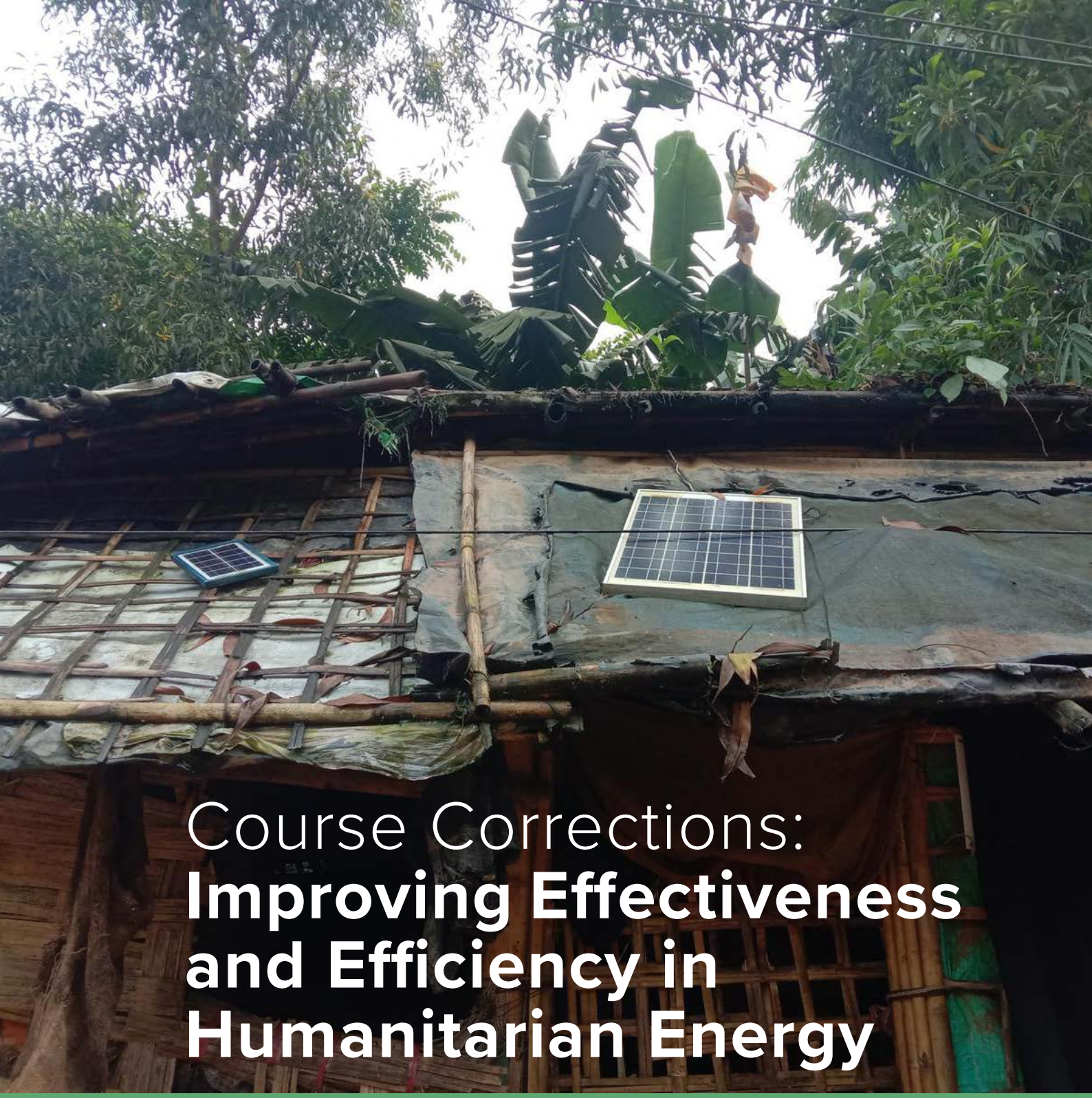

Course Corrections: **Improving Effectiveness and Efficiency in Humanitarian Energy**

Learning from the Past to Design for the Future

Innovation Norway

GPA
GLOBAL PLATFORM FOR ACTION

Table of Contents

List of Acronyms

AC	Alternating Current
AMPERE	Accessing Markets through Private Sector Enterprises for Refugees Energy
BEMCOS	Bidibidi Electronic Multipurpose Cooperative Society
CEI Africa	Clean Energy and Energy Inclusion for Africa
DC	Direct Current
DCCU	Dzaleka Christian Church Union
EAC	Energy Attribute Certificate
EEN	Energy & Environment Network
EnDev	Energising Development
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (English: German Corporation for International Cooperation)
GPA	Global Platform for Action on Sustainable Energy in Displacement Settings
HE	Humanitarian energy
HEED	Humanitarian Engineering and Energy for Displacement
HELP	Humanitarian Energy Learnings Platform
HIP Norway	Norway's Humanitarian Innovation Programme
IFC	International Finance Corporation
IOM	International Organization for Migration
I-REC	International Renewable Energy Certificates
KKCF	Kakuma-Kalobeyei Challenge Fund
LED	Light-emitting diode
LPG	Liquefied petroleum gas
MEMR	Ministry of Energy and Mineral Resources (Jordan)
NGO	Non-governmental organisation
NRC	Norwegian Refugee Council
O&M	Operation and maintenance
PPA	Power Purchase Agreement
P-REC	Peace-Renewable Energy Credit
PV	Photovoltaic
RBF	Results-based finance
READS	Roadmap for Energy Access in Displacement Settings
SDG	Sustainable Development Goal
SSL	Solar streetlights
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNITAR	United Nations Institute for Training and Research
USAID	United States Agency for International Development
USD	United States Dollars
WHH	Welthungerhilfe (English: World Hunger Aid)
Zipo	Zipolopolo

Acknowledgements

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Cover Photo: Small solar panels on a household roof. The household does not benefit from the powerlines overhead. © Nazifa Rafa

Executive Summary

Energy access is critical for safety, dignity, and resilience in humanitarian settings. In these contexts, millions of people face acute energy poverty, meaning they lack access to clean energy for cooking and sufficient electricity. However, despite decades of effort, access to reliable, clean, and sustainable energy in such settings, especially for forcibly displaced people, remains limited. This persistent gap highlights a crucial challenge; while humanitarian energy (HE) programming is expanding, its effectiveness remains constrained by systemic inefficiencies and a widespread failure to learn from past shortcomings.

This report systematically identifies key challenges in HE interventions and develops an evidence-based process for capturing project learnings. This was achieved through a mixed-methods approach combining desk research, stakeholder interviews, and case study analysis. Findings from the research were used to propose an initial design for the Humanitarian Energy Learnings Platform (HELP), intended as an inter-donor system for capturing learnings. The case studies were used to test the forms and processes that constitute HELP.

The research revealed five categories of project challenges encompassing 25 failure factors. The categories were Technological (e.g., maintenance gaps), Economic (e.g., unsustainable financing models), Social (e.g., cultural misalignment), Implementation (e.g., poor coordination), and Governance (e.g., policy barriers). The written literature emphasised economic barriers, whereas practitioners highlighted implementation challenges that underscored operational blind spots. The interviews also explored how deep cuts in overseas development assistance are forcing a transition to market-driven models, but progress is impeded by siloed ways of working, rigid funding and procurement regulations, lack of evidence about the HE opportunity, and some actors' reluctance to relinquish the free-distribution status quo.

Two clear strategies for addressing failure emerged from the research: a set of interventions to aid the shift to market-based interventions, and adoption of the Humanitarian Energy Learnings Platform (HELP) to force reflection and openness about project successes and failures. The transition to market-based solutions can be aided by building evidence and capacity, making structural changes to funding and procurement, facilitating cultural changes around attitudes towards profit and failure, and enhancing collaboration between actors. HELP requires commitments from donors to mandate its use, dedicated resources for its operation, and a concerted effort to build up the knowledge bank through a rapid review of completed projects. It consists of paired digital forms completed at the outset and end of project implementation. The forms capture the project context, record learnings, document achievements, and contain contact details for people involved in a project. The forms are stored in a centralised, searchable repository with controlled access, so that sector actors can learn from past and ongoing projects and connect with people involved in them.

While humanitarian energy programming is expanding, its effectiveness remains constrained by systemic inefficiencies and a widespread failure to learn from past shortcomings.

With growing austerity and shifting funding landscapes, now is the time to promote more candid approaches towards sharing failures and successes. The humanitarian sector finds itself in a paradoxical situation where funding for humanitarian interventions is plummeting while the numbers of forcibly displaced people escalate. The only way to reconcile these pressures is to innovate and to accelerate efficiency of delivery. This will require new levels of collaboration and openness, and investment in systems to make our inevitable failures productive for all. The rapid adoption of HELP could convert both successes and failures into shareable, accessible learnings to improve the design and implementation of future projects.

1. Introduction

PHOTOGRAPH ABOVE: *Small solar panels on a household roof. The household does not benefit from the powerlines overhead. © Nazifa Rafa*

Access to reliable, affordable, and sustainable energy is a cornerstone of human dignity, safety, and resilience. Energy access interventions in humanitarian contexts are critical for meeting basic needs, powering healthcare facilities, enabling education, and supporting livelihoods [1]. Humanitarian energy (HE) can be defined as "institutions, policies, programmes, global initiatives, actions and activities which use a range of sustainable and fossil fuel energy sources in contexts of displacement, to meet the energy needs of people in camps and urban settings, self-settled refugees, host communities, and internally displaced people" (pg. 6) [2]. As a sector, it covers the needs of populations in both emergency and protracted situations caused by famine, climate change, disasters, violence, persecution, and war. Enabling access to energy in

1. Introduction

humanitarian contexts is not merely a technical challenge but a moral imperative, intertwined with global commitments to the Sustainable Development Goals (SDGs) and the humanitarian principles of alleviating suffering. Yet, SDG7, which aims for universal access to clean, sustainable energy for all by 2030, does not explicitly consider humanitarian settings [3, 4].

The number of forcibly displaced people has surged to over 123 million globally, driven by conflict, climate disasters, and economic instability [5], but funding for humanitarian responses has declined. For instance, the 2024 appeal by the UN and humanitarian partners faced a record US$28.5 billion funding shortfall, forcing cuts to critical services [6]. The 2025 dismantling of USAID has created unprecedented levels of financial cuts and uncertainty. As needs grow and resources shrink, extraordinary levels of collaboration, innovation, and accountability in how energy projects are designed, funded, and implemented are required. Maximising efficiency and effectiveness in HE efforts is more critical than ever. One promising path lies in improving processes for assimilating learnings from past interventions and incorporating them into new project design.

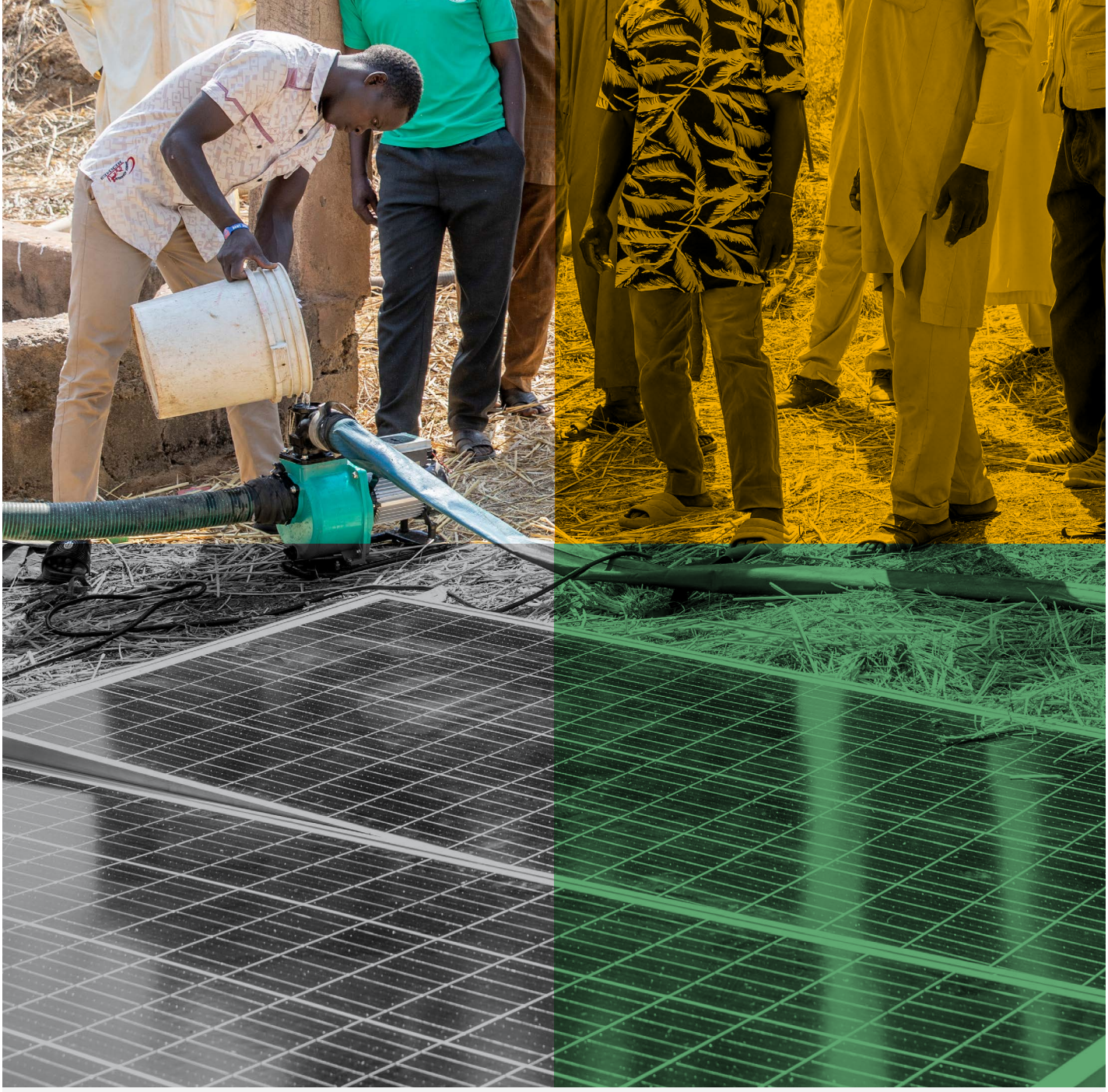
Valuable learnings from prior unsuccessful projects could become 'productive failures' if used to inform future initiatives.

Fast and deep cuts in humanitarian financing underscore the urgency of optimising limited resources. In humanitarian settings, energy interventions have historically been deployed via free distribution rather than market-based methods [7, 8]. Outcomes to date have been poor, and most displaced communities continue to use polluting cooking fuels and lack access to reliable electricity sources [9]. The sector is facing growing pressure to demonstrate impact while navigating complex operational and political environments. This requires a paradigm shift of openly acknowledging failures, sharing lessons, and encouraging discourse around unsuccessful interventions.

However, energy projects in humanitarian settings are often siloed, with poor coordination between actors, inconsistent monitoring frameworks, and a reluctance to report setbacks [10, 11]. This stems from energy not being treated as a standalone sector in humanitarian responses, and the way that humanitarian contexts are usually excluded from national energy planning. Projects tend to operate as pilot initiatives and implementers are forced to chase short-term funding rather than long-term impact and sustainability [10, 11].

The sector's inability to systematically capture and share lessons learnt is a missed opportunity for transformative progress. While failure can be unavoidable in complex crises, honesty about shortcomings could drive innovation, and the valuable learnings from prior unsuccessful projects could become 'productive failures' if used to inform future initiatives [12]. There is no objective data to show how often HE projects fail. However, anecdotal evidence from people who work in the sector suggests that it is a widespread problem, and that even successful projects usually encounter barriers or challenges that cause them to fall short of expectations.

This report systematically documents the challenges affecting energy access initiatives in humanitarian settings, offers a procedure for learning from energy projects, and provides evidence-based recommendations to optimise funding and foster collaboration. It was commissioned by Innovation Norway's Humanitarian Innovation Programme (HIP Norway) and the Global Platform for Action on Sustainable Energy in Displacement Settings (GPA), two entities at the forefront of advancing sustainable energy access in humanitarian contexts.



2. Project Approach

PHOTOGRAPH ABOVE: *Mercy Corps' Rural Resilience Activity (RRA) program has been implementing irrigation systems on farms across Adamawa state to support dry season farmers, including this solar-powered system. © Ezra Millstein/Mercy Corps*

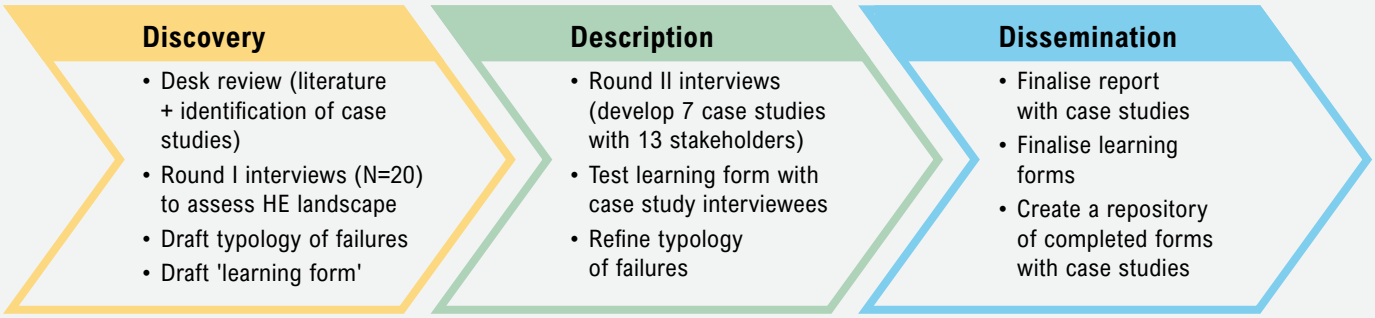
This project aims to address systemic inefficiencies in humanitarian energy (HE) programming by:

- Identifying root causes of failure: Systematically documenting why energy access initiatives in humanitarian settings underperform or collapse.
- Creating actionable frameworks: Developing a typology of common failures and a standardised platform for capturing lessons learnt.
- Fostering sector-wide learning: Facilitating dialogue among stakeholders to normalise discussions around failure and adaptive management.

It employs a mixed-methods approach combining desk research, stakeholder interviews, and case study analysis. It is structured into three iterative phases of Discovery, Description, and Dissemination **(Figure 1)**:

2. Project Approach

FIGURE 1: *Project Approach*



Solar streetlight. However, the solar panel is covered by foliage from a tree. A nearby solar array would surely be a more sensible way of powering the light. There are also overhead power lines - presumably grid power that refugees are not allowed to use. © Aimee Jenks, GPA

3. Methodology

PHOTOGRAPH ABOVE: *GRF energy access - technicians Rwanda. © Practical Action*

3.1 Literature review for identifying success and failure factors

The literature review aimed to identify success and failure factors in HE projects by analysing relevant academic and grey literature. Recognising the nascent and fragmented nature of the field, we used a curated Zotero library of 350+ publications at the time of the review compiled by HE researchers [13]. This database, organised by themes such as energy services and country case studies, provided a structured foundation for analysis. We applied inclusion criteria to focus on post-2010 studies explicitly addressing HE contexts and excluded documents that were out of scope (e.g., strategy papers, news articles). Articles were prioritised based on their alignment with failure/success analysis. We

3. Methodology

also further added new publications recommended by GPA and HIP Norway colleagues, including the Roadmap for Energy Access in Displacement Settings (READS) report series by UNITAR.

The final list of literature consisted of 42 publications. Data from these publications was systematically extracted into a spreadsheet capturing key pieces of relevant information, including the technologies and fuels in question, examples of failure, and reasons why projects did or did not work. Detailed search strategies, screening processes, and data extraction methods are provided in Appendix A. This review also informed the design of the topic guide for the stakeholder interviews phase.

3.2 Key informant interviews for the HE landscape assessment

Twenty interviews were conducted with key informants working in HE for a quick assessment of the landscape. They fell into six categories: donors and innovation funders (n=6), expertise providers (n=1), government agencies and funds (n=2), international NGOs (n=4), UN agencies (n=3), and private sector developers (n=4). Participants were invited via the wider team's extensive networks. The interviews themselves took place online, and each lasted for one hour. They consisted of questions about respondents' experiences with HE projects (including those that failed), why projects fail, how funding structures affect project outcomes, how to increase support for market-based HE projects, how learnings at present are captured and fed into future programming, and the usefulness of a platform for capturing learnings. The data was qualitatively analysed based on the interview transcriptions and the interviewer's notes.

3.3 Creation and validation of learning forms through case studies

A key contribution of this project is to offer an evidence-based template and procedure for learning from different energy projects by creating a simple system to document project-level success and failure factors using forms to capture these learnings. An initial draft of the forms was developed from the literature review and first round of interviews, which were reviewed by HIP Norway, GPA, and other interviewees who had expressed interest. The forms were subsequently tested and refined through seven case studies selected based on the literature review, key informant interviews, and consensus among authors, the HIP Norway, and GPA. The selection depended on whether the case studies represented a diversity of contexts, energy projects, and failure factors, had public availability of information on the projects, and offered good accessibility to HE organisation (donors, implementers, etc.) who have been involved with the projects. A second round of targeted interviews with 13 stakeholders was undertaken to draw up the case studies, which were also subsequently used to validate the forms, contributing to the development of a learning platform.

Interviews consisted of questions about respondents' experiences with HE projects (including those that failed), why projects fail... and the usefulness of a platform for capturing learnings.

4.

Discovery Phase: Research Results

PHOTOGRAPH ABOVE: *Residents moving through a displacement camp in Nigeria. © Obute Emmanuel, Mercy Corps*

This section consists of findings from the literature review and key informant interviews. For the purposes of this report, the results have been combined and abridged and are presented with a focus on elements of project failure. The full data set contains a plethora of rich insights about the current state and potential trajectory of energy access in humanitarian action. This is being developed into an academic journal article that will be linked to the report in due course.

Five themes connected to HE failure emerged from the literature review and interviews: Technological, Economic, Social, Implementation, and Governance. Interestingly, the implementation theme did not emerge from the literature review. This could allude to bias in the way that project reports are written up after

4. Discovery Phase

they have been completed. Within each of these themes are numerous "failure factors" that are discussed in the sections below.

4.1 Reflections on working on HE projects

Humanitarian settings are inherently complex and uncertain. HE projects often face greater political, economic, social, and environmental risks than those in the wider development sector. These challenges are compounded by operational difficulties such as uncertainties surrounding donor funding, the need to rapidly deploy projects, and complex and uncertain politics surrounding people living in humanitarian settings. The web of stakeholders is extensive and fragmented, with overlaps and gaps between different actors' mandates, creating complex dynamics between parties. Complicated processes, procedures, and regulations require careful navigation and are subject to change. For example, private sector entities generally cannot directly enter a displacement settlement or refugee camp without obtaining permissions; so, they need to work with governments, humanitarian organisations, or implementing partners. The resulting system is slow, bureaucratic, and exclusionary to non-humanitarian actors, creating barriers to integration with national systems and services.

There is considerable inertia surrounding the way that humanitarian actors operate, with heavy reliance on free-distribution approaches. Traditionally, humanitarian actors have focused on distributing products and services in humanitarian settings free of charge, based on the lack of sustainable transitions from initial short-term emergency response phases. This mode of operation makes sense in initial disaster relief settings, but in protracted crises which result in more permanent settlements, these actions have resulted in significant market distortions. The proliferation of free products or services can create a sense of entitlement to their provision, eroding people's willingness to pay for them. In many cases, there are even secondary markets, where refugees sell agency-distributed products.

Market-based HE interventions offer a sustainable alternative to the traditional handout model and consist of products being sold to end-users by the private sector. They are not always appropriate, especially in fragile environments, emergency situations, and other restrictive contexts. Yet in larger and more protracted cases, where settlements continue for decades, viable markets have emerged, where financial returns are said to be feasible but limited. However, it is exceptionally challenging to engage the private sector in humanitarian contexts. One interviewee described the private and humanitarian sectors as "two entirely different worlds" operating under different paradigms: *"The private sector see[s] end-users as customers or clients, whereas the humanitarian sector see[s] them as beneficiaries".*

PHOTOGRAPH ABOVE: *Smiling Through the Harsh Winter in Zaatari camp, Jordan. © Shawkat Alharfoush, UNHCR*

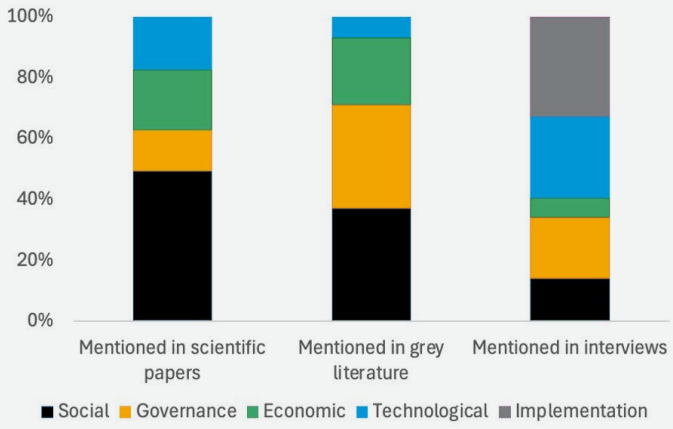
4. Discovery Phase

4.2 Failure factors

4.2.1 Prevalence of failure factors across literature and interviews

The incidences of the five categories from the interview and literature sources diverged significantly; Implementation or Technological factors, cited in 60% of interviews, were the categories least emphasised by the literature review (as shown in **Figure 2**). This could be because written outputs tend to capture failures deemed significant, generalisable, or theoretically relevant for publication, and often emphasise established frameworks and potentially over-represent larger-scale, systemic, or easily quantifiable issues like economic sustainability or technical breakdowns. Conversely, interviews with practitioners reveal the immediate, contextual, and often messy challenges faced during implementation. The dominance of the Implementation category in interviews, which was absent in the literature, is particularly telling; it likely represents critical, recurrent operational pain points that practitioners experience acutely but are either overlooked in the academic literature, underreported due to conflicts of interest or general bias, considered too context-specific for broad publication, or fall outside traditional theoretical frameworks. This discrepancy underscores that while literature provides valuable systemic insights, practitioner perspectives are essential for uncovering the nuanced, practical, and often unforeseen obstacles that truly shape project success or failure in the field.

FIGURE 2: *Distribution of categories as mentioned in literature review and interviews*



The literature review revealed, perhaps unsurprisingly, that these challenges rarely operate in isolation: project issues typically arise from systemic interdependencies between these five themes and are compounded by the volatile contexts in which projects operate [14]. It also showed how risks in one domain (e.g., financing gaps) often amplify vulnerabilities in others (e.g., community buy-in), and that "success" metrics (e.g., rapid deployment) may inadvertently undermine long-term sustainability. In the next section, we explore these interlinkages, emphasising how siloed interventions exacerbate failure cycles, and how integrated strategies could break them.

4.2.2 Description of failure factors

This section summarises success and failure factors for HE projects according to the five (interlinked) categories surfaced from the literature review and first round of interviews: Technological, Economic, Social, Implementation, and Governance.

Technological factors

Technological failures highlight systemic risks from poor product quality and insufficient provision for maintenance and repair. They were reported 48 times in the literature review and 21 times in the interviews. For example, refugee camps in Sub-Saharan Africa can face recurring issues with faulty solar components and inadequate repair services [15, 16], while design flaws – like underperforming streetlights in Nepal and Rwanda (**Box 1**) [17] – often stem from unrealistic efficiency assumptions. For donors, this signals the need for stricter quality standards, localised technical training, and lifecycle cost analysis to avoid premature obsolescence.

4. Discovery Phase

Each project is highly context-specific and should start by understanding the population's needs. When conducting these assessments, it is important to recognise that the populations in humanitarian settings are not homogenous: projects need to account for how there are usually multiple different groups of people with their own preferences and financial means. Interviewees warned of the pitfalls of relying on poor baseline data generalised from other humanitarian locations or making assumptions based on experiences from outside of humanitarian settings. Ideally, a feasibility study should be conducted before full project roll-out to understand energy demand and willingness to pay. However, this is often overlooked, resulting in inappropriate, ineffective, and low-quality project designs.

Products should be designed to last, with provisions for long-term maintenance and repair services. Financial provision for maintenance is often scarce, leading to technical failures. Low-quality products can breed mistrust for similar goods (**Box 2**). However, it can be difficult to find quality suppliers that are willing or able to enter these often hard-to-reach and insecure areas.

BOX 1: *Example from the literature: Technological Failures in Rwanda's Gihembe Solar Streetlights*

In mid-2019, four "advanced" solar streetlights were deployed at Gihembe refugee camp with the expectation that a 0.32 kWp PV panel and 3 kWh Li-ion battery would yield a mere 2% annual capacity shortage. In practice, and due to a cascade of technical missteps, performance ratios fell roughly one-third below design targets, averaging just 36–46% of the initial estimate. Key failures included mismatched power electronics, such as an extra DC–AC converter added to accommodate voltage incompatibilities, inefficient LED drivers, and unaccounted wiring losses. Soiling of panels also went unaddressed, further degrading output. Compounding these design flaws, improperly tuned battery monitors masked repeated over-discharge events, and weak remote monitoring paired with no local repair capacity meant outages persisted unchecked. In the end, what was meant to be a shining example of off-grid innovation became little more than a blackout, a stark reminder that even the most promising solar projects can collapse without grounded performance assumptions, seamless system design, and a robust maintenance plan. *Source: [17]*

BOX 2: *Anecdotes from the interviews: Technical Failure of Briquettes in a Nepalese Refugee Camp*

A humanitarian agency promoted briquettes as a cooking fuel in a Nepalese camp. The locals openly preferred firewood and complained that the briquettes were inadequate to cook with. This was spectacularly demonstrated when a fire ripped through the camp, destroying everything in its path except the briquettes, which remained intact despite having their packaging incinerated. Ultimately, if a technology is not fit for purpose then it will not be adopted, and it is important to listen to feedback from local communities to ensure that products meet their needs. This example also presents the importance of considering social factors, which will be discussed below.

Economic factors

Economic misalignments are the most common driver of project failure, particularly those related to incorrect financial or business model assumptions. They were reported 68 times in the literature review and 16 times in the interviews. High upfront costs for solar mini-grids, clean cookstoves, and productive-use appliances – coupled with unsustainable grant reliance – render projects vulnerable to shocks [15, 18–21]. The collapse of Ethiopia's Gaia ethanol project, as illustrated in **Box 3**, further illustrates how market volatility and subsidy dependence can derail even well-intentioned initiatives [22]. For investors and donors, this underscores the urgent need for blended finance mechanisms, market-based approaches, and scalable business models that reduce aid dependency and increase project resilience. Given the heightened context-specific risks, financial guarantees and de-risking mechanisms are important to underwrite risks which can attract greater investment and funders.

Ideally, a feasibility study should be conducted before full project roll-out to understand energy demand and willingness to pay. However, this is often overlooked, resulting in inappropriate, ineffective, and low-quality project designs.

4. Discovery Phase

BOX 3 – *Example from the literature: Economic Failures in Ethiopia's Gaia Ethanol Project*

Launched in 2004, the Gaia Project in Ethiopia sought to alleviate energy poverty in refugee camps by distributing ethanol cookstoves and fuel, thus leveraging byproducts from the sugar industry. Despite early successes, including reduced deforestation, improved health outcomes, and the distribution of 4,000 stoves, the initiative collapsed under systemic economic pressures. The project's financing model was heavily dependent on grants from the Shell Foundation and NGOs and proved unsustainable as subsidies dwindled, leaving it vulnerable to market volatility. Compounding this, Ethiopia's government-owned sugar factories prioritised ethanol for gasoline blending, and by 2015 were diverting 90% of ethanol supplies to the automotive market. This supply chain disruption left refugee camps without consistent fuel access, eroding trust and forcing a return to fuelwood. Government policies did not help: state-controlled ethanol pricing and subsidies for transport artificially suppressed feedstock costs for industrial use while neglecting rural energy needs. Meanwhile, high upfront stove costs and reliance on imported tankers strained budgets, exacerbating long-term affordability challenges as subsidies faded. Ultimately, Gaia's dependence on short-term grant funding, vulnerable supply chains, and distorted policy priorities led to its demise. *Source: [22]*

The shift to market-based solutions is hampered by an affordability gap caused by both the unwillingness and inability to pay for energy. Addressing the inability to pay necessitates a suite of solutions such as subsidies (which can be delivered through mechanisms like carbon credits, Peace-Renewable Energy Credits (P-RECs)[1], and results-based financing (RBF)[2]) and increased access to credit through formal and informal mechanisms. It also requires accompanying income-generating opportunities to enhance both the demand for energy and ability to pay for it, such as by integrating productive end uses into HE project design.

Successful projects include economic planning for the long-term provision of sustainable products and services. One interviewee observed how the lack of operation and maintenance budgets leads to failure and waste: *"We know that we could have renewable energy for 15 years*, but it is shortened to 3–5 years". Collaborations with the private sector and governments are instrumental to developing markets that have long-term viability, as are changes to the donor model so that there is less focus on short-term pilots. One interviewee reflected that *"I don't know why donors seem to love piloting little energy kiosks and hubs so much! What might be possible if a reliable stream of funding were to go into a smaller number of larger energy projects?".*

Social factors

The identified social failures point to persistent blind spots related to cultural misalignments and gender dynamics. Interestingly, there was a large discrepancy in social failure instances in the literature review (48 times) versus the interviews (only five times). This could be because interviewees tended to only report the top-of-mind reasons for project failure, suggesting that social aspects could be more of a contributor than a driving cause of failure.

The literature review revealed that projects often underestimate resistance to new technologies, especially for clean cooking interventions. This was illustrated by the rejection of briquettes in Dollo Ado, Ethiopia [23], or solar cookers in Dzaleka, Malawi [24], due to mismatches with local cooking practices. Worse, energy interventions risk reinforcing inequalities, as seen in Nepal [25], where public lighting primarily benefitted men by enabling them to socialise outside after dark – an activity considered culturally inappropriate for women (**Box 4**). **Box 5** provides an additional example of unintended consequences for an energy project that resulted from social factors. To ensure adoption and safety, practitioners must prioritise co-design with communities, gender-sensitive planning, and behaviour-change strategies.

[1] The P-RECs, developed by the non-profit organisation, Energy Peace Partners, are a type of Energy Attribute Certificate (EAC) designed to connect renewable energy projects in fragile, energy-poor countries with international buyers, promoting both clean energy development and social impact. The P-RECs are issued under the International Renewable Energy Certificates (I-RECs) and allow companies to purchase renewable energy and its associated social benefits, while also supporting projects in areas affected by conflict and instability

[2] RBF is a development finance approach that links funding to the achievement of pre-agreed and verified results.

4. Discovery Phase

BOX 4: *Example from the literature: Social Failures in Nepal's Post-Earthquake Solar Streetlight Project*

Following the 2015 earthquakes, Nepal's Humanitarian Engineering and Energy for Displacement (HEED) initiative installed solar streetlights in Uttargaya, a relocated Tamang village, aiming to enhance safety and community cohesion. While the lights improved physical security and extended productive hours, they inadvertently exacerbated social divisions and entrenched gender inequities. The project misaligned with traditional norms: streetlights disrupted sacred rituals by enabling all-night ceremonies, which youth dismissed as "uninteresting", deepening generational rifts. Elders, excluded from participatory planning, resented unequal lighting distribution, sparking inter-household jealousy as some homes gained illumination while others remained in darkness. Gender dynamics worsened as men dominated newly lit public spaces like playgrounds, marginalising women and girls, who continued to shoulder domestic chores despite newfound flexibility. Though safety improved, the project reinforced hierarchies: women remained confined to domestic spheres while men's social lives flourished, and youth aspirations clashed with communal traditions. This case illustrates how even well-intentioned energy interventions can deepen social fractures when cultural practices, generational values, and gender roles are overlooked, emphasising the need for inclusive co-design and gender-sensitive strategies to align technology with community realities. *Source: [25]*

BOX 5: *Anecdotes from the interviews: Social Factors with Solar Lamps in Mozambique*

Portable solar lamps were distributed to a displaced community in Mozambique in response to an increase in night-time gender-based violence in a camp. The assumption was that the lamps could be used to light the way at night and deter predatory behaviour. However, a follow-up visit revealed that the lamps were only ever used indoors, as beneficiaries feared that using them outside would draw attention to their movements and attract thieves. This project was not an outright failure – there was a need for indoor lighting and the lamps were still used – but a better understanding of the social context could have led to the provision of more suitable lighting technology.

Energy access plans should be centred around the needs of both the displaced and host communities, involving them directly in project design. Land ownership issues, sharing of resources, and equity concerns about energy access can cause tensions between host communities and refugees. It is similarly important that interventions are sensitive to the inter-ethnic dynamics between different communities within camps.

Equity considerations should be at the forefront of project design, though creating truly inclusive projects takes great care and experience. One interviewee recounted a flawed instance where target beneficiaries (who were physically disabled) had to travel to a bank to receive a voucher for a clean cooking product. They also acknowledged the challenges of including marginalised groups – such as people with disabilities, the elderly, and people from minority cultures – within refugee communities where complex power dynamics can silence and obscure their voices.

Implementation factors

The implementation category emerged from the interviews, but not from the literature review. In the interviews, it was the most frequently reported failure category (reported 26 times) and often centred on fragmented coordination. Implementation failures, notably "poor coordination and partner engagement" (reported 9 times) and "insufficient project duration" (reported 6 times), were some of the common types of challenges raised. This signals that siloed operations (for example, **Box 6**) and unclear accountability structures exacerbate risks, particularly in complex humanitarian settings requiring integrated efforts.

BOX 6: *Anecdotes from the interviews: Implementation Failures with an Ethiopian Mini-grid*

A private sector HE developer received funding and investment to construct a mini-grid in a displacement camp in Ethiopia. However, after the money had been granted, they discovered that their project was incompatible with Ethiopian regulations. These stipulated that profits from the mini-grid would have to remain in the country, thus making it impossible for the developer to repay their overseas investor. The developer decided to shift the project to Kenya. However, they could not secure the required local partners and the project never happened. This demonstrates how the lack of planning, contextual experience, and partnerships can lead to failure.

4. Discovery Phase

Successful projects require deep inclusion of stakeholders, especially those working on the ground. They also require effective communication to manage expectations and mandates throughout the project lifecycle. Unfortunately, there is rarely enough dialogue between the suite of stakeholders involved in implementing projects.

Strong, adaptable implementing teams with access to the relevant knowledge and expertise are more likely to produce results. Exceptional projects might be driven by a single individual but are underpinned by organisational expertise and good leadership. HE capacity can be a stumbling block; energy is a cross-cutting theme, and there is often no assigned energy expert to provide technical support to projects as energy is not always considered an official cluster or sector in humanitarian response [9]. The ability to adapt to unpredictable events, such as funding cuts, civil unrest, and climate disaster, is critical as humanitarian settings are so volatile. Several interviewees noted the adverse consequences of the high staff turnover in humanitarian agency offices, coupled with inadequate use of knowledge databases, which cause important knowledge and relationships to be lost.

Poor cooperation between donors and humanitarian organisations frequently results in duplication of efforts. Multiple examples of this were provided, including an instance of three NGOs piloting the same technology in the same location simultaneously, and another where six agencies simultaneously provided solarised solar streetlights in the same camp. Each used their own individual procurement processes rather than adopting a shared approach, wasting valuable resources and increasing the repair burden (see Case Study 1).

Governance factors

Governance-related failures are among the most critical challenges in HE projects, with systemic barriers leading to inefficiencies, wasted resources, and unsustainable outcomes. They arose 41 times in the literature review and 11 times in the interviews, again alluding to them being most often a contributor to project failure. Governance-related barriers include restrictive legal frameworks, exclusion of refugees from decision-making, and emergency-driven operational models. A striking example can be found in the Rohingya refugee camps (**Box 7**), where energy interventions faltered due to policy restrictions on grid connections, limited refugee agency, and misaligned aid structures, ultimately undermining both affordability and long-term viability [26]. These governance gaps not only hinder cross-sector collaboration but also deter private sector engagement, perpetuating reliance on short-term donor models.

BOX 7: *Example from the literature: Governance Failures in the Rohingya Camps*

In 2020, the Bangladeshi government abruptly deemed household grid connections in Cox's Bazar illegal. They severed all supply, forcing refugees to tap wires clandestinely or share host-community meters, which they could not do directly due to requirements for land titles and national IDs that refugees simply cannot obtain. Energy interventions were treated as temporary "emergency" fixes, designed for quick reversal rather than sustained impact, with subsidies and project lifecycles tied to short-term donor cycles rather than long-term camp tenure. Procedurally, refugees had no real say: community meetings and pilot consultations became perfunctory, their feedback ignored, and channels for redress nonexistent, leaving grievances to echo unheard among camp leadership and aid agencies. As funding shortfalls deepened, organisations cut back on vital support, driving some refugees to sell scarce solar lanterns or LPG tokens just to buy food. This top-down, emergency-driven governance not only barred meaningful refugee participation but also fostered dependency, inflated risks, and ensured that, without a shift towards inclusive, rights-based energy policies, any gains would flicker out as quickly as the lights they installed. *Source: [26]*

Bureaucratic requirements compound the difficulties of operating in remote humanitarian settings, especially displacement contexts. Settlements for forcibly displaced people are often situated in remote and poorly accessible locations. This increases costs across the whole project lifecycle and can require the creation of entirely new supply chains. The ownership status of land in displacement

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settings is not always clear, which can cause issues securing space for project development or integrating operations to provide services to the wider host community. This is a critical issue: easier links between displacement projects and regional markets could boost financial feasibility, attract private sector participation, and reduce tensions between host and refugee communities.

HE projects are plagued by regulatory, legal, and procurement barriers, as well as security issues and corruption. Examples of challenges encountered include equipment getting stuck at customs, securing permits and approvals, complex and unpredictable government processes, and excessive bureaucratic requirements that can take years to process. There were references to instances where equipment had been stolen or vandalised within weeks of installation and also to institutionalised corruption under tightly controlled regulations, which created an inefficient yet profitable system for those involved.

4.2.3 Typology of failures

Within each of the five categories, we identified a range of associated challenges to create a structured framework for analysing the root causes of project challenges, issues, and failures. This typology is shown in **Table 1** and has been adapted into learning forms used in the subsequent phases.

TABLE 1: *Typologies of failures: different failure factors by category.*

Failure Categories	Ref	Failure factors
TECHNOLOGICAL	*T1*	Technology has quality and durability issues
	T2	Technology inappropriate for local context
	T3	Technology inappropriate for intended purpose
	T4	Operation, maintenance, and repair issues *during* project
	T5	Operation, maintenance, and repair issues *after* project
	T6	Problems with electricity access/fuel supply chain
	T7	Insufficient user education
ECONOMIC	*E1*	Incorrect financial or business model assumptions
	E2	Customers *unable* to pay for product/service
	E3	Customers *unwilling* to pay for product/service
	E4	Unable to access follow-on funding to continue project
SOCIAL	*S1*	Failure to include all community groups during project design
	S2	Tensions between different community groups
	S3	Community misunderstanding of project activities
	S4	Poor community involvement throughout project
IMPLEMENTATION	*I1*	Project duration insufficient for sustained impact
	I2	Lack of relevant expertise and experience
	I3	Poor coordination and partner engagement
	I4	Lack of integration with wider ecosystem/other programmes
	I5	Unforeseeable events
GOVERNANCE	*G1*	Policy and regulatory barriers
	G2	Problems physically accessing the target location/community
	G3	Administrative, supply, and procurement issues
	G4	Legal and customs issues
	G5	Crime, corruption, and security challenges

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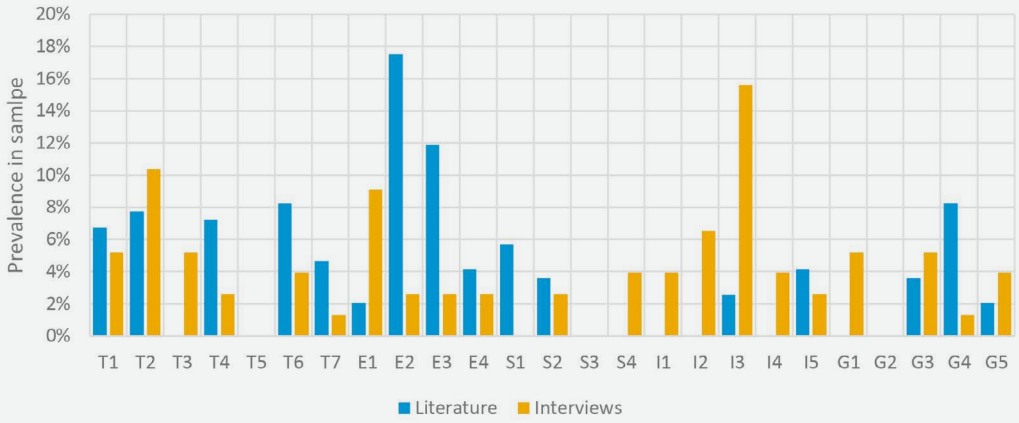
Overall, the anecdotes about failure from the interviews and data from the literature review reveal recurring pitfalls with HE projects: economic models divorced from community realities, technologies misaligned with local conditions, and fragmented implementation. Figure 3 shows the prevalence of each of the failure factors identified through the two research methods. Overall, the most common factors were E2: customers unable to pay for product/service (n=36 occurrences); E3: Customers unwilling to pay for product/service (n=25); and T2: Technology inappropriate for local context (n=23). This highlights the important role of feasibility studies in helping understand ability to pay, willingness to pay, and customer needs in advance of implementation.

FIGURE 3: *Prevalence of failure factors mentioned in literature and interviews.*



4.3 Towards market-based solutions for HE

As HE needs are increasingly outpacing available resources, practitioners argue that, to achieve sustainable impact, market-driven models are now essential. There may be contexts where free-distribution models can be justified, such as in emergencies or highly restricted policy environments (e.g., Cox's Bazar, where refugees cannot work and therefore are completely aid dependent). These will require adequate and long-term after-sales services to ensure longevity of products. However, moving beyond these historically dominant free-distribution approaches is seen as critical to breaking cycles of dependency, enhancing efficiency, and unlocking scalable, long-term energy solutions in humanitarian settings. This section presents strategies to facilitate the transition to market-based HE interventions, as suggested by interviewees. They are grouped into four strategies that are summarised in Table 2 and elaborated upon in the sections below.

TABLE 2: *Strategies to facilitate the transition to market-based HE interventions*

Building evidence and capacity	Structural changes to funding and procurement
• Enhanced understanding of the contexts that are well-suited to private sector involvement • Better understanding of success and failure • More data on energy demand and willingness to pay • More experimentation with blended finance	• Shift to more predictable, longer-term funding • Amendments to procurement regulations • Enhanced donor flexibility
Cultural changes in the humanitarian sector	**Enhanced collaboration**
• More open attitude towards failure • Widespread buy-in to market-based approach	• Create spaces for collaboration and dialogue between refugees, humanitarian practitioners, private sector actors, donors, and investors • Involve the private sector in the design of funding calls • Create a formal donor coordination mechanism

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4.3.1 Building evidence and capacity

There is a lack of clarity on how to attract the private sector to HE projects, and humanitarian settings in general, and its potential contribution. This includes not only private sector companies offering products and services, but also the investors and development finance institutions. It is unknown how much these companies can be engaged in the humanitarian sector, and it is unclear where the line is between market-based feasibility and the need for the traditional free-distribution model. In practice, humanitarian actors could work with companies to understand what market information is needed, and how this is best collected and presented. Small-scale funding in high-potential locations could even be provided to energy providers to conduct market assessments directly.

There is a requirement for more evidence to support informed decisions about HE investments, particularly concerning energy demand and willingness to pay in HE settings. This information will allow both the private sector and potential financiers to better understand the commercial opportunity and to design appropriate solutions. There also needs to be more evidence-based analysis of the root causes of success and failure to support the design and implementation of higher-quality projects.

Further work is required to understand how blended finance can support sustainable HE projects. Potential sources of funds include traditional development funding, grants, private capital, and humanitarian funding. Risk-sharing facilities or guarantees can help to de-risk humanitarian projects for the private sector. Several donors observed that projects at the intersections of multiple sectors, such as energy for healthcare provision, are both more successful (because they generate holistic solutions to problems) and more attractive to investors (because they often stimulate energy demand and are perceived to be more impactful). The GPA's blended finance report examines the challenges and opportunities in this area [27].

PHOTOGRAPH ABOVE: *Jacketed wood stove.*
© International Lifeline Fund

4.3.2 Structural changes to funding and procurement

The shift to market-based solutions requires escaping the constraints of short-term budget cycles. Donor agencies and government funding bodies face political pressures to demonstrate rapid results during crises, leading to accelerated project timelines that prioritise immediate outputs over sustainable planning. This constricts the space for thoughtful project development (which takes time rarely allowed by annual budgets), and for clearly communicated, reliable year-on-year budget allocations that facilitate long-term planning. Some progress has started here, but it is slow; continued and enhanced advocacy efforts are required to change these processes.

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Similarly, procurement regulations need to be amended to encourage innovation, increase project competition, and ensure maintenance provision. These regulations need to be designed in a way that appeals to the private sector and fosters creativity. Some changes are already occurring; for example, Innovation Norway has developed guidance for innovative procurement [28] and offers training on it. Switching from standard "procure and provide" models to service-based models can happen within the existing procurement rules, but requires coordinated effort across procurement teams, management, and technical specialists.

Donor flexibility is paramount for transformative impact. This agility not only enhances project resilience but also unlocks opportunities for scalable, market-driven energy access that meets the dynamic needs of communities in humanitarian settings. By permitting adaptive approaches and calibrated risk-taking, it empowers companies to pilot innovative solutions, iterate based on real-time feedback, and pivot amid volatile contexts, ultimately accelerating scalable, market-driven energy access for displaced communities.

4.3.3 Cultural changes in the humanitarian sector

Donors should be actively engaged in projects, hire more technical energy specialists, and be open to the idea that they might fail. Those funding projects – whether humanitarian donors, investors, or foundations – should take time to understand the context, ask hard questions, and value people with experience. They often lack an open attitude towards failure and an unwillingness to learn from it, which can suppress learning and therefore reduce the likelihood of success for future projects.

Humanitarian actors need to be open to non-traditional financing mechanisms. There is still a lack of wider buy-in to market-based models in general, with some believing that free distribution of products is the only ethical approach, and resistance to alternative sources of finance like carbon credits and renewable energy credits. Carbon credits are believed to have particularly high potential. These are now widely accepted and used in traditional development settings yet can cause friction with humanitarian actors. One interviewee gave an example of how a proposal to use carbon credits as a revenue stream for a cookstove project caused project delays by sparking overly lengthy debates about the ethics of data protection and benefit-sharing, which are business-as-usual decisions in non-humanitarian environments.

4.3.4 Enhanced collaboration

Increasing direct collaboration between end-users, the private sector, and donors could drive fit-for-purpose operations and funding mechanisms. Innovation and understanding directly arise from bringing refugees and the private sector together to solve problems. The most creative project ideas often come from communities and refugee-led organisations that are solving problems for themselves. Likewise, donors and the private sector need to engage closely from the design stage of a call for proposals to ensure that they are appropriate and commercially viable. This requires acceptance of a new division of work, where the humanitarian sector enables the private sector to bring its technical expertise to humanitarian settings.

Similarly, more cooperation between donors and agencies could prevent duplication of efforts and boost resource efficiency. This is something that the GPA has worked on since 2020, and there is an opportunity to leverage the "Greening Donor Group" [29] and their political commitments to the Climate and Environment Declaration [30]. A formal donor coordination mechanism would help ensure more impactful use of resources and be able to provide more national-level support. One interviewee argued for a joint donor strategy that pushes for economies of scale by concentrating resources on specific topics and technologies.

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PHOTOGRAPH ABOVE: *Main street - Somali Market, Kakuma. © SNV*

5.1 Case studies of success and failure

Case studies were assembled by combining pre-existing reports and data with a second round of key informant interviews. Some of the reports drawn upon were publicly available, and others were shared upon request. Following this desk-based review, interviews were conducted with those involved in the project for further exploration, aiming to speak to at least two people for each case study, although this was not always possible. The interviews followed a structured question set designed to align with the learning forms, integrated into the Humanitarian Energy Learnings Platform (HELP), with additional project-specific questions added where necessary. Beforehand, interviewees completed this form in advance and provided feedback (see more about HELP

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in Section 6). The cases were subsequently written up in two ways: a traditional case study format, presented below, and using the HELP form, which can be found in Appendix B. This process helped to reveal shortcomings with the form and thus further refine it.

TABLE 3: *High-level summary of the case studies and their failure factors*

			Failure factors				
Case	**Success / failure?**	**Energy category**	**Techno-logical**	**Economic**	**Social**	**Implement-ation**	**Governance**
CS1: Solar streetlights in Bangladesh	Success and failure	Energy for community facilities	T1, T4, T5	E1, E2, E4	S4	I3	G3, G5
CS2: Replacing diesel with solar mini-grids in Kenya	Success	Household electricity; energy for enterprises; energy for community facilities			S2		G3
CS3: Briquette production in Kenya	Failure	Household cooking	T1	E1, E2, E3		I4	
CS4: e-Waste circularity in Uganda	Success and failure	Household electricity; energy for enterprises; energy for community facilities	T5, T7	E2, E3, E4		I4	G1, G3
CS5: Building sustainable markets for energy products	Success	Household cooking; household electricity; energy for enterprise; energy for community facilities		E4		I1, I4, I5	G1
CS6: Electricity metering in Jordan	Failure	Household electricity; energy for enterprises	T4	E1, E2, E4		I2, I3, I4	G3
CS7: Pellet stoves in Malawi	Failure	Household cooking	T6	E2, E3, E4			

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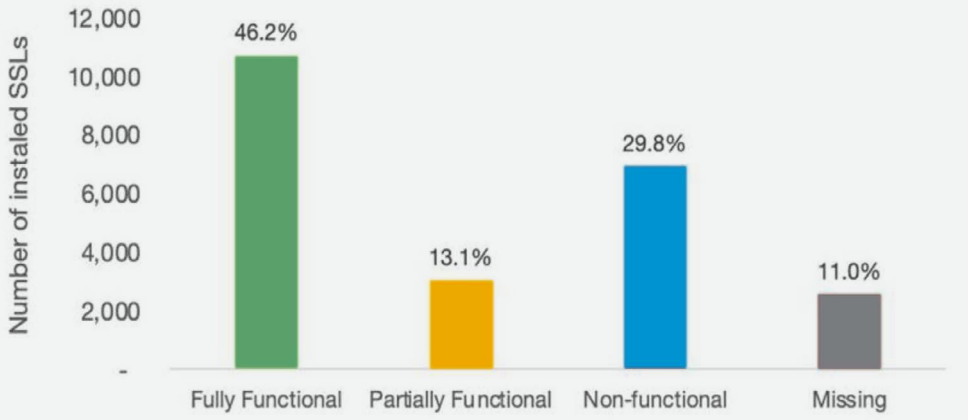
CS1: Solar Streetlights in Rohingya Refugee Camps, Cox's Bazar, Bangladesh

What happened

The Rohingya refugee crisis, triggered by violence in Myanmar's Rakhine State in 2017, led to rapid camp expansion in Cox's Bazar, Bangladesh, now hosting ~900,000 refugees. Since the expansion, more than 23,000 solar streetlights (SSLs) have been installed by approximately 60 implementing agencies. While many of these installations have improved perceptions of safety and nighttime access – particularly for women and girls – less than half of the SSLs remain fully functional, as shown in **Figure 4**.

FIGURE 4: *Functionality of SSLs in Cox's Bazar.*



Data from EEN (Data Update Apr. 24).

Solar streetlights, Rohingya refugee camps in Cox's Bazar.
© Rihab Khalid, MECS

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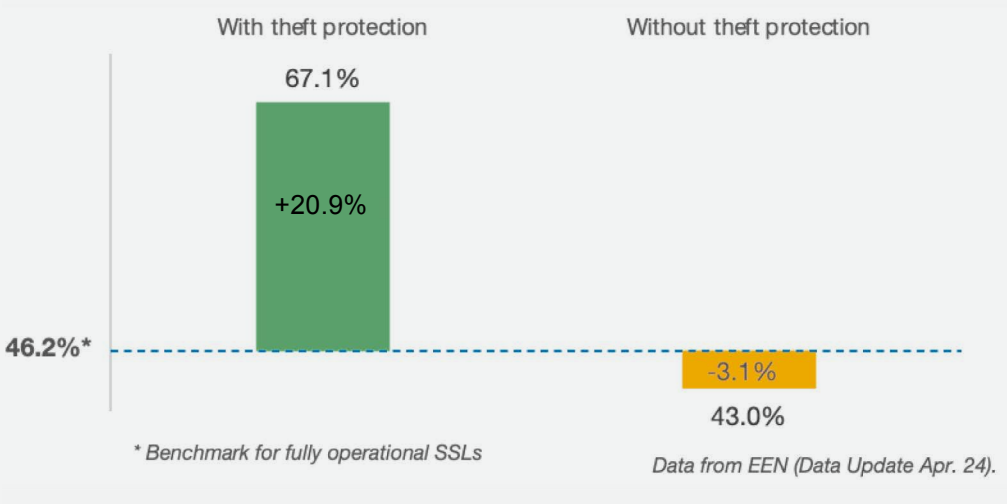
An estimated 37,700 SSLs are needed to meet coverage standards for nearly 190,000 households and key pieces of camp infrastructure, including latrines, health centres, and pavements. With approximately 10,700 fully operational SSLs, a substantial functionality gap of around 27,000 units persists. Significant inroads towards achieving full coverage can be made by reactivating the 9,900 SSLs that are no longer fully functional.

Why it happened

The overall implementation programme is comprised of multiple projects that have been implemented separately. The involvement of over 60 agencies has led to a fragmented implementation landscape, the deployment of a diverse set of technologies, and inconsistent approaches to operations and maintenance. This uncoordinated procurement has resulted in inconsistent warranties, limited standardisation of spare parts, and unstandardised training for repairs. The absence of repair budgets from some installers and short-term funding cycles have compounded the problem. This can be partially attributed to weak local coordination and standardisation practices; other sectors in humanitarian response, such as WASH and shelter, are officially coordinated and have ownership by agencies. However, these structures do not exist for energy, which creates space for bad practices.

Most SSLs could have a lifespan of up to 10 years, but in practice, many are deteriorating within 4–5 years due to irregular cleaning, poor battery maintenance, and exposure to theft or vandalism. Theft of SSL components has also been a major issue. However, installing anti-theft measures has been demonstrated to be an effective way of maintaining functional SSLs. These changes demonstrate a degree of adaptive management in response to recurring risks. **Figure 5** shows that such SSLs are 21% more likely to be fully functional than average, yet only 13% of have such protection.

FIGURE 5: *Impact of fitting theft protection on SSL functionality*



Of the 9,900 SSLs that are not fully functional, 48% are missing panels and 46% batteries, as shown in **Figure 6.** These items are widely used in other electrical applications and have a high resale value: large groups of people have been known to gather suddenly at SSL sites and forcibly removed equipment, even mid-repair.

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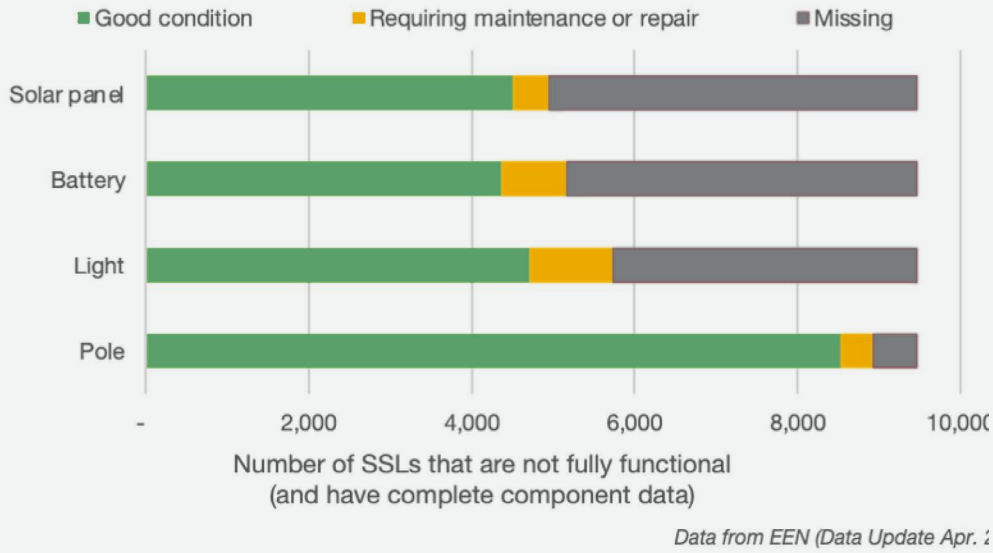
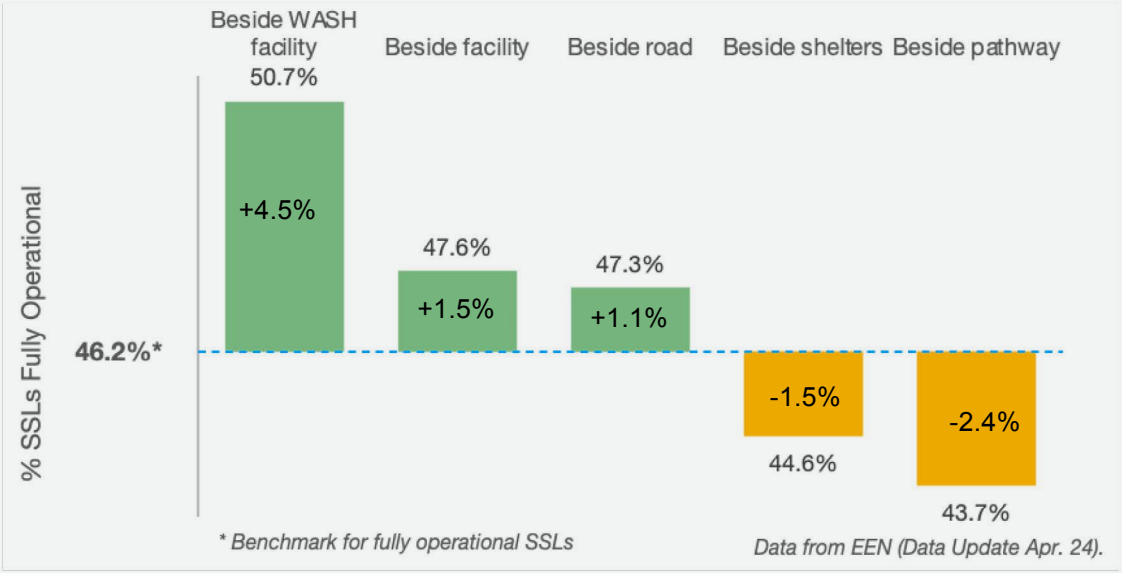
FIGURE 6: *Condition of SSL components for non-functioning SSLs*



Location also affects functionality. SSLs near WASH facilities perform better (51% fully operational) than those along pathways (44%), as shown by **Figure 7**. These differences could be down to targeted selection by thieves or different levels of willingness among the community to engage in maintenance activities for SSLs, like cleaning solar panels, based on their location. Both hypothetical causes underline the importance of inculcating a strong sense of community ownership.

FIGURE 7: *Impact of location on SSL functionality*



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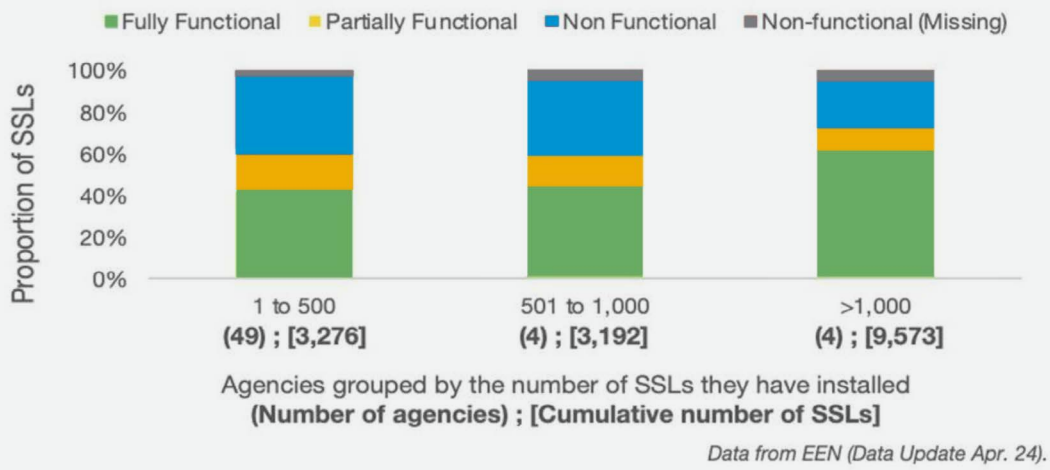
Implementer experience also plays a role. Agencies that have installed more than 1,000 SSLs each – collectively responsible for over 9,500 units – report a 62% functionality rate, well above the average for smaller implementers (43–45%), as shown in **Figure 8**. This highlights the value of economies of scale and the potential for knowledge sharing between agencies.

FIGURE 8: *Impact of agency installation numbers on functionality*



Data from EEN (Data Update Apr. 24).

The United Nations High Commissioner for Refugees (UNHCR) is the largest installer of SSLs in Cox's Bazar, having installed over 5,000 lights. They also have the largest proportion of functional lights of any agency to have installed more than 100 units. UNHCR notes that their 400 mini-grid-connected lights, which were installed in 2017, have much better functionality rates than their standalone counterparts. But the modality of mini-grid powered SSLs is not a panacea. Conversely, some mini-grids installed by development banks now show minimal functionality. These agencies annually requested installation sites without community consultation, deployed technology with zero operation and maintenance (O&M) plans or local training, then departed. Systems failed within weeks – some vandalised – eroding community trust in solar solutions. This underscores that implementers without ironclad O&M commitments should not install technologies.

The main difference between the two sites was the approach to operations and maintenance: UNHCR appointed people from the local community to be in charge of routine operational tasks, such as checking battery water levels and regularly cleaning the solar panels. Crucially, this model succeeded because a dedicated Energy & Environment (EEN)[3] team was maintained – a rare capacity among humanitarian operations, with only 3–4 UNHCR operations globally (including Cox's Bazar, Ethiopia, and Jordan) having specialised energy staff. This highlights the indispensable role of on-ground technical expertise.

Wherever possible, UNHCR encourages donors to fund mini-grid powered streetlights and to contribute to localising repair services, such as the Green Innovation Hub – a facility that builds local technical skills run by UNHCR and the NGO Forum for Public Health with technical support from Schneider Electric, UNITAR, and Electriciens sans frontières – that equips refugees with the tools and training to own local SSL maintenance.

[3] https://rohingyaresponse.org/cross-cutting/energy-and-environment/. Accessed 24 July 2025.

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However, donors tend to overlook these recommendations. One of the main reasons for this is that donors tend to prioritise funding solutions with smaller up-front costs, which can be easily justified by more attractive unit output numbers. However, if full lifecycle costs are considered – and the significant hidden costs for operating and maintaining the system over several years are factored in – mini-grid-powered SSLs tend to be more cost-effective. Other reasons commonly cited by donors for moving forward with standalone units are that disbursement windows can be too tight, and there is not enough time to seek Board approval to fund solutions that are not fully aligned with authorised spending objectives.

Lessons learnt

The programme's shortcomings above have been acknowledged by some of the agencies involved. Recent efforts have focused on improving coordination, standardising technology, and embedding maintenance responsibility to sustain SSL performance. The Solar Lighting Guidelines, developed by the EEN, now serve as a shared technical framework across agencies, stipulating that implementers must either maintain their installations or formally delegate this responsibility to a qualified partner. A dashboard, which is maintained by EEN, allows for visibility of SSL functionality across the camp, even if the last update was over a year ago. This raises broader questions about project continuity and institutional commitment: dashboards and monitoring tools only remain valuable if maintained beyond initial funding cycles.

As the focus of more donors shifts to outcomes from outputs, donor procurement teams are increasingly including warranties and dedicated operations and maintenance budgets in agency contracts, addressing a major weakness of earlier deployments.

In addition, community-based maintenance models have been piloted in several areas, with residents being trained to clean panels and proactively report faults, reinforcing local stewardship and helping to deter thefts.

Some agencies have begun separating the procurement of poles and foundations from core components (lights, panels, batteries), maximising opportunities for local sourcing and cost savings. Other agencies have been encouraged by the high-performance rates that mini-grid powered lights and local maintenance approaches can offer, but remain limited due to a lack of structured collaboration that could translate into a concrete willingness to share technical knowledge and harmonise approaches across organisations.

While SSL functionality remains uneven, these efforts represent a clear pivot towards a more coordinated, technically sound, and sustainable approach to community lighting.

CS2: Replacing Diesel with Solar Mini-grids in Kalobeyei Settlement, Kenya

What happened

The Kalobeyei settlement was established in 2016 as an extension to the older Kakuma refugee camps in Turkana County, northwest Kenya. It was designed not just to relieve pressure on Kakuma but to pilot a more integrated humanitarian–development approach that promotes refugee self-reliance and shared services with host communities. Unlike the Kakuma camps, which operate under more traditional encampment models, Kalobeyei was intentionally planned to allow for greater movement, economic activity, and market integration, including access to energy, livelihoods, and education. These structural and regulatory differences have made Kalobeyei a more conducive environment for innovative service delivery models, including mini-grids led by the private sector.

Renewvia, a global solar development company, now operates the largest mini-grid in East Africa, providing over 2,700 connections from a 541 kW solar system in Kalobeyei. The project has secured the necessary finance to expand into a 2.4 MW solar facility with 5 MWh of battery storage, serving 19,000 customers by 2026.

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PHOTOGRAPH ABOVE: *Sauda Meli watches television with her children at her home in Kalobeyei Village. © GIZ*

The initiative began with GIZ commissioning feasibility studies to explore the potential for solar mini-grids in both the host town and refugee settlement. In 2018, the International Finance Corporation (IFC) assessed Kakuma's annual market size (household and business energy spending combined) at US$56 million, indicating strong commercial potential. Based on this promising data, the Kenyan government approved the provision of energy services to both displaced and host communities, and Renewvia was appointed as the project developer through the subsequent competitive tender.

Initial operations began in 2019 with two small systems: one was a 20 kW installation with 60 kWh battery storage serving around 120 host community customers, and the other, in Kalobeyei, was a larger system with 60 kW of solar and 120 kWh of battery storage, serving 500 connections.

The project scaled significantly in 2022, following support from IFC's Kakuma-Kalobeyei Challenge Fund (KKCF), a competitive business challenge for US$730K with a top-up of US$750K in 2025. Kalobeyei is located approximately 3 km from Kakuma town and the Kakuma refugee camps, and all fall within Turkana County. While Kakuma camps host the majority of the displaced population, Kalobeyei's planning model and regulatory treatment differ markedly – factors that have allowed for more market-oriented infrastructure projects like Renewvia's mini-grid.

In 2025, Renewvia secured a major financing package from Clean Energy and Energy Inclusion for Africa (CEI Africa), consisting of a US$4.48 million senior secured loan and up to US$4.2 million in results-based grant funding, including a US$1.26 million forgivable loan [31].

Why it happened

Renewvia's successful transition from a grant-dependent pilot to a commercially driven enterprise was anchored in strong demand assessments, government support, and community engagement.

A market assessment done in 2018 by the KKCF found that the Kakuma area consumed $56 million a year, and that there was "considerable potential" for people in the area to benefit greatly from new private sector interventions due to the large population, high

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density, and presence of street markets [32]. Looking ahead, the outlook for future energy demand is strong, with IFC projecting peak hourly demand to rise above 6 MW, particularly if Kakuma gains municipal status.

Early operations confirmed high demand and willingness to pay among consumers, but capacity constraints in the system led to frequent reliance on diesel backup. This significantly increased operating costs, resulting in financial losses for the operator. Faced with the choice between restricting supply or absorbing these losses, Renewvia opted to maintain uninterrupted service, strengthening customer trust in the reliability of their service, improving customer retention, and thus positioning the company well for future growth.

To ensure affordability, Renewvia matched national utility tariffs, which required an 82% subsidy per kWh. The gap was filled through an RBF programme by EnDev, or Energising Development, an international multi-donor programme focused on promoting access to sustainable modern energy services in developing countries [19]. Refugee businesses, in particular, demonstrated strong productive use demand, consuming up to 11.5 times more energy than households. This robust commercial base helped strengthen the underlying project economics and attract the additional investment needed to scale up the size of the facility.

Nonetheless, key barriers to scaling remained. One constraint inhibiting the flow of investment to expand the facility was the lack of 'anchor clients': a small number of larger energy off-takers, which would have helped to de-risk the prospect's economics. One apparent solution emerged when UNHCR tendered for the provision of energy services to power their camp operations. However, UNHCR's procurement process did not share the draft Terms of Reference with other donors in advance, and did not favour companies already operating locally. Renewvia was therefore overlooked as the solution provider. A European firm was commissioned to provide a small, standalone facility to service UNHCR's facilities, an outcome that missed the opportunity for more integrated energy service provision, especially supporting local capacity development.

Social dynamics in Turkana also presented challenges. Perceptions of inequality between host and refugee communities, especially in employment, led to tensions, including informal stop-work orders. To support community inclusion, GIZ later funded service extensions to eight surrounding host villages, strengthening Renewvia's social licence to operate, though these areas proved less commercially viable.

The enabling policy and regulatory environment were also essential to project success. The Kenyan government's decision to allow refugees to legally access mini-grid electricity, and to participate in income-generating activities, directly supported Renewvia's commercial case. These permissions are not universal in refugee contexts, and the relative regulatory openness in Kalobeyei (as compared to Kakuma's camps) was a key factor in the project's viability. Importantly, Kalobeyei's classification as a settlement, rather than a formal refugee camp, allowed for more flexibility in service provision and integration into the national energy strategy.

Lessons learnt

This case reinforces the value of getting high-quality market data for the private sector as an essential first step. Strong feasibility analysis and demand modelling are critical to unlocking investment. Renewvia's insistence on service continuity, even at financial loss, fostered consumer trust, cultivated long-term customer retention, and ultimately laid the foundations for long-term customer retention and future growth.

The project also highlights the need for better-aligned procurement systems between humanitarian agencies and energy developers. In particular, UN agencies need to be more open to signing power purchase agreements (PPAs) or directly purchasing electricity services at fixed tariffs from private sector actors. Doing so could offer a game-changing delivery model: guaranteed off-take through long-term contracts creates predictable revenue streams,

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helping companies secure financing and reduce perceived investor risk. More collaborative planning around energy budgets and early consultation on procurement terms can help humanitarian agencies play a catalytic role in enabling market-based energy solutions.

Finally, treating host and refugee populations as a shared energy market, rather than as separate entities that can be singly served or overlooked, is key to securing social legitimacy across the community and is aligned with the reality of integrated daily trade and interaction between both groups.

CS3: Briquette Production in Kakuma Refugee Camp, Kenya

What happened

Kakuma Refugee Camp, located in Turkana County in northwest Kenya, was established in 1992 to host refugees fleeing conflict in Sudan. Over time, the camp has expanded and now accommodates refugees from multiple countries, including Somalia, Ethiopia, the Democratic Republic of Congo, and Burundi. Together with the adjacent Kalobeyei Settlement, the area hosts more than 200,000 forcibly displaced people. While Kakuma remains governed under encampment policies, it has seen increasing efforts to introduce market-based and livelihood-oriented interventions in energy, sanitation, and enterprise development. One such initiative was the briquette production project led by Sanivation, designed to address both sanitation and energy challenges.

Between 2017 and 2019, Sanivation implemented a project in Kakuma supported by the Bill and Melinda Gates Foundation. The initiative sought to address two major challenges in refugee settings: poor sanitation infrastructure and lack of access to clean, affordable cooking fuel. The project introduced 500 above-ground, container-based toilets, which were well adopted by camp residents and operated without major issues during the pilot phase.

PHOTOGRAPH ABOVE: *Briquette cookstoves in Kakuma, Kenya © Vincent Ubeling*

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Collected faecal sludge was heat-treated and mixed with charcoal dust to create fuel briquettes. Around 50 tonnes of briquettes were produced annually, but only half of this was sold, with an average monthly sales volume of 2 tonnes. A brief spike in demand occurred when marketing efforts targeted local restaurants, reaching a peak of 11 tonnes in one month. However, this momentum quickly dissipated as Sanivation found it difficult to compete with traditional charcoal, which remained widely available and preferred by many users.

Briquettes were priced at KES 20/kg, slightly lower than the KES 23/kg price of charcoal, and 75% of customers cited this lower price as their main reason for purchase. Additionally, 55% of users reported that briquettes cooked faster. Nevertheless, it is unclear whether these prices were subsidised or if briquettes were provided free to certain groups. Despite the project being promoted in a UNHCR article as a success story – claiming that "Superball briquettes [were] changing lives" [33] – no independent financial or technical assessments were made publicly available during implementation.

As the project progressed, logistical and financial challenges mounted. Distribution and marketing costs were higher than expected, and the price of charcoal dust – a key input – was double what had initially been projected. Facing low sales and no viable private distribution model, Sanivation approached UNHCR with a proposal to purchase and distribute the briquettes directly. UNHCR declined, opting instead to continue free firewood distribution to maintain peace with host communities. The Sanivation project was subsequently discontinued, having reached just 5% of its target sales.

A post-project evaluation estimated that the 20-year cost of the combined container-based sanitation and briquette model was significantly higher than that of alternative options. It concluded: "the nature of the cost drivers makes it unlikely that the overall cost can be shifted sufficiently to bring the CBS/briquette business model to a point of being financially competitive with double vault UDDTs [Urine Diversion Desiccating Toilets] or pit latrines in Kakuma" (pg. 21) [34].

Why it happened

The failure of the project was partly due to structural challenges common across similar briquette initiatives in Africa. As noted in multiple studies, briquette production remains heavily reliant on grants and has rarely succeeded as a private-sector-led solution, especially in low-income or humanitarian contexts. A broader evaluation covering Ethiopia, Kenya, and Uganda found that production costs were so high that the selling price would have to be double that of charcoal to break even [35]. In one Ugandan settlement, the price paid by an NGO for briquettes exceeded the local charcoal price by more than 70%, despite briquettes being a lower-quality fuel.

In Kakuma, competing against free firewood, which was still distributed during the project, created a distorted market environment. Many camp residents lacked adequate income to spend on fuel at all, a reality that was at odds with the project's attempt to establish a financially sustainable business.

The project also suffered from weak demand due to user preferences. Briquettes were widely viewed as inferior to charcoal in terms of quality and cooking experience. Furthermore, the main raw material, namely agricultural waste, also had value as fertiliser, creating supply constraints. Reported production volumes may have been overstated in light of these biomass availability and processing challenges.

Finally, the project's timeline and investment strategy reflected a broader trend in the sector: the prioritisation of innovation and donor visibility over long-term viability. As reported in an evaluation of a similar project funded by the IKEA Foundation in Dollo Ado, Ethiopia, the briquette-making model – while innovative in linking gender, livelihoods, and environmental goals – was considered "among the

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least successful and least commercially viable of the cooperative projects at this time. It is almost entirely dependent on external support and provision of inputs" (pg. 14) [23].

Lessons learnt

While the Sanivation project was innovative in combining sanitation and energy solutions, it ultimately failed due to a lack of commercial viability. One of its strengths was the effective rollout of container toilets, which were widely accepted and functionally reliable. Additionally, some refugee households did purchase the briquettes, even in a context of limited purchasing power and free firewood. This is an indication that alternative fuels can be adopted if they align with user needs and constraints.

However, financial and market analysis should have preceded the technical trials. A more rigorous study of briquette initiatives in East Africa at the preparation stage could have revealed the systemic issues faced by similar projects: high production costs, weak demand, subsidised competition, and input supply challenges. These issues are not unique to Kakuma and have undermined briquette operations across the region.

Ultimately, market-based approaches cannot thrive where free distributions remain dominant and purchasing power is extremely limited. The practice of distributing products for free or via conditional vouchers often undercuts private sector delivery. Until humanitarian actors reconsider these models and engage in structured procurement with private suppliers, energy innovation in refugee settings will continue to face significant barriers to scale and sustainability.

Additional Comments

Information regarding this project was obtained only from literature available online, without any interview or completed forms from those involved in the project. Those who were contacted either did not respond or did not wish to participate.

Assorted electrical applicances at a repurposing laboratory 'Batlab' in bidibidi refugee camp. © GPA

CS4: e-Waste Circularity in Bidibidi Refugee Settlement, Uganda

What happened

Bidibidi Refugee Settlement, located in Yumbe District in northwestern Uganda, was established in 2016 in response to the influx of South Sudanese refugees fleeing civil conflict. With a population of over 240,000, Bidibidi is one of the largest refugee settlements in the world. It is supported by Uganda's progressive refugee policy, which allows freedom of movement, the right to work, and access to public services. Despite this enabling environment, energy access and waste management remain major challenges, particularly as solar products and electronics become more widely used.

The 'Greening Humanitarian Responses through Recovery, Repair, and Recycling of Solar Products in Displacement Settings' project is a forward-thinking initiative that started in 2020 with needs assessments across five refugee settlements in Uganda and Kenya. The Bidibidi Refugee Settlement in Uganda was

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selected for the 2021 pilot project based on the solar e-waste needs identified. The project uses circular economy principles, extending the life cycle of solar energy products and other electronics while also supporting local livelihoods.

Led by the International Organization for Migration (IOM) in partnership with Strathmore University, Mercy Corps Uganda, and private sector partners, including BRIGHT Products, AceleAfrica, Open Energy Labs, and the WEEE Center, the project introduced two primary components within its circular model: a product repair facility and a battery repurposing laboratory ('Batlab'). The latter is supported by AceleAfrica, which trained the current technicians from the refugee and host communities to operate the local facility. Both services are locally managed by a community-led e-waste cooperative, officially registered in 2024 as the Bidibidi Electronic Multipurpose Cooperative Society (BEMCOS).

The project evolved in two phases. The first pilot phase (2020–2023) provided free solar lantern repairs, gathered community feedback, and raised awareness on the risks of improper e-waste handling. Technicians were selected from both refugee and host communities and trained by BRIGHT Products to repair damaged solar lanterns. This created a feedback loop between technicians and the private sector, enabling BRIGHT Products to gather direct insights into common failure points, user handling, and real-world repair challenges. These inputs informed the development of a new solar lantern model that was better adapted to the needs of users in displacement settings, with improved durability, enhanced repairability, and longer product lifespan. In parallel, partners like TotalEnergies and AceleAfrica helped set up the Batlab and began repurposing end-of-life batteries into second-life packs. Solvoz contributed by developing sustainable procurement criteria to guide humanitarian sourcing of solar products and repair services.

A second 'Transition-to-Scale' phase ran from 2023 to 2025 and sought to identify a viable, self-sustaining circular business model for e-waste management, with a community-led cooperative offering e-waste management services at-a-fee. Market research confirmed payments were being made for e-waste repair services across all five zones in the camp, and that 81% of solar lantern owners surveyed indicated their willingness to pay for repairs. Following this assessment, the second phase sought to identify a financial model that could be self-sustaining under certain operating assumptions (e.g., receiving and processing sufficient volumes of e-waste). To date, five repair centres – staffed by 30 refugee technicians – have repaired over 5,800 solar lanterns, processed 15,700 end-of-life batteries, and repurposed ('second life') 150 battery packs for sale. Educational outreach to the community has been strong, with awareness campaigns reaching over 110,000 people and advising them about the health and environmental dangers of e-waste, which can contaminate local water sources and soil, as well as generate dangerous air-pollution from burning.

While the community-led business initiative does not yet fully cover all costs, plans are underway for a third phase, which aims to scale up a model that can be fully self-sustaining by increasing geographic reach and the number of repair services offered.

Why it happened

The project was driven by a critical gap in e-waste management across refugee settlements. A comprehensive needs assessment conducted across five refugee settlements in Uganda and Kenya highlighted critical gaps in e-waste disposal practices in Bidibidi: 57% of refugees reported discarding broken electronics in the bush, 18.5% burned e-waste, and 62% stored disused electronics at home due to a lack of safe disposal options. In response, private sector actors were engaged to explore opportunities and barriers for piloting an e-waste management model in a refugee context. The importance of improved products, stronger promotion of repair culture, and increased access to tools and spare parts emerged as key findings to take into the first phase of the pilot.

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Strong partnerships with technical and private actors underpinned the project's operational success. Training and equipment provided by BRIGHT Products, AceleAfrica, and others helped build local capacity, while ongoing collaboration ensured real-time learning and product adaptation. Market assessments validated demand for paid repair services, justifying the shift away from free repair during the Transition-to-Scale phase. Although regulatory barriers, affordability concerns, and supply chain gaps remain, the cooperative-led model created space for bottom-up ownership and service delivery, offering a viable path forward in low-resource settings like Bidibidi.

Lessons learnt

Several lessons have emerged from the first two phases of the e-waste circularity initiative. First, securing a reliable volume of e-waste, especially batteries, is critical for the viability of the business model. Monthly review meetings and community mobilisation have helped track underperforming areas, while innovations like mobile collection points and road drives have increased participation across all zones.

Second, access to affordable spare parts remains a persistent constraint. Documenting frequently required components and building stronger supplier relationships are ongoing efforts to reduce this barrier. Third, enhancing the technical capacity of local technicians is essential for service diversification. Training by Open Energy Labs, D.light, and Tulima Solar has expanded technician skills to include solar home systems, cookstoves, and solar irrigation devices, with future opportunities to add mobile phone repair services.

A fourth lesson concerns product trust and regulation. Establishing certification pathways for repurposed items, especially second-life battery packs, is essential for scaling the model. Collaboration with the Uganda National Bureau of Standards is ongoing to ensure that safety and quality standards are met, which will be vital for consumer confidence. Fifth, balancing affordability with cost recovery is particularly challenging in low-income humanitarian settings. A February 2024 assessment found that the average willingness to pay for solar lantern repairs was UGX 6,978, while a market assessment indicated that other repair businesses in the area charged between UGX 5,000 to UGX 15,000, depending on the solar brand, size, and complexity of the repair service [36, 37]. These findings are informing BEMCOS's pricing and outreach strategies.

Finally, the project underscores the importance of strong, long-term partnerships. While collaboration with key private actors has been effective, broader engagement with national recycling efforts and private-sector buyers is still limited. Expanding these connections is necessary to strengthen the e-waste value chain and fully embed circular economy practices in the humanitarian response. As e-waste volumes continue to rise in refugee settings, models like BEMCOS and the Batlab offer promising approaches to address environmental risks while fostering local livelihoods and community resilience.

CS5: Building Sustainable Markets for Energy Products in Bidibidi Refugee Settlement, Uganda

What happened

Energy access in remote, off-grid settings relies on making quality and affordable products available to local households and businesses. However, servicing hard-to-reach, low-income communities presents many challenges, costs, and risks. Energy supply companies, micro-finance institutions, and local communities require tailored support to build sustainable markets.

Many projects have been implemented to support the energy ecosystem, enabling companies and communities to overcome some of the challenges in accessing appropriate energy products.

The following case study, the Accessing Markets through Private Sector Enterprises for Refugees Energy (AMPERE) Project implemented by Mercy Corps in Uganda, provides an example outline of the types

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PHOTOGRAPH ABOVE: *Customer using D-light's solar light and cell phone charger. © Sean Sheridan for Mercy Corps*

of support required to foster an energy ecosystem, impacts which can be achieved, and lessons for future similar projects.

The AMPERE project was created to support energy companies in developing markets for quality energy products in refugee settlements. It also aimed to address consumer finance and product appropriateness. This pilot project ran from July 2019 to June 2020 in the Bidibidi refugee settlement in West Nile, Uganda, with the objective of demonstrating the lessons learnt and positive impacts to extend, expand, and replicate successful approaches.

Initial research identified key barriers to market development in this context, including affordability and consumer finance, product suitability, consumer awareness, and last-mile distribution requirements [38]. Mercy Corps acted as a catalyst for market development, enabling companies to access consumer groups, creating product distribution centres, and conducting community awareness and mobilisation campaigns. They also provided technical assistance to develop business models for sales and consumer relationship building. The project addressed affordability constraints with approved products being subsidised by 60% for the first six months and 50% for the remainder of the project.

Two energy companies, D-Light and Village Power, were selected through competitive tender to develop markets in Bidibidi. While the product sales exceeded targets, these companies did not have markets anywhere in the West Nile, so extending markets all the way from Kampala to just the refugee settlement proved too expensive and their sales discontinued once the project support ended. GIZ and Mercy Corps have since partnered to support D-Light to build a regional presence to enhance market sustainability and provide a wider consumer base, including refugees.

Why it happened

The sale of 4,000 solar products, exceeding initial targets, was a clear indicator of untapped demand for reliable energy solutions in refugee settings. This level of uptake represented about 9% of households in the Bidibidi settlement, suggesting that, when appropriate products are made accessible and awareness is effectively raised, refugee consumers are both willing and able to adopt energy technologies. The success also suggests that access to distributed energy in

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humanitarian settings does not depend solely on free distribution models; with the right conditions, market-based solutions can reach a meaningful portion of the population.

A major factor behind this success was the combination of effective community engagement, thoughtful consumer segmentation, and adherence to high product quality standards. By segmenting the market based on affordability and usage needs, the project team was able to offer a choice of solar products suited to different household profiles. Importantly, financing mechanisms, such as pay-as-you-go or instalment models, were used to ease the upfront cost barrier, making the products more accessible to low-income consumers. The involvement of local community members in outreach and sales also helped build trust and ensure that the benefits and operation of the products were clearly understood, which further stimulated demand.

Lastly, the project validated that a market systems approach – one that strengthens local value chains and supports private-sector-led delivery – can be viable even in refugee settlements that are often seen as high-risk or commercially unviable. Rather than relying solely on subsidised distribution or humanitarian programming, the initiative supported the growth of a functional, albeit still fragile, market for solar products. This not only improved energy access in the short term but also demonstrated to stakeholders that market-based interventions can have a role in long-term planning for energy solutions in displacement contexts. The project's ability to move beyond a purely donor-led model marked an important step toward building a more sustainable and self-reinforcing local energy economy.

Lessons learnt

One of the clearest takeaways from this project is that while pilot initiatives are useful for testing ideas and demonstrating early-stage potential, they are not enough to drive systemic change or sustained outcomes on their own. Short-term timelines and limited funding often result in missed opportunities to consolidate and expand successful models. In this case, no follow-on investment was secured to build on the momentum of the pilot, highlighting the need for longer-term strategies that support market maturation over several years.

Private sector actors also found it difficult to operate in a market that was geographically isolated and limited in purchasing power. Businesses cannot be expected to serve only remote refugee populations without broader ecosystem development and market linkages that include host communities and regional economies. This underscores the importance of designing energy access interventions that align both humanitarian goals and development strategies, so that commercial sustainability can eventually take hold.

Another challenge came from regulatory hurdles. In Uganda, private companies must obtain specific permits from the Office of the Prime Minister to operate within refugee settlements. These administrative requirements, which are also common in many refugee-hosting countries, increase costs and delay implementation. They point to a wider need for coordinated dialogue between governments, humanitarian agencies, and private sector stakeholders to enable a smoother regulatory environment that supports market development while maintaining necessary oversight.

Finally, the COVID-19 pandemic significantly disrupted project momentum by shifting donor priorities, reducing consumer spending, and constraining business operations. It serves as a reminder that unexpected shocks, whether global health crises or abrupt funding cuts, can derail even well-designed projects. Future programming must factor in such risks and build greater flexibility and contingency planning into project design, ensuring that initiatives can adapt and remain viable in the face of uncertainty.

CS6: Electricity Metering in Azraq Refugee Households, Jordan

What happened

Azraq Refugee Camp in Jordan was established in 2014 to accommodate Syrian refugees fleeing conflict. Located in a remote desert area and administered by

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the Government of Jordan with UNHCR and other humanitarian agencies, Azraq was designed to be more structurally permanent than previous camps. Unlike other camps, Azraq initially lacked electricity in residential shelters, with power first connected to households in December 2016. By May 2017, the first phase of solar power plants was completed. These solar facilities, along with grid connections, aimed to provide each household with 2 kWh of electricity per day, sufficient for lighting, phone charging, a fan, some TV use, and refrigeration, while also supplying power to essential camp infrastructure.

However, the Government of Jordan did not permit national electricity utilities to install meters inside the camp. Instead, the national energy regulator allowed for a private metering system to be operated within the camp network. Private sector companies expressed interest in managing such systems, and estimates indicated that the payback period for this approach would have been under two years. This was a significant cost-saving opportunity for the UNHCR.

Electricity consumption for the households in Azraq has grown considerably, with households installing appliances such as air conditioning units, heaters, washing machines, and so on. Since electricity was provided for free and without limits, the UNHCR was charged the highest possible tariff for all electricity used, so that paying for unlimited consumption for the camps cost millions of dollars per year.

Reliable, unlimited, and free electricity was provided 24 hours a day for several months until UNHCR restricted the supply to 12 hours per day in an attempt to reduce consumption. This has caused households to use as much as possible when supply is available and was not effective in managing consumption levels. Additionally, it means that many camp facilities, including medical centres, require their own electricity supply, and often resort to using diesel generators.

Recognising the inefficiencies of this approach, the Norwegian Refugee Council (NRC), with funding from Innovation Norway, implemented a pilot project

PHOTOGRAPH ABOVE: *View of refugee camp in Jordan. © NRC*

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aiming to provide 190 households with a controller that would allow 24-hour access to essential electricity needs and to enable households to manage their own consumption. Households were not expected to pay for electricity in the scope of this project.

NRC Jordan partnered with energy companies Neurotech and Wattero to develop a smart controller that divided electricity into two categories: critical supply (lighting, medical devices, water filters, etc.) and secondary supply (TV, phone charging, fan, other appliances), separating essential functions from non-essential ones. Regulatory concerns over the controller's wireless network technology (LoRaWAN) led to the end of the collaboration with Wattero, and a new controller was developed with Neurotech.

The new device was well received, and participants reported reduced consumption and more efficient use of electricity. Community engagement throughout the project was strong, and the pilot demonstrated that households were willing to use metering systems. Toward the end of the project in 2023, a major policy breakthrough occurred: UNHCR and Jordan's Ministry of Energy and Mineral Resources (MEMR) reached an agreement to allow the national utilities to install approved electricity meters in shelters. As a result, the NRC/Neurotech controllers were phased out, and preparations began for a camp-wide rollout of smart energy dispensers expected by November 2025.

Why it happened

The success of the project in demonstrating the feasibility of metering in Azraq can be attributed to several interrelated factors. First, the pilot confirmed that refugee households were receptive to energy metering technologies and were willing to adapt their consumption behaviour when given the tools to do so. By providing 24-hour electricity alongside consumption monitoring, the project achieved both service improvement and greater user awareness of energy use.

Second, effective collaboration with the community played a key role. Participants were involved from the beginning, which helped build trust and fostered cooperation during the trial. This engagement, combined with tangible improvements in energy access, may have helped influence broader institutional shifts, including the eventual policy change permitting meters installed by the national utility companies.

Finally, the pilot helped expose the inefficiencies and financial burden associated with unrestricted electricity provision in camp settings. By trialling an alternative model, NRC and its partners highlighted a viable path forward for balancing service quality, cost control, and user autonomy. These outcomes reinforced the case for smarter, more regulated energy management systems within refugee contexts.

Lessons learnt

While the pilot achieved several positive outcomes, it also revealed key areas for improvement. First, the lack of a clear, shared vision among stakeholders on the future of electricity infrastructure in the camp created uncertainty and limited the project's strategic alignment. Miscommunications between NRC and Neurotech over project goals, costs, and deliverables likely stemmed from unclear objectives and NRC's limited experience in working with private-sector energy providers.

The smart controller developed for the pilot was significantly more expensive than comparable technologies already available on the Jordanian market and was incompatible with existing utility systems. This design decision ultimately prevented the solution from being scaled. Furthermore, it is unclear why the project chose to split electricity loads into two categories rather than using a lifeline tariff approach, which is already applied in many countries and was proposed for Azraq. The suggested 2 kWh daily allowance per household would have been sufficient for essential usage, eliminating the need for added complexity in the supply system.

Additionally, earlier consultation with smart metering experts could have improved project outcomes. Engaging specialists at the design stage might have

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introduced lower-cost, scalable options aligned with Jordan's existing grid infrastructure and regulatory standards. Instead, the first controller failed regulatory approval due to the wireless technology used: a problem that may have been avoidable with clearer technical preparation or guidance from the regulator.

Finally, maintenance challenges were reported with the controllers, reinforcing questions about the decision to develop a bespoke, unproven technology when market-tested alternatives already existed. Although the pilot contributed to a broader shift in energy policy for refugees in Jordan, it serves as a cautionary example of how innovation projects must be grounded in existing systems, regulatory frameworks, and user needs in order to achieve meaningful and sustainable impact.

Additional Comments

Without reviewing the initial project concept, proposals, and design, and without any input from Neurotech or UNHCR staff who were engaged in discussions with the government on metering, it is difficult to provide a detailed or accurate analysis of the project, further pointing to the need for a transparent learning system.

The majority of the failure factors seem to result from issues which could have been addressed with more effective project design. It was mentioned by both the contracted representatives from Innovation Norway and NRC that clearer objectives, detailed cost analysis, and more comprehensive stakeholder engagement would have produced better outcomes in terms of system costs, approved and effective technology, and regulatory alignment with national systems.

While the project demonstrated that equitable electricity was possible through the device that was developed and could reduce costs, lessons from this project shows that advocacy to address higher-level barriers to electricity access should be considered in future projects.

CS7: Pellet Cookstoves in Dzaleka Refugee Camp, Malawi

What happened

Dzaleka refugee camp is home to about 56,000 refugees and is situated 60 km north of Lilongwe, Malawi. The camp has existed since 1994 as a result of the Rwanda genocide crisis. It was initially designed to host 10,000 to 12,000 people. Because of the continued influx of people, mainly from the Democratic Republic of Congo, it has become very congested. The refugees and asylum seekers are not officially allowed to work, but they do, and over the years the camp has developed a large marketplace where people buy and sell goods and services. Access to energy is poor. There is very little electricity and demand for firewood has led to extensive deforestation around the camp. Consequently, most people cook with charcoal and firewood, which they buy in the local market and originates from other parts of the country.

A German NGO with a longstanding presence in the camp called Welthungerhilfe (WHH), in collaboration with their partners UNHCR and the Malawi Ministry of Homeland Security, identified the need to look for alternative, more environmentally friendly cooking technologies. The World Food Programme was already piloting a solar cooker and UNHCR tried the introduction of biogas digesters. These both had limited success as they represent high tech and expensive devices, unaffordable for people and with technical challenges that led to non-functionality in a short time. WHH, in collaboration with GIZ, struck a partnership with Zipolopolo, or Zipo for short, a Malawian company whose operations to date had been focused in Lilongwe. Zipo manufacture and sell both gasifier pellet stoves and accompanying pellet fuel made from groundnut shells, an agricultural waste product. This was a new technology in the camp. There was potentially an opportunity to promote the Zipo technology in Dzaleka via results-based financing (RBF) under GIZ's EnDev programme. However, before exploring this further, WHH intended to commission a pilot project with their own funding to test acceptance of the stove and learn

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PHOTOGRAPH ABOVE: *A general view shows Dzaleka refugee camp hosting over 53,000 refugees. © Tiksa Negeri, UNHCR*

lessons to avoid failures such as the biogas and solar stove projects.

The project ran from January to November 2023 with a budget of 30,000 EUR. The money was used to raise awareness about the Zipo solution and to subsidise both the stoves (80% subsidy initially) and the fuel (50% subsidy initially).

The Zipo stove initiative saw strong uptake in the camp, with evidence of widespread adoption and acceptance of the technology. This success was due in part to a set of well-coordinated strategies: cooking demonstrations effectively showcased the stoves' performance and benefits, persuading residents of their value; the subsidised price point aligned with users' willingness to pay, making the product financially accessible; and the use of local intermediaries, particularly through the Dzaleka Christian Church Union (DCCU), helped the Zipo team navigate the camp context with greater legitimacy and cultural awareness. Furthermore, the demand for fuel proved significantly higher than expected, indicating both a readiness to use the technology and a genuine need for more reliable cooking solutions.

Why it happened

The Zipo team started with an awareness raising campaign to inform people about the technology and generate demand. They chose to focus on showing people the benefits of Zipo rather than trying to convince them verbally. Several times per week, the team performed cooking demonstration where they prepared local dishes on the Zipo stove, inviting the local community via radio, posters, flyers, and vehicles with load speakers that drove through the camp. Zipo partnered with a local church administrative organisation, DCCU, who hosted the demonstrations and acted as a local fuel retailer.

For the first four weeks, uptake was slow. People were cautious and some returned to the demos multiple times before making a purchase. Then sales suddenly accelerated. Zipo reached the initial target of 1,000 stove sales within the first three months of their six-month programme. A survey run by WHH found a customer approval rate of over 90%, with most households having saved money since switching to Zipo.

At that point, the subsidy ended. The same survey estimated that two-thirds of households would be

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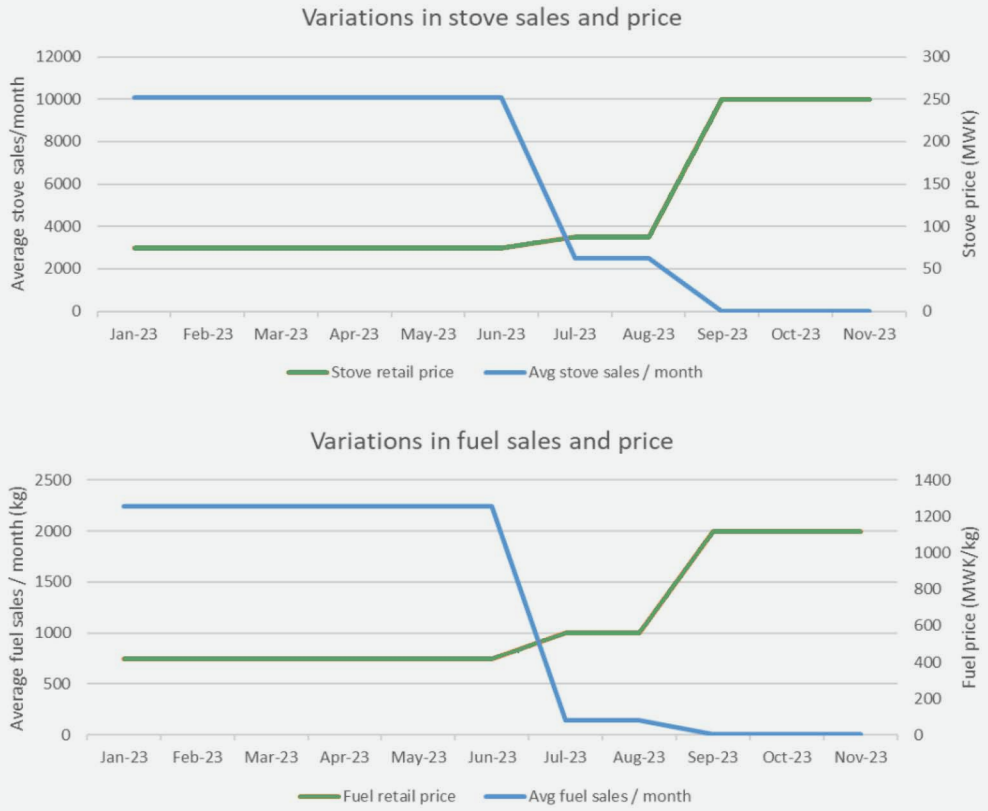
willing to pay for unsubsidised fuel, so it seemed worthwhile continuing with an unsubsidised retail model. After a brief phase out, the subsidy was removed completely, meaning that the retail price of the stove tripled while that of the fuel doubled.

Sales of both went straight to zero (**Figure 9**). Zipo decided that the EnDev results-based financing programme, which this project was intended as a precursor to, was financially unviable for them, so they withdrew from the camp.

FIGURE 9: *How sales of stoves and fuel varied with price. Source: sales data from Zipo.*



Lessons learnt

The Zipo project offers a clear illustration of how quickly a perceived success can shift into failure when pricing structures are not aligned with user expectations. The removal of the subsidy marked a turning point in the project's trajectory, highlighting just how critical the price point was to adoption and sustained use. Despite early uptake, the full market potential of the product was never realised once costs reverted to their unsubsidised levels.

Another contributing factor to the project's stagnation was the failure to reach an agreement between Zipo and EnDev for scaling the initiative beyond the pilot. This breakdown in negotiations prevented the initiative from transitioning to an RBF model that may have enabled continued subsidy or wider distribution. More transparency about the terms of engagement from the outset would have allowed Zipo to make a better-informed decision about participating. Conversely, it might have allowed WHH to reallocate efforts

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PHOTOGRAPH ABOVE: *A general view shows Dzaleka refugee camp hosting over 53,000 refugees. © Tiksa Negeri, UNHCR*

toward a different energy provider more aligned with the RBF structure.

From the beginning, there was a recognised risk that once the subsidy was withdrawn, previously distributed stoves would fall into disuse. WHH attempted to mitigate this by prioritising widespread adoption during the pilot phase, in the hope that a critical mass of users would sustain demand. Their analysis showed that unsubsidised Zipo fuel was still more affordable than charcoal, theoretically making the model viable without ongoing financial support.

However, two factors undermined this assumption. First, Zipo fuel was only available at a single distribution point in the camp – the DCCU's central location – while charcoal remained readily accessible from vendors on nearly every street. This disparity in convenience may have outweighed the marginal financial savings for users. As one stakeholder noted, *"an outsider's calculation on cost/benefit is not the same as the people in the camps"*. Second, the broader humanitarian context shaped expectations around entitlement: many residents were accustomed to receiving free products and may have resisted paying the full price as a matter of principle. It is plausible that some intentionally boycotted Zipo stoves after the subsidy was removed, seeing the shift as a withdrawal of support rather than a pathway to sustainability.

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PHOTOGRAPH ABOVE: *Technicians in Rwanda conducting assessments. © Practical Action*

6.1 The Humanitarian Energy Learnings Platform (HELP)

The ultimate objective of this project was to design an evidence-based template and learning procedure to document project-level success and failure factors, along with lessons learnt. This section of the report explains the process of designing this system, which we have called the Humanitarian Energy Learnings Platform, or HELP.

The system development process was iterative and combined findings from the interviews and literature review with active testing and refinement. It was clear from the outset that HELP would become exponentially more powerful as more stakeholders adopted it, so it was important to understand how it

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could be useful to different parties and integrate with their current systems. The key informant interviews presented in Section 3 therefore also included questions about how learning is documented at present, limitations with the status quo, and how a system for capturing and sharing learnings could be useful to them. The findings are summarised below and informed the first draft of the HELP forms, which are structured around the failure factors that emerged from the interviews and literature review. This draft was reviewed by HIP Norway, the GPA Coordination Unit, and several interviewees who had expressed interest in it. It was then further tested and refined through the case studies: case study interviewees were asked to fill out the HELP form in advance of their interview and provide feedback on it. The research team also directly tested the form by using it write up the case studies (see Appendix B).

6.1.1 Measuring success and failure

The number of systems distributed was the primary success indicator for most respondents. Traditional humanitarian actors use this number to proxy developmental impacts, whereas the private sector uses it to calculate revenues and profit. This metric benefits from being easy to measure; parallel alternatives include units repaired or energy consumed.

Traditional donors usually require reporting on more complex outcome measures and monitor a spectrum of outcome indicators. These included the number of jobs created, household members reached, greenhouse gases averted, and policies influenced. They often use structured frameworks to track impact and performance across their portfolio, enabling standardised reporting and facilitating regular monitoring. Some expressed discontentment with these systems, observing that they can be complex and fail to deliver value for money. Many donors also commission independent evaluations of projects after they have been completed. These can be expensive but are regarded as the best way of truly understanding what happened in a project.

Formal documentation of learnings is usually stipulated by donors and shared in reports written by project implementors. These reports are generally a requirement of receiving funding and often include a section dedicated to capturing learnings and aspects of the project that did not work. However, there is a bias in self-reporting failure, and there was a concern that most learnings go undocumented. Donor reports are not necessarily made publicly available, compounding this loss of learnings. Some donors address this through periodic consolidation and produce public-facing knowledge sharing and lessons learnt products, but they can be overly generalised and tend to focus on positives. Two humanitarian implementers reported having their own internal knowledge platforms for capturing honest learnings that are not shared outside of their organisations.

Many interviewees highlighted the important role that in-person events play in sharing knowledge. Conferences and workshops could facilitate organic learning between organisations and create a space for colleagues to connect with each other and share their experiences transparently.

6.1.2 Limitations with the current approach

There is a lack of transparency about failure in the HE sector. Lessons learnt products are biased towards positive reporting, and one UN agency interviewee observed that “we just invite reports and shout about how wonderful the project is”. The reliance on reports to capture project learnings and outcomes is problematically subjective, particularly when authored by people involved in the project development, who may be unwilling to admit culpability for failed initiatives.

There was widespread acknowledgement that transparently sharing project outcomes and lessons learnt would benefit the entire HE community. However, as already discussed, donor reports are often kept behind closed doors. Even when they are made available, their unstandardised formats makes it difficult to systematically examine what works and what does not, preventing different

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organisations from effectively learning from each other. Donors would benefit from dedicating more staff to learning. Pooling resources across donors could be a cost-effective way of accelerating knowledge sharing and standardising the way that it is captured.

6.1.3 HELP requirements

All respondents emphasised the importance of developing a system that is simple and low maintenance. Project actors already struggle with overly burdensome reporting requirements, so it is important to make their contributions as frictionless and time-efficient as possible. The template, or form, should have space to capture details about the context, any external events that affected proceedings, and contact details to enable reach-outs to people involved in the project.

The forms should be supplemented with in-person events and webinars. These would provide safe spaces to share and acquire knowledge. The GPA was regarded as best placed to coordinate this.

Anticipated challenges involve ensuring data quality, managing subjectivity, protecting data, and balancing truthfulness against the need to protect people and partnerships. One interviewee suggested that the form should be completed by an expert who had interviewed relevant people in the project rather than by project actors themselves. This would help to ease the workload for project participants while ensuring the forms are completed in a standardised and high-quality way. Talking to different people involved in a single may result in varying analyses of why it succeeded or failed, which leads to an unresolved quandary about how to verify the content.
Lastly, the widespread taboo around failure split interviewees into two camps: those who maintain that softer language is necessary due to political sensitivity and to reflect the complexity of context, and those who believe that normalising the use of the word "fail" is a critical component of a much-needed cultural change.

6.1.4 Applications of HELP

Most interviewees would be interested in using and contributing to HELP, although some more so than others. One believed it could be "worth its weight in gold" and another highlighted its potential to accelerate innovation through cross-pollination of ideas. The three interviewees (out of twenty) who were less interested already had their own internal knowledge management systems in place but acknowledged that it would be a useful resource if a critical mass of other parties adopted it. There was recognition that multi-donor alignment around a centralised lesson learnt process could drive impact, efficiency, and effectiveness.

Respondents identified an array of ways in which they could use data collected by HELP, especially regarding the improvement of project development. The most anticipated application was to extract learnings from other similar projects to inform the design and implementation of a new one. HELP could prevent project duplication by adding early visibility to activities being conducted by other donors and implementors, thus, as one interviewee put it, "stopping people from reinventing the wheel and making the same mistakes". Hard data collected from the system would help engage investors, humanitarian organisations, and funders in showing what works and what does not, replacing the fragmented anecdotal evidence that project developers rely on at present. Other uses included 1) training new staff; 2) designing project-specific indicators to help proactively mitigate failure; 3) identifying knowledge gaps to inform research funding; 4) helping donors understand what is happening on the ground; and 5) conducting evidence-based risk assessments prior to project commencement.

6.2 HELP proposal

6.2.1 Description of HELP

The heart of HELP consists of two project forms – one to be completed at the outset of each project and

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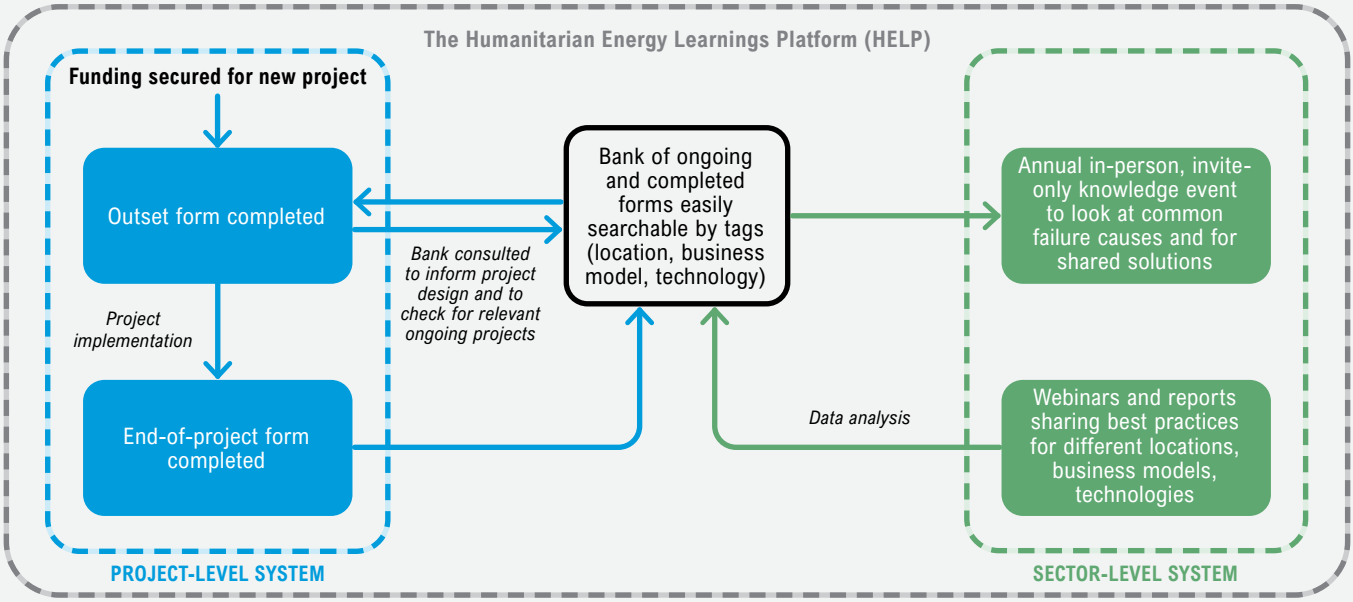
one at the end – that are stored in a closed-access repository of ongoing and completed projects. A diagram depicting this system is shown in **Figure 10** below. The first form, known as the "outset form", focuses on capturing project details, goals, and potential failure factors. The second is completed after the end of the project ("end-of-project form") and records what happened during the project. Ideally, projects should consult this knowledge bank of other forms before commencing. This would allow them to connect with other similar ongoing initiatives, to avoid duplication, and to proactively mitigate likely causes of failure. Periodic analysis of the repository data would be used to generate an enhanced understanding of why projects fail and a data-driven understanding of how to optimise HE interventions for different locations, business models, and technologies. This knowledge would be further disseminated via regular in-person events, reports, and webinars.

FIGURE 10: *Schematic for the Humanitarian Energy Learnings Platform*



Although our research revealed enthusiasm to engage in this system, it needs to be mandated by as many donors as possible to accelerate widespread adoption and coverage. HELP has positive network effects: its value increases with its usage. The quicker it is implemented across project portfolios, the faster developers, donors, and investors can start to benefit from its insights. However, HE projects tend to be both under-resourced and overly burdened with paperwork, so it is unrealistic to expect people to reliably engage in this system unless explicitly required to do so.

The literature review and interview elicited key challenges regarding standardised and honest project reporting, recording of lessons learnt, project coordination, and transparency of project outcomes. Table 4 outlines how HELP attempts to address challenges related to a lack of transparency about and learning from past project failures.

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TABLE 4: *Key challenges in HE learning and how HELP addresses them*

Challenge	How HELP addresses it
There is no systematic method for capturing learnings from HE projects.	The forms mandate those involved in a project to capture learnings in a structured way.
HELP must work for a range of project outcomes across the spectrum of success and failure.	The HELP forms focus on learning equally from pain points and successes to explicitly address the knowledge gap and bias. However, it also captures project achievements and aspects of implementation that were particularly successful. Comparing the goals stated in the outset form with those achieved in the end-of-project form allows the reader to assess the degree of success or failure.
At present, there is no streamlined way for a project developer to a) identify similar projects to their own and b) access learnings from them that can be incorporated into their project design.	Forms are tagged with keywords (technology, business model, location, target population), allowing project developers to identify other similar projects and to reach out to key personnel from them. Developers can extract learnings by reading the forms for these relevant projects and can even contact people involved in them for further advice.
There is a lack of transparency about what really happened in projects.	Donors can compare the "outset" and "end-of-project" forms to see how the delivered outcomes and outputs compared to the intended ones and understand the reasons behind any gaps.
Evidence about what works and what does not for HE projects tends to be anecdotal and undocumented.	HELP formalises this knowledge capture. Data from the forms should be extractable in CSV files, making it easy to conduct analysis on why certain types of projects tend to fail, leading to proactive changes to future project design and funding allocations.
Poor coordination between donors leads to project duplication and waste.	The "outset" form is completed and shared prior to project implementation, allowing actors to see pipeline projects in real-time, as well as their intended outcomes and outputs.
It is important to make the system as frictionless and easy-to-use as possible.	We have tried to make the forms as short and as quantitative as possible. Ideally, the "end-of-project" form would be completed through a one-hour interview with an expert who would subsequently fill in the form on the interviewee's behalf, thus ensuring data quality while minimising effort from project personnel.
Data on failure is sensitive and, if misused, could create a scandal about the HE sector, which would be trailblazing in adopting this kind of system.	The form bank needs to be only accessible to authorised users and kept out of the public domain to encourage transparency in the HE sector without the risk of bad publicity/blaming or sensitive information sharing.
The stigma around failure may prevent people from authentically engaging.	HELP should be mandated by donors so that participation is compulsory. It should be implemented alongside in-person events and advocacy activities to help spur a cultural shift to make failure less taboo.

6.2.2 HELP forms

For effective operationalisation, the outset and end-of-project forms must transition from static spreadsheets to dedicated digital tools. Platforms like Google Forms, KoBoToolbox, or ODK are strongly recommended for structured data capture, ensuring consistency and enabling mandatory fields. Collected data should be securely stored in a centralised, closed-access repository (e.g., cloud storage or a dedicated humanitarian platform) to build the essential knowledge bank. Crucially, these tools allow seamless export to CSV for robust analysis in visualisation software (Power BI, Looker Studio, Tableau), generating dynamic dashboards on failure trends and success factors (see example in **Figure 11**). To enhance usability, PDF rendering tools for creating snapshot reports from individual forms should be integrated. Platform selection should prioritise humanitarian needs: affordability (nonprofit pricing), offline capability, ease of use, and strong API/integration potential with existing sector systems.

This digital foundation transforms the forms into a dynamic learning system, enabling proactive risk

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mitigation through access to past project insights. It also will drive data-driven optimisation of future HE interventions.

The following section shows the outset and end-of-project forms and highlights their key features.

Outset form

Template ref: *this matches the outset and end-of-project forms to each other. In the future, an extra field could be added stating which other forms had been consulted in the process of completing it, thus tracking the flow of knowledge throughout the repository.*

a) **Project details:** these are the tags enabling searches of forms in the knowledge bank.
b) **Project goals:** this field clearly states the project's intended outcomes.
c) **Outline of any particularly innovative project aspects:** this field helps differentiate between higher-risk, more innovative projects and those that are business-as-usual.
d) **Potential failure factors:** these are the evidence-based failure factors from the literature review and interviews, as outlined in **Table 1**. Here, they act as a lightweight risk assessment, allowing the individual completing the form to anticipate and therefore mitigate against reasons that the project might fail. The forms also leave room to record other failure factors not present in the current categorisation, which over time, may help in refining the failure factor list further. Donors could use insights from the knowledge bank (e.g., that biogas projects most often fail due to fuel supply chain issues and absence of maintenance) to assess the project at this stage and challenge the project developer to improve their plan or design.

FIGURE 11: *Example of a dashboard visualisation generated from HELP*

Outset form

Please fill out boxes in green and overwrite text in red, if required.

a)

Template Ref:	
Date of template completion:	

b)

PROJECT DETAILS	
Donor(s):	
Lead organisation(s):	
Other parties involved:	
Project timeframe:	
Location:	
Budget:	
Energy technologies:	
End-user type:	
Further end-user targeting:	
Cost borne by end-users:	

Brief project description

c)

Project goals

d)

Please outline an particularly innovative project aspects

e)

POTENTIAL FAILURE FACTORS				
		Failure factors	Relevant	Explain the factor in more detail
TECHNOLOGICAL	T1	Technology has quality and durability issues		
	T2	Technology inappropriate for local context		
	T3	Technology inappropriate for intended purpose		
	T4	Operation, maintenance, and repair issues *during* project		
	T5	Operation, maintenance, and repair issues *after* project		
	T6	Problems with electricity access/fuel supply chain		
	T7	Insufficient user education		
ECONOMIC	E1	Incorrect financial or business model assumptions		
	E2	Customers *unable* to pay for product/service		
	E3	Customers *unwilling* to pay for product/service		
	E4	Unable to access follow-on funding to continue project		
SOCIAL	S1	Failure to include all community groups during project design		
	S2	Tensions between different community groups		
	S3	Community misunderstanding of project activities		
	S4	Poor community involvement throughout project		
IMPLEMENTATION	I1	Project duration insufficient for sustained impact		
	I2	Lack of relevant expertise and experience		
	I3	Poor coordination and partner engagement		
	I4	Lack of integration with wider ecosystem/other programmes		
	I5	Unforeseeable events		
GOVERNANCE	G1	Policy and regulatory barriers		
	G2	Problems physically accessing the target location/community		
	G3	Administrative, supply, and procurement issues		
	G4	Legal and customs issues		
	G5	Crime, corruption, and security challenges		
OTHER		Factor 1		
		Factor 2		
		Factor 3		

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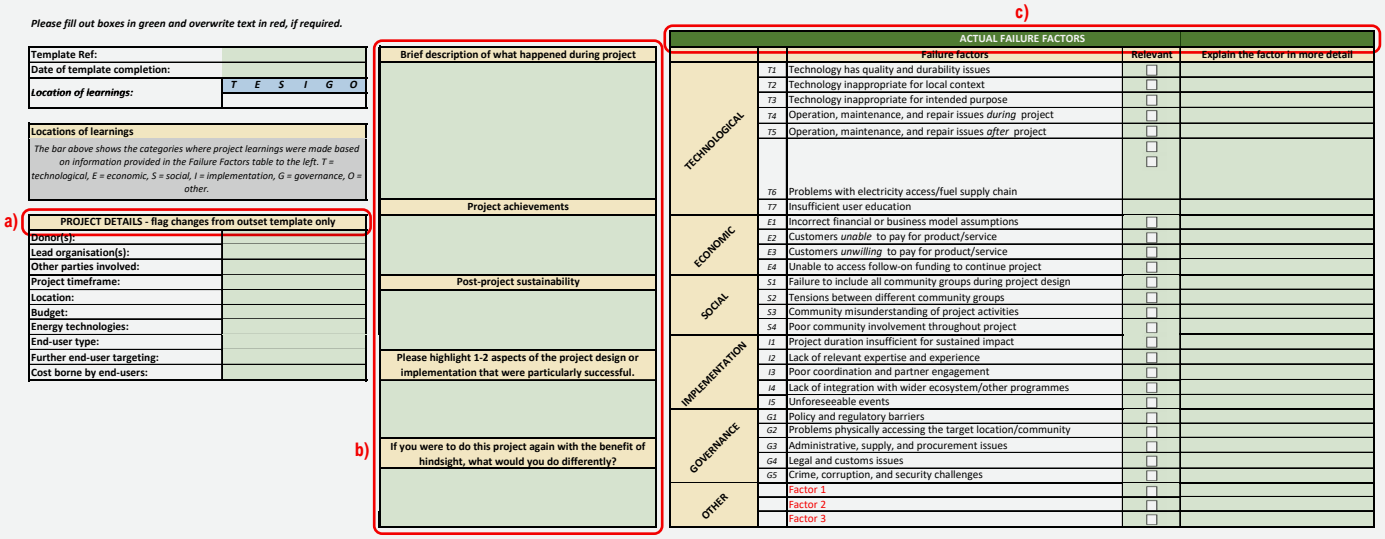
End-of-project form



Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	
Date of template completion:	
Location of learnings:	T E S I G O

Locations of learnings
The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T = technological, E = economic, S = social, I = implementation, G = governance, O = other.

a)

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	
Lead organisation(s):	
Other parties involved:	
Project timeframe:	
Location:	
Budget:	
Energy technologies:	
End-user type:	
Further end-user targeting:	
Cost borne by end-users:	

Brief description of what happened during project
Project achievements
Post-project sustainability
Please highlight 1-2 aspects of the project design or implementation that were particularly successful.
b) **If you were to do this project again with the benefit of hindsight, what would you do differently?**

c)

ACTUAL FAILURE FACTORS				
		Failure factors	Relevant	Explain the factor in more detail
TECHNOLOGICAL	T1	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☐	
	T5	Operation, maintenance, and repair issues *after* project	☐	
	T6	Problems with electricity access/fuel supply chain	☐ ☐	
	T7	Insufficient user education		
ECONOMIC	E1	Incorrect financial or business model assumptions	☐	
	E2	Customers *unable* to pay for product/service	☐	
	E3	Customers *unwilling* to pay for product/service	☐	
	E4	Unable to access follow-on funding to continue project	☐	
SOCIAL	S1	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☐	
	S3	Community misunderstanding of project activities	☐	
	S4	Poor community involvement throughout project	☐	
IMPLEMENTATION	I1	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☐	
	I4	Lack of integration with wider ecosystem/other programmes	☐	
	I5	Unforeseeable events	☐	
GOVERNANCE	G1	Policy and regulatory barriers	☐	
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☐	
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Although not displayed here, another tab of the spreadsheet collects contact information for the project: name, organisation, role in project, email address, and LinkedIn profile. The outset form should be completed once a project has been confirmed but before work on it starts (likely upon award of funding).

End-of-project form

Please note that seven completed end-of-project forms corresponding to each of the case studies in Section 5 can be found in Appendix B.

a) **Project details:** to avoid duplication these only need completing if they have changed from the outset form.
b) These fields capture narrative information about what happened during the project, particularly with respect to achievements and successes, and what the respondent would do differently in hindsight. A comparison against the project's goals section of the outset form lends visibility to what was achieved versus what was promised.
c) **Actual failure factors:** this matrix has the same structure as in the outset form, but here the failure factors quantitatively capture what went wrong during the project and provide space to elaborate on what happened.

6.2.3 Outstanding challenges and limitations

HELP has been carefully designed to address several critical bottlenecks in the nexus of humanitarian action and sustainable energy access. However, it is important to also recognise its limitations. The system cannot and should not replace independent evaluations, whereby a third party conducts an unbiased assessment of a project. It does not attempt to provide a true judgement about what happened in a project and is constrained and biased by being based on the opinion of a single individual.

A primary outstanding challenge is how to address this subjectivity. One obvious solution would be to invite multiple project stakeholders to complete end-of-project forms so that different perspectives could be incorporated into the final version. However, this would be logistically challenging, and it would be resource-intensive to deal with the resulting data. Through the case studies, we tested how the content of the forms varied between different people involved in a single project, and the answer was very little. This has informed our recommendation that just one party – ideally someone involved in implementation on the ground – should be responsible for completing the form. A future system could allow multiple actors

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to submit forms for the same project or a light peer review that could capture objections to its content.

Failure is a sensitive topic and, in some cases (particularly where culpability lies with individuals or organisations) people may not be comfortable sharing their true perspectives on why a project really failed. One obvious way of protecting contributors would be anonymisation. However, this would not necessarily be very effective, as other project actors may be able to discern who contributed based on the content. It was also deemed important to feature contact details that facilitate direct connections between people working on similar initiatives. One way that we have attempted to manage this is by collecting data about failure through quantitative checking of boxes, which allows the user to state a failure factor without needing to dive into potentially harmful details (such as allegations of corruption).

Implementation of HELP will require dedicated resources. These would be used to manage the knowledge bank, to conduct data collection interviews (if this is the selected approach over self-completion), to liaise with different actors who have adopted the system, to organise events, to conduct analysis, and to present it in a useful way. We anticipate that these would be relatively meagre and that costs could be shared between donors.

7.

Conclusions and Recommendations

PHOTOGRAPH ABOVE: *Solar streetlights in Rohingya refugee camps – Cox's Bazar, Bangladesh. © Rihab Khalid, MECS*

This project explored barriers encountered in energy access initiatives in humanitarian settings, examined current shortcomings in knowledge sharing, and proposed an inter-donor system to document, analyse, and share project outcomes and learnings. HE failure is widespread and can be attributed to factors that fall into five categories: Technological, Economic, Social, Implementation, and Governance. Many of the reasons that projects fail are structural, meaning they relate to constraints around the way that the humanitarian sector is funded, such as the nature of funding cycles, reductions in funding, and cultural reluctance to embrace market-based solutions. However, some can also be attributed to the absence of systems that enable transparent documentation and sharing of lessons in a systematic, searchable way.

7. Conclusions and Recommendations

Two clear strategies for addressing failure emerged from the research: (i) a set of interventions to aid the shift to market-based interventions (Table 2), and (ii) adoption of the Humanitarian Energy Learnings Platform (HELP) to require reflection and openness about project failure. The transition to market-based solutions can be aided by building evidence and capacity, making structural changes to funding and procurement, facilitating cultural changes around attitudes towards profit and failure, and enhancing collaboration between actors. HELP requires commitments from donors to enforce its use, dedicated resources to operate, and a concerted effort to build up the knowledge bank through a rapid review of completed projects.

With growing austerity and shifting landscapes of humanitarian (and development) funding, now is the time to promote more candid approaches towards sharing both failures and successes.

The process of failing and learning is innately human, and in the business world, failure is embraced as a way of iterating, improving, and scaling. However, this change requires space and tolerance for failure, which unfortunately does not currently exist in public-facing spheres. This report was written during a politically turbulent period where governments all over North America and Europe were redirecting their support for international development to the defence industry. The humanitarian sector finds itself in a paradoxical situation where funding is plummeting in parallel to growing needs for humanitarian interventions. The only way to reconcile these pressures is to innovate and to accelerate efficiency of delivery, while creating collaborative, honest and safe spaces for humanitarian actors to convene. This will require a cultural shift and investment in new systems to make our inevitable failures productive for all.

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Appendices

Appendix A

We conducted a literature review to understand how success and failure factors are articulated for energy projects in both academic and grey literature. We leveraged a publicly available Zotero library[4] where more than 350 publications on humanitarian energy have been compiled and organised by humanitarian energy researchers [13] has been used to locate relevant articles and reports. The Zotero library is widely recognised as one of the most comprehensive knowledge databases on humanitarian energy to date, as demonstrated by its reference in the GPA's *The State of the Humanitarian Energy Sector: Challenges, Progress and Issues* in 2022 as an example of progress under the topic of technical expertise, capacity building, and training [9]. This allowed us to focus on relevant categories of literature, namely:

1. 'Energy service categories', which were further divided into the key domains of energy use, consumption, and production in humanitarian energy settings: (i) household cooking, (ii) household electricity, (iii) energy for enterprises and livelihoods, (iv) energy for community facilities, and (v) energy for operations and institutions. The total number of studies under this cluster is 65.
2. 'Country case studies and information' under 'Themes', which was further disaggregated to specific countries such as Bangladesh, Kenya, Rwanda, and Uganda. For this cluster, we scoured through a total of 250 articles (including duplicates and repeated subcategorisation under multiple countries). Humanitarian settings in sub-Saharan Africa (i.e., Kenya, Rwanda, and Uganda) offered a greater number of publications than other settings. It is important to note that this cluster also has a large number of not-so-relevant documents, including country or organisation strategies.

For abstract screening, we only included papers that: (i) have been published after 2010, (ii) specifically focus on 'humanitarian' energy (i.e., not rural, slums, etc.), (iii) either focus on specific case studies or the overall humanitarian landscape as a whole, (iv) point to impact/success factors/enablers/recommendations and/or failure factors/barriers/challenges in one way or another. Any other forms of publications were excluded. These included for example, strategy or guidance documents of plans for national governments or organisations, which were more common under the 'Country case studies and information' tab; 'prospective' humanitarian projects, that is publications that assess the potential for a specific kind of humanitarian energy project or approach; webpages or documents highlighting roles or describing the work of organisations in the humanitarian energy sectors; or publications like news articles or presentations as they do not offer extensive reporting on the projects.

During the abstract screening, we further labelled articles with priority scores: 1 to denote high priority as they match all of our inclusion criteria and could also point to important case studies; 2 for medium priority, as they match most of our inclusion criteria; and 3 for low priority, to be excluded from our review due to noncompliance with our inclusion criteria. We focused on priority 1 and 2 articles.

The final list of papers from the Zotero library was N=36. We also added other publications recommended by GPA and HIP Norway colleagues, including the Roadmap for Energy Access in Displacement Settings (READS) report series by UNITAR. We finally had N=42 studies for our literature review. We then developed a data charting Excel sheet to capture information from the publications. These included extracting details on humanitarian energy technologies or approaches, case study countries, project description, including objectives, and finally, impact/success factors/enablers/recommendations, and/or failure factors/barriers/challenges. We then conducted some high-level analysis of the information gathered, primarily related to the failure typologies.

[4] https://www.zotero.org/groups/4386168/humanitarian_energy_research_library/library.

Appendices

Appendix B

CS1: Solar Streetlights in Rohingya Refugee Camps, Cox's Bazar, Bangladesh

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	SSL_CXB_1					
Date of template completion:	2025/05/13					
Locations of Learnings:	***T***	***E***	***S***	***I***	***G***	***O***
	2	**3**	**1**	**1**	**2**	**0**

Locations of learnings

The bar above shows the categories where project learnings were made

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	Various (ADB)
Lead organisation(s):	Various (UNHCR, IOM)
Other parties involved:	WB/LGED, Save the Children, GUK, CAFOD
Project timeframe:	Various, since 2017
Location:	Cox's Bazar, Bangladesh
Budget:	Unknown; multiple projects
Energy technologies:	Solar Street Lighting (SSL) tech
End-user type:	Community facilities
Further end-user targeting:	N/A
Cost borne by end-users:	None

Brief description of what happened during project

The project aimed to enhance safety and accessibility by installing solar streetlights (SSLs) in key communal areas like toilets and hospitals, with a focus on reducing gender-based violence. Since the camp's expansion in 2017, multiple agencies have installed SSLs independently, leading to inconsistent technologies and maintenance challenges. As of April 2024, only 46% of the 21,997 installed streetlights were functional.

Project achievements

A combination of different projects have successfully illuminated key communal areas and high-risk zones, improving perceptions of safety and reducing incidences of gender-based violence. The development of a standardized specification and guideline for SSL installation and maintenance will help align future installations across implementing agencies.

Post-project sustainability

Revenue streams through P-RECs or carbon credits are being explored. The sustainability of the project will always be doubtful, given ongoing O&M costs and limited revenue generating opportunities. The diverse and uncoordinated technologies used increases the size of the inventory needed and requires more technicians or specialist training. Agencies are now asked to present their SSL O&M plans, and there is a growing focus on involving, and training, local communities.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

The framework for selecting lighting locations—based on population density, risk levels for gender-based violence, and community feedback—was a strong aspect of the design. The project adapted over time to include GIS analysis and formalized placement criteria.

If you were to do this project again with the benefit of hindsight, what would you do differently?

Future efforts should standardize SSL and battery technology. Centralized coordination among agencies could decrease the heterogeneity of SSL solutions in CXB. Introducing community-based models earlier could foster local ownership and reduce theft. Additionally, ensure all procurement includes warranties and clear O&M plans at the outset.

Appendix B

CS1: Solar Streetlights in Rohingya Refugee Camps, Cox's Bazar, Bangladesh

ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	T1	Technology has quality and durability issues	☑	Lifespans for SSLs could be 10 years, but this depends on the location (salinity). Implementations by >60 agencies has resulted in a wide variety of SSL components used
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☑	Lack of O&M in programming, caused in part by short-term funding commitments for humanitarian interventions
	T5	Operation, maintenance, and repair issues *after* project	☑	
	T6	Problems with electricity access/fuel supply chain	☐	
	T7	Insufficient user education	☐	
ECONOMIC	E1	Incorrect financial or business model assumptions	☑	Donors can make selection of SSL technology based on up front unit costs, rather than full life cycle analysis (which would include O&M), and potentially training refugees with basic operational skills
	E2	Customers *unable* to pay for product/service	☑	No revenue model for refugees paying for SSLs in CXB
	E3	Customers *unwilling* to pay for product/service	☐	
	E4	Unable to access follow-on funding to continue project	☑	Donor interventions can end at instllation
SOCIAL	S1	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☐	
	S3	Community misunderstanding of project activities	☐	
	S4	Poor community involvement throughout project	☑	Recently, more is being done to create community models to
IMPLEMENTATION	I1	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☑	Comprised of multiple projects; implemented separately by over 60 agencies with fragmented approaches
	I4	Lack of integration with wider ecosystem/other programmes	☐	
	I5	Unforeseeable events	☐	
GOVERNANCE	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☑	SSL implementation should include integrated spare part inventories to support maintenance.
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☑	Theft of batteries and lights is the biggest issue.
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Appendix B

CS2: Replacing Diesel with Solar Mini-grids in Kalobeyei Settlement, Kenya

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	Renewvia_1					
Date of template completion:	2025/05/14					
Locations of Learnings:	***T***	***E***	***S***	***I***	***G***	***O***
	0	**0**	**1**	**0**	**1**	**0**

Locations of learnings

The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T = technological, E = economic, S = social, I = implementation, G = governance, O = other.

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	IFC
Lead organisation(s):	Renewvia
Other parties involved:	AECF, CEI (crowdfunder), UNHCR, GIZ
Project timeframe:	Ongoing
Location:	Kalobeyei, Kenya
Budget:	$750k (to build the distribution network)
Energy technologies:	Solar-powered mini-grid
End-user type:	All
Further end-user targeting:	N/A
Cost borne by end-users:	Partial cost

Brief description of what happened during project

Renewvia aimed to expand in Kalobeyei, targeting 19,000 customers by 2026. With an initial 451kW system, they integrated an earlier 61kW system and planned further expansion to a 2.4MW system with 5MW of battery storage. The project was initially supported by significant grant funding, but as it matured, Renewvia pursued commercial financing and engaged the IFC. However, procurement constraints prevented them from supplying UNHCR, limiting their ability to scale more rapidly.

Project achievements

The project successfully connected over 3,000 customers, significantly reducing energy costs for local businesses, and demonstrating the feasibility of attracting commercial financing into energy projects within a refugee-hosting area. It secured major funding from crowdfunder, CEI ($4.47m loan), plus $4.2m in results-based financing.

Post-project sustainability

Renewvia is progressing toward long-term sustainability, supported by a secured loan and staged IFC funding linked to procurement milestones. However, exclusion from key procurement processes, notably UNHCR's, has limited access to anchor clients, constraining growth potential.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

1) The initial system required frequent use of costly diesel generators for backup power, causing the facility to operate at a loss for several years. Despite this, Renewvia prioritized uninterrupted service over load shedding, maintaining customer trust and supporting their long-term goal of reaching 300,000 people.
2) The project's modular, scalable design and metered service model enabled flexible expansion, supported financial viability, and positioned it for sustainable, demand-driven growth.

If you were to do this project again with the benefit of hindsight, what would you do differently?

Future projects should prioritize stronger coordination between development partners and humanitarian agencies to avoid missed opportunities—such as UNHCR bypassing capable local suppliers like Renewvia. Early engagement with procurement teams and greater transparency in tender processes would enable local firms to compete fairly. Embedding local participation requirements in donor-backed tenders would also boost private sector development and sustainability.

Appendix B

CS2: Replacing Diesel with Solar Mini-grids in Kalobeyei Settlement, Kenya

ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	T1	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☐	
	T5	Operation, maintenance, and repair issues *after* project	☐	
	T6	Problems with electricity access/fuel supply chain	☐	
	T7	Insufficient user education	☐	
ECONOMIC	E1	Incorrect financial or business model assumptions	☐	
	E2	Customers *unable* to pay for product/service	☐	
	E3	Customers *unwilling* to pay for product/service	☐	
	E4	Unable to access follow-on funding to continue project	☐	
SOCIAL	S1	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☑	Host communities can be resistant, and there can be misperceptions of taking land from the people living in Turkana, which suffers from underemployment. The visibility of jobs going to refugees can be damaging; need to be seen to include the locals.
	S3	Community misunderstanding of project activities	☐	
IMPLEMENTATION	I1	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☐	
	I4	Lack of integration with wider ecosystem/other programmes	☐	
	I5	Unforeseeable events	☐	
GOVERNANCE	G1	Policy and regulatory barriers	☐	
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☑	The Terms & Conditions of an RFP for public tender for services to power camp operations were not shared with donors beforehand: It did not consider local companies, so Renewvia was overlooked and a smaller standalone facility was built instead.
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Appendix B

CS3: Briquette Production in Kakuma Refugee Camp, Kenya

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	Sanivation					
Date of template completion:	2025/06/10					
Locations of Learnings:	***T***	***E***	***S***	***I***	***G***	***O***
	1	**3**	**0**	**1**	**0**	**0**

Locations of learnings

The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T = technological, E = economic, S = social, I = implementation, G = governance, O = other.

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	Bill and Melinda Foundation
Lead organisation(s):	Sanivation
Other parties involved:	UNHCR
Project timeframe:	July 2019 - June 2020
Location:	Kakuma Refugee Camp, Kenya
Budget:	
Energy technologies:	Briquettes
End-user type:	Households
Further end-user targeting:	N/A
Cost borne by end-users:	

Brief description of what happened during project

Using waste from container-based household toilets and charcoal dust to manufacture briquettes for cooking.

Project achievements

Produced 50tonnes per year of briquettes, sold about 2 tonnes per month on average, showing that there was some market for cooking fuel, although limited

Post-project sustainability

None. Once the project closed due to non-viability, there was no further manufacture of briquettes from human waste.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

Household sanitation units were well adopted.
Despite some free firewood distribution, there were some sales of briquettes

If you were to do this project again with the benefit of hindsight, what would you do differently?

Complete a more comprehensive financial analysis of the production, distribution and sales costs, including an analysis of the wider briquette manufacturing industry in East Africa.
Greater discussion with stakeholders around free firewood distribution and encouraging market-based approaches.

Appendix B

CS3: Briquette Production in Kakuma Refugee Camp, Kenya

ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	*T1*	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☐	
	T5	Operation, maintenance, and repair issues *after* project	☐	
	T6	Problems with electricity access/fuel supply chain	☐	
	T7	Insufficient user education	☐	
ECONOMIC	*E1*	Incorrect financial or business model assumptions	☐	
	E2	Customers *unable* to pay for product/service	☐	
	E3	Customers *unwilling* to pay for product/service	☐	
	E4	Unable to access follow-on funding to continue project	☐	
SOCIAL	*S1*	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☑	Host communities can be resistant, and there can be misperceptions of taking land from the people living in Turkana, which suffers from underemployment. The visibility of jobs going to refugees can be damaging; need to be seen to include the locals.
	S3	Community misunderstanding of project activities	☐	
IMPLEMENTATION	*I1*	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☐	
	I4	Lack of integration with wider ecosystem/other programmes	☐	
	I5	Unforeseeable events	☐	
GOVERNANCE	*G1*	Policy and regulatory barriers	☐	
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☑	The Terms & Conditions of an RFP for public tender for services to power camp operations were not shared with donors beforehand: It did not consider local companies, so Renewvia was overlooked and a smaller standalone facility was built instead.
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Appendix B

CS4: e-waste circularity in Bidibidi Refugee Settlement, Uganda

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	BatLab
Date of template completion:	2025/06/06

Locations of Learnings:	*T*	*E*	*S*	*I*	*G*	*O*
	2	3	0	1	2	1

Locations of learnings

The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T = technological, E = economic, S = social, I = implementation, G = governance, O = other.

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	Innovation Norway
Lead organisation(s):	IOM
Other parties involved:	Private Sector: BRIGHT Products, AceleAfrica, Open Energy Labs, Strathmore University, WEEE Center. Implementing Partner: Mercy Corps
Project timeframe:	5 years
Location:	Bidibidi Refugee Settlement, Uganda
Budget:	Not disclosed
Energy technologies:	Battery laboratory (end-of-life L-ion cells testing, repurposing, and assembly), Solar Lanterns and electronics repair
End-user type:	Households (both host and refugee), Youth, Informal repair technicians and artisans, Small businesses and enterprises
Further end-user targeting:	E-waste informal collectors, spare parts suppliers
Cost borne by end-users:	Partial cost

Brief description of what happened during project

IOM Uganda piloted the first comprehensive e-waste management circular economy model in a displacement setting, in partnership with the private sector. A community-led business cooperative was successfully establishe alongside a network of five repair kiosks. An on-site Battery Laboratory (Batlab) was also operationalized to test and repurpose end-of-life lithium-ion cells into second-life battery packs. The 15,733 depleted lithium-ion cells were sourced both from the settlement and also from private sector companies outside the settlement.

Project achievements

•30 direct jobs created (both refugees and host community), enhancing social cohesion.
•5 repair and collection hubs operational across Bidibidi (3 physical hubs + 2 mobile tricycles)
•110,920 people reached with awareness campaign
•Over 5,900 e-waste items collected
• So far, 150 second-life battery packs have been built through repurposing these end-of-life lithium batteries
•User data collected and shared with the private sector to improve solar products design.
•Sustainable procurement guidelines developed
• Developed a Toolkit for E-waste Management in Displacement Settings

Post-project sustainability

A community-led enterprise model, formally registered as a cooperative, ensures continued local operation and decision-making beyond the project lifecycle.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

A key success was the co-design approach, which involved all project partners, refugee and host community members, and local authorities, and ensured solutions were tailored to local needs. Community participation through the IOM Community Response App provided real-time feedback, guiding private sector R&D and enabling continuous refinement of solutions based on end-user experience.

If you were to do this project again with the benefit of hindsight, what would you do differently?

If we were to do the project again, we would leverage the cooperative's governance to source more flexible financial mechanisms: access to flexible financing mechanisms for the cooperative remains a challenge, and early efforts to bridge this gap can help cooperatives to grow with greater confidence and stability.

Appendix B

CS4: e-waste circularity in Bidibidi Refugee Settlement, Uganda

ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	*T1*	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☐	
	T5	Operation, maintenance, and repair issues *after* project	☑	Anticipated complications post-project due to sophiscated Batlab technology and maintenance costs. Availability and difficulties accessing spare parts without technical support or funding.
	T6	Problems with electricity access/fuel supply chain	☐	
	T7	Insufficient user education	☑	
ECONOMIC	*E1*	Incorrect financial or business model assumptions	☐	
	E2	Customers *unable* to pay for product/service	☑	Many community members, especially refugees, had limited disposable incomes. There was willingness to pay from the community, but reliance on donor aid and free repairs affected the rapid adoption of a services-at-a-cost model, which need more awareness raising.
	E3	Customers *unwilling* to pay for product/service	☑	
	E4	Unable to access follow-on funding to continue project	☑	After the initial pilot, there was a gap in securing long-term support. The current business model aims to avoid operational gaps by integrating different revenue models.
SOCIAL	*S1*	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☐	
	S3	Community misunderstanding of project activities	☐	
	S4	Poor community involvement throughout project	☐	
IMPLEMENTATION	*I1*	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☐	
	I4	Lack of integration with wider ecosystem/other programmes	☑	Linkages with national recycling efforts, formal e-waste handlers, and private sector buyers need to be strengthened to ensure value chains and market access for recovered materials.
	I5	Unforeseeable events	☐	
GOVERNANCE	*G1*	Policy and regulatory barriers	☑	Lack of government subsidies hinder private sector investment in refugee settlements in West Nile.
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☑	Non-standarized spare parts and availability of spare parts (supply chain). Certification of 2nd life batteries by Uganda National Bureau of Standards took longer than anticipated, as the process requires several in-person audits and quality testing.
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Capacity building	☑	Training in business management and financial literacy is key for business models in displacement settings to succeed. In addition, when expanding to other electronics, technical training is also needed to be able to expand quality repair services.
		Factor 2	☐	
		Factor 3	☐	

Appendix B

CS5: Building Sustainable Markets for Energy Products in Bidibidi Refugee Settlement, Uganda

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	AMPERE					
Date of template completion:	2025/06/10					
Locations of Learnings:	***T***	***E***	***S***	***I***	***G***	***O***
	0	**1**	**0**	**3**	**1**	**0**

Locations of learnings

The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T =

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	RVO
Lead organisation(s):	Mercy Corps
Other parties involved:	D-Light, Village Power, HOT, Response Innovation Lab
Project timeframe:	July2019 - June 2020
Location:	Bidibidi Refugee Settlement, Uganda
Budget:	
Energy technologies:	OGS market
End-user type:	Households & Enterprises
Further end-user targeting:	N/A
Cost borne by end-users:	Partial cost

Brief description of what happened during project

This project set out to investgate barriers and provide supports to energy companies towards developing markets for quality energy products in refugee settlements. Products were subsidised during the project and exceeded targets, however sales discontinued once supports were no longer provided.

Project achievements

Sold 4,000 products demonstrating there is a market for OGS products in these communities and an opportunity for energy companies, once adequate supports are in place.

Post-project sustainability

Minimal. Once the subsidies and other supports ceased, the companies no longer made sales in the settlement.
Stakeholders learned that energy companies need to establish operations in the region, also serving local towns, not only refugee settlements. Supports for this to create longer sustainability have been put in place through later projects.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

Effective Community engagement throughout design and implementation of project
High level of sales demonstrating market-based approaches can work in refugee settlements with appropriate supports

If you were to do this project again with the benefit of hindsight, what would you do differently?

Work with donors and energy companies to develop longer-term, phased projects which support sustained operations in the region, including the wider community, not only focused on the refugee settlements

Appendix B

CS5: Building Sustainable Markets for Energy Products in Bidibidi Refugee Settlement, Uganda

ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	T1	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☐	
	T5	Operation, maintenance, and repair issues *after* project	☐	
	T6	Problems with electricity access/fuel supply chain	☐	
	T7	Insufficient user education	☐	
ECONOMIC	E1	Incorrect financial or business model assumptions	☐	
	E2	Customers *unable* to pay for product/service	☐	
	E3	Customers *unwilling* to pay for product/service	☐	
	E4	Unable to access follow-on funding to continue project	☑	Project funding and timeline was only for 12 months, not long enough to build sustained market for OGS companies
SOCIAL	S1	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☐	
	S3	Community misunderstanding of project activities	☐	
	S4	Poor community involvement throughout project	☐	
IMPLEMENTATION	I1	Project duration insufficient for sustained impact	☑	Duration and funding inadequate to build markets and operations for energy businesses
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☐	
	I4	Lack of integration with wider ecosystem/other programmes	☑	Project focused only on Bidibidi refugee settlement and did not include building wider markets in host communities or company operations in nearby towns
	I5	Unforeseeable events	☑	COVID also strongly affected markets, affordability and donor willingness to fund project extensions
GOVERNANCE	G1	Policy and regulatory barriers	☑	Access permissions are required for companies to enter/operate in refugee settlements, adding administative challenges and costs for energy companies
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☐	
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Appendix B

CS6: Electricity Metering in Azraq Refugee Households, Jordan

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	Metering Jordan_IN					
Date of template completion:	2025/06/10					
Locations of Learnings:	***T***	***E***	***S***	***I***	***G***	***O***
	1	**3**	**0**	**3**	**1**	**0**

Locations of learnings

The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T =

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	Innovation Norway
Lead organisation(s):	NRC
Other parties involved:	Neurotech
Project timeframe:	October 2020 – June 2023 (inc. no cost extension)
Location:	Azraq Refugee Camp, Jordan
Budget:	NOK 6,000,000
Energy technologies:	Electricity Metering
End-user type:	Households
Further end-user targeting:	N/A
Cost borne by end-users:	

Brief description of what happened during project

The project aimed to develop a smart controller that would help households to monitor their electricity consumption. The collaboration with Wattero ended due to regulatory difficulties. The project continued with NRC and Neurotech, and a smart controller was developed and successfully tested. However, there was uncertanty regarding the end cost of the controllers and partner communication was challenging. In the end, UNHCR decided to collaborate with another electricity company that would provide standard, cheaper electricity controllers to all the HHs. The project ended without plans for further scaling and the controllers were dismantled from the shelters.

Project achievements

The smart controller that was developed fulfilled the project's objectives of ensuring equitable access to electricity for households. The controller was designed to regulate and oversee the electricity consumption in households. An unforeseen outcome of the EER project was that participants reduced energy consumption and were only using electricity when needed. The project received positive feedback from beneficiaries.

Post-project sustainability

The financial sustainability of this project was challenging due to the high cost of each energy controller.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

The design of the solution and the involvement of end users were successful aspects in this project. The end users were very happy with the controller which allowed them to make smarter choices regarding their energy consumption. This enabled them to access 24hrs electricity.

If you were to do this project again with the benefit of hindsight, what would you do differently?

Addressing the business model of the project in the beginning of the project + better communication and collaboration with UNHCR + better and more frequent communication between Neurotech and NRC on alligning goals etc + Involvement of NRC HQ (innovation).

Appendix B

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ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	T1	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☑	The controllers were not easily repaired and maintained, according to NRC.
	T5	Operation, maintenance, and repair issues *after* project	☐	
	T6	Problems with electricity access/fuel supply chain	☐	
	T7	Insufficient user education	☐	
ECONOMIC	E1	Incorrect financial or business model assumptions	☑	NRC could not afford to procure the controllers.
	E2	Customers *unable* to pay for product/service	☑	The controllers ended up being too expensive for NRC. UNHCR commited to imlement another system.
	E3	Customers *unwilling* to pay for product/service	☐	
	E4	Unable to access follow-on funding to continue project	☑	NRC submitted a scaling application to Innovation Norway, which did not result in a new grant.
	S1	Failure to include all community groups during project design	☐	
	S3	Community misunderstanding of project activities	☐	
	S4	Poor community involvement throughout project	☐	
IMPLEMENTATION	I1	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☑	Lack of expertise and experience in working with the private sector.
	I3	Poor coordination and partner engagement	☑	The collaboration and communication between NRC and Neurotech became challenging over time, especially regarding the goals of the project and the pricing of the controllers.
	I4	Lack of integration with wider ecosystem/other programmes	☑	UNCHR is in charge of the camps in Jordan, and the dialogue with them could have been better to avoid duplication of efforts.
	I5	Unforeseeable events	☐	
GOVERNANCE	G1	Policy and regulatory barriers	☐	
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☑	NRC Jordan did not have experience in running an agile project, and were not used to collaborating with the private sector. This resulted in delays and other hick-ups in project management.
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Appendix B

CS7: Pellet Cookstoves in Dzaleka Refugee Camp, Malawi

Please fill out boxes in green and overwrite text in red, if required.

Template Ref:	Zipo_1b					
Date of template completion:	2024/01/01					
Locations of Learnings:	***T***	***E***	***S***	***I***	***G***	***O***
	1	**3**	**0**	**0**	**0**	**0**

Locations of learnings

The bar above shows the categories where project learnings were made based on information provided in the Failure Factors table to the left. T = technological, E = economic, S = social, I = implementation, G = governance, O = other.

PROJECT DETAILS - flag changes from outset template only	
Donor(s):	WHH
Lead organisation(s):	Zipolopolo
Other parties involved:	Dzaleka Christian Church Union
Project timeframe:	Jan - Nov 2023
Location:	Dzaleka Camp (established
Budget:	30,000 EUR
Energy technologies:	Pellet stove
End-user type:	Households
Further end-user targeting:	N/A
Cost borne by end-users:	Partial cost to full cost

Brief description of what happened during project

Sales exceeded expectations during the pilot, which was extended due to high demand. However sales fell to zero once funds ran out and the subsidy was removed.

Project achievements

*- Sold 1500 stoves, exceeding target of 1000.
- Sold 15 tonnes of pellet fuel, which also exceeded sales expectations of 10 tonnes, suggesting strong adoption of the stoves.

Post-project sustainability

None. Once the subsidy was removed the sales of both stoves and fuel fell to zero and Zipo eventually exited the camp.The WHH team knew there was a risk of disadoption after the end of the subsidy. However, their calculations showed that cooking with unsubsidised pellets was cheaper than charcoal, so they hoped that HHs with stoves would continue to buy fuel. This turned out not to be the case. This was partially attributed to the culture of free giveaways in the camp - people were not willing to pay for products that were previously subsidised, even if they could afford to do so.

Please highlight 1-2 aspects of the project design or implementation that were particularly successful.

*- Strong adoption and acceptance of new technology due to awareness-raising campaign with focus on cooking demos.
- Exceeded all sales targets during implementation.
- Inclusion of local community members in sales process.

If you were to do this project again with the benefit of hindsight, what would you do differently?

More research prior to implementation would have helped better understand the baseline cooking scenario so that the pellet intervention could be designed to last.
Zipo fuel could only be bought from one retail outlet in the camp. Adoption might have been "stickier" after the removal of the subsidy if Zipo fuel was more convenient to buy.

Appendix B

CS7: Pellet Cookstoves in Dzaleka Refugee Camp, Malawi

ACTUAL FAILURE FACTORS				
		Failure factors	**Relevant**	**Explain in more detail**
TECHNOLOGICAL	*T1*	Technology has quality and durability issues	☐	
	T2	Technology inappropriate for local context	☐	
	T3	Technology inappropriate for intended purpose	☐	
	T4	Operation, maintenance, and repair issues *during* project	☐	
	T5	Operation, maintenance, and repair issues *after* project	☐	
	T6	Problems with electricity access/fuel supply chain	☑	Pellet fuel was only sold at one retail point in the camp. The lack of easy access compared to charcoal may have factored into disadoption after the subsidy removal.
	T7	Insufficient user education	☐	
ECONOMIC	*E1*	Incorrect financial or business model assumptions	☐	
	E2	Customers *unable* to pay for product/service	☑	No sales made after removel of subsidy caused price of stove and fuel to double and triple respectively.
	E3	Customers *unwilling* to pay for product/service	☑	
	E4	Unable to access follow-on funding to continue project	☑	Attempts to find further sources of funds to continue the subsidy after the pilot were unsuccessful.
SOCIAL	*S1*	Failure to include all community groups during project design	☐	
	S2	Tensions between different community groups	☐	
	S3	Community misunderstanding of project activities	☐	
	S4	Poor community involvement throughout project	☐	
IMPLEMENTATION	*I1*	Project duration insufficient for sustained impact	☐	
	I2	Lack of relevant expertise and experience	☐	
	I3	Poor coordination and partner engagement	☐	
	I4	Lack of integration with wider ecosystem/other programmes	☐	
	I5	Unforeseeable events	☐	
GOVERNANCE	*G1*	Policy and regulatory barriers	☐	
	G2	Problems physically accessing the target location/community	☐	
	G3	Administrative, supply, and procurement issues	☐	
	G4	Legal and customs issues	☐	
	G5	Crime, corruption, and security challenges	☐	
OTHER		Factor 1	☐	
		Factor 2	☐	
		Factor 3	☐	

Course Corrections: **Improving Effectiveness and Efficiency in Humanitarian Energy**

Learning from the Past to Design for the Future