Such tools are being deployed in India and other case study countries, though presently they are only used to support O&M. In particular, the data and monitoring provided by these tools could enable the monetisation of the environmental and social impacts of healthcare facility solarisation through the sale of carbon credits, distributed renewable energy certificates (D-RECs) or peace renewable energy certificates (P-RECs). Partners such as Mercy Corps, through its Enter Energy initiative in Ethiopia, have already begun piloting the use of such revenue streams to finance electrification projects in fragile and displacement settings.[19] Further research is needed to understand their potential for use to support humanitarian healthcare electrification. ◆

The Humanitarian Healthcare Electrification Gap

Humanitarian actors and their partners have well-established frameworks and technical capacity for quickly establishing healthcare facilities to deliver basic services and emergency care. However, the mandates and operating frameworks of these actors can present limitations when delivering healthcare to people living in situations of long-term fragility and displacement due to protracted situations of conflict. These constraints lead to a problem in which it is common for solar PV systems initially installed at HHF to deteriorate over time due to a lack of proper maintenance.

Due to their short-term, typically one or two-year budget cycles, humanitarian actors have limited capacity to budget for the long-term purchase of electricity or O&M of on-site power sources. They may also require external technical expertise to develop and maintain higher-tier electrification solutions, such as large standalone systems and mini-grids, which can replace or reduce the need for diesel generators that power hospitals and other facilities with greater electricity demand and critical loads.

For example, in the Mauritania case study presented in Section 4, NORCAP provided technical expertise to support UNCHR's effort to repair and develop an O&M plan for the solar PV systems installed at four HHF in Mbera Refugee Camp. The project included training for facility staff to enable them to conduct basic maintenance. However, the issue of funding for continued long-term O&M remains somewhat uncertain.

In long-term displacement contexts, responsibility for HHF is commonly transferred to host government health authorities who may also lack the financial or technical capacity to maintain these systems. In other cases, governments actors may have available capacity but may not know how to operationalise it to manage long-term O&M. For example, in India, SELCO Foundation is working with state governments to build O&M management capacity by training existing bio-medical staff to maintain healthcare electrification systems. In another example, SEforALL, as part of its healthcare electrification roadmap research in Madagascar, identified several existing government health infrastructure and system strengthening funds, which can be drawn on to fund O&M nationwide, thus operationalising existing financial capacity.

The lack of reliable electricity access for HHF and other facilities serving people in fragile and displacement contexts is intertwined with the broader healthcare electrification gap in sub-Saharan Africa. However, the gap in fragile and displacement settings is more severe and more challenging to close. These settings are inherently more complex operating environments. Due to a lack of data and certain restrictive features of country migration policies, HHF are often not prioritised in the national energy planning of host countries. Additionally, major global electrification initiatives, for the most part, do not specifically account for these facilities. As a result, HHF are frequently overlooked in large-scale healthcare electrification efforts, which tend to focus on healthcare facilities that are part of country national electrification plans.

It should also be noted that too many healthcare facilities serving fragile and displaced communities are completely without electricity access. These facilities are often operated by local actors in areas where conflict is severe or political and security challenges prevent more active engagement from the international community. Though these contexts are difficult to monitor and largely beyond the scope of the present report, they too are a large part of the humanitarian healthcare electrification gap and should not be overlooked. ◆


A health centre in rural India
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CHAPTER 3

HHF Electrification Pipeline

To put the lessons derived from the research and case studies into action, the GPA has identified a pipeline of HHF which require multi-stakeholder collaboration to design sustainable electrification solutions that will improve healthcare services delivery.

To that end, the GPA conducted a landscaping survey in collaboration with NORCAP energy experts assigned across sub-Saharan Africa. The data collected spans 175 facilities across 81 sites and 12 countries in the region. The implementing partners providing healthcare services at these facilities include local NGOs, international NGOs, and national healthcare services. Each site represents a designated refugee or displacement settlement, which may include one or multiple healthcare facilities. The majority of the facilities are health posts or clinics, which represent the most common types of facilities accessed by displaced people. One hospital is included in the pipeline in Somalia.

Table 3: Humanitarian Healthcare Pipeline Mapping

COUNTRY	NO. OF SITES IDENTIFIED	NO OF FACILITIES REPORTED
CAMEROON	*6*	*6*
CHAD	*32*	*38*
DJIBOUTI	*4*	*4*
ETHIOPIA	*7*	*23*
KENYA	*5*	*9*
MALI	*1*	*8*
MAURITANIA	*2*	*14*
NIGER	*12*	*12*
SOMALIA	*2*	*2*
TANZANIA	*1*	*15*
UGANDA	*8*	*37*
ZAMBIA	*1*	*7*
TOTAL AS REPORTED	***81***	***175***

In more densely populated settlements, mini-grids can support healthcare electrification as well as PUE and residential electricity supply

Of the sites identified, 62% include facilities located inside of camp settings and 30% are facilities located outside, while the remaining 8% include facilities located both in and outside of camps. Around 83% of the sites surveyed have one or two health facilities present, while 5% had between three and nine facilities, and 12% had over 10 facilities.

All but eight had an electricity source available, usually an on-site solar PV system, diesel generator, or hybrid system, as only six sites reported a grid connection. However, 40% of sites reported having little to no electricity access at most facilities, as the systems were non-functioning or poorly functioning. In all cases, supply was unreliable and only sufficient to power basic energy needs that were indirectly related to healthcare provision, such as lighting, fans for cooling, and a computer.

Regarding average daily electricity demand per site,* based on the load from current equipment and appliances installed at the facilities within each site, 15% estimated demand below 25 kWh, 60% estimated demand between 26 to 50 kWh, 2% estimated demand between 51 to 100 kWh, and 10% estimated demand above 100 kWh. Demand data was not made available for 13% of sites. Additionally, it should be noted that most of the facilities are underpowered and some do not currently receive any electricity supply on a daily basis. Thus, actual consumption is often well below estimated demand.

When analysing the reported information, a trend emerged that facilities with lower demand were mainly equipped with small-scale DRE systems, while those with larger loads used diesel generators or hybrid diesel-solar PV systems for electricity provision. ◆

Figure 2: ***Electricity Sources Used by HHF in the Pipeline***

TYPICAL ELECTRICITY SOURCES USED BY HHF	%
DIESEL GENERATOR AND STAND ALONE PV SYSTEM	32
STAND ALONE PV SYSTEM	30
DIESEL GENERATOR	14
NO ELECTRICITY	10
GRID CONNECTED	7
HYBRID MICRO GRID	7

40% of sites reported having limited to no electricity access at most facilities, as the systems were non-functioning or poorly functioning.

* The data presented comes from self-reported demand estimates based on the potential demand of existing appliances at each facility, square meterage, or number of beds. The ranges are for illustrative purposes only, and full energy needs assessments must be conducted for each site and facility included in the pipeline.

HHF Electricity Demand Profile

Based on the data collected to develop the pipeline of identified HHF as well as the case studies, it was found that most HHF are small health posts, which bear similarities in terms of number of beds, average load, and equipment used to an off-grid primary healthcare facility as categorised by WHO.

*Table 4: **Size and Load of HHF Compared to Other Off-Grid Health Clinics***

	HUMANITARIAN HEALTHCARE FACILITY	OFF-GRID PRIMARY HEALTHCARE FACILITY (WHO)[20]
AVERAGE NO. OF BEDS	*13*	*5 to 10*
AVERAGE DAILY LOAD	*10 to 36 kWh*	*18 kWh*

The type and quantity of energy-consuming equipment can vary greatly from one site to another. Most sites identified in the pipeline and the case studies are equipped with few medical devices, and the majority of electricity demand comes from appliances supporting basic comfort and functioning of the facility, such as fans, air conditioners, and refrigerators. The chart below presents the electricity consumption profile of an HHF included in the Mauritania case study as an example.

Interviews with practitioners as well as data provided about the operations of the facilities included in the pipeline revealed a number of differences between HHF located in displacement settings and standard small rural clinics. In particular, while HHF are usually similar in size to rural clinics, they often have significantly higher levels of patient traffic as they cater to the dense populations of refugee settlements in addition to members of the local host community.

HHF are also often required to provide a much wider range of medical services than their rural counterparts. Prioritising HHF for projects to expand their access to reliable, clean electricity will enable them to better meet the full range of healthcare needs among the communities they serve. ◆

*Figure 3: **Example Humanitarian Health Post Electricity Demand, Mauritania***

TYPICAL HUMANITARIAN HEALTH POST CONSUMPTION SHARE	%
VACCINE REFRIGERATOR	41
FAN	27
LIGHTS (LED)	15
COMPUTER	9
MICROSCOPE, RADIO AND OTHERS	8

*Table 5: **Equipment Used in HHF and Other Off-Grid Health Facilities***

EQUIPMENT	HUMANITARIAN HEALTH POST	OFF-GRID PRIMARY HEALTHCARE FACILITY (WHO)[21]
VACCINE REFRIGERATOR	*Yes*	*Yes*
ROOM LIGHTING (LED)	*Yes*	*Yes*
FAN	*Yes*	*Yes*
MICROSCOPE	*Yes*	*Yes*
EXAM LIGHT	*Yes*	*Yes*
RADIO	*Yes*	*No*
COMPUTER	*Yes*	*Yes*
OXYGEN CONCENTRATOR	*No*	*Yes*

Solar system refurbishment underway in Tanzania

©UNHCR

CHAPTER 4

Case Studies for Closing the Gap

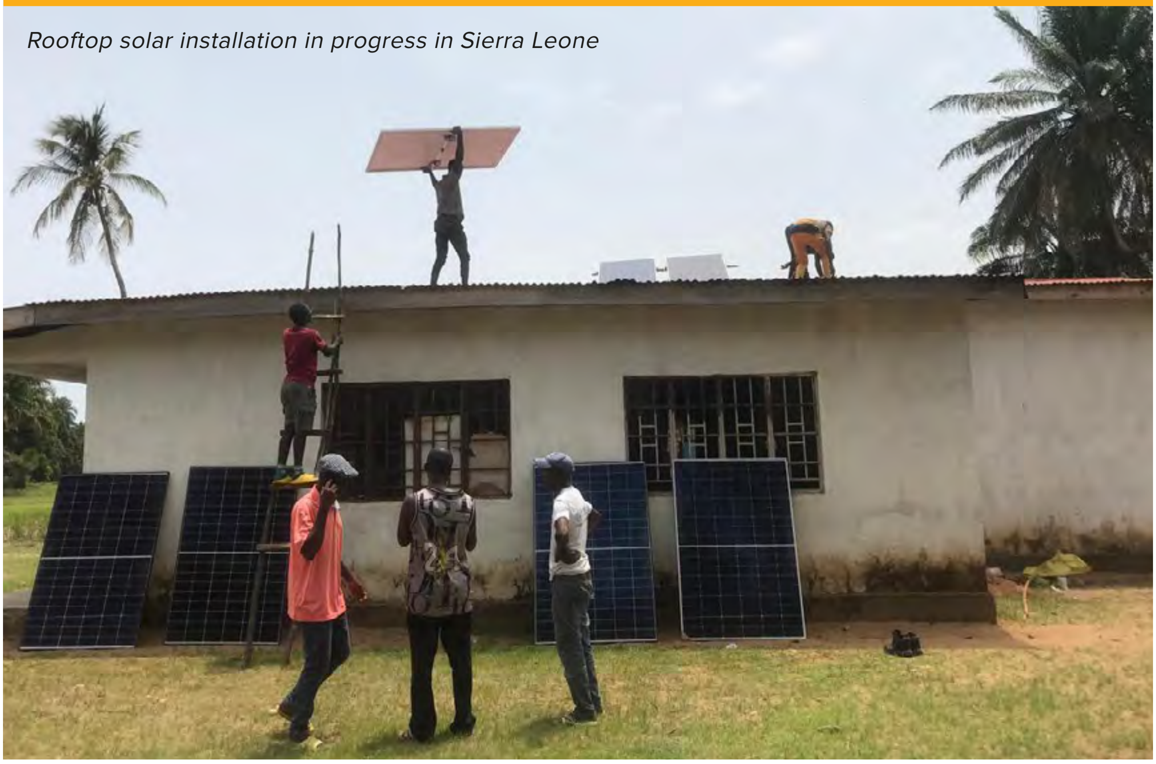
The 11 case studies presented in this section aim to provide a more detailed picture of current efforts to electrify healthcare facilities in sub-Saharan Africa. They are presented in three subsections which detail the diversity of approaches being employed by different partners working at different scales.

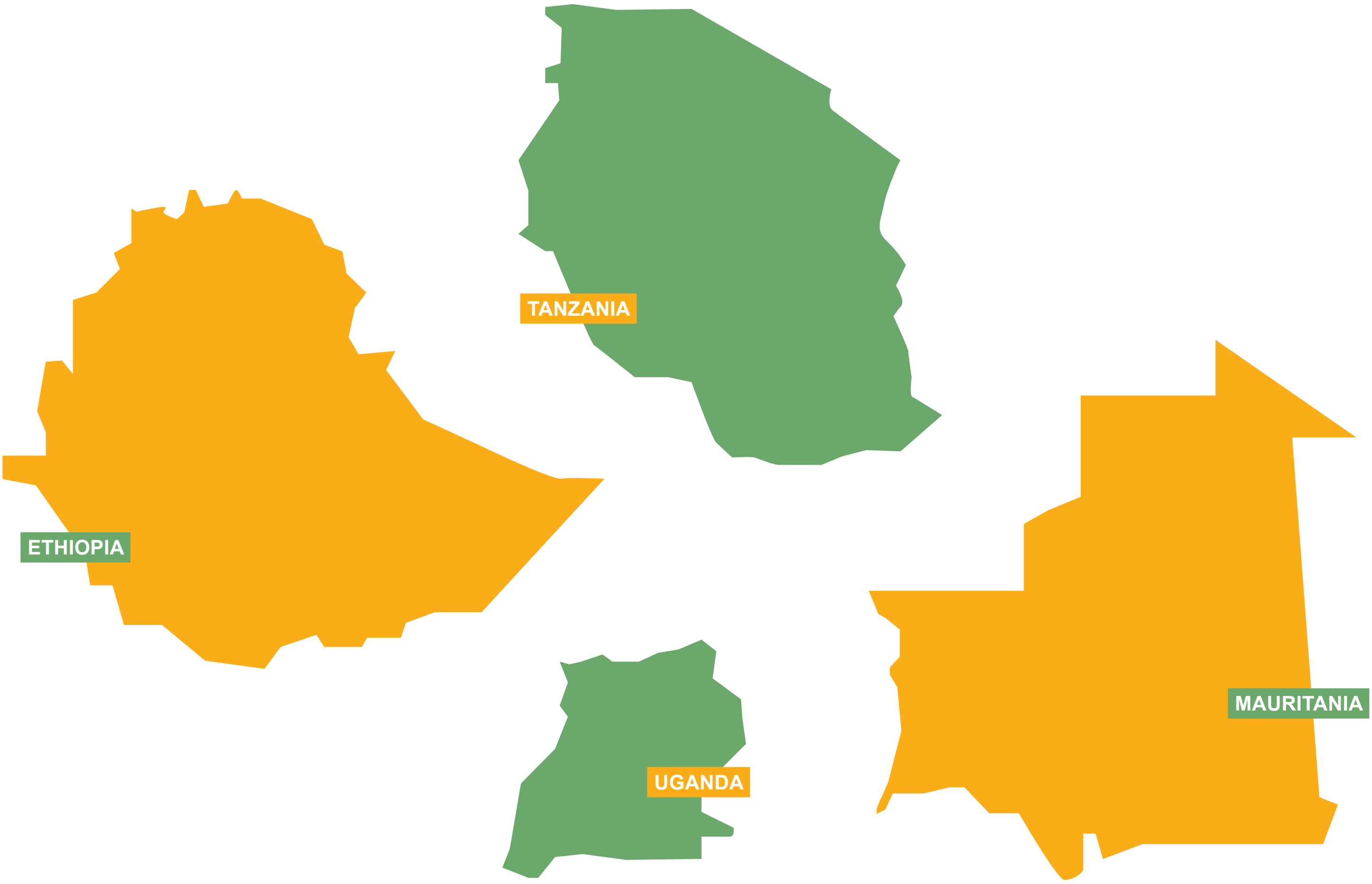
Four ***Humanitarian Organisation-Led Electrification Case Studies*** provide insights into the ways that humanitarian actors are attempting to overcome the O&M challenge and deliver sustainable energy access to HHF.

Three ***Development Organisation-Led Electrification Case Studies*** draw lessons from the experience of development organisations tackling healthcare electrification at a greater scale and with more resources than possible for most humanitarian actors. These cases also demonstrate the importance of developing improved methodologies of programme delivery and of better understanding how vulnerable and displaced people interact with care facilities other than HHF.

Finally, four ***Healthcare Electrification Investment Cases*** present research on large-scale strategies for healthcare electrification that propose a number of innovative, and oftentimes private sector-led, approaches to the O&M challenge. While these initiatives are in the early stages, it will be important for humanitarian partners to monitor their progress and adapt the successful approaches that emerge to tackle the humanitarian healthcare electrification challenge. ◆

Rooftop solar installation in progress in Sierra Leone





HUMANITARIAN ORGANISATION-LED ELECTRIFICATION CASE STUDIES

These four cases provide a comprehensive picture of the approaches humanitarian actors are taking today to electrify HHF and other facilities serving people living in fragile and displacement settings.

MAURITANIA and ***TANZANIA*** highlight the challenges faced by humanitarian partners and government actors in securing funding for managing O&M of standalone solar energy systems installed in humanitarian healthcare contexts. They also demonstrate strategies being explored to address these challenges by leveraging technical expertise, building maintenance costs like spare parts and service costs into programme budgets, and training local stakeholders in basic maintenance. The experience in Tanzania also demonstrates how bundling standalone solar project sites together can potentially help lower project costs and speed up the pace of electrification efforts.

ETHIOPIA *and* ***UGANDA*** showcase the potential of mini-grids to deliver long-term electricity supply for healthcare in contexts where they are feasible to implement. Electrifying not only healthcare but also other public services, households, and productive uses of energy supports the commercial viability of a mini-grid project and unlocks new options for covering the cost of O&M. Ethiopia also presents the use of a community-led cooperative as a structure for managing long-term O&M, building local economic development and job creation into the programme.

Mauritania

O&M of solar energy systems is a long-term process that requires proactive system monitoring, effective management, and identification of areas for improvement. Handover of completed systems to government partners can prove challenging where there is limited financial or management capacity or a lack of commitment to long-term maintenance. When upgrading the solar PV systems of the health centres and posts in Mbera Refugee Camp, the partners involved aimed to not only ensure electricity supply sufficient to power crucial medical equipment and other services but also to improve the preparation and management structure for long-term O&M of the new systems by investing in capacity building for both government partners and the reputable EPC company selected for the project.

- **253,615 refugees in the country[22]**
- **49% electrification rate, with 91% urban and 5% rural electrification[23]**

KEY STAKEHOLDERS

UNHCR	Funding and project management.
NORCAP	Technical support on project design and oversight of project development and commissioning.
Ministry of Health of Mauritania	Long-term management and maintenance of facilities with support from humanitarian and development partners.
Local Enterprise	Provision of O&M services following installation.

Established in 2012, Mbera Refugee Camp is home to over 115,000 refugees as of 2024. primarily coming from Mali, and a significant increase in arrivals over the past two years has placed additional strain on the camp's already inadequate healthcare infrastructure. The healthcare system in Mbera is supported by UNHCR and other international partners. With support from the World Bank's INAYA programme, the Government of Mauritania is integrating the camp's health services into the national system. In partnership with the World Bank and UNHCR, the government is also aiming to solarise 100% of the camp's infrastructure by 2026.

The three health posts and one larger health centre in the camp all rely on inadequate, outdated solar PV systems with poor battery storage capacity. In response, the UNHCR sought to refurbish and expand the systems to provide adequate power for reliable vaccines, operation of critical medical devices, comfortable working conditions, and the introduction of a new telemedicine service. ◆

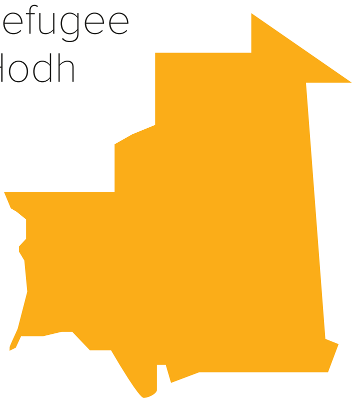
Mauritania

PROJECT OVERVIEW

LOCATION

Mauritania

Mbera Refugee Camp, Hodh Chargui region



Solar panels in need of maintenance

©Fabrice Igor Chuente Tejiom

project scope & status

PROJECT SCOPE

O&M of the solar energy systems installed at **1 large health centre** and **3 small health posts**

PROJECT STATUS (Q4 2024)

Partially funded and procured

population impacted

Over **133,000 people**, with a focus on women, as the facilities oversaw 1,106 births in 2020[24]

power source

63.92 kWp in off-grid solar PV systems with diesel back-up and battery storage

funding information

$180,000 grant secured from UNHCR to cover one-time cost of replacing components of an existing solar energy system (inverters and batteries)

Mauritania

PROJECT PROCESS

1 ENERGY NEEDS ASSESSMENT

To determine the repairs needed to the existing installations, UNHCR conducted an assessment led by the technical expert assigned from NORCAP. Energy audits and discussions with key stakeholders were conducted to determine the status of the solar energy systems and expected future loads of the facilities.

2 FUNDING

After struggling to secure funding for the project from external donors, UNHCR Mauritania opted to allocate a share of its internal budget to maintenance of the solar PV systems powering health facilities in the camp. Donors often face obstacles in engaging long-term in renewable energy projects due to their short-term budget cycles, often making it challenging to secure sustained funding for O&M.

3 DESIGN & IMPLEMENTATION

The repair project design was carried out by the NORCAP energy expert assigned to UNHCR Mauritania. Repair needs were also determined for the four individual solar PV systems powering the independent blocks of the larger health centre. Previously, the diesel backup generator at the centre ran for round 9 hours per day to ensure continuous electricity supply. Repair plans were also developed for the solar kits powering the three health posts. A national tender was launched to select a local company to repair the systems, in line with UNHCR Mauritania's goals of building local capacity and lowering operational costs.

4 TRAINING AND O&M

Following the repair of systems, technical training on preventive and corrective maintenance will be provided to health centre staff previously designated for the facility's technical management in order to be able to conduct basic O&M and address simple issues that arise. The health facilities, along with technical resources from the Ministry of Health, will be responsible for ensuring the proper functioning of the systems throughout their lifecycle. The facilities currently have funds allocated for ongoing O&M. UNHCR, via its ground partner, will also play a supervisory role and intervene in response to systems breakdowns. In the project development process, plans were also made and executed for UNHCR's country office to gradually allocate a portion of its budget to cover the costs of the NORCAP energy expert to enable continued support for the energy access work.

Battery storage supporting an off-grid solar system

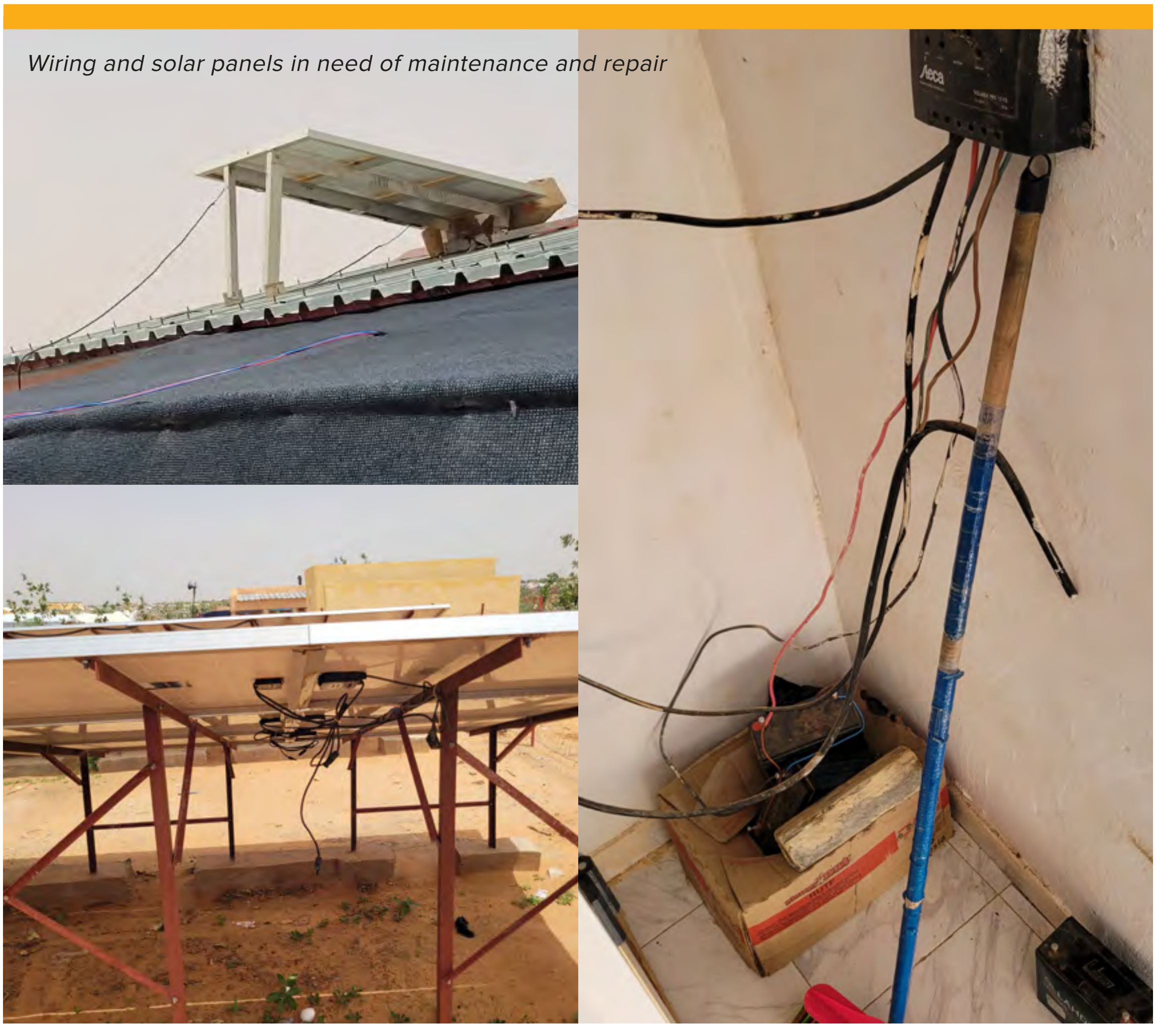
Mauritania

PROJECT IMPACTS

- Reliable electricity supply will provide the Internet access needed to launch a telemedicine service and enable staff to participate in online training programs.
- Funds previously used for fuel can be re-directed to other needs, such as purchasing medicine and laboratory reagents.
- Gradual transitioning of budgeting for energy expertise from NORCAP to UNHCR enabled the latter organisation to build its internal capacity and mainstream energy within the agency.

LESSONS LEARNED

- **Engaging national healthcare authorities to oversee O&M for HHF is one pathway to overcome the difficulty in securing long-term O&M contracts for these facilities.**
- **An in-house approach to HHF electrification by humanitarian agencies supported by external experts allows for customization and faster implementation, but the model can be slow to implement and costly to scale.**



Wiring and solar panels in need of maintenance and repair

©Fabrice Igor Chuente Tejiom

Tanzania

The capacity of the HHF in Nyarugusu and Nduta camps has long been insufficient, driving hundreds of refugees to seek treatment from Tanzania's overburdened and financially strapped national health services, where they face long waitlists to access care. In 2020, partners delivering healthcare services in the camps designed an electrification project to improve services for and promote positive relations between the refugees and the surrounding host community in Kasulu and Kibondo districts.

- **241,883 refugees[25] and 46,000 IDPs in country[26]**
- **46% electrification rate, with 75% urban and 36% rural electrification[27]**

KEY STAKEHOLDERS

UNHCR	Oversight of project implementation and securing permits.
NORCAP	Technical support on project design, support with fundraising, oversight of project development and training.

Nyarugusu Camp hosts 134,333 refugees who are served by seven health facilities: one 1,128 bed capacity hospital, two health centres, and four health posts. Nduta camp hosts 56,614 refugees served by one hospital, six health posts and two community-based rehabilitation centres. Despite improvements over the years, challenges such as inadequate financial resources, electricity shortages, insufficient infrastructure, and medical supply shortages prevent practitioners from providing adequate care. The health facilities have basic equipment, but several rely on costly diesel generators for power. Most equipment for more advanced and emergency care is absent or non-functional, with no X-ray or CT machines, for example. There are often shortages of medications and trained doctors, limiting the camps' ability to perform safe surgical procedures. ◆

"The capacity of HHF in Nyarugusu and Nduta camps has long been insufficient, driving hundreds of refugees to seek treatment from Tanzania's overburdened and financially strapped national health services."

Tanzania

PROJECT OVERVIEW

LOCATION

Tanzania

Nyarugusu and Nduta Refugee Camps, in Kasulu and Kibondo districts, Kigoma Region

©UNHCR

project scope & status

PROJECT SCOPE

14 sites, including two hospitals and **12 health posts** equipped with solar power; 4 sites are located in host communities

PROJECT STATUS (Q4 2024)

Implementation completed with O&M ongoing

population impacted

Over **182,000 people** across both camps and the host communities in Kasulu and Kibondo

power source

324 kWp in off-grid solar PV systems (excluding diesel back-up and battery storage)

funding information

$1.4 million grant from the Swedish Postcode Lottery

Tanzania

PROJECT PROCESS

1

ENERGY NEEDS ASSESSMENT

The needs assessment was conducted by a NORCAP energy expert seconded to UNHCR Tanzania. It was found that the health posts assessed in Nyarugusu Camp served between 15,000 and 30,000 patients per month. Yet they lacked essential appliances like fridges, ovens, and sterilisers and were not equipped to provide emergency services. Three health posts relied on diesel backup power and all lacked functional streetlights. The camp's main hospital was fully powered by a diesel generator which consumes around 5,376 litres of fuel per month on average. The hospital in Nduta was also fully reliant on a diesel generator consuming 3,600 litres of fuel per month. Its health posts struggled with limitations in electricity supply and available equipment, which impacted the ability to provide quality care.

2

FUNDING

The project was presented at the Clean Energy Challenge Marketplace Dialogues held in 2021 by the Global Platform of Action (GPA) and UNHCR. Based on proposals made, UNHCR Tanzania secured funds from the Swedish Postcode Lottery for installing the systems.

3

DESIGN & IMPLEMENTATION

Individual solar PV systems with backup batteries were designed for each health post as well as the hospitals and associated facilities. The estimated lifetime for each system is 10 years for the battery and 20 years for the solar modules. Facilities providing a wider range of services, including emergency care, were also equipped with diesel backup generators. Procurement was done through UNHCR partners and following UN guidelines.

4

TRAINING & O&M

Forty individuals (refugee and host community technicians) trained on the operation and maintenance of the solar PV systems. Training was held in both camps. The local energy enterprise installing the systems is currently signed on to ensure O&M for at least two years, with a performance guarantee included in the contract. The implementing partners and trainees will take over responsibility for system maintenance after two years, with UNHCR providing support. This approach emphasises the project's contribution to refugee resilience. In the project development process, plans were also made and executed for UNHCR's country office to gradually allocate a portion of its budget to cover the costs of the NORCAP energy expert to enable continued support for the energy access work.

Tanzania

PROJECT IMPACTS

- Initial estimations revealed that the project will lead to a reduction in annual fuel consumption of 118,758 to 158,400 litres from the facilities, which will avoid around 317,222 kilograms of CO_2 emissions per year and contribute to Tanzania's environmental and climate goals.

- Reduced fuel consumption will lead to significant cost savings, estimated at around $135,384 to $180,576 per year. The project has also resulted in a lower cost of serving patients.

- The improved impact monitoring put in place for the project by UNHCR will generate data about the number of beneficiaries, benefits for women, improved safety, and other key impacts.

- Transitioning of energy expertise from NORCAP to UNHCR supported the mainstreaming of energy within the agency.

LESSONS LEARNED

- **It is important to build capacity at different levels to solve ongoing challenges with maintenance. During installation, the expert's close monitoring of the process aided quicker responses to problems faced by the energy installers, such as discovery of faulty equipment. Some challenges, like stones thrown by children in the vicinity, may be difficult to solve in the short term and require longer-term behaviour change efforts.**

- **To enhance safety and longevity, the technical experts included protection devices for internal facility wiring to address system failures caused during and after installation. Many facilities face challenges around wiring and equipment reliability, and adequate budgets should be made available during projects to improve this infrastructure.**

- **Partnering with organisations such as NORCAP that provide technical capacity is a strategic way for humanitarian and development partners to bridge internal knowledge gaps to expand access to renewable electricity for HHF.**

- **Bundling facilities inside camps with others located in host communities makes it possible to electrify more facilities at once, contributing to scale and speeding up the process of healthcare electrification.**

Nyarugusu Main Hospital during installation of PV panels

Ethiopia

In June 2024, Alianza Shire began the implementation of a 126.96 kWp PV-battery mini-grid system in Dollo Ado designed to provide clean energy to power 16 priority communal services inside the Kobe Refugee Camp and host community. The programme created a framework for assessing the energy needs of healthcare and other community services in displacement contexts. It also provided a model for designing comprehensive solutions to address these needs that will remain viable over the long term.

- **1.07 million refugees and asylum seekers in the country[28]**
- **7% of refugee households across the country have access to electricity, mainly for lighting, from diesel generators[29]**
- **Nearly 70% of host community members and 40% of refugees use battery powered lanterns for basic lighting[30]**
- **55% national electrification rate, with 94% urban and 43% rural electrification[31]**

KEY STAKEHOLDERS

Alianza Shire*	Led all programmatic activities, development of O&M models, and stakeholder coordination.
ZOA	ZOA, an international relief and recovery organisation, led on-the-ground implementation activities in the Dollo Ado Refugee Camps until June 2023.
Save Environment Ethiopia (SEE)	An Ethiopian NGO, SEE led on-the-ground implementation activities and worked closely with the established energy cooperative between July 2023 and December 2024. After project closure, SEE will continue supporting the cooperative leading mini-grid O&M.
Organisations managing 16 communal services	Co-management of energy produced by mini-grid and key decision makers alongside RRS.
Ethiopia Refugees and Returnees Service (RRS)	Government refugee services coordinator responsible for managing main health centre in Kobe. After installation assumed ownership of mini-grid.
Dollo Ado Woredas (District Governments in Ethiopia)	District government partner managing relationships with local population and support to project through different agreements and permissions.

* Alianza Shire is formed by Acciona.org Foundation, Signify, Iberdrola, AECID, and Innovation and Technology for Development Centre at the Technical University of Madrid (itdUPM).

Dollo Ado area in Southeastern Ethiopia, near the borders with Somalia and Kenya, hosts about 220,598 refugees across five camps: Bokolmanyo, Melkadida, Hilaweyn, Buramino, and Kobe. Refugees in Ethiopia can access primary healthcare through government facilities within camps, where referrals are assessed. For secondary and tertiary care, refugees are referred to public or private facilities located outside the camps. Prior to the implementation of recent projects, only 3% of the total population in these camps had access to electricity, primarily through sources like diesel generators, PV systems, standalone solar kits, lanterns, and mini-grids managed by energy cooperatives.

Kobe Refugee Camp hosts 39,476 refugees. Community services in the camp include eight healthcare facilities, 11 schools, five community centres, and 10 NGO buildings. Alianza Shire aimed to develop an innovative solution that would ensure long-term, reliable supply of high-quality, affordable energy to enable improved services in Kobe. ◆

Ethiopia

PROJECT OVERVIEW

LOCATION

Ethiopia

Kobe Refugee Camp, Dollo Ado District, southeastern Ethiopia

A solar mini-grid powering public services

©Alianza Shire

project scope & status

PROJECT SCOPE

Installation of solar mini-grid to power **16 priority communal services**, including four health facilities

PROJECT STATUS (Q4 2024)

O&M and monitoring, evaluation, and learning

population impacted

39,476 refugees residing in Kobe Camp

power source

126.69 kWp solar mini-grid with battery storage

funding information

Project cofounded by EU Trust Fund for the Horn of Africa through Spanish Agency for International Development Cooperation (AECID)

Ethiopia

PROJECT PROCESS

1 ENERGY NEEDS ASSESSMENT

Representatives providing 34 community services were interviewed, and two surveys were conducted to assess the technical, management, and legal aspects of energy access. The first survey gathered data on the current energy situation, including electricity availability, daily supply hours, and the number of users. The second survey focused on load profiles for current and ideal electricity usage. It was found that all eight health facilities in Kobe struggled with unreliable electricity supply and two had no access at all. The load profile and user data made it possible to identify four facilities for priority electrification and determine that they could potentially consume up to 15.96 kWh per day.

2 FUNDING

The system was cofounded by the European Union's Trust Fund for the Horn of Africa through the Spanish Agency for International Development Cooperation (AECID) and it was developed in line with a directive from the Ethiopian Energy Authority which permits the self-generation and supply of energy independent from state utility providers for non-commercial purposes. As such, the energy generated by the mini-grid is donated, but the O&M costs will be paid for by the direct beneficiaries who have been engaged in the project since the beginning.

3 DESIGN & IMPLEMENTATION

The total PV capacity of the mini-grid is 126.96 kWp, of which 21.7% (27.6 kWp) is connected to DC with charge controllers and 78.3% (99.4 kWp) is connected to AC with PV inverters to provide higher system efficiency.

4 O&M

A local energy cooperative was engaged to carry out the O&M for the system. The cooperative was formed in Kobe through an earlier programme implemented by the UNHCR and IKEA Foundation. The cooperative's operations and mini-grid O&M costs are covered by direct beneficiaries paying a concessional electricity tariff based on consumption. The fees are significantly lower than the typical costs for energy sources (electricity, fuel, or firewood) in the area. The cooperative manages monthly payments from the beneficiaries in partnership with one of the financial institutions active in the camp.

Keeping panels free of dust and debris maximises electricity production

©Alianza Shire

Ethiopia

PROJECT IMPACTS

- The system will deliver clean, reliable electricity that will significantly improve the quality of services provided in the camp, including healthcare. Over the long term, this will lead to improved health outcomes in the refugee community.

LESSONS LEARNED

- **Establishing a local energy cooperative to lead mini-grid O&M in partnership with local technicians represents one possible pathway toward sustainable, community-led operation of energy systems in displacement settings. This approach can help overcome the limited capacity of government stakeholders where it exists while also supporting local development.**

- **Engaging experts from multiple backgrounds can support the development of energy solutions that are efficient, realistic, and holistic.**

Installation works underway

©Alianza Shire

The Kobe Solar Power Plant is inaugurated in Ethiopia

©European Union

Uganda

Today Uganda hosts the most refugees of any country in Africa, providing shelter for people fleeing conflict in Sudan, South Sudan, and the Democratic Republic of Congo, as well as other neighbours. This inflow of displaced people has strained Uganda's resources and infrastructure, creating challenges in providing adequate food, healthcare, and education for both refugees and local communities. Rwamwanja Refugee Settlement hosts approximately 76,000 refugees living in around 20,000 households. The partners in the USAID's Scaling Up Renewable Energy (SURE) Uganda initiative are constructing two solar mini-grids that will provide clean electricity access for households and community services in Rwamwanja, including two health centres.

- **1.7 million refugees and asylum seekers[32]**
- **47% electrification rate, with 72% urban and 35% rural electrification[33]**

KEY STAKEHOLDERS

USAID/Power Africa	Providing funding, setting overall objectives, and monitoring progress. Supporting technical implementation through deployment of a mission engineer.
Tetra Tech	Implementer of USAID SURE program. Execution of mini-grid project on the ground, oversight and guidance for local implementation partner.
NOA Energy Services Uganda SMC Limited	Local implementation partner responsible for demand assessment, design, installation, commissioning, operation, and maintenance of mini-grids in Kyempango and Ntenungi.
Ministry of Energy and Mineral Development	Policy support and regulatory approvals, ensuring project aligns with national energy strategy and objectives.
Kamwenge District Government	Local oversight, camp access, and community engagement. Facilitating integration of project within local infrastructure.

Rwamwanja Refugee Settlement was established in 1964 to host refugees from Rwanda and re-opened in 2012 to accommodate people fleeing insecurity in the eastern DRC. Today, the health facilities in the settlement lack the medicine and equipment necessary to effectively assist the high number of patients seeking treatment. As a result, residents often suffer from otherwise curable diseases and conditions, such as malaria, upper respiratory tract infections, diarrhoea, and anaemia. The main energy sources used in the settlement today are solar home systems, batteries, diesel generators, candles, and kerosene. ◆

Uganda

PROJECT OVERVIEW

LOCATION

Uganda

Kyempango and Ntenungi villages, Rwamwanja Refugee Settlement, Kamwenge District, southwestern Uganda

Building local capacity to conduct O&M improves project sustainability

©GIZ

project scope & status

PROJECT SCOPE

2 solar mini-grids

serving over 660 connections, including **358 connections** in Kyempango and **300** in Ntenungi, including two healthcare facilities

PROJECT STATUS (Q4 2024)

Design and procurement completed, implementation ongoing

population impacted

Over **20,000** in Kyempango and over **1,800** in Ntenungi

power source

Two **120 kWp** solar mini-grid with **430 kWh** battery storage

funding information

Over **$900,000** grant from USAID/Power Africa

Uganda

PROJECT PROCESS

1 ENERGY NEEDS ASSESSMENT

A door-to-door survey was used to register customers, and one-on-one meetings were held with a representative sample which included households, schools, hospitals, and other public service institutions, to assess demand and willingness to pay. Socio-economic, topographical, and environmental studies were conducted, and a health and safety plan was developed.

2 FUNDING

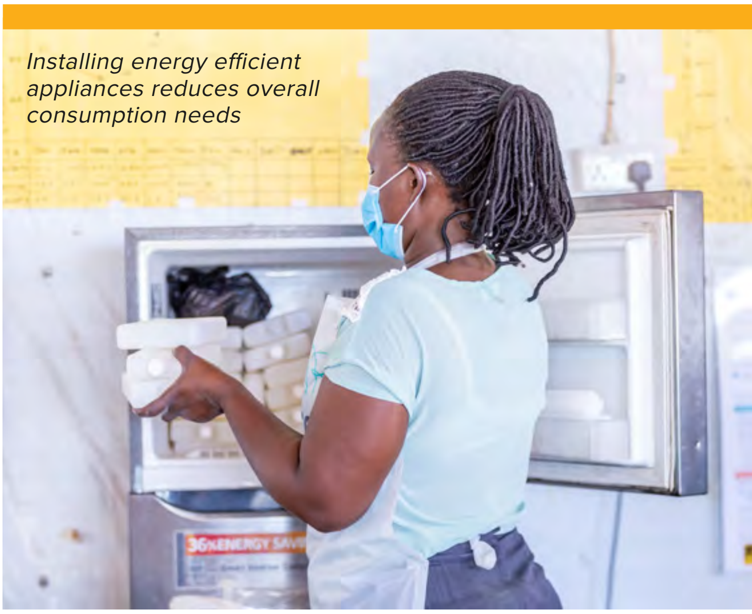
The project is being funded by USAID/Power Africa with a budget of $900,000 for the whole program.

3 DESIGN & IMPLEMENTATION

The Kyempango and Ntenungi mini-grids will each have a nominal PV capacity of 120kWp with a 430 kWh battery bank. The battery storage component will comprise lithium-ion batteries with an assumed 5,000 cycles and 90% depth of discharge. The systems will be designed with future expansion in mind, using a 150kWp inverter. A total of 8.72 km of low voltage distribution lines will be strategically routed to avoid natural barriers and serve all customers effectively. Procurement will be done through reputable vendors with a proven track record in delivering high-quality materials. Construction will be completed by the local implementation partner and an international third party construction oversight partner.

4 O&M

O&M of the mini grids will be handled by the local implementation partner and will include regular monitoring, rapid response to technical issues, and proactive upgrades to accommodate growing energy demand. A concession agreement is expected to be signed between the mini-grid developer and the government. The systems are expected to operate for 15 years after handover to the government, and O&M costs are expected to be covered by the payment of electricity bills.



Installing energy efficient appliances reduces overall consumption needs

©GIZ

Uganda

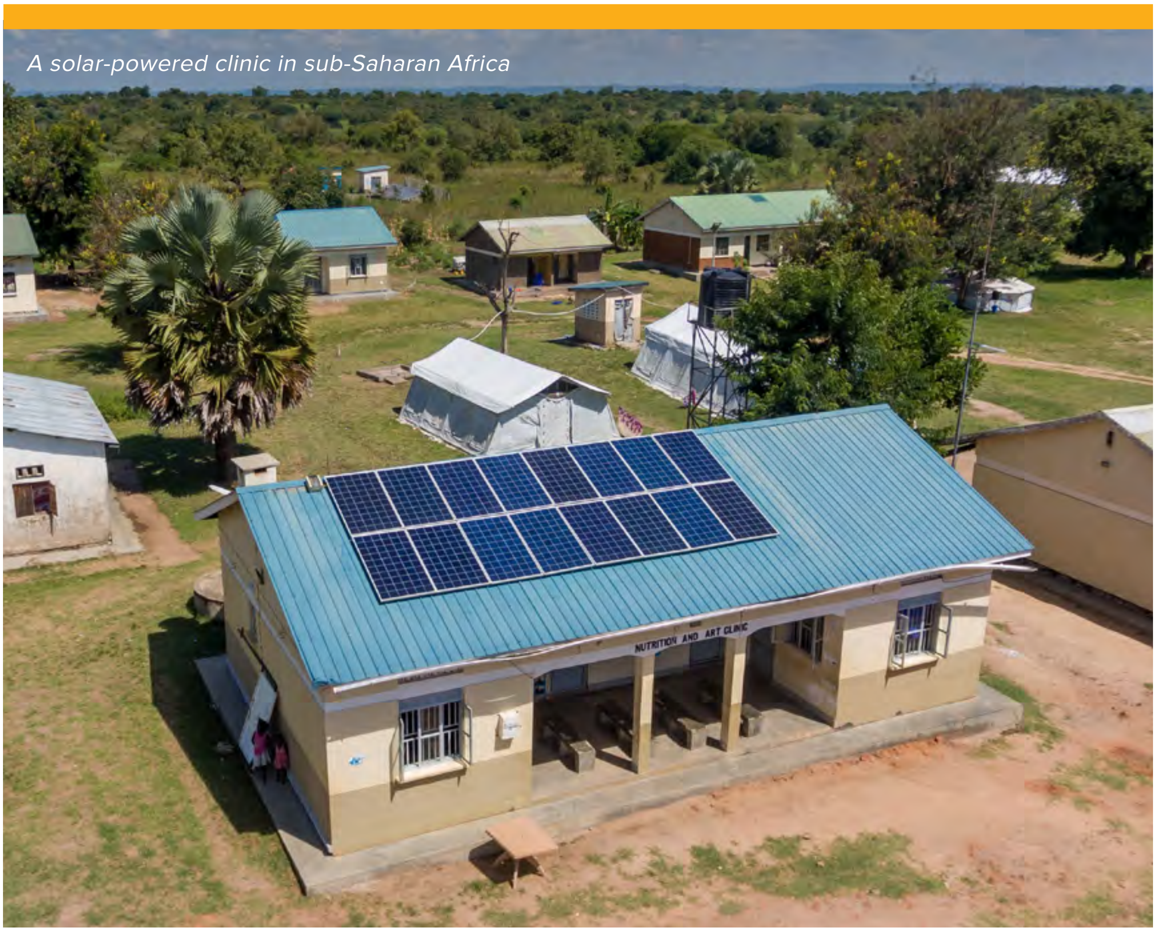
PROJECT IMPACTS

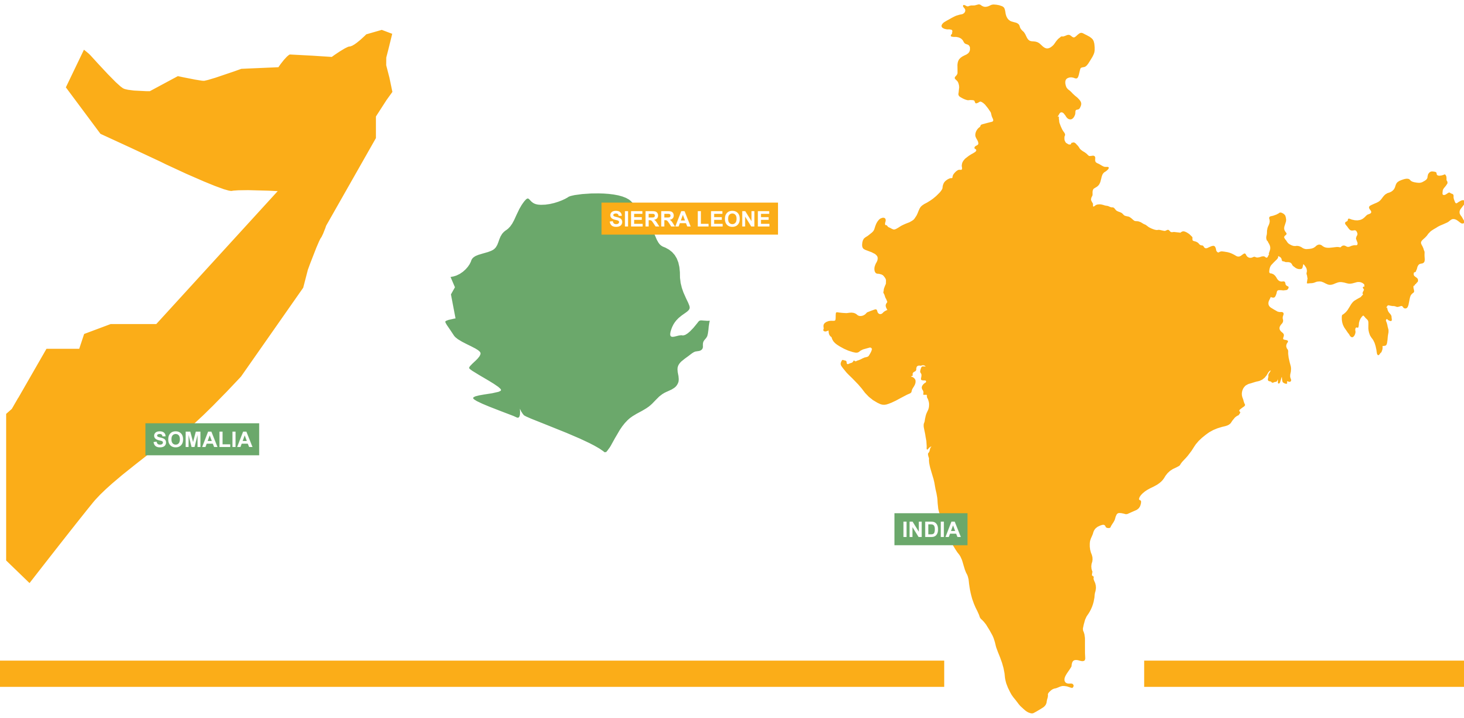
- Including health centre electrification in a larger project to power households and public services is expected to improve the quality of medical services provided and health outcomes of the community. Community members are expected to benefit from improved nutrition and sanitation, among other factors that contribute to health and disease prevention, thanks to electricity access in their homes.

LESSONS LEARNED

- **In countries such as Uganda where there are local partners with significant experience in mini-grid development, it is important to leverage this expertise. Local partners and teams on the ground, typically have a strong understanding of local context and processes which can speed up implementation and reduce costs.**
- **Demand stimulation activities are an important component of designing and maintaining mini-grids over the long term, particularly if O&M activities are to be paid for with electricity sales revenues.**
- **Communication should be maintained between local teams and government counterparts to understand local policies and prevent delays. At the same time, it is important to include a buffer in the project development timeline to account for unexpected delays and challenges.**

A solar-powered clinic in sub-Saharan Africa





DEVELOPMENT ORGANISATION-LED CASE STUDIES

In tackling the humanitarian healthcare electrification gap, there are lessons to be drawn from the experience of development partners who have piloted new approaches to healthcare electrification in recent years. Many of the facilities included in these cases are located in countries where people have lived or are living in situations of fragility and displacement. This reality drives home the need for new partnerships between humanitarian and development partners to improve knowledge sharing to understand the best methods of electrifying HHF with renewable energy.

WHO's project to solarise 51 healthcare facilities in ***SOMALIA*** demonstrates how addressing healthcare electrification for people living in fragile and displacement settings makes financial sense, especially in off-grid contexts where diesel-powered grid networks are the main alternative power source. It also shows how programs led by consortiums of local and global partners make it possible to electrify facilities more quickly and at a lower cost.

The multi-phase partnership to develop a scalable model for electrifying healthcare facilities in ***SIERRA LEONE*** provides insights on how to centre local partners in project design and implementation. While this approach takes time and effort, it provides valuable opportunities to build local capacity in a more in-depth way than through short-term training programmes. Such investments can create a strong foundation for long-term, sustainable, and locally led maintenance of the electricity sources and overall operations of health centres in sub-Saharan Africa.

INDIA provides a snapshot of a large-scale programme which employs a variety of models for energy delivery and O&M which are tailored based on geographic characteristics, the local operating environment, and the capacity of different stakeholders. The programme is leveraging digital tools to support country-level monitoring and efficient management of newly electrified healthcare facilities. It is also piloting different public-private partnership models and promoting inclusion of energy-efficient medical technology and built environments in the facilities targeted.

Somalia

To increase access to energy for Somalia's flailing health services and improve patient outcomes, WHO partnered with SELCO Foundation, government stakeholders, and a local energy company to design and install DRE systems across 51 critical facilities in the country. Learnings from the programme demonstrate the potential to accelerate the pace and reduce the cost of healthcare electrification in fragile and displacement contexts by bundling these projects into larger development initiatives.

- **39,475 refugees and asylum seekers live in Somalia and nearly 4 million people are internally displaced[34]**
- **48% electrification rate, with 76% urban and 31% rural electrification[35]**

KEY STAKEHOLDERS

Department of Environment, Climate Change and Health, WHO Headquarters	Programme coordination, technical guidance, and funding.
WHO Somalia Country Office	Programme implementation at country level. Leading partner coordination, oversight, and scale up.
WHO Eastern Mediterranean Regional Office	Support in procurement of solar energy systems.
Federal and State Governments of Somalia	Health facility selection, ownership of installed systems, management of long-term O&M.
SELCO Foundation/ GlobalSDG7Hubs	Technical support with a focus on assessment and procurement.

For the past 30 years, Somalia has faced ongoing political instability and severe droughts, which have displaced 3.8 million people and left 6.7 million food insecure. The instability has also directly impacted Somalia's healthcare system, and the country has some of the lowest health indicators globally. Disparities in health services exist across regions and districts, creating imbalances between urban and rural areas as well as the quality of care offered at public and private health centres. Funding the public healthcare system is a major challenge, with Somalia relying on international and private funding due to limited government revenue. Additionally, the average cost of grid electricity is one of the highest globally, at $0.5 to $1.25 per kWh. This is mainly due to the heavy reliance on diesel to power the country's electricity system.

To improve access to quality essential health services, WHO supported the government of Somalia in solarising 51 critical healthcare facilities. A unique aspect of the programme is the partnership between three stakeholders with different expertise and geographic scopes: WHO as a global UN agency, the Indian non-profit SELCO Foundation, and a local energy company with a strong on-the-ground presence in Somalia's challenging operating context. ◆

Somalia

PROJECT OVERVIEW

LOCATION

Somalia
Countrywide


Health facilities powered using solar PV
©Tamarso


Staff member from a local clean energy enterprise conducts monitoring at a health facility
©Tamarso

project scope & status

PROJECT SCOPE

Electrification of **51 health facilities**, including maternal and child health centres, a hospital, and laboratories

PROJECT STATUS (Q4 2024)

Phase 1 in monitoring, evaluation and learning stage; fundraising underway for Phase 2

population impacted

1,000 to 30,000 people served per facility with at least **50** estimated maternal deliveries per month at each

power source

255 kWp off-grid solar PV systems with battery storage and inverter (5 kWp solar panel capacity per system)

funding information

$35,000 grant per system from King Salman Humanitarian Aid and Relief Center via WHO

Somalia

PROJECT PROCESS

1

ENERGY NEEDS ASSESSMENT

Assessments were conducted across 81 facilities selected through nominations by Somalia's federal and state governments. A guideline for selection was created and priority was given to functional facilities with adequate staffing and no prior support.

2

FUNDING

The first phase of implementation was funded through a WHO health infrastructure programme carried out by the WHO Somalia Country Office during the COVID-19 pandemic to address the urgent need for oxygen concentrators. Following this, WHO HQ collaborated with the WHO Country Office to expand the scope of the programme and install solar PV systems in other facilities meeting essential needs.

3

DESIGN & IMPLEMENTATION

The energy needs assessments were used to develop a standard solar PV system design, keeping in mind variations in population coverage, healthcare services provided by the facility, and average hours of operation. Facility energy needs were estimated based on a standard list of energy efficient medical devices. A list of missing medical equipment was prepared for each facility, with some devices included during the time of solar energy system deployment. A 5 kWp system with an inverter and battery bank to ensure uninterrupted electricity supply was installed at each facility.

Technical and procurement guidelines for the solar PV systems were created with the support of WHO HQ and SELCO Foundation. Procurement and installation services were carried out by WHO's country and regional offices with the support of a local Somali energy company.

4

O&M

A stipulation to provide five years of O&M services was included in the contract for system installation with maintenance provided twice per year. Over the long term, the Somali Ministry of Health will ultimately be responsible for managing O&M of the systems.

A hospital serving vulnerable communities in Somalia

Somalia

PROJECT IMPACTS

- Considering the high cost of electricity in Somalia ($0.5 to $1.25 per kWh), the benefit would be substantial in terms of energy, let alone the financial impacts derived from a healthier population and reduced out of pocket expenditures for patients.

- Considering that the electricity typically generated in Somalia is largely derived from expensive diesel, the solarisation efforts would reduce diesel usage to the same value as a kWh generated from the solar energy system. Furthermore, the introduction of energy efficient appliances and medical equipment would further reduce energy demand.

- Each of the health facilities surveyed reported a minimum of 50 maternal deliveries per month. Health facilities surveyed reached out to between 1,000 to 30,000 individuals per month on average, depending on remoteness, and would hence serve large communities. The availability of reliable electricity and medical equipment is expected to enable a dramatic increase in the quantity of health services for the impacted population.

LESSONS LEARNED

- **The needs assessment was based on the power demand of the list of medical devices approved by local health authorities. This made it possible to identify a standard solar PV system design based on the healthcare service delivery needs, which was then confirmed by a site readiness assessment.**

- **Engaging a local energy business to conduct the energy assessments and system installation had many benefits, including enabling communication in local languages, quick data collection, and ease in addressing certain logistical challenges due to the company's established presence. The company's local technician network also lowered costs and enabled rapid and proper delivery of O&M services.**

- **Operating context can have a large impact on system and project costs. In Somalia, high transportation costs, driven by a need for special security measures when accessing several sites, represented a significant additional cost in installation.**

A health facility in Somalia powered using solar PV

©Tamarso

Sierra Leone

In Sierra Leone, healthcare and energy infrastructure remain inadequate, especially in rural regions. Despite their importance in providing necessary care to vulnerable and remote populations, many primary health facilities in the country face challenges such as a lack of sufficient staffing and accommodation, medical supplies, and infrastructure, as well as unreliable access to electricity and potable water supply. The challenges described above are also common among healthcare facilities in displacement settings. Sierra Leone too has experienced periodic challenges with internal displacement due to factors such as civil unrest, natural disasters, and health emergencies. The country also faces challenges related to climate change, including flooding and droughts, which have increased the vulnerability of communities. Thus, humanitarian partners can learn from the multi-stakeholder partnership led by The Energy Nexus Network (TENN) and GlobalSDG7Hubs which piloted a democratised programme approach to empower local partners to close the country's healthcare electrification gap.

- **Over 25% of children under five years old suffer from stunted growth, and an estimated 260,000 children endure acute malnutrition annually[36]**
- **29% electrification rate, with under 55% urban and 5% rural electrification[37]**

KEY STAKEHOLDERS

The Energy Nexus Network	Lead partner managing program design, implementation, and monitoring activities.
GlobalSDG7Hubs	Primary technical partner supporting on system assessment methodology, design, and procurement.
Ministry of Health	Initiating program scale-up based on success of pilot and acting as lead partner going forward.

There have been significant efforts to strengthen Sierra Leone's healthcare sector since the Ebola outbreak of 2014 to 2016. However, a slew of preventable disease and health challenges continue to burden the country's population, and in many places, energy remains a significant limiting factor to the quality of care patients can receive. Despite their importance, many primary health centres in the country face challenges such as inadequate staffing and accommodation, medical supplies, and infrastructure, as well as unreliable access to electricity and drinking water supply.

Sierra Leone's electricity grid is unreliable and has not been extended to remote areas, as low population density and difficult terrain would render this effort very costly. Many households, businesses, and institutions rely on grid power supplemented by diesel generators, as well as traditional lighting and sources like firewood or charcoal for cooking.

TENN is a regional knowledge hub for scaling DRE based in Freetown. TENN partnered with GlobalSDG7Hubs to pilot a solution to address the healthcare electrification gap in Sierra Leone's most vulnerable communities. A significant feature of the programme is the inclusion of a sustainability plan for O&M checks and services. Another aim of the programme is for the deployed systems to be locally owned, operated, and managed by key DRE ecosystem actors where the healthcare facilities are located. ◆

Sierra Leone

PROJECT OVERVIEW

LOCATION

Sierra Leone
Countrywide

Rooftop solar panels being installed

©The Energy Nexus Network

project scope & status

PROJECT SCOPE

Electrification of **18 primary health** facilities in phases 1 and 2; electrification of **2,000 facilities** nationwide in scale-up phase

PROJECT STATUS (Q4 2024)

Implementation of phases 1 and 2 completed; scale-up in development

Health facility staff participate in a training on basic system O&M

©The Energy Nexus Network

population impacted

180,000 people in initial phases

power source

1.1 kWp to **3.4 kWp** per solar PV system

funding information

Grant from GlobalSDG7Hubs to electrify **18 facilities** in initial phases

Sierra Leone

PROJECT PROCESS

1

ENERGY NEEDS ASSESSMENT

Facilities representing the different tiers of Sierra Leone's healthcare system were selected after detailed discussions with responsible health authorities at the national, district, and local levels. Multiple rounds of visits to health facilities were made to determine their energy needs. The assessments revealed not only electrification issues but also insufficient infrastructure for water, hygiene, and sanitation; staff quarters; and waste management. Appliance needs for not only medical service provision, but also staff comfort were taken into account.

2

DESIGN & IMPLEMENTATION

Three standard system sizes ranging from 1 kWp to 3 kWp were created for the different health facility types in Sierra Leone. Each system incorporates energy-efficient lighting, ventilation, and essential medical appliances. In the scale-up phase of the project, water, sanitation, and hygiene, as well as improvements to the built environment for health facilities will also be considered.

TENN conducted an assessment of the local DRE market to determine component availability and identify EPC companies that procure equipment from reputable suppliers. Based on this, tender documents were prepared and local contractors selected. After installation, thorough testing and commissioning were carried out to verify system functionality and performance.

3

TRAINING & O&M

The lead solar technicians from the EPC companies selected for the project conducted comprehensive training sessions for local technicians and health facility staff. Training focused on providing a basic understanding of system components, maintenance, troubleshooting, and repairs to equip participants with the ability to address common issues that may arise during system operation.

GlobalSD7Hubs provided incubation support to the enterprises selected for this programme to integrate O&M within their operations. TENN subsequently developed a sustainability plan to monitor the deployed systems and signed contracts with the EPC companies to provide product warranties and O&M services for a minimum of two years. TENN's involvement in installation and monitoring helps bridge capacity gaps of local EPCs. The O&M costs for the first five-to-ten years were also integrated into the programme budget to ensure long term sustainability after handover to the Government of Sierra Leone.

It is often necessary to navigate difficult terrain to reach remote health facilities

©The Energy Nexus Network

Sierra Leone

PROJECT IMPACTS

- The innovative aspect of this programme was the successful development of a model through which local organisations can lead or be closely involved in programme design, execution, and long-term monitoring.
- The healthcare facilities solarised are expected to see significant savings on their energy bills and diesel costs.
- The needs of healthcare staff were also considered, and improvements in the energy supply and appliances available in their quarters is expected to improve wellbeing and living conditions, contributing to staff retention.

LESSONS LEARNED

- **Empowering and supporting a local or regional entity like TENN to lead on all aspects of the programme is crucial to build that organisation's capacity and experience. This supports programme sustainability and creates potential for replication in other contexts by the same entity.**
- **Scaling healthcare electrification programmes takes time because of the capacity building requirements of not only local partners such as TENN, but also the overall country-level ecosystem for supporting infrastructure and service development in remote areas. Building capacity from the bottom up is crucial for long-term sustainable development, but considerable time is needed to establish a local anchor and for the ecosystem to achieve scale.**

Installation and trainings taking place at a health facility in Sierra Leone

India

Energy for Health is a national-level programme aimed at closing the healthcare electrification gap and boosting climate resilience in India's rural and remote communities. Led by SELCO Foundation and the IKEA Foundation, the programme adopts a unique bottom-up approach to addressing the energy-health nexus while establishing scalable processes at every level. A key aspect of the programme includes the introduction of customised digital tools to support data collection, management, and analysis to support an O&M approach managed at the national level but which engages and builds the capacity of local companies.

- **Around 5% of primary health centres, serving over 24 million rural inhabitants, still lacked any electricity supply in 2019[38]**
- **The maternal mortality rate (MMR) in India is 103, well below the SDG 3 target of 70 per 100,000 live births. Assam, a remote, flood prone and border province of India, is the worst performing state, with an MMR of 195[39]**

KEY STAKEHOLDERS

SELCO Foundation	Responsible for programme design. Leading fundraising, partnership development, and implementation. Manages and ensures O&M of facilities.
IKEA Foundation	Anchor funding partner contributing approximately 50% of program resources.
Government of India	Specifically, the Ministry of Health and National Health Mission. Funding partner issued directives to support healthcare electrification. Designs and forms national guidelines on healthcare electrification.
State-Level Governments in India	Funding (in some states) and implementation partner, helps identify sites. Assists in assessments, procurement, and implementation.
Domestic Philanthropies	Provide gap funding for health facilities in selected states.
Local Energy Enterprises	Act as implementation partners in their respective regions.

Despite significant progress on development in recent decades, India faces significant inequity across regions due to its diverse geography and large population. Populations in remote and harsher terrains especially find essential infrastructure services inaccessible, leading to higher disease burdens, lower education levels, and high rates of economically induced migration. While India has a robust healthcare system, rural regions often face challenges such as poorly equipped and understaffed centres, poor health indicators, and energy poverty. Due to challenges in maintaining grid quality, many rural health facilities struggle with inconsistent power supply, voltage fluctuations, and frequent outages, which negatively affect the delivery of essential healthcare services.

To address these challenges, SELCO Foundation and IKEA Foundation in 2020 launched the Energy for Health programme with support from India's Ministry of Health and Family Welfare. It aims to institutionalise the use of renewable energy in India's healthcare sector while powering 25,000 facilities across 12 states. ◆

India

PROJECT OVERVIEW

LOCATION

India

Countrywide

Energy consumption can be monitored remotely using digital tools

©SELCO Foundation

project scope & status

PROJECT SCOPE

Electrification of **25,000** health facilities in rural and remote areas

PROJECT STATUS (Q4 2024)

Implementation, with over **6,000 facilities** electrified as of December 2024

population impacted

170 million patients benefiting from improved care and 160,000 healthcare staff benefitting from improved working conditions

power source

1-6.5 kWp, depending on health facility, with battery backup; estimated **100 MW** to be installed nationally

funding information

$100 million in grants from the IKEA Foundation, India's national and state governments, domestic philanthropies, and corporate social responsibility funds

PROJECT PROCESS

1 ENERGY NEEDS ASSESSMENT

Health energy assessments and site-level surveys are being carried out in all 12 states, giving priority to primary health facilities. The health assessments evaluate the facilities' infrastructure, medical services, staff capacity, patient volume, and overall functionality. Current energy infrastructure, consumption patterns, energy sources, solar energy potential, and feasibility for solar PV system installation are also assessed. Health facilities that do not meet certain key criteria around staff capacity and functionality are rejected at this stage. Design and implementation guidelines to support electrification of selected facilities are being produced using input collected through field consultations and focus groups with local stakeholders and healthcare staff.

2 FUNDING

By 2026, SELCO Foundation aims to directly electrify 16,000 facilities with funding from the IKEA Foundation and domestic philanthropic partners. A longitudinal evaluation of these facilities and implementation will provide a clear picture and insights into the efficacy of the programme. Electrification of the remaining health facilities will be funded and executed by the Government of India, with SELCO Foundation providing technical advisory services.

SELCO Foundation's previous partnerships and commitments with the national and state governments, as well as India's prioritsation of the solar sector in its development agenda, contributed to SELCO Foundation successfully advocating to India's Ministry of Health and Family Welfare to facilitate allocation of state funds for the programme.

3 DESIGN & IMPLEMENTATION

A set of replicable system designs are being created for different types of health facilities that provide specific ranges of services and use similar equipment. Inefficient equipment is also being replaced with new technology. Project costs are developed based on local supply chains, terrain and transportation infrastructure, and state-level human resource availability. Local tenders are then floated for implementation of the energy systems.

4 TRAINING & O&M

O&M costs for five years are built into the programme costs, and Indian government authorities will ultimately be responsible for ensuring the long-term operation of the solar PV systems installed. Trainings on best practices in the O&M of off-grid solar PV systems are planned at every level. Multiple models for O&M have been developed through consultation with government departments, energy enterprises, and civil society. A digital platform complete with data collection, management, and analysis tools is being built to support programme flow, site-level assessments, and O&M. O&M activities will also be supported using a customer relationship management system, remote monitoring system, and physical monitoring system.

India

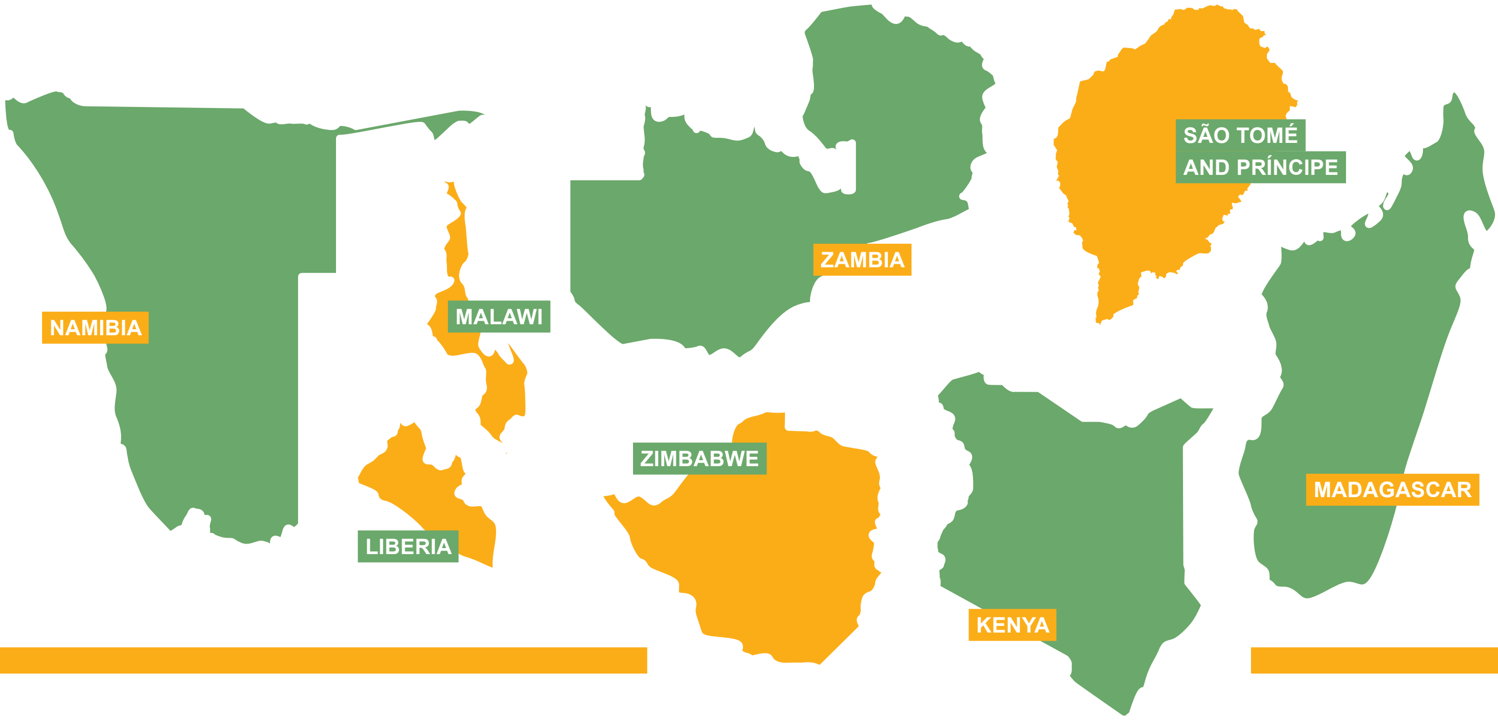
PROJECT IMPACTS

- It is estimated that solarisation of all 25,000 sites targeted could potentially avoid 5 million tonnes of CO_2e.
- Including equipment replacement and procurement in the programme will not only improve the quality of care provided but also reduce overall energy demand by increasing efficiency.
- Guidelines and pilot programmes being developed to improve the built environment of selected health facilities will lead to facilities having better lighting and ventilation as well as reduced energy consumption.

LESSONS LEARNED

- **Especially when working in remote locations with challenging terrain, use of digital monitoring systems can reduce O&M costs over time and aid decision-making among stakeholders working in the local ecosystem, promoting long-term sustainability and efficiency.**
- **Successful development and implementation of a country-level healthcare electrification initiative requires strong partnerships with national and local government actors as well as local energy enterprises and NGOs.**
- **Additional time should be allocated to secure and disburse government funding, as the processes can be lengthy and face delays. Government decision-making often requires consultation and sign-off at multiple levels. Maintaining coordination and knowledge sharing at every level is also essential to speeding up processes.**

Patients at a community health centre with reliable electricity access receive higher quality care



HEALTHCARE ELECTRIFICATION INVESTMENT CASES

The final studies included in this research are investment cases prepared with the aim of building out large-scale multi-stakeholder partnerships to electrify health facilities across countries and regions. The research conducted for each case provides valuable insights into potential new models for financing and managing healthcare facility solarisation and long-term O&M, with a focus on ESCO models and public-private partnerships (PPP).

UNICEF's plan to solarise 294 facilities in ***KENYA***'s Turkana County demonstrates how a PPP that employs an ESCO model could be used to ensure sustainable electrification of health facilities that serve displaced communities. The case also highlights the importance of a strong enabling environment in making such an approach feasible, as Kenya's supportive policies for both refugee communities and off-grid electrification underpin the proposed approach.

The ***MULTI-COUNTRY STUDY*** details UNDP's efforts to develop a large-scale platform for coordinating healthcare electrification across 22 countries globally. The Solar for Health programme, currently in its second pilot phase, aims to employ an ESCO model to electrify and ensure maintenance of systems, with a focus on large-scale healthcare facilities. Humanitarian partners should track the progress of and learn from the models employed in the pilot countries as they are implemented on the ground. It will also be important to advocate for the inclusion of fragile and displaced communities in these projects going forward.

The ***SÃO TOMÉ AND PRÍNCIPE*** and ***MADAGASCAR*** cases present approaches for sustainably electrifying healthcare in small island developing states (SIDS). This is a crucial problem to solve in the broader challenge of electrifying healthcare in fragile and displacement settings because SIDS are highly vulnerable to climate change, and many of their communities are threatened by displacement as a result. The preparation processes for these electrification roadmaps detail novel approaches to system design, as well as examples of best practices in working with government partners to budget for installation and O&M.

Kenya

UNICEF developed a business case to solarise 294 healthcare facilities in Turkana County, which hosts 774,370 refugees from over 10 countries. To overcome the limitations of donor-funded projects which frequently fail to consider the cost of long-term maintenance for energy systems, UNICEF proposes to deploy innovative business models that incorporate O&M from the outset, such as an ESCO model in combination with renewable energy credits. This approach not only ensures sustainability but also aligns the interests of all parties involved, demonstrating a financially viable solution for the long-term functionality of solar PV systems in public health facilities serving people living in fragile and displacement contexts.

- **774,370 refugees[40] and 1.5 million IDPs in Kenya[41]**
- **76% electrification rate with 98% urban and 66% rural electrification[42]**

KEY STAKEHOLDERS

UNICEF	Lead partner. Developed investment case for solar powering all health and education facilities in Turkana County.
DONOR	Funding partner or consortium of partners who would co-finance project CAPEX.
GOVERNMENT	Cohort of government ministries and agencies to support project implementation, including establishment of ESCO fund for ongoing maintenance payments.
Electricity Service Company	Local private company to be selected via competitive process. Would sign PPAs and operate systems over long term. Would generate revenue by selling power to institutional customers. Company would also co-invest in the capital costs of the system.

While significant progress has been made in electrification and clean energy access in Kenya thanks to a supportive policy and business environment, an estimated 1,500 health facilities in the country are still lacking access to reliable electricity. Turkana is among 14 designated underserved counties in the country where progress has lagged. It is also highly vulnerable to climate change, having been impacted by severe droughts in recent years.

Kenya is also home to nearly 1 million refugees, most of whom live in protracted situations of displacement. The majority have resided in camps for over 30 years, with new influxes over the years, mainly from Somalia and South Sudan. Refugees in Kenya generally experience challenges in accessing healthcare, whether they are in rural camp complexes or urban areas like Nairobi. Turkana County hosts approximately 279,452 refugees and asylum-seekers, primarily in Kakuma Refugee Camp and the Kalobeyei Integrated Settlement.[43] In Turkana County, 64% of refugees never access electricity, while 29% access electricity on a daily basis.[44] Electrifying the majority of health facilities across Turkana county is expected to significantly improve the quality of healthcare provided to both refugees and members of vulnerable host communities. ◆

Kenya

PROJECT OVERVIEW

LOCATION

Kenya
Turkana County, northwest Kenya

A health facility in Turkana County

©UNICEF

project scope & status

PROJECT SCOPE

Solarisation of **294 health facilities** and **578 educational facilities** in Turkana County

PROJECT STATUS (Q4 2024)

Fundraising ongoing

population impacted

1.2 million people, including both refugees and underserved host communities

power source

For health facilities:
2.4 MWp of solar PV, 6.0 MWh of battery storage, and 1.4 MW of inverter power

Full project,
10.3 MWp of solar PV, 25.9 MWh of battery storage, and 5.6 MW of inverter power

funding information

$4.7 million for CAPEX and **$800,000** for OPEX for health facilities and **$19.3 million** for the full project scope

Kenya

PROJECT PROCESS

1 ENERGY NEEDS ASSESSMENT

Survey data was collected on each facility and used to develop a representative profile of the average facility in each category considered (e.g. clinic, hospital, or dispensary). Each profile included the equipment used and estimated electricity demand for providing the services required of each facility type by the government of Kenya.

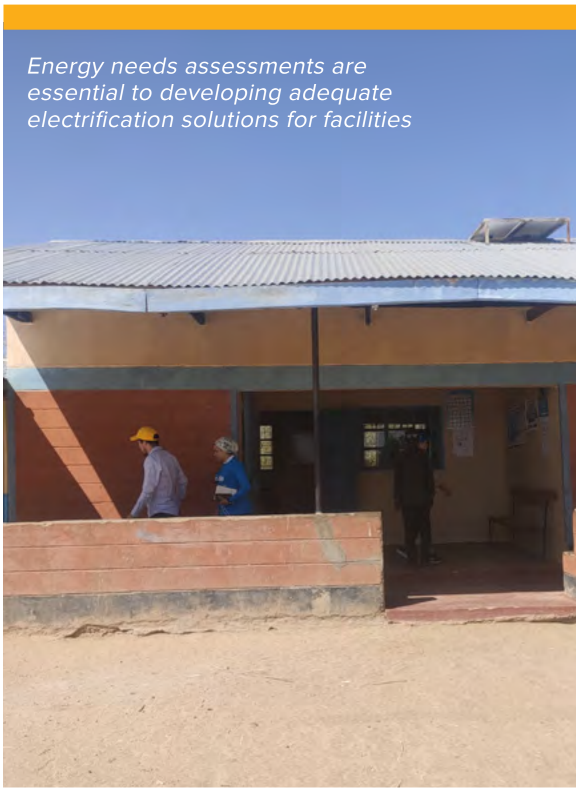
2 DESIGN

Based on the representative facilities and using the RESizing Tool, standard solar PV systems were developed for each facility type. Developed by UNICEF, the RESizing tool enables any UNICEF staff member, even those without prior technical knowledge, to conduct surveys of health and education facilities for the purposes of solarization and estimate system and funding requirements. Several parameters were included in the design of each system to guarantee reliability of access. In particular, it was ensured that during the month of the year with the lowest forecasted solar irradiation at the site, each system could still generate 20% excess electricity to accommodate for potential demand peaks. The sizing additionally anticipates 25% load growth. The lithium-ion batteries for each system were assumed to have a depth of discharge of 80%, with the battery bank running for a minimum of 12 hours on days with reduced solar irradiation. The system sizes for Turkana County range from 5.2 kWp to 54.6 kWp for the solar PV system, 13.1 kWh to 137.4 kWh for the battery, and 4.0 kW to 27.3 kW for the recommended inverter size.

3 PREPARATION FOR FUNDRAISING & IMPLEMENTATION

The systems are expected to cost between $15,000 and $150,000, including labour for installation, depending on the facility type and system size. To electrify all 294 healthcare facilities targeted is estimated to require $4.7 million for CAPEX and $800,000 for OPEX for five years of OPEX spending. The five years of energy service utilisation will be guaranteed through a PPA which includes an option for renewal.

The ESCO selected for the project will also provide a share of funding for CAPEX, as will the potential donors. The Government of Kenya will sign five-year PPAs with the facilities and sell them electricity. Revenue from the electricity sales will be used to pay the ESCO to conduct O&M on the systems, thus ensuring their long-term operations.



Energy needs assessments are essential to developing adequate electrification solutions for facilities

©UNICEF

Kenya

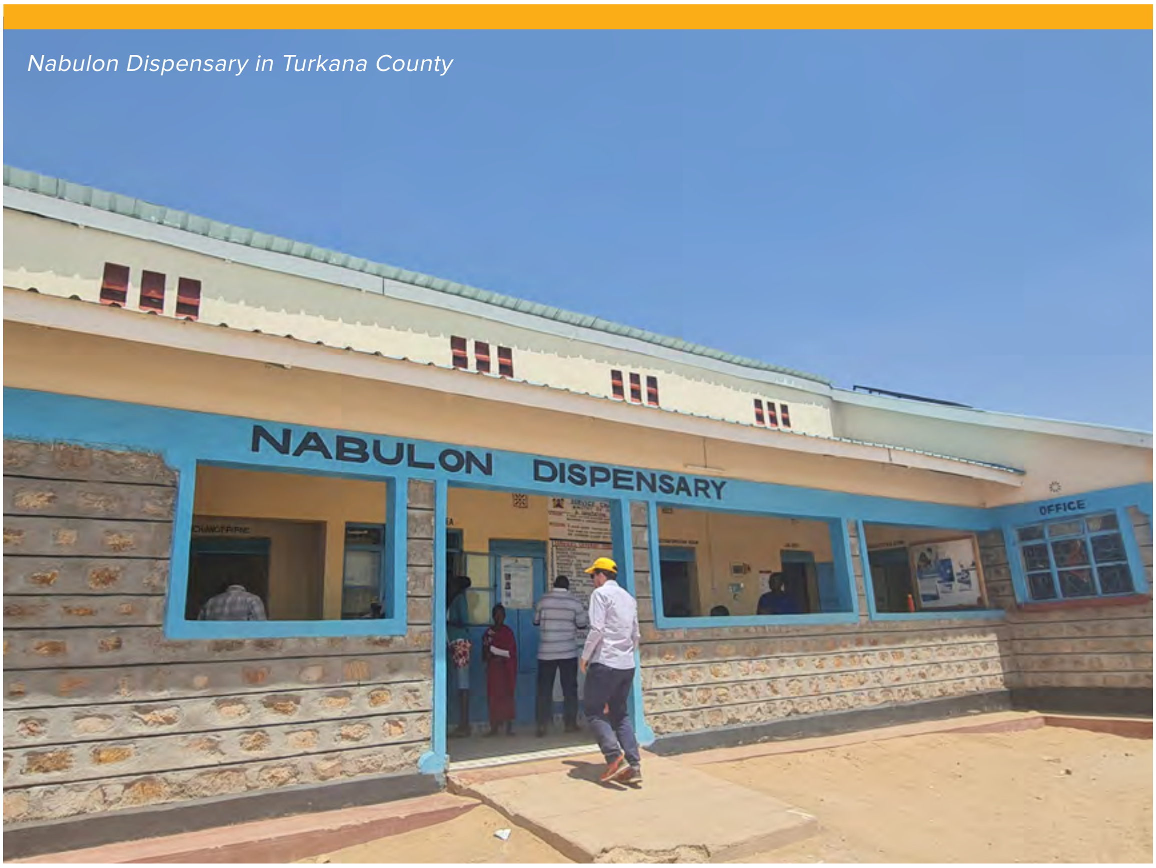
PROJECT IMPACTS

- Electrification of almost all healthcare facilities in Turkana County is expected to contribute significantly to the resilience of both displaced people and host communities in the face of worsening climate change impacts.
- Successful implementation of this innovative energy delivery model in a healthcare context will generate knowledge and pave the way for its adaptation and use in other operating contexts.

LESSONS LEARNED

- **For assessments, a combination of the sizing tool, offline survey, site visit, and extrapolation was useful in understanding energy demands and requirements.**
- **Donor-funded initiatives for solar PV systems in public health facilities and schools typically prioritise the costs of equipment alone. It is important to consider funding for OPEX as well as a working model for long-term project sustainability.**
- **A strong enabling environment and close government partnership is key. The ability to establish a PPP and employ an ESCO model is possible in part because of enabling steps taken by the Government of Kenya in recent years.**
- **The full scope of the project includes both health and education facilities. It bundles together communal services to achieve economies of scale and aid fundraising efforts.**

Nabulon Dispensary in Turkana County



Multi-Country Study

The UNDP's Solar for Health (S4H) programme aims to simultaneously address the global gaps in universal health coverage and access to modern energy. A successful pilot completed in 2017 with funding from the Global Fund and Innovation Norway installed 7.7 MWp of solar capacity across 650 healthcare facilities in Zimbabwe, Zambia, Libya, Namibia, Sudan, and South Sudan. In the next phase, the UNDP aims to employ innovative, catalytic financial models to ensure the long-term financial, operational, and environmental sustainability of systems installed under the programme. It will be crucial for humanitarian partners to follow the results of this phase of S4H and identify opportunities to apply these models in fragile contexts as well as include displaced people in the scale-up of the programme.

◆ **Over 25,000 refugees and IDPs were living across Namibia, Liberia, Malawi, Zimbabwe, and Zambia in 2024[45]**

KEY STAKEHOLDERS

UNDP	Leading phases in different countries and 22-country scale up. Disseminating results of feasibility study for Phase 2 to regional and country offices to collect feedback.
KOIS	Impact finance firm which co-conducted feasibility study on innovative financial models for healthcare electrification.
Differ	Solar energy investment and advisory firm which co-conducted the feasibility study.

The pilot phase of S4H revealed that the common approach of solar PV system installation followed by asset transfer to government authorities can jeopardise the long-term sustainability of energy supply to healthcare facilities, as partners often lack the financial and technical capacity to ensure continuous O&M. In the second stage of the project, with support from Differ, KOIS, and country-level partners, UNDP will pilot alternative energy delivery models aimed at guaranteeing energy services provision to healthcare facilities over the long term. This new approach will also ensure that UNDP seeks private sector support and input to scale up S4H over time. ◆

Multi-Country Study

PROJECT OVERVIEW

LOCATION

Second phase will span
Namibia
Liberia
Malawi
Zimbabwe
Zambia

project scope & status

PROJECT SCOPE

Eventual solarisation of over **18,000 healthcare facilities** across 22 countries globally

PROJECT STATUS (Q4 2024)

Pilot completed; project concept developed for second phase

power source

Solar PV systems with back-up power to be developed based on country context and needs

A ground-mounted solar system

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PROJECT PROCESS

1

FEASIBILITY STUDY

The UNDP commissioned KOIS and Differ to assess innovative financing mechanisms to leverage private capital for healthcare electrification across the five selected countries. For each country, the research partners conducted an analysis of the broader country and macroeconomic contexts, as well as key barriers to the use of a market-based approach to healthcare electrification. Over 100 interviews were conducted with key stakeholders, including government officials, regulators, healthcare facilities, energy service providers, and donors. Interviews with over 30 potential investors, including private investors, international financial institutions, development finance institutions, local banks, foundations, and impact investment funds were also conducted to assess their requirements, constraints, and interest in supporting an S4H financing facility. A scalable S4H financing model was then designed to address key challenges identified by stakeholders.

2

DESIGN

Led by UNDP, the S4H platform is not a financing channel but a mechanism to coordinate ecosystem actors to deliver holistic interventions in the energy and health sectors. To address limited investment attractiveness and low access to affordable financing in last-mile communities, S4H will aggregate projects into portfolios of relevant ticket sizes and risk-return profiles to attract different investor types. A PPP model will be used in which ESCOs own the solar assets and sign initial 7-year PPAs to sell electricity to the healthcare facilities. The PPAs will set out contractual and financial obligations between financiers, national health authorities, and local ESCOs. Results-based payments disbursed from an energy payments funding mechanism and coupled with the distribution of payments throughout the contract period will align the financial incentives of funders and ESCOs. Capacity building support will also be provided to ESCOs, government stakeholders and healthcare facilities included in S4H.

3

PREPARATION FOR FUNDRAISING & IMPLEMENTATION

In mid-2020, country-level workshops were held to validate the financing model proposed, and the UNDP coordinated formal expressions of interest from the relevant ministries to proceed with the implementation phase. UNDP via its country offices will oversee the S4H initiative as it is implemented by different stakeholders, from procurement to investment monitoring, ensuring quality standards and successful programme implementation.

UNDP will coordinate with relevant ministries to engage with donors and investors to mobilise early interest and commitments for the S4H programme. This will include developing a proposal for funding from the Green Climate Fund and Project Preparation Facility. Based on the initial design of the PPP model in the feasibility study and local requirements, UNDP and its financial transaction advisor will develop a financial model and investment term sheet to fundraise with donors, DFIs, and other investors. The full design and launch of an S4H innovative financing facility is expected to take between one and 1.5 years in each country.

Multi-Country Study

PROJECT IMPACTS

- S4H aims to pilot workable financing models and build the capacity of international and local financial institutions, governments, and ESCOs to provide market-based access to reliable electricity for healthcare facilities serving a wide range of communities, including those in fragile and displacement settings.
- The S4H platform will harmonise interventions from various stakeholders working on healthcare electrification to address coordination gaps that hinder the sustainability and cost-effectiveness of donor-funded installations.
- The full scope of the programme will have significant impact on the quality of healthcare received by and climate resilience of communities in developing countries, while also avoiding emissions from increasing energy demand.

LESSONS LEARNED

- **Smaller and more remote healthcare facilities serve more vulnerable populations and can have greater potential impact, but they are more costly to serve. Subsidies are necessary to make these markets appealing to ESCOs and investors.**
- **Once the S4H market is defined in each country, several key challenges must be addressed on the demand and supply sides to implement the programme at scale. These include (i) low ability to pay for healthcare facilities, (ii) lack of access to capital for ESCOs, (iii) a tendency to overlook concerns about the long-term sustainability of deployed solar installations, and (iv) low availability of off-grid product and service providers, especially in rural areas.**

Solar-diesel hybrid systems can be used to ensure 24/7 electricity supply at larger facilities with critical loads

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São Tomé and Príncipe

Despite having the renewable resources to meet all its energy needs, São Tomé and Príncipe today is highly dependent on fossil fuel imports. The country also faces challenges with unreliable electricity access and voltage fluctuations from its poorly maintained national grid. To assess the potential for renewable-powered electrification of the country's health system and create a roadmap to support potential fundraising efforts, the International Renewable Energy Agency (IRENA) conducted a sectoral assessment of the health and energy infrastructure of São Tomé and Príncipe. The resulting investment case provides information on and cost estimates for the solar PV system designs, as well as funding needs based on energy requirements. It provides recommendations on local skills development, ownership, and improving the quality of the country's health infrastructure.

- **Infant mortality rate of 32 per 1000 live births[46]**
- **Second highest disability-adjusted life years among SIDS, driven by maternal, neonatal and nutritional deficiencies[47]**
- **65% of total energy supply came from fossil fuels in 2020[48]**

KEY STAKEHOLDERS

The International Renewable Energy Agency	Lead partner. Conducted study and coordinating various stakeholders.
Ministry of Energy and Natural Resources	Shared secondary data and facilitated data collection.
Ministry of Health	
Government of Walloon and the Federal Ministry for Economic Affairs and Climate Action (BMWK) **of Germany**	Provided funding for assessment.
SELCO Foundation	Technical partner. Conducted study and created design templates.
UNDP Country Office	Local partner and contributor at country level.

SIDS like São Tomé and Príncipe often bear the disproportionate brunt of climate change, facing rapidly increasing rates of non-communicable diseases, malnutrition and shortage of medicines. The limitations of the island's healthcare system are compounded by the unreliable electricity supply from the ageing national grid. Currently, the island's 40 health facilities are all connected to the grid, but 43% receive some amount of power from a diesel generator, and a large portion of the national healthcare budget is allocated to purchasing fuel. ◆

São Tomé and Príncipe

PROJECT OVERVIEW

LOCATION

São Tomé and Príncipe

Countrywide

Reducing the use of expensive diesel through solaristion can lower the cost of serving patients

©International Lifeline Fund

project scope & status

PROJECT SCOPE

Renewable-powered electrification of all **40 healthcare facilities** in the country, including health posts, health centres, and **2 hospitals**

PROJECT STATUS (Q4 2024)

Study completed

population impacted

231,856 residents of São Tomé and Príncipe

Solar systems can be customised to fit a facility's electricity demand profile

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funding information

$3.2 million for solar as backup power for basic loads and **$10.2 million** for solar as primary power source for regular loads

PROJECT PROCESS

1

ENERGY NEEDS ASSESSMENT

The assessment employed an ecosystem approach to understand the country's energy needs, identify challenges in energy supply and financing, and gather data to identify appropriate solar PV system designs, training programmes, ownership models, and funding models. It included secondary research and primary data collection from 14 representative healthcare facilities. Interviews were conducted with key stakeholders, including facility staff, local suppliers of DRE components, and the health and infrastructure ministries.

2

DESIGN

Customised DRE solutions and cost estimates were developed for health posts, centres, and hospitals, covering solar PV system design for medical and electrical appliances. Solutions were tailored for basic and regular loads, and regular loads with laboratory services. Scenarios were created with solar as either the primary or backup energy source, depending on the facility's services. Procurement guidelines and strategies specific to the SIDS context were designed to incentivise quality and timely after-sales service while strengthening local entrepreneurship for installation and maintenance.

3

PREPARATION FOR FUNDRAISING & IMPLEMENTATION

A key aspect of the research was to assess the funding needs based on the energy requirements and possible expansion of the country's healthcare facilities. The different cost components include system, O&M, remote monitoring, and transportation costs. The cost estimates developed through the research will be used by the government and multi-lateral agencies to raise funds for implementation. Resources for the maintenance of systems will be unlocked either through untied funds present in the district or national governance structures or by including this work in the installation contract for the enterprises.

4

TRAINING & O&M

Capacity building will include training to equip local health facility staff, vendors, and other designated personnel to use medical appliances for service delivery and manage the energy systems, including aspects of basic maintenance. Any future programme must integrate clear responsibility for DRE systems, including decision-making and financial capacity, to ensure long-term sustainability and effective asset handover between entities. O&M costs can be built into tenders or the health system budget.

Solar power can reduce reliance on unreliable grid electricity supply

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São Tomé and Príncipe

PROJECT IMPACTS

- Primary data suggests that nearly 43% of health facilities in the country currently use diesel generators and consume 80 to 300 litres of fuel monthly. Solarization can save energy costs and reduce emissions from the healthcare sector by eliminating the need to use diesel backup power.
- Solar-enabled reliable electricity supply can reduce appliance damage, extend operational hours, and prevent medicine and vaccine wastage by maintaining a constant temperature for storage.

LESSONS LEARNED

- **In addition to supporting data collection and coordination efforts, government partners can also provide important information on the status of ongoing and planned health and energy programs in a country to unlock synergies and avoid duplication of work.**
- **It is important to budget for and develop an effective management structure for O&M and spare parts to ensure the long-term reliable operation of solar PV systems. Models for funding and ownership should be developed based on the capacities of the stakeholders involved.**
- **Oftentimes decentralised solar PV systems are designed using a piecemeal approach that has the effect of ignoring large areas of demand and overlooking operational sustainability. There is a need for a more robust and holistic approach to ensure the current and future energy needs are met.**

A ground-mounted solar system

Madagascar

As 75% of Madagascar's healthcare facilities lack access to electricity today, closing this gap can have a significant impact on the country's ability to respond to humanitarian emergencies driven by worsening cyclones and other natural disasters. A consortium of partners led by SEforALL developed developed a market assessment and roadmap[49] for electrifying Madagascar's healthcare system. Lessons drawn from this large-scale initiative can support more effective design of healthcare electrification projects in other humanitarian and displacement contexts.

- **Natural disasters, primarily storms, have periodically displaced hundreds of thousands over the last decade[50]**
- **36% electrification rate, with 93% urban and 23% rural electrification[51]**

KEY STAKEHOLDERS

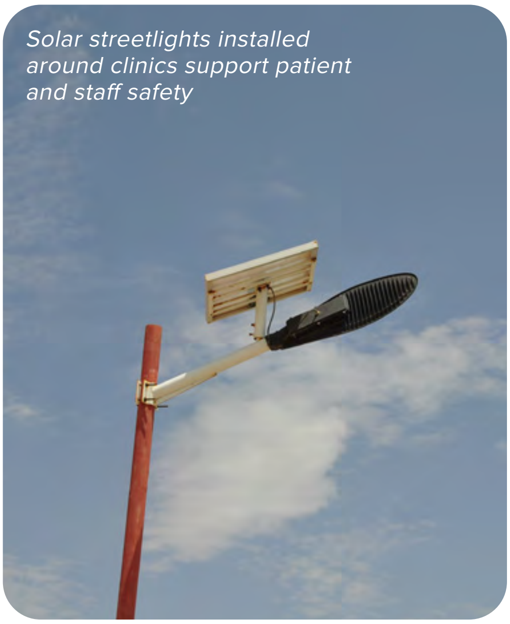
SEforALL	Market assessment and roadmap, strategic approach, convening, and reporting on development activities.
Global Energy Alliance for People and Planet (GEAPP)	Funding for roadmap research and report.
Ministry of Public Health	Access to health facilities and coordination with facilities on electrification efforts.
Ministry of Energy and Hydrocarbons	Follow-up and coordination of programmes and projects in energy sector with technical and financial partners and other state entities.
Trama TecnoAmbiental	Report preparation.
Sustainable Investment Support Ltd. (AIDES)	Support for on-the-ground data collection and analysis.

Healthcare services in Madagascar are primarily delivered by the public system. The country has 3,898 healthcare facilities, the majority of which have no access to electricity or are solely dependent on a solar refrigerator for vaccine storage. Only 10% of basic health centres are connected to the national grid, and even those that are connected frequently experience length power cuts lasting up to 24 hours. Most basic health centres in rural areas lack electricity entirely, with some relying on solar refrigerators for vaccine storage. Some district hospitals have electricity from an off-grid source, but reliability varies greatly. Many facilities lack essential medical and connectivity equipment, such as sterilisers, functional refrigerators, computers, or microscopes.

SEforALL developed a roadmap to electrify healthcare facilities in Madagascar, with a focus on basic health centres and district hospitals. The project had three primary objectives. It aimed to first provide the government with data on energy deficits in health centres and then prepare strategic information and implementation guidelines for the government and its partners to allocate budgets for sustainable electrification of facilities. The roadmap also proposes sustainable delivery models, including innovative approaches to ensure reliable electricity supply over the long term. ◆

Madagascar

PROJECT OVERVIEW



Solar streetlights installed around clinics support patient and staff safety

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LOCATION

Madagascar
Countrywide

project scope & status

PROJECT SCOPE

2,976 healthcare facilities with no access or unreliable electricity access across **four facility types**

PROJECT STATUS (Q4 2024)

Roadmap published

population impacted

Over **22 million** across **2,976 facilities** of all types, with a focus on basic and district health centres

power source

Standalone solar energy systems with backup power as applicable

funding information

$83 million, including **$52 million** in CAPEX and **$32 million** in OPEX, needed to electrify all targeted facilities within 10 years

Madagascar

PROJECT PROCESS

1 ENERGY NEEDS ASSESSMENT

Stakeholder consultations were held with a working group of over 30 Malagasy government representatives and technical and financial partners from the health and energy sectors, NGOs, and the private sector. Site visits were conducted at 15 facilities, with interviews conducted at each, and several information databases of site data were reviewed and cross-referenced. Extensive document review was also conducted.

It was found that most basic health centres require not only power sources but also basic equipment, including lighting, sterilisers, refrigerators, as well as digitalization, which requires access to housing and infrastructure. District hospitals require back-up power solutions to mitigate unreliable electricity supply from other sources.

2 ROADMAP DESIGN

Replicable technical solutions were developed for basic health facilities with design variations made depending on facility type, solar irradiation levels at the site, current electricity access level, and patient traffic. Customised approaches were created for district hospitals, with consideration given to the services provided and equipment available. For sites already connected to a power source, a backup system was considered, while for those without access, standalone solar PV systems were selected as the best solution. Actual implementation of the roadmap and electrification of facilities will be done by different groups of partners using a variety of the approaches proposed.

3 PREPARATION FOR FUNDRAISING & IMPLEMENTATION

A roadmap for delivering sustainable energy access for healthcare facilities across Madagascar between 2024 and 2032 was developed. The initiative will require an estimated $52 million for CAPEX and $31 million for OPEX over 10 years, divided into three phases: programme structuring and piloting, implementation, and consolidation and service improvement.

4 TRAINING & O&M

The roadmap identifies essential trainings to ensure system solvency and maintenance over time: practical training on basic maintenance for local staff, technical repair trainings for regional technicians or staff of the Ministry of Public Health, and training of trainers in electrical and plant maintenance to ensure knowledge transfer at other levels.

Additionally, the roadmap highlights the importance of the health facilities covering O&M and equipment replacement costs for their power source. Several potential revenue sources are identified, such as the sale of electricity-enabled services, a feed-in-tariff, additional municipal taxes, a local development fund, and monetisation of climate impacts (as through climate finance or renewable energy certificates).

Madagascar

PROJECT IMPACTS

- Large-scale improved energy access across Madagascar's healthcare system is expected to greatly improve the functioning of facilities and quality of care provided.
- The business models, potential revenue sources, and implementation strategies identified in the research will support long-term sustainable operation of the systems installed and can serve as inspiration for actors working in other contexts.

LESSONS LEARNED

- **Cost optimization, identification of a suitable revenue/payment model, building local O&M capacity, and ensuring facility staffs' desire for access are key to sustainable healthcare electrification delivery approaches.**
- **Ensuring improved healthcare for communities requires an integrated approach which places the facility at its centre and considers both electrification and equipment needs.**

Reliable access to clean electricity improves patient and staff comfort

Even in facilities connected to the grid, unreliable power supply can impact service provision


A solar mini-grid supporting the delivery of quality healthcare to refugee communities

©Alianza Shire

CHAPTER 5

Closing the Humanitarian Healthcare Gap

While the task is daunting, closing the humanitarian healthcare electrification gap is essential to ensuring that no one is left behind in the pursuit of SDG 3 and SDG 7. To close the gap will require close coordination between government (both national and local), humanitarian, development, private sector, and community stakeholders. At the international level, existing and emerging platforms such as HEPA, SEforALL's Powering Healthcare programme, SELCO Foundation's GlobalSDG7Hubs, and S4H can play an essential role in actively promoting coordination among UN agencies, bringing in other partners to address the humanitarian healthcare challenge, and advocating for its inclusion in the broader healthcare electrification agenda. ◆

Recommendations on Forming Partnerships to Close the Gap

At the country level, both the structure of partnerships and the approaches developed must be tailored to the context and stakeholder capacities. However, the research conducted for this report and the examples provided by the cases studies highlight several characteristics that are essential to successful partnerships:

LEVERAGE COMPLEMENTARY EXPERTISE

Effective partnerships must consist of stakeholders with the complementary mandates and expertise needed to develop holistic approaches. For example, humanitarian organisations bring strong relationships and knowledge on implementation in the most remote and complex environments, which are crucial to fully achieving the SDGs by 2030. Development partners are closely engaged with host governments on national planning for energy and healthcare. Gaps in expertise can also be overcome through approaches such as seconding experts, incorporating technical support into grants, and capacity building programmes.

ENSURE EFFECTIVE LEADERSHIP TO GUIDE COORDINATION & PARTNERSHIPS

In every partnership it is important to identify a "champion" who can organise and reinforce coordination between all stakeholders. As the case studies demonstrate, this lead partner can be an INGO, government authority, UN agency, Cluster Programme, or local organisation. What is important is that this partner has the capacity and authority to keep activities on track and achieve deliverables.

IDENTIFY APPROPRIATE INCENTIVES

To ensure partners remain engaged and prioritise sustainable electrification of healthcare facilities, it is essential to identify and build appropriate incentives into partnerships. For humanitarian agencies and national governments, climate commitments and cost savings drive their interest in healthcare solarisation. To engage private sector partners, it is important to develop approaches that are commercially viable. Health ministries often prioritise needs such as procurement of medicine and staff retention over electrification, making it necessary for donors and partners to demonstrate the cost savings provided by solarisation and build these concerns into holistic project design. Local government actors, meanwhile, often favour projects which can improve healthcare infrastructure to serve host communities as well as displaced people, making it necessary for projects to benefit both.

Strategic Recommendations for Closing the Gap

Through this research process, six key areas have been identified where partners must work together to overcome key challenges to healthcare electrification in fragile and displacement settings:

INCLUDE HUMANITARIAN HEALTHCARE ELECTRIFICATION IN NATIONAL AND REGIONAL PLANNING

While appropriate in some contexts, humanitarian agency-led projects to electrify single HHF or a small group of facilities are generally too costly and slow to implement in order to achieve SDG 3 and SDG 7 by 2030. However, because they are few in number, HHF represent only a fraction of the costs of a national healthcare electrification programme or large-scale international partnership. Partners must work together to integrate HHF into national planning to drive economies of scale, dilute the risks associated with working in more challenging environments, and reduce the overall cost of sustainable healthcare electrification at the country level. The World Bank's proactive inclusion of 19 HHF in its Haské electricity access project in Niger provides one example of how to accomplish this goal.

EXPAND FUNDING AND FINANCING OPTIONS TO OVERCOME COST BARRIERS

Solar technology is one of the cheapest sources of electricity in sub-Saharan Africa in terms of levelised cost of energy. Yet its rollout, including in off-grid contexts, is hindered by the high CAPEX requirements compared to traditional diesel generators and a lack of suitable financing options. The higher up-front cost of PV technology is particularly challenging for humanitarian organisations with one or two-year budget cycles, as earmarking more funding for energy supply requires reduced spending on programme activities. Partnerships which set up appropriate incentive structures can help overcome the limitations of the humanitarian budget cycle by unlocking access to capital from other sources, creating opportunities to employ more sustainable business models, such as PPPs, and innovative financing tools, such as guarantee mechanisms for financial de-risking, or carbon finance and D-RECS that monetise environmental and social impacts. Where potential demand is sufficient, partnerships can also enable larger electrification solutions, such as mini-grids, which can provide livelihood opportunities by supporting PUE and cover O&M costs through electricity sales. ▶

DESIGN CONTEXT-APPROPRIATE APPROACHES FOR ENSURING LONG-TERM O&M

While the CAPEX cost of clean energy installations can be formidable for humanitarian partners, OPEX of small solar PV systems are relatively inexpensive by comparison. Yet developing sustainable approaches to long-term O&M of solar PV systems for HHF and other healthcare facilities in fragile and displacement contexts remains a key challenge. In some instances, particularly when working in very remote and challenging locations, the most appropriate solution may be to employ the BOT model favoured by humanitarian agencies while incorporating technical assistance and procurement reforms to ensure a long-term commitment to managing O&M. In other cases, it will be more effective and less costly to service HHF by actively engaging the private sector via an ESCO model. Partners must collaborate to expand the array of approaches available and ensure that the right strategy is applied in every context.

DEVELOP SOLUTIONS FOCUSED ON ENABLING HEALTH SERVICES

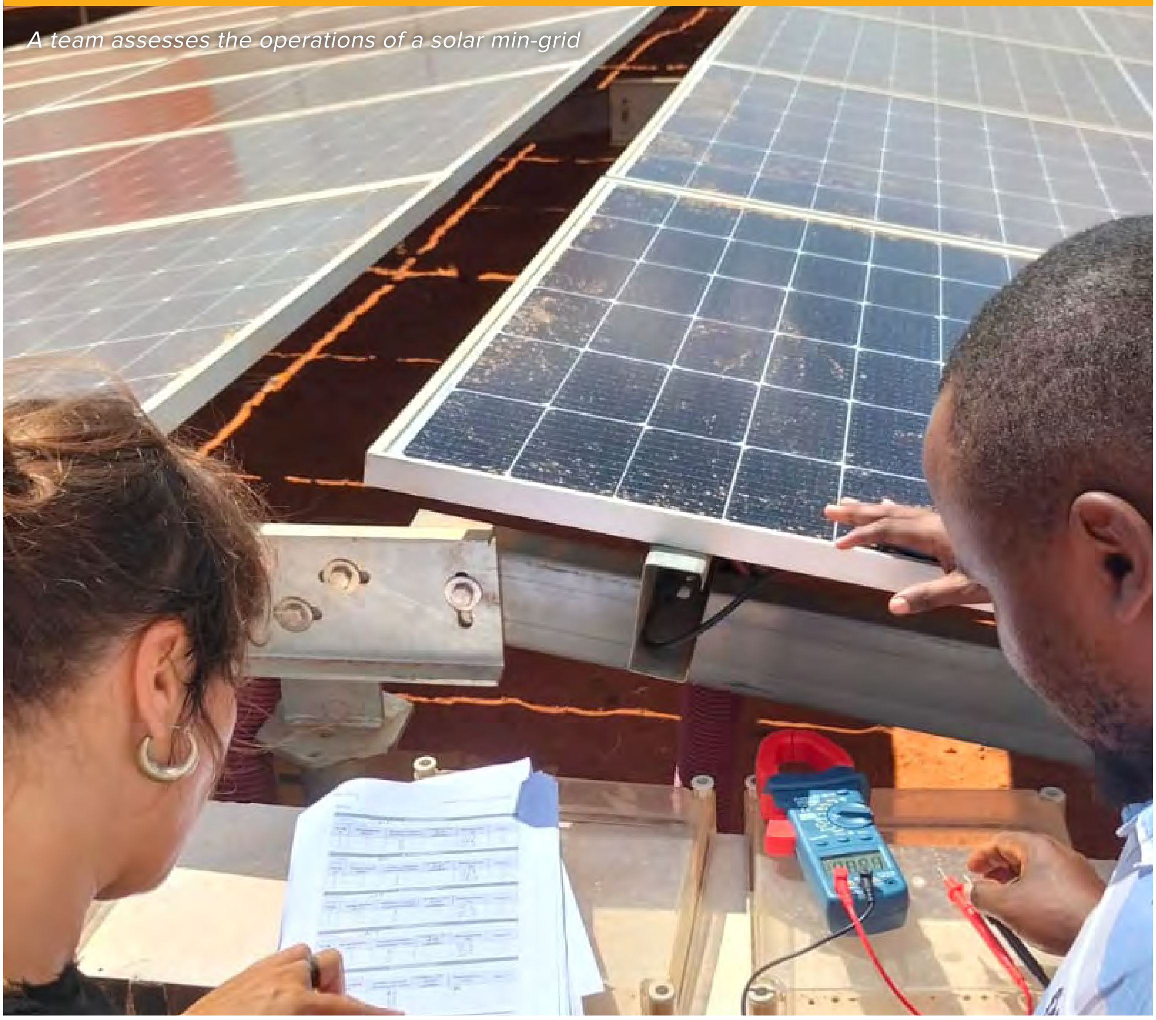
Many medical services require the use of electricity-consuming equipment, such as vaccine refrigerators and oxygen concentrators, as well as appliances that support connectivity and comfortable working conditions, such as computers and fans. Particularly for smaller facilities, the cost of this equipment represents only a small portion of the overall CAPEX for electrification, yet without them, there is no need for electricity. Thus, it is important for partners working on HHF electrification to conduct assessments in collaboration with technical experts to identify the current and future electricity needs of a facility. Procurement of energy efficient appliances to maximise long-term sustainability and cost savings must be included in the electrification solution developed for the facility to ensure that new electricity supply translates into higher quality services provided and improved patient outcomes. The Health Facility Solar Electrification initiative launched by Gavi, UNICEF, and WHO with technical support from the SELCO Foundation provides an example of how an equipment-first approach to solarisation can reduce costs and speed electrification efforts.

FOSTER DATA COLLECTION AND SHARING

All stakeholders must work together to improve data collection on the full range of facilities where fragile and displaced people are seeking healthcare services and the energy needs of these facilities. This includes conducting energy assessments at the start of projects and ongoing collection of consumption data via smart meters. There are several GIS tools on healthcare and electrification mapping which have been developed by the Energy Sector Management Assistance Programme, the World Resource Institute, the European Commission's Joint Research Centre, and others, which could serve as a starting point for incorporating data on the needs of displaced people. Improved data collection and sharing will make it possible to tailor system design to fit humanitarian contexts, better prioritise facilities for electrification, and maximise the impact of enabling improved healthcare services for both displaced and host communities by incorporating HHF into national electrification planning. ▶

BUILD CAPACITY OF LOCAL PARTNERS TO MAXIMISE IMPACT AND SUSTAINABILITY

While this work can be a long-term effort, incorporating local organisations and enterprises into projects is essential for maximising impact and ensuring the sustainability of any energy project. Leveraging existing structures and resources can reduce costs, create jobs, and stimulate the local economy, boosting communities' overall resilience. Building the capacity of local government and healthcare stakeholders also supports more effective long-term management of O&M for solar PV systems once ownership is transferred. Involving local actors can also support the development of solutions that better address community needs. Collaboration for inclusion ensures that projects are not only economically viable but also maximally impactful, promoting a sense of long-term commitment from the community. ◆



A team assesses the operations of a solar min-grid

©Alianza Shire

Call to Action for Closing the Gap

To support accelerated progress on closing the humanitarian healthcare electrification gap and joint action on SDG 3 and SDG 7, the GPA has identified the following action steps for different stakeholders, according to their capacities and expertise:

Donors and Investors	• Enable multi-year, flexible funding and financing to meet project-specific needs for qualified and experienced programme delivery partners and based on emerging best practice, as presented in this report. • Ensure adequate resourcing, require O&M inclusion in project design, and leverage remote monitoring and dMRV to ensure long-term system functioning and enable innovative financing solutions. • Advocate and work with governments hosting displaced communities to integrate HHF into national development planning. • Leverage dMRV to integrate carbon finance as a revenue stream for ongoing O&M costs, such as system parts replacement, repair works, and staff.
Hosting Governments	• With support from partners, take ownership of healthcare electrification initiatives in the country's displaced communities, developing the overall strategy that stakeholders contribute to, coordinating stakeholders, deploying expertise and resources, and ensuring safety and quality standards are followed. • Integrate displacement settings into wider national and regional healthcare solarisation and electrification planning. • Work with partners to identify existing financial and technical capacity within the healthcare system at the national or local level, where available, and develop clear plans for operatinalising this capacity to ensure long-term O&M of government-owned systems. • Enact policies that enable private investment in healthcare infrastructure and provision of energy service delivery to health facilities while ensuring access for vulnerable communities. • When engaging private sector partners, ensure easy and timely payments to companies in exchange for quality, reliable O&M services.
Development Partners	• Advocate and work with governments hosting displaced communities to integrate HHF into national development planning. • Work with humanitarian organisations to include HHF in large-scale healthcare electrification programmes. • Support host governments with expertise, financing, policy support, and sharing of best practices. • Build capacity of host and local government partners to design and execute healthcare facility electrification programmes, including management of long-term O&M costs. • Work with government and humanitarian partners to improve data collection on displaced people's engagement with national healthcare systems, including integration of HHF into electrification planning mapping tools.

Call to Action for Closing the Gap

Humanitarian Organisations	◆ Ensure a minimum level of specialist energy expertise or strong project management skills when designing and implementing HHF electrification activities. ◆ Build expertise in house to enable a more long-term and holistic approach to energy planning in humanitarian healthcare settings and ensure continuity within projects. ◆ Bundle projects slated for electrification together to speed up the electrification process, achieve scale, and reduce costs. ◆ Conduct energy needs assessments that assess future demand based on load growth, and bundle energy efficient appliance procurement into projects. ◆ Advocate and work with national healthcare providers to integrate sustainable HHF electrification into wider national/regional health systems, in a protection-sensitive manner. ◆ Maintain consistent budget for O&M in the initial years after an emergency, while planning longer-term, localised O&M processes through knowledge transfer to local NGOs or community members. ◆ In collaboration with development and private sector partners, train local community members and health facility staff to properly use systems and conduct basic O&M tasks. ◆ Provide basic data on healthcare electrification needs in humanitarian contexts to build a robust project pipeline (which could be coordinated by the GPA).
Private Sector	◆ Deliver quality installation and ensure community engagement and awareness throughout the process. ◆ Provide adequate training and follow-up support to community members together with the overall responsible healthcare provider to ensure local ownership and skills are available to operate and maintain DRE systems. ◆ Collaborate with government, development, and humanitarian partners to mitigate risks of investing in HHF electrification and develop delivery models that enable sustainable long-term service provision. ◆ Leverage dMRV and train local technicians to minimise the need for site visits and reduce overall costs for providing quality O&M over the long term (five to 10 years).
Local Community Members	◆ Participate in planning, construction, and installation of systems. ◆ Advocate for the development of inclusive, holistic project approaches which address displaced and host communities' long-term healthcare and energy access needs while creating jobs and improving livelihoods. ◆ Work as skilled technicians to conduct ongoing O&M of solarised health systems, ensuring access to quality healthcare and reduced pollution in the community.

Annex: Further Resources

HUMANITARIAN PARTNERS WORKING ON HEALTHCARE AND ELECTRIFICATION

- Group of Friends of Health for Refugees and Host Communities led by UNHCR
- Health Cluster led by WHO
- IOM Migration Health Assessment Centres

LARGE-SCALE HEALTHCARE ELECTRIFICATION INITIATIVES

- Health and Energy Platform for Action (HEPA) led by WHO
- Health Electrification and Telecommunications Alliance (HETA) led by USAID/Power Africa
- Multilateral Energy Compact for Health Facility Electrification led by SEforALL
- Powering Healthcare programme led by SEforALL
- Sustainable Energy for Improving Healthcare Delivery led by SELCO Foundation
- Solar for Health (S4H) led by UNDP

ADDITIONAL HEALTHCARE ELECTRIFICATION PROPOSALS AND PROJECTS

- Health Facility Solar Electrification Initiative in Ethiopia (WHO, UNICEF, GAVI, and Ethiopian Ministry of Health)
- Rwanda Healthcare Solarisation proposal (Joint SDG Fund)
- Malawi Healthcare Solarisation case study (UNICEF)
- Kalobeyei Refugee Settlement Mini-Grid Expansion case study (UNHCR)
- Scaling Up Sustainable Energy in Jordan's Public Buildings case studies (Chatham House)
- Solarisation of Hospitals in Sudan (UNFPA Sudan)

POLICY RESOURCES

- Sustainable Energy Policy Hub (SEforALL)
- Household Energy Policy Repository (WHO)

DATA AND HEALTHCARE ELECTRIFICATION PLANNING TOOLS

- The Energy Data Platform (ESMAP/World Bank)
- Clean Energy Access Tool (JRC)
- Energy Access Explorer (WRI)
- Global Electrification Platform (ESMAP/World Bank)
- HOMER Powering Health Tool (USAID, ESMAP/World Bank and HOMER Energy)
- Humanitarian Healthcare Facilities Electrification Mapping (UNITAR)

RESOURCES FOR PRACTITIONERS

- From Procurement to Performance: Towards a Private Sector-Led Service-Based Model to Scale Up Sustainable Electrification of Public Institutions (SEforALL and ESMAP/World Bank)
- Powering Health Toolkit (USAID)
- Energizing Health: Accelerating Electricity Access in Healthcare Factilities (WHO, IRENA, SEforALL, and World Bank)

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A map of healthcare sites recommended for solarization in humanitarian settings of Sub-Saharan Africa.

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