Financial impact assessment of the Humanitarian Energy Plc minigrid in Sheder refugee camp

April 2025

Washington D.C.
1220 19th St NW, #500
Washington, D.C. 20036
United States of America

Acknowledgement

This study was commissioned by Mercy Corps through its Transforming Humanitarian Energy Access (THEA) programme which is implemented in partnership with Ashden and the Global Platform for Action in Displacement Settings (GPA). The programme is funded with UK aid from the UK government via the Transforming Energy Access platform.

The THEA programme aims to promote more sustainable energy delivery models in humanitarian settings in order to increase access to clean energy solutions for displacement-affected communities. It does so by leveraging a blend of research and evidence-building, data-driven advocacy, and the implementation of market-based energy interventions. By identifying sustainable, inclusive energy delivery models, THEA aims to facilitate their replication and scale up, ultimately enhancing energy access in displacement settings.

The study aims to assess the financial impact of a minigrid in Sheder refugee camp that was installed and is operated by Humanitarian Energy Plc and supported through Mercy Corps' Enter Energy programme.

THEA partners: *Funded by:*

This material has been funded by UK aid from the UK government; however the views expressed do not necessarily reflect the UK government's official policies.

Abbreviations and Acronyms

ACPU	Average Consumption Per User
ARPU	Average Revenue Per User
AMDA	African Minigrid Development Association
CAPEX	Capital Expenditure
ETB	Ethiopian Birr
HH	Households
HTML	Hypertext Markup Language
HuMen	Humanitarian Energy
KPI	Key Performance Indicator
kWh	Kilo Watt Hours
NPS	Net Promoter Score
OPEX	Operating Expenditure
PUE	Productive Use of Energy
THEA	Transforming Humanitarian Energy Access
USD	U.S Dollar
US$	U.S Dollar
Y1	Year one

Report Summary

The financial impact assessment of the Humanitarian Energy Plc mini-grid site in Sheder refugee camp provides insight into the financial viability and overall performance of the minigrid which was developed as part of the Enter Energy Initiative launched by Mercy Corps to provide access to sustainable energy services and improve climate resilience in displacement-affected communities.

Ethiopia has a significant displaced population that continues to lack access to modern energy sources. Studies show that more than 90% of refugees in camp settings do not have access to electricity, with only 19% having access to clean cooking solutions [1]. At the same time, humanitarian operations contribute to 194,000 tCO_2 greenhouse gas emissions yearly using diesel power generators, leading to the deterioration of the environmental conditions of the already fragile settings where they intervene[2].

As part of the Enter Energy Initiative, Mercy Corps cofounded Humanitarian Energy Plc with Rensys Engineering and Trading Plc, a private Ethiopian company that provides renewable energy solutions for underserved communities. Humanitarian Energy Plc designs, finances, deploys and operates power assets serving refugee and host communities in Ethiopia, as well as humanitarian operations, providing reliable, 24-hour, clean energy services. In May 2024, the company launched its first 254 kWp solar PV-based minigrid in the Sheder refugee and host community, in the Fafan zone of the Somali Regional State of Ethiopia. The minigrid is Ethiopia's first commercially licensed private solar PV minigrid under the current legislation, with over 1,135 connections having been made by 31 March 2025 and plans to serve additional customers with access to clean, reliable and sustainable energy services. The company charges and collects consumption-based payments from its users; charges are affordable at 0.15$/kWh (day-time tariff) and 0.18$/kWh (night-time tariff)[3], pre-paid and based on kWh-based metering.

This report follows a financial impact assessment of customers connected to the minigrid to answer two fundamental questions:

1) Do the projects deliver electricity or other energy services to the target community at an affordable tariff or price?
2) Are the models cost-effective for scaling?

The report presents findings related to:

- Evaluating the minigrid's current performance by assessing key KPIs against target KPIs

[1] Chatham House: Moving Energy Initiative report

[2] Global Platform for Action: Decarbonising Humanitarian Energy

[3] The initial site tariff included a day-time tariff of 0.34$/kWh and a night-time tariff of 0.41$/kWh prior to the floating of the ETB in July 2024.

- Exploring key trends relating to the minigrid's performance and using these to evaluate scalability
- Identifying opportunities for performance improvement at the existing site

I. Key findings

The report leveraged data gathered from the Humanitarian Energy Plc site to inform key insights. Data sources included customer surveys, payment records, technical management tools etc.

The minigrid site is currently exceeding targets across 7 KPIs while 1 KPI is slightly below the target level.1 KPI is currently unconfirmed.

Figure 1 - KPI Overview

KPI	Description	Target	Current Average	Status
1	% of connected HHs engage in regular payments for energy products and services	70%	82%	●
2	# of signed contracts	HH/Business -1,579 PUE Hub Businesses[3] - 6	HH - 1,027; Business - 93 PUE Hub Businesses -10	●
3	Average daily power generation for the grid overall	Y1 – 500 kWh/day	616 kWh/day	●
4	Average daily power consumption for the grid overall	Y1 – 434 kWh/day	443 kWh/day	●
5	Customer challenge rate	N/A	16%	○
6	Issue Resolution	75% of challenges resolved	100% resolved	●
7	Customer satisfaction and service rating	3 or above out of 5	92% rate above 4/5	●
8	Over-indebtedness of customers (payments not creating a heavy burden, changing food consumption patterns, causing stress	<10% experience 'heavy' burden	4% experience heavy burden	●
9	Reduced energy spending	75% of customers spend less	93% spend less	●

** KPI current averages indicated as of March 31, 2025*

Limitations of the study

Timeline:

- The commissioning and start of operations dates were May 2024 and June 2024, respectively.
- Although the KPI targets were set to be achieved by 31 May 2025, this study evaluates KPI performance over ten months from 1 June 2024 to 31 March 2025. Hence, performance improvements can be expected by the end of year one (31 May 2025) compared to current values.
- The PUE Hub was connected in September 2024 and, as a result, did not have complete data coverage for the entire assessment period. Additionally, a collective of millers is yet to be connected which is expected to significantly increase consumption rates.
- A social institution (health facility) that was connected to the minigrid in January 2025 similarly did not have full data coverage for the assessment period.

Data

- For KPI 2, the 1,579 connection target by Y1 (31 May 2025) refers to all single-phase clients, including both household and small business customers - this is due

to the fact that in most cases connected households share the same meter for their small business.

- The study encountered data issues caused by malfunctioning meters after a firmware update, affecting daily recordings but not monthly summaries. Meters experienced connection problems that prevented timely data uploads. When connectivity was restored, data missing from previous days was incorrectly recorded under the day of reconnection. As a result, daily data accuracy was compromised, though monthly data remained unaffected.
- The social institution (health facility) connected in January 2025 required the site's distribution infrastructure to be extended – consequently, this customer was required to pay a one-time connection fee contributing to 40% of overall site revenue, skewing the revenue profile of the site.

Some of the key findings relating to the KPIs are highlighted below:

- **Most connected household customers have completed a payment in each month indicating widespread acceptance of the minigrid.** 82% of customers completed at least one electricity payment in each month rising to 91% for customer payments every two months. In contrast, approximately 9% of customers were considered to be inactive, i.e. did not complete a payment and stopped consuming electricity in the period – this includes 6% of customers who did not complete a payment in 30 days, 2% for 60 days and 1% for 90 days. This group of customers may be financially burdened by electricity payments.
- **Despite trending behind its households target, the site is oversubscribed by productive use of energy (PUE) businesses which may translate to favourable economics.** The minigrid has entered contracts with 1,027 household and 93 business customers and is projected to fall short of its 1,579 target. The site's management attributed this shortfall to i) multiple households sharing connections resulting in under-reporting, and ii) over-estimation of the target due to shifts in the refugee population post customer surveys. Conversely, the minigrid has signed 10 businesses within the PUE Hub, ~70% greater than the target. This signals positively for the long-term revenue potential of the site due to PUE businesses' greater energy demand and propensity to pay as compared to households.
- **Daily power generation exceeds target levels; although consumption lags generation by ~28% driven by losses**. Average daily power generation of 616 kWh/day exceeds the target by 23%. The site is nearing full utilization by March 2025, with only 17% unused capacity in March 2025 and it exceeds typical mini-grid utilization. CrossBoundary research indicates average utilization of 27% from 10 sites across Kenya, Zambia and Nigeria between 2020 and 2021. This site achieves 64% site utilization over the reporting period.
- **Consumption at the site currently exceeds target levels demonstrating strong consumer demand; this is driven by PUE businesses who have significant electricity demand.** Average daily site consumption stands at 443kWh. Average Consumption Per User (ACPU) has increased steadily indicating a viable consumer base. Although overall consumption is led by households, ACPU is driven by productive use of energy (PUE) hub businesses who have an average of 144

kWh/month, in contrast with refugee businesses (36 kWh/month) and refugee households (11 kWh/month).

- **Revenue at the site currently exceeds the Y1 target level.** The payments received by the site currently exceed its year one target by 18%. Revenue was primarily driven by the receipt of customer connection fees from a social institution (health facility) which required an extension of the site's distribution infrastructure. The fee represents an outlier in the site's overall revenue profile and contributed ~40% of total site revenue. At the customer level, ARPU (excluding connection fees) has steadily increased in line with ACPU driven by PUE Hub businesses.
- **Devaluation of the ETB by over 100% since July 2024 has significantly impacted tariffs and consequently revenue in USD terms.** Following the floating of the currency, the site's revenue experienced a decline in USD terms despite increasing consumption. In parallel, USD denominated expenses such as salaries are likely to have increased in line with the currency depreciation creating a need for a tariff review to ensure financial sustainability. Although depreciation based on historical trends was factored into the tariff design, the decision to float the ETB and the subsequent extent of devaluation was unexpected.
- **Operating expenditure at the site is approximately within budget (>1%Y1 Target) in ETB terms, but costs have risen steadily driven by USD denominated costs.** Staff salaries was the largest contributor to OPEX and included salaries for full time staff, field officers and technicians. USD-denominated staff salaries appear to have increased OPEX disproportionately due to the currency devaluation.
- **Based on customer survey results, the site appears to have a satisfied and loyal customer base.** A customer satisfaction rate of 92% combined with a 16% challenge rate and 100% issue resolution rate provides the backdrop for long-term users of the minigrid. The most critical challenge has been related to power restoration delays after customers 'top-up' which is related to faulty firmware update from the smart meter supplier; however, most customers expressed satisfaction with service reliability, and improved productivity.
- **Most customers indicate power from the minigrid is affordable and has not created a strain on their finances.** 90% of customers reported they have experienced a decrease in their monthly energy spend. Four in every five customers indicated their electricity payments have not presented a financial burden. This indicates current pricing is aligned with the financial capacity of the customer base and customers are satisfied with the cost of the service. These indices should be monitored closely in view of any increases in tariffs.

Impact of the ETB devaluation on the Sheder site tariff

The initial site tariff included a day-time tariff of 0.34$/kWh and a night-time tariff of 0.41$/kWh prior to the floating of the ETB in July 2024. Following the devaluation of the ETB, the tariff reduced in USD terms to 0.15$/kWh and 0.18$/kWh respectively. Approvals have already been obtained from the regulator to review the tariffs in order to bring them back to pre-devaluation prices in terms of their USD value. This will be implemented following an awareness raising process with the community.

Key findings related to the fundamental questions posed are highlighted below:

1) **Current site tariffs are viewed as affordable, however a worsened exchange rate environment will likely require a tariff review to ensure financial sustainability**

   As covered above, findings from this study suggest that the minigrid site currently delivers electricity to the community at an affordable price. This is evidenced by responses to the customer surveys where a significant majority (90%) indicate that they have experienced a reduction in electricity payments while most customers (~80%) report that they are not financially burdened by their electricity payments.

   However, there will be a need to re-assess affordability in the context of a significantly altered exchange rate environment. Since July 2024, the ETB has declined by over 100 percent against the USD. This depreciation means that revenues have declined in USD terms. Additionally, USD-denominated expenses such as salaries will have appreciated in local currency terms. Humanitarian Energy Plc will therefore need to review its current tariffs to ensure they are sufficient to cover all operational costs, including fixed expenses, debt repayments, maintenance, and any ongoing investments in system upgrades or improvements. Approvals have already been obtained from the regulator to review the tariffs in order to bring them back to pre-devaluation prices (in terms of their USD value). This will be implemented following an awareness raising process with the community.

   Ultimately, there is a need to balance the financial viability of the minigrid site with the social and economic implications for customers. Increased tariffs are likely to affect affordability, resulting in more customers being 'burdened' by electricity costs. However, this review may be essential to ensuring the minigrid can continue to operate and serve the customers.

   Humanitarian Energy Plc can explore various approaches to optimize tariffs in USD terms including but not limited to:

- **Implementing a universal tariff increase:** The site currently utilizes a day-time and night-time tariff structure – Humanitarian Energy Plc can apply an escalation on both day and night tariffs for all customers. However this approach will need to be implemented cautiously as depending on the extent of the increase, it may lead to a significant drop-off in consumption, particularly for household customers who might be burdened by electricity payments.
- **Adopting a tiered tariff structure targeting Business customers:** Given the high incidence of connected businesses, Humanitarian Energy Plc may request that business consumers pay a higher tariff, to offset the impact on smaller, household customers (primarily refugees). The extent of the tariff increase should be measured to ensure electricity costs remain lower than diesel generators costs to avoid a decline in

usage from this customer group. These customers currently contribute 26% of total revenue[4].

2) **High electricity demand, tariff acceptance and high ACPU/ARPU provide a strong foundation for scalability**

Assessing the site's true cost-effectiveness will require further insight into overall expenses for the minigrid (i.e. including capital expenditure, financing costs etc.) and revenue streams (e.g. including from subsidies, if any). However, available OPEX and revenue data suggests the site is currently viable. Even after factoring in the impact of currency depreciation on site revenues, the underlying performance indicators point to strong potential for scale-up in Ethiopia and other markets – provided appropriate risk mitigation measures are in place. These indicators include:

- **High electricity demand:** Perhaps the most significant contributing factor to the site's performance is the presence of many productive use consumers with high electricity demand – this drastically increases the viability of the site as it augments the relatively modest usage from refugee household customers.
- **Tariff acceptance:** Most customers indicate reduced energy spend compared to previous sources and limited financial burden, suggesting they would be long-term users of the minigrid. Interviews with Humanitarian Energy Plc also reveal that most customers would be comfortable with an increased tariff (i.e., after re-basing to match the revised USD exchange rate).
- **High ACPU/ARPU:** Both high electricity demand and tariff acceptance are reflected in the high ACPU and ARPU at the site, particularly when compared to other minigrid sites across Sub-Saharan Africa. The site's ARPU and ACPU are noticeably higher than sites in East and Southern Africa while being comparable to sites in West and Central Africa which historically have high consumption. This outcome is more pronounced when considering the customer profile of this site – most consumers are refugees which generally have lower financial capacity than the average household customer in part due to limited opportunities for income generation in refugee settings.

It is important to also highlight the crucial role Mercy Corps played in supporting demand activation through awareness raising campaigns and the financing of the PUE hub along with subsidies of 50% to electric appliances for the businesses it hosts. This Enter Energy partnership model between a commercial supplier and a non-profit organisation to support demand creation should be further explored and scaled up.

II. Recommendations to improve overall performance and scalability

Future minigrid sites seeking to serve refugee and host customers can strategically locate sites around anchor productive use customers to effectively help drive demand/revenue. This approach ensures the energy needs of vulnerable groups can be met while improving financial sustainability.

[4] Based on revenue from October 2024 when PUE Hub businesses were connected to the minigrid

There is also need for concerted efforts by relevant stakeholders involved in the minigrid's development to leverage hedging mechanisms to offset macro-economic risks such as those experienced in Ethiopia.

Additionally, Humanitarian Energy Plc can seek to improve overall performance of this site by (i) Optimizing revenue and (ii) Reducing OPEX costs:

(i) Optimizing revenue:

- Number of customers: despite underperforming for its target of household customers for which the site has reached saturation, an opportunity exists to acquire more business customers - data shows productive use consumers have significantly higher electricity than any other customer group and should be prioritized.
- Increase consumption from existing customers:
  - Explore approaches to increase consumption from existing households through appliance financing – Mercy Corps and Humanitarian Energy Plc are currently conducting a clean cookstove pilot to increase consumption for this segment of users
  - Identify opportunities to support scaling of existing productive use consumers – Mercy Corps is supporting linkages to microfinance/credit providers and access to appliances
  - Review tariffs to align with revised USD/ETB – in view of >100% depreciation of the ETB against the USD and increase in USD-denominated costs from a local currency perspective, Humanitarian Energy Plc should consider reviewing tariffs to improve financial sustainability of the minigrid through either i) Implementing a universal tariff increase, or ii) Adopting a tiered tariff structure for businesses and households. Humanitarian Energy Plc has already obtained approvals from the regulator to review the tariffs in order to bring them back to pre-devaluation prices in terms of their USD value. This will be implemented following an awareness raising process with the community.

(ii) Reducing OPEX costs:

- Given staff salaries form the greater share of OPEX, Humanitarian Energy Plc should seek to find the optimal balance of staff at the site – e.g., by retaining only critical staff at the site and identifying opportunities to streamline corporate overheads attached to the site, where feasible. Additionally, Humanitarian Energy Plc can explore opportunities to increase efficiency of individual site visits to reduce the number of required trips.