Impact of Last Mile Results Based Financing Project

Submitted to GIZ EnDev
Kampala, Uganda.

Study conducted by
Palm Establishment Limited
P O Box 109040,
Kampala, Uganda

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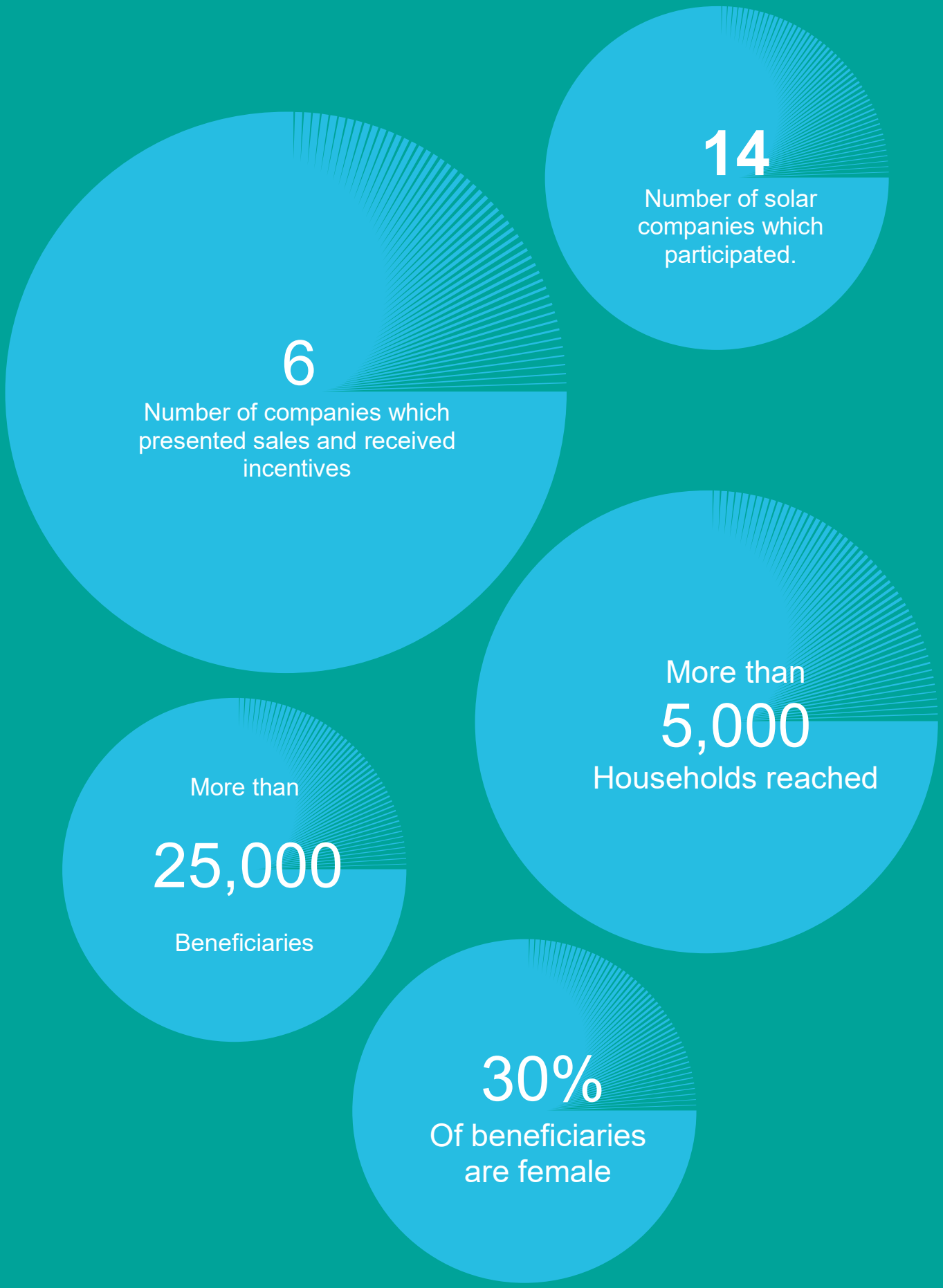
Key achievements of Last Mile Results Based Financing Project



Impact of Last Mile Results Based Financeing (LMRBF) Project implemented in Uganda.

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Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
E info@giz.de
I www.giz.de

Contact
Energising Development

E endev@giz.de
I www.endev.info

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Acronyms

AAER	Adopt Adapt Expand Respond
AI	Asset Finance
BDS	Business Development Services
CD	Customer Default
COVID-19	Coronavirus Disease of 2019
CR	Customer Remoteness
CREEC	Centre for Research in Energy and Energy Conservation
DAC	Development Assistance Committee
EnDev	Energising Development
GIZ	German Development Agency
GOU	Government of Uganda
GPS	Global Positioning System
IA	Impact Assessment
IEA	International Energy Agency
IVA	Independent Verification Agent (IVA)
KII	Key Informant Interview
kWh	Kilowatt hours
LMRBF	Last Mile Results Based Financing Project
M&E	Monitoring and Evaluation
MEMD	Ministry of Energy and Mineral Development
MSD	Market Systems Development
NDP III	Third National Development Plan
OECE	Organisation for Economic Co-operation and Development
PAYGO	Pay-As-You-Go
PEL	Palm Establishments Limited
PSFU	Private Sector Foundation Uganda
RBF	Results Based Financing
RI	Remoteness Index
SDG	Sustainable Development Goals
SHS	Solar Home System
SIM	Subscriber Identity Module
SPSS	Statistical Package for the Social Sciences
TOC	Theory of Change
TV	Television
UGX	Uganda Shillings
USAID	Unites States Agency for International Development
WOM	Word-of-Mouth

Acknowledgement and disclaimer

Jimmy Ebong – Team Leader and Director Palm Establishment Limited; Johnmary Migadde, Godfrey Isingoma, Lillian Akot and Kwebiha Junior - Associate Consultants with Palm Establishments Limited (PEL) assessed the impact of Last Mile Results Based Financing Project (LMRBF) and consequently wrote this report. The consultants acknowledge all individuals and institutions engaged during the exercise. Without their support, this assignment would have been arduous, if not impossible to accomplish.

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Finally, the opinions expressed in this report are purely those of the consultants but are based on data collected through literature review, KIIs, Telephone survey and observations made during the study. It is therefore the consultants and not EnDev who are responsible for any errors of commission or omission, which may be found in this report.

Executive Summary

Gesellschaft für Internationale Zusammenarbeit (GIZ) through Energising Development (EnDev) project commissioned Palm Establishments Limited (PEL) to assess the impact of Last Miles Results Based Financing (LMRBF) and to manage a project closure event and share findings of the impact assessment with stakeholders in the solar off grid sector. This report presents findings of the impact assessment and recommends measures to improve design and implementation in order to optimise impact of future Results Based Financing (RBF) initiatives.

Key findings, conclusions and recommendations of the impact assessment are summarized as follows.

End-line results.

Out of a total of 14 solar companies which were on-boarded 6 (Six) companies were able to make eligible sales and received incentives. Four (4) companies presented sales but were deemed ineligible for incentives. Another 4 (Four) companies did not present any sales during the project period. Where only a few companies benefit persistently, there is likely to be a market concentration in favour of the few companies benefitting and such companies may monopolise the market in the long run.

Over 5,000 sales were successfully verified by the Independent Verification Agent (IVA) through four rounds of verification, resulting in disbursements of Uganda Shillings (UGX) 377,507,909.50 for customer remoteness RBF and UGX 265,475,524.71 for asset financing RBF. No disbursements were made for customer default RBF. Although the project's target was 10,000 verified Tier 2 sales, more than 5,000 households in remote areas were reached with Tier 2 sales, providing access to electricity for approximately 27,925 people. Additionally, 30% of all SHS purchases were made by women.

Project design

The project design was based on an assumption of costs and risks of serving the last mile customers. The assumption is that expanding access of solar energy to the last mile communities is impeded by high costs and risks associated with lower incomes, a lower likelihood of affording SHS, and a potentially higher rate of defaults. The LMRBF project was designed to induce solar companies to extend sale of their products and after sale services to the last mile customers. Most of such last mile customers are based in rural areas. The project design was inspired by the need to overcome the challenge of high costs and risks in reaching out to the last mile customers. The design was tailored to lead to increased sales and business viability of participating companies and livelihood transformation at household levels. Three Results Based Financing (RBF) schemes were meant to deliver incentives that would induce sale. These RBF schemes were; Customer Remoteness RBF, Asset Finance RBF, and Customer Default RBF. The project design and its various features were adequate to induce increases in sales.

Project implementation

EnDev Uganda, PSFU, 14 Solar companies, an Independent Verification Agent (IVA) were involved in the implementation of the LMRBF project. The RBFs targeted solar companies. The solar companies were to be incentivised for selling SHS and enhancing access to solar energy

to last mile customers of Solar Home System (SHS). The IVA independently verified sales reported by solar companies against customer information, also provided by companies. Payment of incentive claims was based on verified eligible sales and customer information.

To what extent has the Customer Remoteness Incentive contributed to offsetting the increased cost of customer acquisition and after-sale service for customers farther from city hubs?

The Customer Remoteness RBF was meant to offset the increased costs of acquiring and servicing customers in remote areas.

End-line results of verified sales and disbursements made show that uptake of the Customer Remoteness incentive was the highest compared to Asset Financing and Default incentives because Customer Remoteness incentive was the easiest to understand and to implement. The Remoteness Incentive successfully incentivized solar companies to venture into remote areas that they would not have otherwise reached, thereby serving more remote customers who would have otherwise remained excluded. This led to increased market penetration and access to last mile customers, located far from city or town centres. Furthermore, companies reported an increase in sales of Solar Home Systems (SHS) in remote areas due to the support provided by the Customer Remoteness Incentive. The incentive effectively motivated companies to overcome the higher costs and associated risks of operating in remote locations, enabling them to serve customers who were previously underserved.

Was the Customer Remoteness incentive used to address the high acquisition costs related to the last mile customers, or fund improvements along the distribution channels, such as improvement of agent structure, awareness campaigns, marketing activities etc.?

Overall, remoteness incentive was used to cover overhead costs related to operations (such as transport for sales agents, commissions to service customers and in some cases staff salaries). There is hardly any indication that the remoteness incentive was used to fund improvements along the distribution channels, such as improvement of agent structure, awareness campaigns, and marketing activities.

To what extent has Asset Financing Incentive addressed the underlying risks of longer shelf time and increased risk of unsold products for cash companies in the last mile.

The Asset Financing RBF was meant to offset the costs associated with longer shelf time and customer payment delays for larger products.

The increase in sales resulted into a reduction of product shelf time, leading to higher income for Tier 2 SHS sales. To benefit from asset financing, a company had to first of all benefit from remoteness incentive. By providing financial support and incentives, such as asset financing, the LM RBF project helped some companies improve their cash flow and inventory management by reducing the time and cost associated with holding inventory. This led to a positive impact on the financial stability for companies that benefited from this scheme.

To what extent has the Asset Financing Incentive addressed the risk of delayed re-payments rates to Pay-As-You-Go (PAYGO) companies participating in the project?

The findings suggest that the asset financing incentive contributed to mitigating the cash flow challenges associated with longer repayment and shelf time. Participating companies were able

to unlock capital by increasing sales and replenishing their inventory. This suggests that the incentive played a role in improving cash flow and working capital management for the companies.

What barriers led to or caused the low uptake of the default incentive and what can be done to address such barriers?

The Customer Default RBF was an optional scheme that provided default protection for PAYGO companies. Participating solar companies reported that the design of default incentive was complex, difficult to understand and implement. The low uptake of the default incentive can be attributed to two reasons, summarised as follows; 1) the Customer Default RBF model defined default differently from the way participating companies understand and operationalize default, 2) registering default, in the way that makes it eligible was costly and time consuming. The process of product recovery and inventory management was long and costly.

How many additional sales did the companies make in comparison to the sales year prior to the project? How much of that is attributable to the LMRBF project?

Solar companies reported increased sales, especially for Tier 2 SHS. In the case of Engie Energy Access, the tier 2 sales increased from 100 systems per month to over 200 per month after participating in the RBF project. Sales for Engie Energy Access for Tier 2 SHS has remained higher after the LMRBF that before. Additional evidence from the demand side survey, posits that nearly half (48%) of last mile customers surveyed had owned the SHS for just a year. This indicates that adoption of SHS by last mile customers increased over the recent year – LMRBF making a significant contribution. All the 6 (six) companies which presented eligible sales reported increased sales, especially for Tier 2 SHS. The increment in sales is largely attributed to the incentives obtained under the LMRBF project and the drive to promote Tier 2 SHS during the LMRBF project implementation.

How did the end-users benefit from the project, e.g., did the customers feel that high quality products and after sales services were more available for them?

The LMRBF enabled connectivity and resultantly access to clean energy to the last mile customers, who previously did not have access. Interventions of the LMRBF reduced the distance to the point of purchasing SHS to less than 5 kilometres for many last mile customers. Last mile customers primarily use SHS for lighting, watching TV and charging phones. Benefits derived from acquiring SHS include improved lighting, and improved access to communication devices. Largely, last mile customers exude positive perceptions regarding quality of services which solar companies provide to them. Most solar companies gave last mile customers warranties. Most warranties last up to 2 (Two) years. Solar companies, represented by their respective staff are easily accessible when last mile customers require their services. Customers' rating of quality of services of solar companies, details regarding warranties and accessibility of solar companies and their staff are presented in the paragraphs that follow.

Did the end users perceive any additional benefits from the SHS purchase that they did not have before?

Access to SHS opened up usage of appliances which were previously inaccessible for the last mile customers. Appliances powered are for lighting, phone charging and Television (TV). The end-users perceived additional benefits from the purchase of SHS that they did not have before to include; improved lighting, access to information as well as access to entertainment.

What worked well and what were the main challenges that companies faced under the Last Mile RBF?

Support which was provided by PSFU was appreciated by most participating companies. PSFU's initiative to provide capacity support was beneficial to a number of local companies, which had capacity constraints.

Furthermore, the design of the LMRBF project was well-suited to companies that already had extensive network of branches and sales agents across the country. For such companies, the project successfully incentivized them to penetrate further into remote areas and reach last mile customers. Additionally, the project encouraged the sale of Tier 2 solar home systems (SHS) to last mile customers. This aligned with the strategy of diversifying product offerings and catering to different customer segments. However, companies which were predominantly dealing in Tier 1 SHS struggled to make Tier 2 sales because they were more expensive and also needed new certifications.

The main challenges that companies faced are related to their capacities and expertise as well as Coronavirus Disease of 2019 (COVID-19) and lockdown containment measures. Capacity challenges included the following;

- Limited ability to comprehend the last-mile concept,
- Difficulty in calculation of Remoteness Index and of other incentives;
- Financial capacities to pre-finance operations;
- Limited capacities regarding database management and records keeping ,
- Inadequate skills to use Global Positioning System (GPS) and
- Limited capacities to manage dealers.

Capacity challenges posed differences in how the LMRBF benefited companies. Multi-national companies that already had established agent network across the country and financial capacity to pre-finance their activities. Local companies did not directly benefit from the incentives because they did not have funds to recruit new agents, buy new Tier 2 products and set up their companies to deliver the results and to expand into the remote areas as discussed above.

What should have been done differently in terms of project design to increase Tier 2 solar energy access amongst last mile customers?

For all the participating companies, Customer Default RBF was complex and not aligned with the considerations of how companies defined default. This is an indication that solar companies were not engaged during design, to co create the RBF. As a result, complexity of default incentives deterred companies from participating in the Customer Default RBF. Customer Default incentive should have been designed to be easy to understand and implement. Additionally, it should have been designed in consultation with the solar companies to ensure their definition of customer default is taken into account.

Capacities of participating companies were strained. Taking into consideration capacities of participating companies at the design stage is important to enhance their effective participation.

In the case of LBRBF, relevant capacities included capacity for database management, capacities for records keeping and bookkeeping, Global Positioning System (GPS) capacities and capacities for managing dealers. Deign should have factored in an element of capacity building for solar companies.

Local companies highlighted resource limitations as a significant obstacle for them to make eligible sales to the last mile. Appropriate linkages to financing should have been facilitated or brokered.

The onset of the COVID-19 pandemic had a negative impact on the sales and revenues of all participating companies. It further strained their already limited resources, leading to financial losses for some companies and necessitating changes in product portfolios. Being a pandemic, little could have been done about COVID-19 at the project design stage. When faced with risks during implementation, projects maintain risk logs. Similarly, LMRBF project could have maintained and continuously updated a risk log. This would have enabled systematic management of the risks of COVID-19 on the project during the pandemic.

Recommendations for project design, implementation and for encouraging participation of solar companies in RBF incentives are provided as follows.

For project design, the following are recommended.

- Build capacities of local institutions as a way to build or strengthen the renewable energy of solar energy ecosystem. This should be done after conducting a thorough due diligence and capacity gap analysis.
- Enhance competition and avoid pitfalls of market concentration and incidences where monopolies may arise in the market and also to allow for localisation of operations. Do not apply the incentives homogeneously since some companies are better established than others.
- Learn from best practices and use such learning to improve future design. Future design should follow and be consistent with best practices identified in literature on RBF and also best practices identified in this impact assessment.
- Enhance access to finance for participating companies (especially local ones) through leveraging on appropriate and strategic partnerships.
- Establish platforms where no platform exists or leverage on existing platforms for knowledge sharing and exchange among participating companies. This will drive systemic change elements such as Adopt Adapt Expand Respond (AAER).

For implementation, the following are recommended;

- Streamline the eligibility criteria for the different schemes and simplify guidelines on what constitutes an eligible sale,
- Simplify the data compilation and entry process by developing user-friendly tools. The tools should be easy to understand and use, even for companies with limited experience in data collection and entry. Exploring digital solutions can also help improve efficiency and compliance.
- Conduct regular monitoring and evaluations of the project's impact and adjust incentives and schemes based on feedback and lessons learned.

For the solar companies, improve participation in RBF schemes as follows;

- ***Remoteness Incentive*** - Expand coverage of the remoteness incentive to address high acquisition costs and after-sales service expenses in remote areas. The incentive should ideally list the eligible districts, sub-counties, parishes and villages (where possible) so that companies can easily identify the eligible customers in such localised contexts.
- ***Asset Financing Incentive*** - Allocate funds to improve distribution channels, agent structures, and marketing activities to address risks associated with longer shelf time and unsold products for cash companies.
- ***Default Incentives*** - Align default incentives with how participating companies define and operationalize default and take into account the lengthy process of declaring a payment default, including product recovery, return, inventory entry, and bad debt write-off.

1 Introduction

1.1 Context

1.1.1 Access to electricity and importance of Solar Home Systems.

The urgent need to improve access of electricity in Uganda is evident. Different sources of information postulates different rates of electrification in Uganda. International Energy Agency (IEA, 2022) estimates electricity access rate for Uganda in 2020 to be just above 20%. According to World Bank (2019) and Unites States Agency for International Development (USAID) and Power Africa's assessment of solar energy market, national electrification rate for Uganda stands at only 42.1 percent, a rate which is below electrification rate for sub-Saharan Africa, which averages 43 percent. According to Uganda National Bureau of Statistics (UBOS) household survey of 2019, electricity access rate has increased to 57%, of which 19% and 38% of connections are on-grid and off-grid. The disparity in access to grid electricity between urban and rural households is appalling. Uganda's national electricity grid powers 60 percent of urban areas compared to 18 percent of rural areas. There is also an urgent need to improve consumption of electricity in Uganda. According to the World Bank (2019), Uganda also faces the challenge of low electricity consumption per capita compared to its neighbouring countries. In 2020, the average electricity consumption per person was estimated to be around 100 Kilowatt hours (kWh) per year, one of the lowest in the world. In comparison, Kenya's per capita consumption stood at 155 kWh per year, and Ghana's at 300 kWh per year.

Insufficient infrastructure for electricity services hampers connectivity and consequently access and consumption of electricity. Many remote areas lack such necessary infrastructure, making it challenging to extend the traditional grid and provide reliable electricity to these communities. Solar Home Systems (SHS) have emerged as a viable solution, with potential to address access and consumption, more so for rural households. SHS offer decentralized and independent source of electricity, utilizing solar energy to power homes and businesses. SHS have gained popularity due to their relative affordability, reliability, and environmental sustainability. SHS provide a clean and renewable energy alternative, reducing the dependence on fossil fuels and minimizing environmental impact. They offer a practical solution for off-grid and underserved areas, where connecting to the main electricity grid is often costly and technically challenging.

The adoption of SHS in Uganda has the potential to significantly improve access to electricity, particularly in rural and remote areas. It can empower communities by providing them with reliable and affordable energy for lighting, charging electronic devices, and powering appliances. Access to electricity through SHS can enhance productivity, education, healthcare, and overall quality of life for individuals and communities.

However, a number of challenges hinder adoption of SHS. These challenges are related to affordability (especially for higher tier SHS), awareness, and inadequate distribution of SHS. Quality of SHS also affect adoption. Quality issues are related to generics that are cheap but offer poor customer experience. Overall, the deployment of SHS in Uganda offers a promising pathway to bridge the electricity access gap and improve the livelihoods of individuals in remote and underserved communities. From a demand sided perspective, deployment of SHS represents a sustainable and inclusive solution to address the pressing energy needs of the country. From the supply side, sustainability is hindered by the fact that several SHS companies struggle with profitability in the short term. RBFs look at both company (supply side) and

customer (demand side) over a duration of time, hence RBFs are relevant to the sustainability thesis.

1.1.2 The cost and risks of serving the last mile customers.

Expanding access of electricity to last mile communities poses a significant challenge due to the high costs and risks associated with reaching and serving customers in these remote and often excluded areas. Last mile markets are characterized by lower incomes, a lower likelihood of affording SHS, and a potentially higher rate of defaults. Volatility of incomes in the last mile market is one of the biggest issues driving affordability over the life of the loan for SHS. As Solar companies add poorer and more remote customers to their existing portfolios of urban and possibly more affluent customers, portfolio risks increase. Consequently, as off-grid solar companies grow, establish their customer base and with an objective of building sustainable businesses, their focus tends to shift away from serving last mile communities in favour of consolidating sales in existing and cheaper to serve markets.

1.1.3 Results Based Financing (RBF) and energy market

Contemporary debate regarding the role of Results Based Financing (RBF) posits that RBF is ever more being viewed as a useful instrument to de-risk private sector investment, as well as attract private sector participation towards delivery of targeted results in last mile markets. For nearly a decade now, RBFs have been piloted and fine-tuned, more so within the context of renewable energy in developing countries. To this extent, RBFs schemes and mechanisms are now ready for scaling (SNV & Sunfounder, 2021; Desiderato & Veen, 2021). In Uganda, the importance of RBF has been valued. Consequently, the Government of Uganda (GOU), through the Ministry of Energy and Mineral Development (MEMD) has adopted and is applying the RBF approach in other government programs in the renewable energy sector.

However, RBFs may be exclusionary to local players and may also carry a potential to distort the local markets. Market distortion may happen in cases where a few companies, that are capable to deliver results are subsidised through RBF. Such an intervention can lead to monopolies. Localisation and inclusion of indigenous companies permits RBFs to build an extensive ecosystem of players with varying products and offerings, stimulating competition and eventually improvement in product and service offerings. RBF programmes can enhance their additionally and sustainability by identifying promising local companies, and build their capacities, helping them create a track record and increasing their investment readiness. Tailored business support featuring - financial management, business planning, marketing, technological innovation, amongst others. RBFs should contribute to system's change but this requires an ecosystem approach in which supply, demand and enabling environment conditions are considered in an integrated manner.

This impact assessment draws insights from the pilot case of the LMRBF and seeks to contribute to the knowledge management objective of EnDev Uganda. The assessment contributes to the discussion on RBFs particularly regarding;

a) Effectiveness of result based financing and the various incentives (i.e. customer remoteness incentive, asset financing incentive, customer default incentive) on enhancing adoption of solar energy solution to last mile households, and;
b) Best practices and successful approaches that can be replicated in future projects and programs by stakeholders and other off-grid sector entities.

1.2 The Last Mile Results Based Financing project.

In order to address cost and risk perception, which hider solar companies to expand reach to the rural customers, the Last Mile Results Based Financing (LMRBF) project was designed and piloted. Energising Development (EnDev), in partnership with Private Sector Foundation Uganda (PSFU) and in coordination with the Ministry of Energy and Mineral Development, implemented the Last Mile Results Based Financing Project (LMRBF). Funded by the United States Agency for International Development (USAID) and the Swiss Development Corporation (SDC), the LMRBF project was launched in November 2020 and concluded in December 2022.

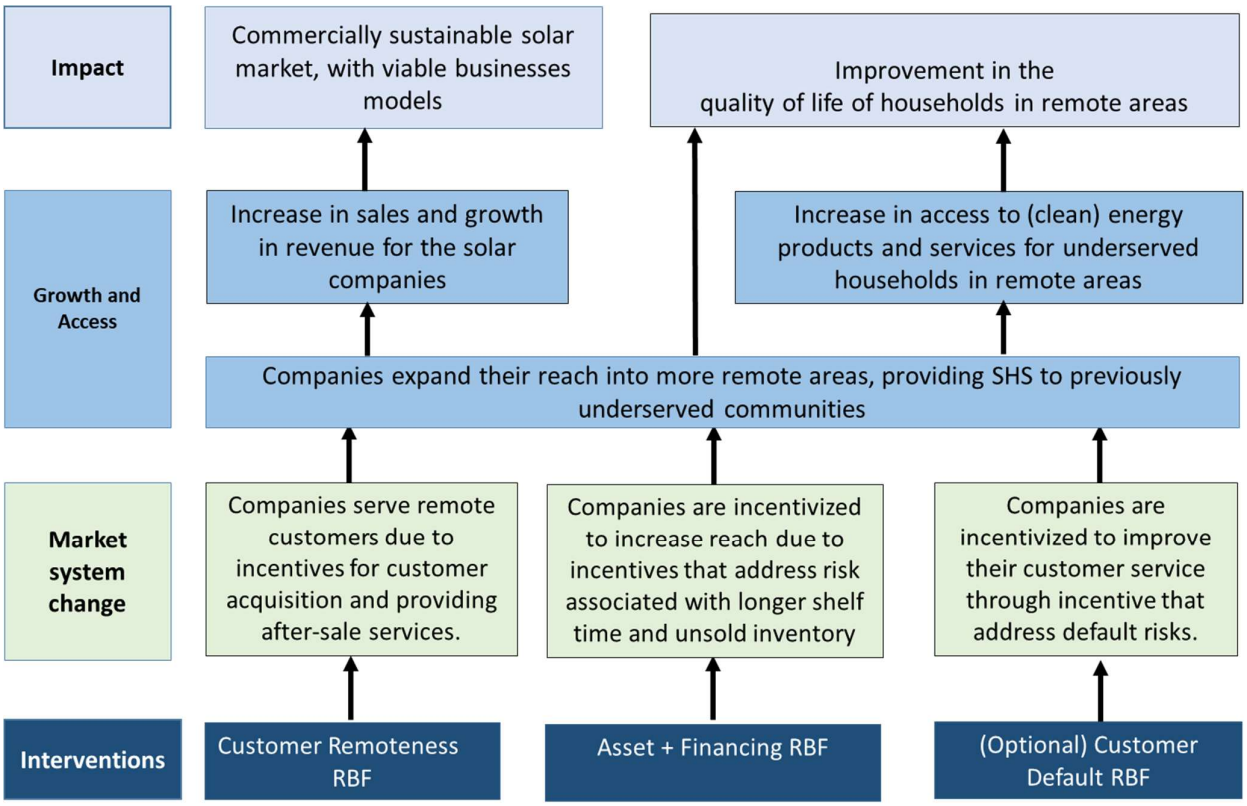
The primary objective of LMRBF was to stimulate sales of SHS to remote customers. The incentives provided by the project were intended to catalyse solar companies to expand their distribution networks and increasing access to SHS in remote areas. Specifically, the LMRBF project aimed to promote the adoption of Tier 2+ SHS technologies in underserved communities and ultimately contribute to the overall goal of improving access to electricity.

In the implementation of the LMRBF project, EnDev adopted a results-based financing approach. Solar companies participating in the project were provided with three incentives based on the results they achieved. These incentives covered the costs associated with customer remoteness, asset financing, and the risks related to customer defaults. The intention behind these incentives was to partially offset the expenses incurred by solar companies in reaching out to remote customers and to compensate them for the risks involved in targeting new and remote customer segments. By mitigating costs and reducing the risks associated with reaching last mile customers, these incentives aimed to incentivize solar companies to expand their operations into more rural and remote areas of Uganda.

LMRBF Theory of change (TOC)

Figure 1 presents a simplified Theory of Change (TOC), of LMRBF, which guided the Impact Assessment (IA). Notably, the design of the project envisaged that LMRBF impacts are realized at business levels and at the level of end-users of solar products. The design of LMRBF envisaged that impact would be realized through 3 (three) pathways. Each of these pathways are related to each of the LMRBF incentives, namely Customer Remoteness RBF, Asset Financing RBF and Customer Default RBF. These pathways and underlying assumptions in the design of LMRBF are elaborated as follows.

Figure 1: LMRBF Theory of Change (TOC)



Pathway 1: Customer Remoteness (CR) RBF

Customer Remoteness (CR) RBF addressed costs associated with acquiring new customers and costs of providing after-sales services, which solar companies face in last mile markets. Addressing acquisition costs and costs for providing after sale services would enhance solar companies to expand reach to more remote areas. Increased sales arising from expanding reach leads to commercially sustainable business operation for solar companies. Solar companies' expansion of sales in remote areas would also lead to last mile end-users' increased access to clean energy, thereby improving quality of life and productivity of such end-users.

Pathway 2: Asset Financing (AF) RBF

Asset Financing (AF) RBF addressed risks and costs associated with longer shelf time and delayed re-payments, which solar companies face in last mile markets. Addressing such risks and costs would lead to solar companies' expanding their reach to remote areas. Expanding reach to remote areas would enable solar companies to increase sales and hence lead to commercially sustainable business operation. Also, expanding reach to remote areas would enhance households' access to clean energy, thereby improving quality of life of such households.

Pathway 3: Customer Default (CD) RBF

Customer Default (CD) RBF addressed risks associated with customer default, which solar companies face in last mile markets. Addressing default risks would then lead to solar

companies' healthier portfolios and means to expand their reach to remote areas. Expanding reach to remote areas would enable solar companies increase sales, leading to commercially sustainable business operation of solar companies. Also, expanding reach to remote areas would enhance households' access to clean energy, thereby, improving quality of life of such households.

Further, the 3 (three) interventions were envisaged to trigger changes at the market systems levels and growth and access levels. At the market systems level, the interventions would lead to SHS products or services being introduced into remote markets. Additionally, the interventions would lead to innovations in supply chains, or business processes that would bring efficiency gains, initially at company level. Innovations were expected to spread to other companies. At the growth level, interventions would trigger growth and open new markets for solar companies and also increase access to energy for end-users.

1.3 Objectives and scope of the assignment

To assess the impact of the LMRBF project, GIZ commissioned PEL to conduct an impact assessment, manage a project closure event and share findings of the assessment with stakeholders in the solar off grid sector at the closure event.

1.3.1 Objectives of the assessment

The assignment had two objectives.

a) To examine the overall impact of the Last Mile RBF Pilot Project for the participating solar companies and their customers.
b) To support the communication on the outcomes of the Impact Assessment (IA) to relevant stakeholders.

1.3.2 Scope of work

The scope of the assignment included the following key activities:

a) Assess the impact of LMRBF project.
b) Develop materials to communicate the impact assessment, and
c) Manage a closure event for the LMRBF project.

1.4 Report layout

This report is presented in 6 sections. The first section presents background information related to the LMRBF and this Impact Assessment (IA). Approach and methodology of the impact assessment is presented in section 2. Findings of the study and discussions of the findings is presented in section 3. Section 4 and 5 presents conclusions and recommendations and references, respectively. Annexes are presented in sections 6.

Wasukira Alex, Engie Energy Access - Sales Team Lead and Technician, Mbale.

2. Approach and methodology

2.1 Approach

2.1.1 OECD DAC evaluation framework and criteria

PEL Consultants adopted the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) criteria as the overarching framework for evaluation of the LMRBF project. Evaluation questions related to the various elements of the OECD DAC criteria are presented in Table 1.

Table 1: OECD DAC Criteria – Evaluation questions

OECD DAC criteria	Key evaluation questions
Coherence	● Was the project relevant to the needs of off-grid solar companies in Uganda and other similar contexts?
	● Was the RBF scheme consistent with the broader policy objectives of increasing access to clean energy and reducing poverty in Uganda and other similar contexts?
	● Did the project align with other development interventions and programs in the off-grid solar sector in Uganda and other similar contexts?
Impact	● What were the wider effects of the RBF project beyond the immediate beneficiaries?
	● Did the project lead to positive changes at the company level – e.g. expanded distribution channels and any other impacts?
	● Did the project contribute to positive changes at the community or national level?
	● Were there any unintended positive or negative effects of the project?
	● Was the impact of the project significant and sustainable?
Relevance	● Was the project consistent with the needs and priorities of the target population and the development goals of the country?
	● Were the objectives of the project clear and relevant?
	● Did the project address the most pressing needs and priorities of the target population?
	● Were the stakeholders involved in the design and implementation of the project?
Effectiveness	● To what extent did the project achieve its intended results and objectives?
	● Were the outputs and outcomes of the project achieved as planned?
	● Were the intended beneficiaries reached, and to what extent?
	● Did the project contribute to positive changes in the lives of the beneficiaries?
Sustainability	● Will the benefits of the project continue after the project ends? ● Were the institutions and systems strengthened as a result of the project? ● Will the beneficiaries continue to use the products and services provided by the project? ● Are there any plans in place to ensure the sustainability of the project results?

2.1.2 Adopt, Adapt, Expand Respond framework and assessing systemic change.

EnDev implemented the LMRBF using a Market Systems Development (MSD) approach. This approach aimed to support solar companies in expanding their outreach and increasing awareness of their products. In order to trace evidence of market systems development, PEL Consultants utilized the Adopt, Adapt, Expand, Respond (AAER) framework. This framework serves as a model for facilitating systemic change, starting from piloting a concept and progressing towards broader adoption by a wider group of actors. The AAER model was applied to assess whether the pilot initiatives achieved sustainability and scale. Table 2 key evaluation questions which were used to apply AAER framework in assessing impacts of the LMRBF project.

Table 2: AAER framework and key evaluation questions

AAER Framework	Key evaluation questions
Adopt	• Is there evidence that a solar company successfully adopted product, service or any other innovation in off-grid and solar sector as a result of the LMRBF?
Adapt	• Is there evidence that a market player(s) continued independently, to undertake or implement an activity or activities around the innovation that they originally adopted as a result of LMRBF?
Expand	• Is there evidence that other market players adopted the innovation (or clear variant thereof) as original market players and that other early adopters are beginning to reap benefits from adopting product, service, and innovation?
Respond	• Is there evidence that the product, service, innovation sparked off by LMRBF triggered a secondary response from players in the wider Off-grid/solar energy, PAYGO sector, or in adjacent sectors connected to it.

2.2 Research methodology

A mixed-method was employed to assess impact of the LMRBF project. A mixed method was effective for capturing both non-numerical attributes (such as preferences, emotions, and attitudes), as well as numerical attributes (such as the number and percentages) of last mile customers. The research utilized sampling methods that were consistent with the mixed-method approach. Data was collected from a sample of 273 research subjects, including stakeholders involved in the project and beneficiaries. The stakeholders encompassed organizations such as EnDev, PSFU, IVA, MEMD, and solar companies.

2.2.1 Qualitative research

The qualitative research methodology aimed to gather insights, perspectives, and understanding from key stakeholders involved in the LMRBF project. Representatives from EnDev, PSFU, IVA, MEMD, solar companies, and last mile customers were interviewed to obtain their views and perceptions on various aspects of the project. To collect qualitative data, Key Informant Interviews (KIIs) were conducted with a total of 27 participants. The sampling for KIIs was designed to include a diverse range of stakeholders involved in the LMRBF project. Table 3 presents category of research participants and the number of respondents for each category.

Table 3: Sampling for Key Informant Interviews.

Stakeholders for KIIs	Number of respondents
Project staff of EnDev	2
Project staff of PSFU	2
Independent Verification Agent (IVA) –CREEC	2
Solar Companies	12
Ministry of Energy and Mineral Development (MEMD)	1
Technician	1
Last Mile end-users/ beneficiaries	7
Total	***27***

Thematic analysis was employed to analyse the qualitative data collected in this study. Thematic analysis was a suitable approach for inductively examining qualitative data and identifying key themes within the dataset. The themes of analysis were derived from the research questions, which specifically focused on the RBF mechanisms and incentives provided by the LMRBF project.

2.2.2 Quantitative research

Quantitative research was applied to collect data on numerically quantifiable human attributes such as number and percentages of last mile customers. Proportionate random sampling was adopted to sample 246 last mile customers of the 5 companies that provided eligible sales under the three RBF schemes. Table 4 presents a summary of sampling for quantitative survey.

Table 4: Sampling for quantitative survey

Company	Sales	Respondents
Engie	4,871	201
Finca	313	10
dLight	159	10
SunKing	189	15
Village Power	53	10
Total	***5,585***	***246***

Structured questionnaires were utilized to collect quantitative data in this study. The PEL team developed structured interview instruments, which were administered to 246 end-users of solar products. To facilitate data collection, the structured questionnaire was scripted in Enketo Smart paper software, enabling research assistants to utilize mobile phones during the data collection process. Quantitative data collected data was analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics and frequencies were employed to analyse and present the research findings.

2.3 Hypothesis and research questions

Supply side assessments focused on solar companies and the three RBF incentives. The evaluation assessed evidenced of impact of the incentives on off-setting costs of solar companies, appetite of solar companies to expand coverage to the last mile as well as evidence of increased sales of solar companies to the last mile. Hypotheses and research questions

corresponding to incentives are presented for each category of incentive as in the paragraphs that follow.

a) Customer Remoteness (CR) incentive

The assessment explored whether Customer Remoteness (CR) incentive induced companies to expand their services into more remote areas, and if such expansions opened markets in remote communities, enabling such companies to serve previously underserved communities.

- **Hypothesis 1**. The Remoteness Incentive contributed to offsetting the increased cost, which arises from high customer acquisition costs and high after sale service costs.

- **Research Question 1 (a):** To what extent has the Remoteness Incentive contributed to offsetting the increased cost of customer acquisition and after-sale service for customers farther from city hubs?

- **Research Question 1 (b):** Was the remoteness incentive used to address the high acquisition costs related to the last mile customers, or fund improvements along the distribution channels, such as improvement of agent structure, awareness campaigns, marketing activities etc.?

b) Asset Financing (AF) incentive

This assessment explored whether the Asset Financing incentive has increased appetite for Solar companies to expand reach to previously underserved or unserved markets, thereby leading to greater access to a wider range of energy products and services to consumers in remote locations or markets.

- **Hypothesis 2.** Providing asset financing incentive to cash companies has reduced the risks associated with longer shelf time of unsold products and risks due to delayed re-payments thereby inducing Solar companies to expand their reach.

- **Research Question 2(a).** To what extent has Asset Financing Incentive addressed the underlying risks of longer shelf time and increased risk of unsold products for cash companies in the last mile.

- **Research Question 2(b).**To what extent has the Asset Financing Incentive addressed the risk of delayed re-payments rates to PAYGO companies participating in the project?

- **Research Question 2(c).** To what extent was the asset financing incentive used to address cash flow/working capital issues related to longer repayment and shelf time?

c) The default incentive

This assessment explored causes of, and barriers to, the low uptake of the default incentive.

- **Hypothesis 3.** There are underlying explanations to why the Default Incentive was not utilized by most solar companies.

- **Research Question 3.** What barriers led to or caused the low uptake of the default incentive and what can be done to address such barriers?

d) Sales of the solar companies

The evaluation explored how the LMRBF investment has contributed to an off-grid market system which is more efficient and effective in reaching out to remote customers.

- **Hypothesis 4:** The LMRBF incentive has resulted in increased sales and revenue growth for the solar companies.

- **Research Question 4:** How many additional sales did the companies make in comparison to the sales year prior to the project? How much of that is attributable to the LMRBF project?

Demand side assessments focused on end-users. The evaluation assessed evidence of increased customer satisfaction, increased usage of the products, increased demand for the products in the target market and increased quality of livelihood. This is expressed in hypothesis 5 and research question 5.

- **Hypothesis 5.** The LMRBF investment has improved the availability of high-quality products and after-sales services for end-users, resulting in a positive impact on their perception of the project's benefits.

- **Research Question 5.** How did the end-users benefit from the project, e.g., did the customers feel that high quality products and after sales services were more available for them?

This evaluation also explored whether access to SHS by customers in remote locations has contributed to improvement in their quality of life. This is expressed in hypothesis 6 and research question 6.

- **Hypothesis 6.** The purchase of SHS has impacted lives of end users in many ways, including benefits such as access to information and improved education hours.

- **Research Question 6**. Did the end users perceive any additional benefits from the SHS purchase that they did not have before e.g., access to information, improved access to energy, improved education through longer study time beyond the daylight hours etc.?

3. Findings and discussions

3.1 End-line results

The LMRBF pilot project aimed to achieve a target of 10,000 verified tier 2 sales by the end of the project. The project timeline was initially set from September 1, 2020, to April 30, 2021, but was extended to September 30, 2022, due to the COVID-19 pandemic and related challenges. A no-cost extension was requested from October 1, 2022, to November 25, 2022, to facilitate incentive payments within the contract duration. A total of 14 solar companies were on-boarded through two application round. Seven (7) companies were selected in each round.

The application process was conducted twice to ensure that a substantial number of solar companies had the opportunity to join the scheme. The first round of applications took place in November 2020, and eight solar companies were selected from the 21 applications received. In the second round conducted in August 2021, seven companies were chosen from the 20 applications received.

Out of a total of 14 solar companies which were on-boarded 6 (Six) companies, namely Engie Energy Access, Village Power Uganda, SolarNow Uganda Limited, Finca Plus LLC Brightlife, Greenlight Planet, and D.Light Limited Uganda, were able to make eligible sales and receive incentives. Four (4) companies presented sales but were deemed ineligible for incentives. These companies include EMFS, Perfect Multiple, Solar Aid Limited, and Relief Line Uganda. Another 4 (Four) companies did not present any sales during the project period. These companies are Kambasco Technology, Sure Power Supplies Limited, S&G, and Battery World Limited. They did not present sales either due to constraints in the project implementation or they realised the project does not fit with their strategies and they dropped off.

A total of 16 claims were processed during the project, with 9,106 sales submitted and verified by an Independent Verification Agent (IVA). Over 5,000 sales were successfully verified through four rounds of verification, resulting in disbursements of UGX 377,507,909.50 for customer remoteness RBF and UGX 265,475,524.71 for asset financing RBF. No disbursements were made for customer default RBF.

Although the project's target was 10,000 verified tier 2 sales, 5,585 households in remote areas were reached with tier 2 sales, providing access to electricity for approximately [1]27,925 people. Additionally, 30% of all SHS purchases were made by women.

3.2 Project design and implementation approach

The design of the LMRBF project aimed to incentivize solar companies to expand sale of their products and after-sales services to reach last mile customers, predominantly those who reside in rural areas. The project design was motivated by the need to address concerns about the perceived higher costs and risks associated with reaching out to these last mile customers. There is a general perception that last mile customers have lower incomes, a lower likelihood of affording SHS, and a higher potential for defaults.

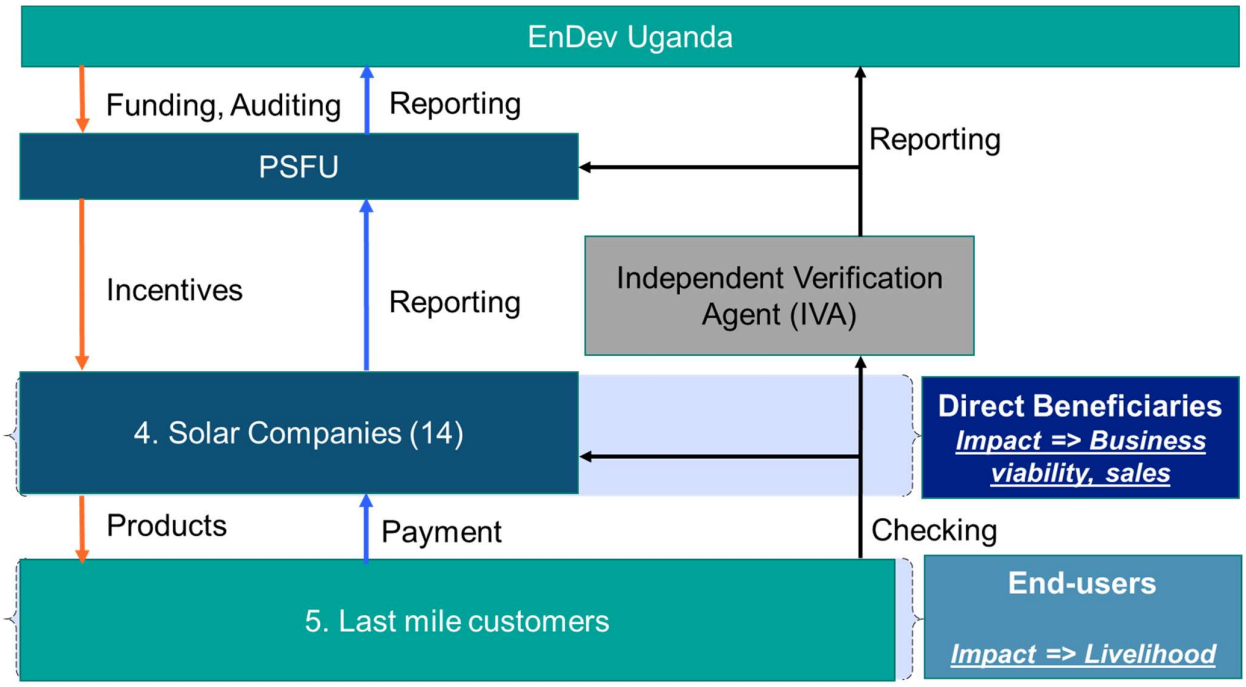
[1] Calculation based on assumption of average number of 5 people per household.

The RBF scheme was developed to support solar companies to grow their respective market presence by expanding their sales into rural and last mile markets. This expansion would be facilitated through a set of 3 (Three) incentives that targeted the costs and risks associated with distributing products in rural areas. Sections 3.2.1 and 3.2.2 present findings and discussions related to specific elements of design and implementation, respectively.

3.2.1 Project design

Figure 2 presents and illustration of design of LMRBF. Explanation of various aspects of design are presented in the paragraphs that follow.

Figure 2: An illustration of LMRBF design



LMRBF design and impact thesis

The design of the LMRBF project was tailored to achieve the intended impact at both the company and end-user levels. The primary objectives were to stimulate increased sales and enhance the business viability of solar companies, while also generating positive livelihood impacts for households. The incentives provided were strategically designed to encourage companies to expand their operations into last mile markets and facilitate sales in those areas.

The use of SHS in last mile communities was expected to lead to various impacts related to household livelihoods. Specifically, the access and usage of SHS for lighting, such as through solar lamps, aimed to improve lighting conditions. Additionally, access to information through technologies like television was anticipated to contribute to enhanced communication and entertainment opportunities for last mile households.

The project had three components: Customer Remoteness RBF, Asset Financing RBF, and Customer Default RBF. The Customer Remoteness RBF was meant to offset the increased costs of acquiring and servicing customers in remote areas. The payment amount was

determined based on the Remoteness Index[2] and the years of free warranty offered. The Asset Financing RBF was meant to offset the costs associated with longer shelf time and customer payment delays for larger products. The payment amount was calculated based on the system landed cost, months covered, and the assumed cost of capital. The Customer Default RBF was an optional scheme that provided default protection for PAYGO companies. PAYGO companies could allocate customers into three credit rating categories, determining the split between cash incentives and contributions to the default pool. The cost of default protection and contribution to the default pool depended on the customer credit ratings.

Alignment with organisational and business strategies of participating companies

The alignment of the Last Mile Results-Based Financing (LMRBF) project with the organisational and business strategies of participating companies varied based on their pre-existing infrastructure and product offerings.

> *"We did not understand the project at the start, but later realized that it was not a good investment for the company. The model was not aligned with company strategy. Our company doesn't sell products on credit, and we don't have the resources to seek customers in remote areas." (KII No.17).*

Companies that already had a reasonable network of branches and sales agents across various districts of the country were better positioned to benefit from the LMRBF incentives. Their pre-existing infrastructure made it easier for them to reach and sell both Tier 1 and Tier 2 solar products to last mile customers, thereby maximizing their potential benefits from the project.

> *"The project model was more suited for established companies that had a network of agents. We don't have resources to mobilize through Local councils and churches, etc. to market our products." (KII No.17).*

> *"After signing the contract, we realized that the project model was not in line with our strategy, and we opted out immediately at the start."(KII No.17).*

However, companies without pre-existing infrastructure and those that were not proximately serving remote customers did not benefit as much from the LMRBF incentives. They faced challenges in reaching and selling to remote customers due to their limited network and geographical reach.

The incentives were designed to specifically promote sales of Tier 2 solar home systems, which posed challenges for companies that had primarily focused on selling Tier 1 products in the past. Such companies that had primarily focused on selling Tier 1 products struggled with the sales of Tier 2 systems to remote customers, as selling Tier 2 products was not their strategic focus. The incentives and reimbursements were tied to a ratio of Tier 1 and Tier 2 sales. For some companies, some sales of Tier 1 products were not incentivised, resulting in reduced amounts claimed for companies with more Tier 1 sales than Tier 2 sales.

> *“Tier 1 is our focus; tier 2 were the bigger systems of 50W and above…. Now our major sales were in tier 1 and so we had to forego tier 1 and resort to tier 2 uh uh tier 2 is not as easy, because people don’t have as much money as I mean (sic) many people don’t*

[2] The Remoteness Index (RI) was purely synthetic and calculated for each household, based on GPS location (location of the SHS). The RI was a decimal number between 0 and 100%, where 0 is urban and 100% is “last mile” or “fully remote”.

have that kind of cash, UGX 1,000,000 to just put on solar, already that was a disadvantage coz (sic) we are getting a less disbursement uh uh yes, by the product choice we had issues". (KII No.18).

"Our targeted customers preferred Tier 1 systems and tier 2 systems were not affordable whereas tier 2 was the priority for the project for a company to realize claims. Customers were fearing to acquire tiers systems because of big loans." (KII No.15).

Well-developed database management systems: Companies with well-developed database management systems, including those using PAYGO systems, performed well under the project. These systems facilitated efficient data capture and monitoring, which contributed to their success in meeting the project requirements.

…We changed our receipts now, the way they look like. Now we have address, personal information, a lot more personal information. The previous one didn't, we now have telephone, number location and this has helped us change a lot going forward (KII No.18).

Some companies that discontinued their participation in the project reported that their business strategy relied on selling solar products through dealers rather than directly to end-users. As a result, they faced difficulties in tracking and reporting sales made directly to end-users, as they lacked direct links to the last mile customers who purchased the products from their dealers. Dealers were reluctant to submit sales data to the parent companies, perceiving it as additional work for which they would not be compensated. This led to challenges in capturing customer information required for claims and verification, particularly for companies positioned to sell to dealers instead of selling directly to last mile customers.

"Dealers come and buy from me and sell, so I really did not care about the last-mile customers. So if my Kiwoko guy comes to me and buys, whoever he sales to in Kiwoko I don't care. If my Arua park guy comes and buys from me, whoever he sales to I don't care because for me he has paid me upfront. Now RBF is about last-mile coz you have to get the coordinates. Because we were not bothered about those last mile, we didn't have coordinates and had to redo the whole exercise with dealers to re-establish where is Mr X, get his coordinates and location that I don't remember. That is why am saying, for me it cost me some money, had to pay people extra to redo it, to recapture. The dealers didn't want to release the information for tax purposes. So information became a problem because I had never done RBF before, but now am doing it (documentation) for every customer (KII No.18).

Financing limitations/constraint

Financing limitations emerged as a significant constraint for companies participating in the LMRBF project, hindering their ability to expand operations and increase sales to last mile customers. These limitations encompassed various expenses that required additional financial resources, including importing components, hiring sales agents and staff for operations in new markets, establishing new branches, and acquiring Global Positioning System (GPS) receivers for customer coordination purposes. Unfortunately, none of the three incentives provided by the project were specifically designed to cover these types of expenses.

“Our company lacked cash flow for distribution and installation of solar systems to remote customers. We would have benefited if the project provided cash advance as part of the incentives ". (KII No.15).

Companies that discontinued their participation in the LMRBF scheme highlighted the need for pre-financing and subsidies to address the financing constraints they faced. They suggested that the project should have provided financial support upfront or subsidies to enhance their capabilities and facilitate the rapid expansion of their sales within the required timeframe of the project. By offering pre-financing or subsidies, participating companies would have been able to alleviate their financing limitations, enabling them to respond quickly to the project's objective of expanding their reach to last mile customers.

“We prefer in business, we do pre-financing, then you cross check after…. Pre-financing on any day would be the preferred model”. (KII No.18).

“In another RBF, we got advance to establish in the refugee areas and the conditions are, if you do not deliver, you refund it. Consider advancing”. (KII No.14).

"A subsidy of say 50% being funded by the project would have benefited the companies to benefit from all the schemes and provided more systems to customers."(KII No.11).

Access to finance for local companies is often a problem. Financing constraints has also been the case with RBFs in other market jurisdictions such as RBFs in Tanzania. Best practice, which is documented in literature (SNV & Sunfounder, 2021) posits that close collaboration with stakeholders in both the energy and financial services sectors, partnerships and linkages to private investment are likely to enhance access to finance for local companies.

Complexity of the RBF concepts and calculating claims

Most KII respondents stated that the design of the three schemes were complicated, and difficult to implement. Verbatim quotation extracted from a KII with D. Light Design Uganda Limited is presented as below.

"The design of the three different schemes and the eligibility criteria was complicated. I would recommend that it is simplified like in the current new EnDev project we are implementing." (KII No.11).

Despite the training support provided by PSFU, several participating companies struggled to fully comprehend the concept and requirements of each of the three RBF schemes. There were also challenges in understanding the criteria for identifying eligible sales under each scheme. Respondents expressed concerns about the complexity of calculating claims under the different incentives, with the customer default RBF being particularly difficult to understand, report, and calculate claims for.

Furthermore, some companies raised concerns about the perceived small size of the incentives compared to the expenses they incurred in reaching out to last mile customers. These companies argued that the current incentive amounts were insufficient to effectively compensate for the costs associated with expanding sales to the last mile.

"The remoteness scheme incentives were very small and too tight relative to the costs of reaching out to remote customers and we were realizing few sales to enable us to make profits. The incentives was not inducing our company to realize adequate sales for claims." (KII No.15).

It was crucial to reassess the incentive structure and ensure that the incentive amounts were aligned with the actual expenses incurred by the companies.

"The RBF boosted our company on the acquisition side but when it comes to the repayment, because these customers place the instalments over time, so because of the nature of the customer also, they are prone to many financial risks, financial shocks and many factors are at play and so the RBF may not necessarily cover the default. (KII No.08)

Tracking sales, records keeping, complexity of the data management tool and reporting

Several participating companies encountered capacity challenges in tracking sales and maintaining accurate records of sales. It was evident that many companies lacked proper systems for records keeping, which is considered essential for effective participation in the LMRBF project.

The collection and entry of sales data, including personal details and receipts, were perceived as complex by most companies. The entry of sales data and customer information required strict discipline and consistent adherence to routine data collection and entry practices. However, since routine data collection was not a common practice for some participating companies, compiling and entering the necessary information for verification became burdensome, time-consuming, and posed administrative challenges. Some companies expressed that the reporting requirements demanded a significant level of effort, sometimes outweighing the perceived gains they obtained from the incentives.

"For the dealer after closing the sales, they would forget those issues of collecting information, so we had to send our staff to look for all those people and get coordinates. The agents did not want to submit the information. The gadgets they were using were smart phones, we did not have GPS machines. They didn't tell us about the devices. (KII No.14).

"The reporting template which was macros in Excel was very hard to understand and unfriendly for entering data. When we had issues, we data entry, we would be told to wait for the developers in Germany to solve the issues." (KII No.11).

"The data entry and computation in the Excel sheet was complicated for us" (KII No.15).

"We had challenges differentiating between the products along tiers for entering in the system for data collection."(KII No.13).

Traits in customers' purchase behaviours and preferences

Companies participating in the LMRBF project encountered challenges related to understanding traits in SHS purchasing behaviours of customers. Many customers bought products on behalf of others – relatives, friends and in-laws. In some cases, customers used agents to buy for them SHS products. This behaviour of purchasing SHS products on behalf of

others added complexity for companies to accurately capture sales data and attribute such sales data to customers appropriately. Furthermore, some customers did not possess Subscriber Identity Module (SIM) cards and telephone numbers and hence used SIM cards and telephone numbers registered in names of others. In some cases, customers were hesitant to provide detailed personal information. This lack of phone numbers and limited willingness to share personal information posed challenges for participating solar companies to collect customer data for the scheme. The absence of complete and accurate customer information hindered the ability to track and verify sales.

> *… I have people who buy and send to their mothers, to take to their villages but when he is buying, he will give his telephone number but this unit is in Kisoro, one guy who works in a shop in Kampala bought for his mother in Masaka. The coordinates we are going to have are for these people but the units are in different places. (KII No.18).*

> *"Our company faced challenges during the verification process because of several reasons. In some cases customers sent technicians to purchase products on their behalf, and the technicians registered their own names instead of names of the actual clients. This led to difficulties in claiming incentives during verification. Additionally, there were customers who were not willing to provide accurate information, making it difficult to trace their systems. Some customers made their purchases through agents, and during verification, they would deny buying from Reliefline, as they were more familiar with the agents rather than the parent company. It was also observed that some customers mentioned buying the product from a company called J Solar, although Reliefline was the actual company delivering the product." (KII No.13).*

Further, it was observed that some customers preferred to have the installation of solar systems conducted by their selected technicians, rather than relying solely on the technicians of participating companies. This preference for independent installation further complicated the process of capturing and verifying sales data, as it required coordination and collaboration with external technicians.

> *"The IVA came back saying people never installed anything, there were only 8% of the people saying they know you. Those people in the villages including my mother would not know coz first of all when you are there to sell, they would tell you we do not want your receipts… the characterisation of the people in the village were not for this project. The people who went for verification instead of asking to attach them to dealers or the works we work with the just went by themselves (KII No.16).*

3.2.2 Project Implementation

Multiple stakeholders were involved in the implementation of the LMRBF project, each playing a distinct role in ensuring success of the LMRBF. Contracts were established to define the relationships between EnDev, PSFU, and IVA, outlining their respective responsibilities and commitments. These contracts served as a framework for effective collaboration and coordination among the parties involved.

EnDev Uganda played a crucial role in supporting the implementation of the project. EnDev contracted PSFU and the Independent Verification Agency (IVA) to manage the project and verify sales respectively. EnDev's role focused on ensuring the quality, transparency, and

effectiveness in LMEBF implementation. GIZ facilitated the development of the project's implementation manual, providing guidance and instructions for its execution. PSFU conducted due diligence to assess the quality and pricing mechanisms of the participating companies, ensuring that the products offered were of high quality and provided value for money to end-users. PSFU also established grant agreements with participating companies. Regular progress meetings and visits to the companies allowed PSFU and GIZ to monitor the implementation of the project, provide guidance and support, and address challenges faced by participating companies.

PSFU, as the Fund Manager served as a central point of contact and support for the participating companies, assisting them in understanding project requirements, and addressing their challenges. PSFU made payments of incentive to the participating companies. They worked closely with EnDev to ensure the quality of the products.

> *"The role of PSFU on the project, we were the Fund Manager for the project and our role involved on boarding the companies, the solar companies to participate in the project. It also involved ah of course on boarding, I mean running the applications, getting the companies on board. The other role was to receive claims. We receive claims, we do the consistence checks of the claims submitted and we then hand them over to the IVA to do the verification. Our other role there was ah to make disbursements…. We receive the claim and o data consistency checks then the claims were now handled by the IVA who did verification. After the verification, the IVA submitted the report to GIZ. GIZ after verification sends us the report, the verified claims for us to pay. So our other role was to disburse payments to the beneficiaries or to the companies. The other one, we were managing the day to day interaction with the companies, offering support were they were having issues, where they are having challenges for example data collection, computing claims. (KII No.03).*

The Centre for Research in Energy and Energy Conservation (CREEC) was the Independent Verification Agency (IVA) for the project. CREEC was responsible for verifying the sales data submitted by the participating companies. They rigorously reviewed the data to ensure accuracy, completeness, and compliance with the project requirements. CREEC also verified the customer information provided by the companies, ensuring its authenticity and adherence to specified criteria. They conducted on-site visits and inspections to verify the installation and functionality of the SHS, assessing compliance of SHS with project requirements.

> *With verification we were trying to verify the truth reported to the funders of this program, that is EnDev and also PSFU which was also involved. We want to verify the data that is sent to them whether it is correct and this was done in three phases. The first phase, we first visit the company and check the receipts, the documents, proof of sales and any documents proving that for this particular reported sale, it was made to this customer on this location with this contract and all other details at this cost. After that we again do, depending on the sizes of the sample, if there are like 1000's, then we do verification of the whole sample, then we do sampling. If there are like 300's then we do verification of the whole of them. …. Telephone, we pick up the phone and call them then we select a few who we visit physically. .. 90% phone interviews and 10% physical verification…. Before the phone call, there is a step of checking data consistence. We create a meeting to go company to verify the physical receipts, a meeting to check 100% of the records. Whatever can't be seen physically is considered ineligible. This is the first elimination*

and thereafter is phone calls. We check if there is a phone number or GPS coordinates, customer name, phone number, location to verify that they are last mile then product profile, is it the one that was reported ah the product cost as well, what mode of payment was made, is it PAYGO or cash. For phone interviews and field visit we followed all the above (KII No.06).

3.3 Solar companies and incentives under the LMRBF

Characteristics of companies which made sales and companies which did not make sales are contrasted in the Table 4.

Table 5: Solar companies which made sales versus those which did not make sales

Characteristics of companies which made sales	Characteristics of companies which did not make sales
• Had already established branches in remote markets	• Had no branches in the new areas where they extended sales
• Had already trained incentivised/ commissioned agents with training in data capture, marketing and installation	• Had to procure new agents or had not train their dealers on the data capture requirements especially for tier 2 systems
• Had already established data capture tools such as customer information systems and GIS and GPS coordinates capture (GPS devices)	• Had no established data capture tools and did not have and know how to use GPS devices for capture of coordinates. Had no or poor receipts capturing little information
• Predominantly multi-national companies with access to funding to pre-finance activities	• Predominantly local companies with no pre-financing to commence the project

3.3.1 Customer Remoteness Incentives

The CR incentive played a vital role in facilitating the expansion of participating companies into remote areas and enabling them to serve customers in these underserved locations. This incentive addressed the additional costs incurred by agents as they ventured into remote areas that were previously beyond the company's usual operational reach. By incentivizing companies to extend their operations and after-sales services to these remote customers, the incentive contributed to increased access to SHS in previously underserved areas.

"…. allowed us to push even further in terms of reach but it would end up costing us a lot ah, first of all, you need to facilitate the agent and then your product is going further, that is a risk as well, because this agent moves with the kits, you are entrusting an agent with products that are worth probably more than what they are earning and that as you go further your cost increases… Because of the incentive you are able to bring that cost down ah by a certain margin and you are able to operate optimally". (KII No.08).

"The customer remoteness scheme offset our acquisition of customers and incentivized the company to expand to areas we were not meeting previously. We received 10.48 million UGX, which was beneficial for the company." (KII No.11).

"Increased sales resulted in increased revenue for the company. Increased sales also impacted on my personal incentives as an individual in the company." (*KII No.11*).

….The cost to the business of bringing the product to that remote customer as far as they can be is already very high and so getting an opportunity where a partner, that is willing to de-risk ah those costs but also help you expand further is something that is attractive…. (KII No.08).

Wasukira Alex, Engie Energy Access - Sales Team Lead and Technician, Mbale.

A number of challenges were encountered by companies regarding the CR incentive. Sales of some companies were rejected because such sales did not meet eligibility requirements of the incentive. These rejections were primarily attributed to sales which are made to customers who are not considered to be "remote enough". Issues with incorrect or missing GPS coordinates further complicated the verification process, leading to difficulties in calculating the Remoteness

Index (RI), which is a critical factor in determining eligibility for the incentive. In some cases, sales were made in urban locations, resulting in the Remoteness Index falling below the threshold set for eligibility and hence such sales were nor incentivised.

> *“Our assumption was that maybe in Buikwe we could receive a small incentive ee (KII No.14).*
>
> *“Some of the sales did not qualify for the remoteness incentive, we did not really grasp that remoteness, you know, because we had sales in Buikwe and also sales in Jinja, Iganga but were rejected….. we didn’t get it clearly that remoteness aspect..(KII No.14).*
>
> *"We thought the remoteness scheme would help us reach out to remote customers. We submitted claims but never got any feedback from the project. The feedback on our claims would have helped our company to understand what did not work and help us to improve." (KII No.15).*
>
> *"The biggest challenge with the project was that there were information gaps and our cash flow both with customers was big." (KII No.15).*

3.3.2 Asset Finance Incentives

The AF incentive had a significant impact on sales, resulting in faster product replenishment and reduced shelf time for participating companies. This led to increased income, particularly for Tier 2 SHS sales, with some companies reporting a doubling of their Tier 2 sales.

> *“By the time the RBF came through, on most of these products and so our sales were less than 100 per month before the RBF. As we went on implementing ah the RBF, we saw this increase, even right now it has helped us drive awareness as more customers bought the products, we achieved beyond the 100 mark to close to 200 per month. It doubled, it has become our normal now, as the product goes into the market, you have more ambassadors that can speak to it. (KII No.08).*
>
> *“. . . . so it greatly helped us release the capital that was locked up in them sitting in the warehouse for long. (KII No.08).*
>
> "Our company benefited from Asset financing because it positively impacted on our revenue." (*KII No.11*).

Notably, some companies which did not make sales under the AS incentive lacked understanding of how the incentive worked. This suggests a need for improved communication and education regarding the incentive. Additionally, it was noted that some companies struggled to differentiate between the different incentives available, indicating a potential need for clearer guidance and distinction between the incentives to avoid confusion.

> "Asset financing required importation, but the process of importation is complicated by taxes, so we were buying from local suppliers. We didn’t want to import because of the complications. The asset financing would have included companies that buy from local companies and are unable to import."(*KII No.15*).

"We did not qualify for asset financing because we were buying products locally." (*KII No.15*).

3.3.3 Default Incentives

Notably, there was no uptake of the default incentive. This is because it was complex to understand and implement. Further, the way companies define and deal with default was not aligned to the way the default RBF model anticipated and dealt with default.

> *"We participated in the customer remoteness index only. We did not understand the others… (KII No.14).*

In the case of one participating company, the process of declaring a payment as a default payment required approximately 60 days. This is longer than what the default incentive considered. Additionally, recovering the product from remote areas, returning it to the store, and updating inventory records were costly and time-consuming processes that the default incentive did not fully account for. This discrepancy between the incentive design and the actual complexities of customer defaults led many participating companies to opt out of the default incentive. Other companies that achieved approved sales for CR and AF RBFs refrained from the default incentive due to its complexity.

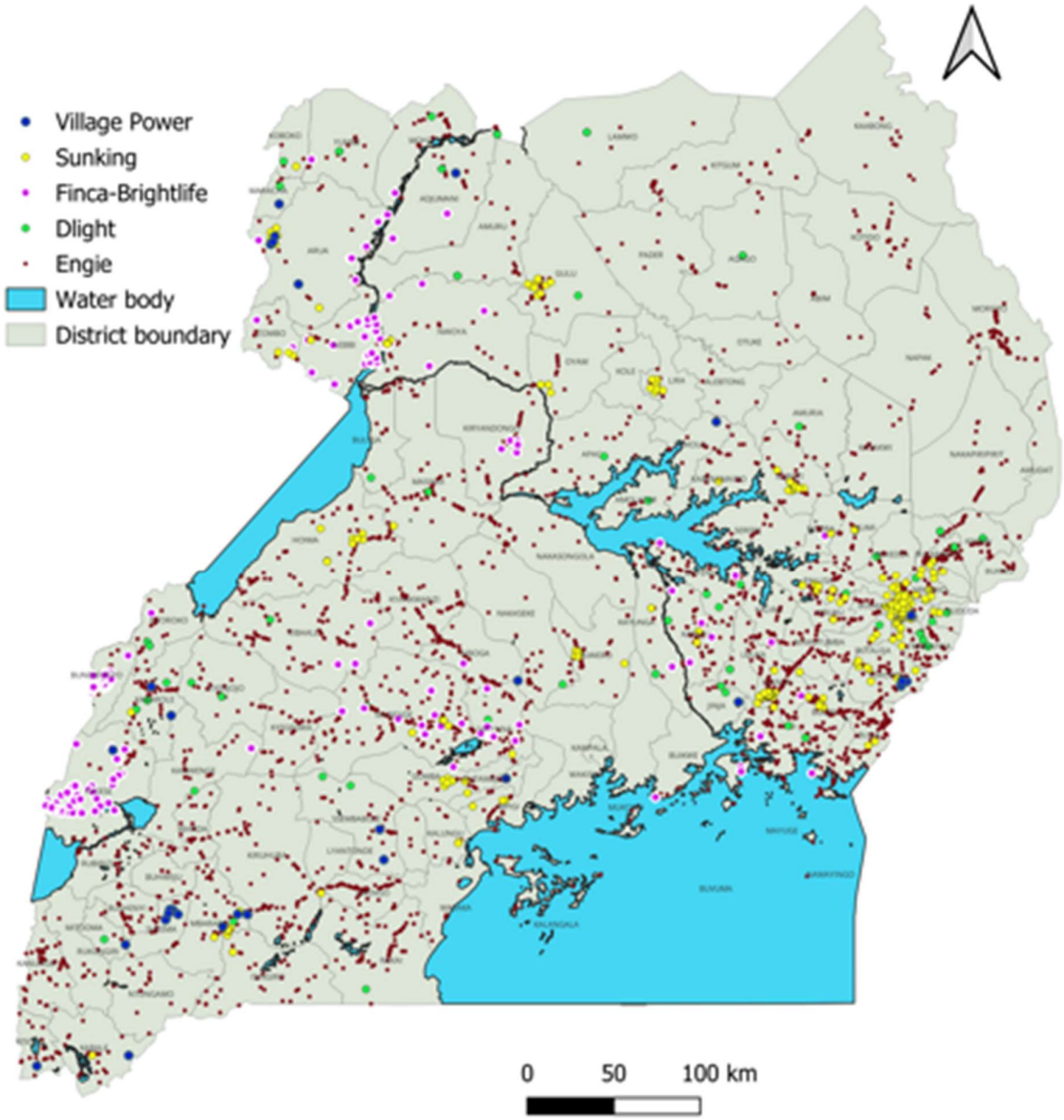
> *"The major thing there really was about aligning how the business operates to what the requirement of the grant is. …. But there are things like now, having to collect the system from the customer or demonstrating that it is back to the warehouse takes a bit of time. So just aligning to the actual model, how it is run in our organisation is something that we had a bit of gaps". (KII No.08).*

> *"It goes beyond okay saying that this customer has taken more than 60 days without paying, there are other things that happen in the field before that customer can be completely declared as a default person. You have to engage them and then there is the repossession and deactivation of the system. Where it is actually, it has to leave the customer's home to come back to us and it's taken back to the warehouse which is, you know these customers are remote. Our agents are selling at the same time along relationship management and so by the time the product is brought, that takes a bit of time, after the re-engaging and then go to the customer, de-activate, bring it to the service centre. The service centre has to do some work on the customer experience side before the product finds its way into the warehouse. Then on the books taken off as a customer default. (KII No.08).*

3.3.4 Sales of solar companies

Analysis of GPS coordinates for sales show that the incentives induced solar companies to make sales to remote customers. Also, participating companies made sales to the last mile customers in all regions and sub regions of the country. This is presented in Figure 3.

Figure 3: Spread of sales made to last mile customers due to LMRBF project.



Notably, sales were concentrated in Eastern Uganda. This is partly because nearly all participating companies were active in Eastern Uganda. Also, according to findings from the demand side survey of end users, referrals appear to be more prevalent in Eastern Uganda. Notably, from the pattern in sales in the GPS data, is that whereas sales made by Engie Energy Access are spread all over the country, other companies made sales in pockets of new last mile markets, in which they extended presence.

Sales of respective solar companies which participated in the LMRBF project increased. Engie Energy Access reported a significant increase in Tier 2 SHS sales, from 100 SHS per month before LMRBF to over 200 systems per month, after participating in the LMRBF project. This growth can be attributed to the incentives provided under the project, which served as a stimulus for increased sales.

…. You see how low the demand for tier 2 is. coz (sic) they are more expensive, affordability is an issue. Us moving from below 100 to now close to 200 tier 2 on a monthly basis is a big movement and I don't think we would have done it without the RBF… (KII No.08).

Referrals prompted increases in sales. Companies received customers referred to them by previous customers, who are satisfied with their products and services. This word-of-mouth promotion resulted in increased sales and enabled the companies to unlock capital from products that had been stored on the shelves for a long time.

… On the demand side it gave us a push in terms of customer demand as we put more products out there.. Our business runs a lot on referrals as customers depend on their neighbours, on their friends for a review of the product. As we put out more of the tier 2 systems, we see that we began to see an increase in demand and customers coming to us for the same product which wasn't the case before. (KII No.08).

Sales claims were rejected due to various reasons. These reasons include the following.

- Untraceable customers - Some customers could not be located at the intended premises as they had moved the systems to different locations. Additionally, inaccurate GPS coordinates led verifiers to incorrect locations, resulting in sales rejection.
- Non-compliance with project requirements - Some products/sales submitted for verification were not implemented within the RBF project timeframe. Furthermore, some companies reported sales of products that were not eligible under the project, such as DC fridges and water heaters.
- Sales not meeting last-mile criteria - Companies submitted sales that did not qualify as last-mile, with a low Remoteness Index (RI) below the threshold. Some companies failed to understand the concept of last-mile customers.
- Challenges with verifications - At the start of the project, the Independent Verification Agency (IVA) visited customers without informing the companies. This led to customers denying access to the IVA. In other cases, customers did not respond to the calls of the IVA. Sales associated with these instances were subsequently rejected.
- Tier 1 system dominance - Some companies submitted an excessive number of Tier 1 systems compared to tier 2, which did not align with the required share of the two tiers. As a result, several Tier 1 systems were rejected.
- Incomplete or inconsistent data sets - Companies submitted incomplete or inconsistent data sets, hindering the IVA's ability to finalize the verification process. Inconsistent data arose because of customers purchasing systems for others and registering different phone numbers, failure to provide phone numbers for verification.

Companies that had ineligible sales attributed their failure to various factors. These factors are related to capacities and expertise of companies, as well as COVID-19 and lockdown containment measures. These factors include the following.

- Lack of understanding - Concepts such as last-mile customers and the calculation of Remoteness Index were not well understood.
- Financial capacities - Local companies, in particular, lacked the resources to pre-finance activities such as staff recruitment, training, and opening branches in targeted districts.
- Database management - Companies lacked proper database management systems to capture and report results, leading to difficulties in maintaining data quality.

- Records keeping - Some companies even lacked receipt books to capture essential customer personal information.
- GPS expertise - For companies whose business models involved selling SHS through dealers, such dealers with whom they dealt were unfamiliar with capturing GPS coordinates and lacked the necessary tools. This created challenges in calculating the Remoteness Index (RI).
- Managing dealers - Some company business models were not suitable for the RBF project, especially those that exclusively sold to independent dealers rather than directly to end-users. This lack of control over dealer operations and sales made it challenging to obtain sales data required for the incentives, particularly the customer remoteness incentive.
- COVID-19 pandemic significantly impacted sales for all companies in two ways; 1) incomes of customers went down, lowering demand for SHS, also and several customers were unable to meet their payment obligations; 2) lockdown imposed by COVID-19 affected movement of sales staff of various companies, thereby affecting sales.

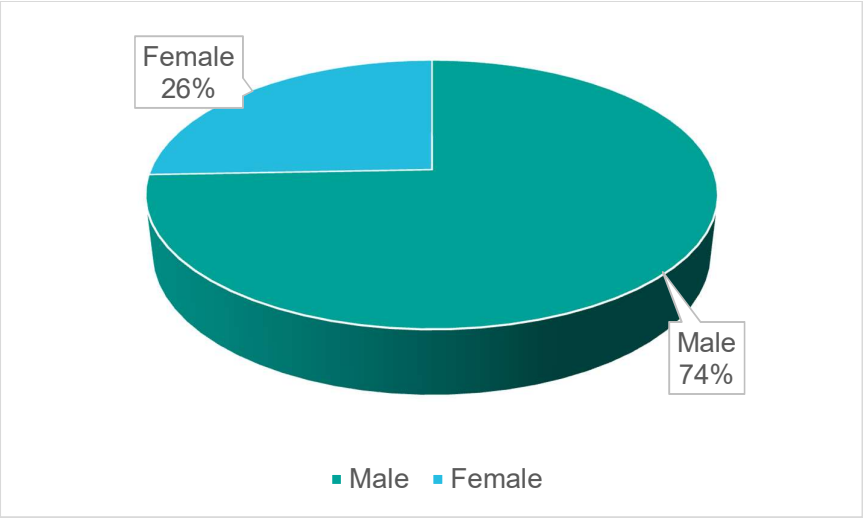
3.4 End-users and incentives under the LMRBF


Nafuna Sumaya, Customer, Engie Energy Access - Mbale

Gender

The profile of last mile customers of SHS surveyed shows that 74% of respondents are male, while 26% are female. This aligns with the broader trend of SHS acquisition, where more male customers tend to purchase SHS compared to female customers. Gender of respondents is presented in Figure 4.

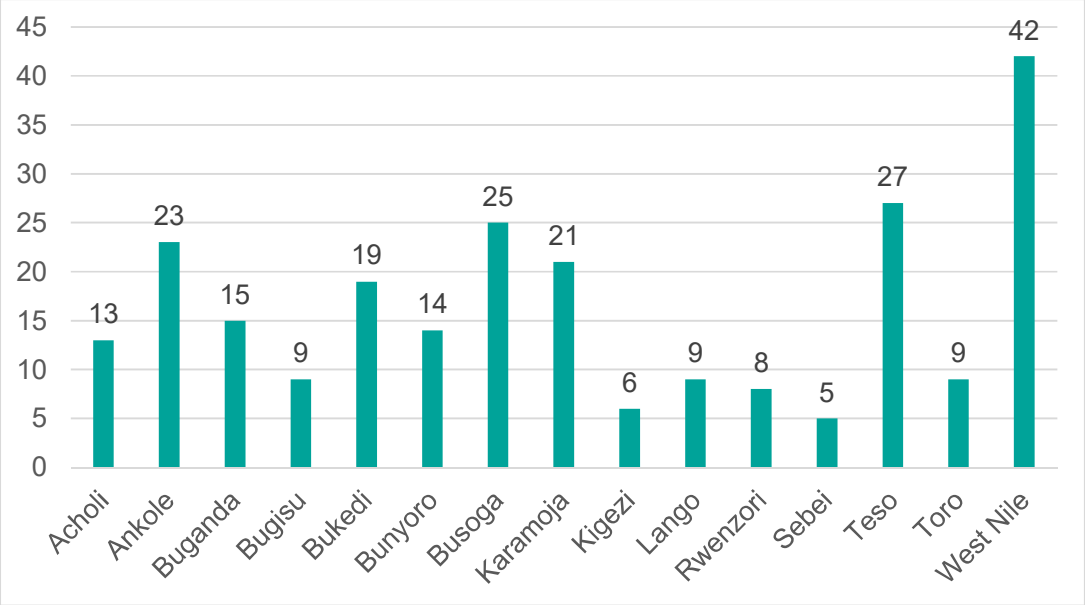
Figure 4: Gender of last mile customers surveyed



Districts and sub regions

Respondents for the telephone interview were from 83 different district of Uganda. These districts are spread over all the 4 regions (Central, Eastern Northern and Western) and 15 sub regions. West Nile (42) contributed the highest number of respondents surveyed, followed by Teso (27), Busoga (25) and Ankole (23). Spread of respondents over the various sub regions are presented in Figure 5

Figure 5: Distribution of respondent across sub regions



Occupation of last mile customers

One half (50%) of customers of SHS are farmers. Others owned grocery shops and some are civil servants who are formally employed. Occupation of last mile customers surveyed are presented in Table 6.

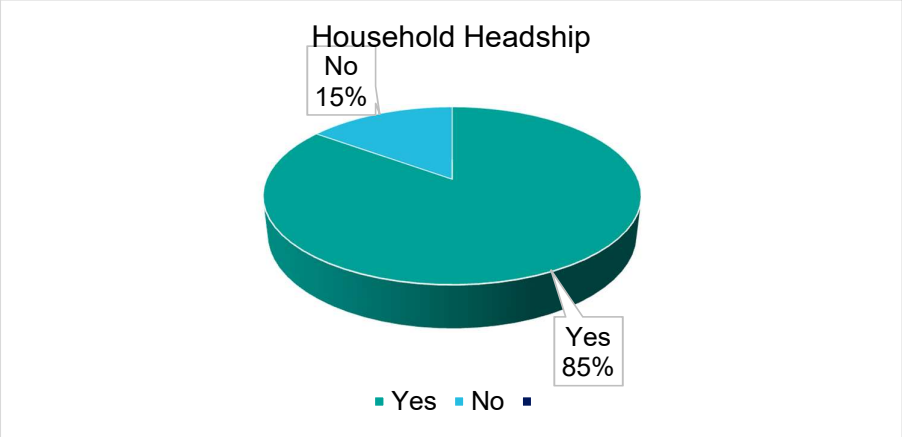
Table 6: Occupation of last mile customers surveyed

	Frequency	Percent	Cumulative Percent
I do farming/crops and livestock	124	50.4	50.4
I own a small shop/grocery	37	15.0	65.4
I am in a formal employment – civil servant	36	14.6	80.1
I am in formal employment – NGO/Private employment?	14	5.7	85.8
If other, please specify	35	14.2	100.0
Total	**246**	**100.0**	

Status of household headship of last mile customers

Notably, the majority of last mile customers surveyed (85%) are heading their respective households. Only a few (15%) are not household heads. Status of household headship is presented in Figure 6.

Figure 6: Status of household headship of last mile customers



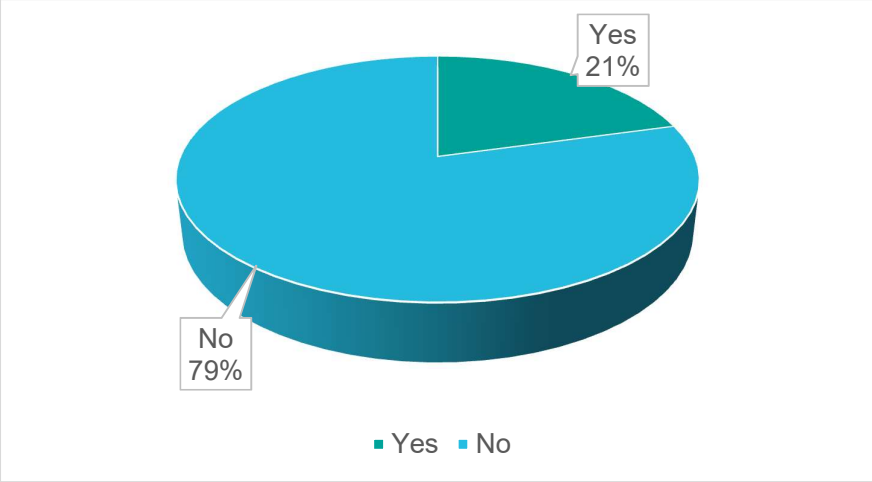
3.4.2 Access of SHS

The LMRBF enabled connectivity and resultantly access of solar electricity to last mile customers, who previously did not have access. Most last mile customers were able to afford SHS of Tier 1 (one) and Tier 2 (Two). Access to Tier 2 SHS dominated and this is consistent with the design of the program. Most last mile customers purchases SHS from agents of participating solar companies, an indication that LMRBF enables solar companies to expand agent network. Further, many report that the distance to the point of purchasing SHS is less than 5 kilometres. Many SHS got to own SHS within the last one year, an indication that they may have purchased SHS as a result of the initiative of LMRBF. The paragraphs that follow present details regarding access and affordability of SHS.

Connectivity to the national electricity grid

A significant majority (79%) of the surveyed last mile customers do not have access to the national electricity grid. For these customers, the availability of solar home systems (SHS) provided by companies supported by the LMRBF project is highly relevant as it allows them to access solar energy and power. SHS serves as a viable alternative for these customers who lack connectivity to the national electricity grid, enabling them to meet their energy needs and improve their quality of life. Status of connectivity to the national grid is presented in Figure 7.

Figure 7: Status of connectivity to the national grid



Type of solar home system purchased

Findings from the survey revealed that a significant majority (81%) of the last mile customers sampled purchased Tier 2 SHS. Notably, the intention of the project was to promote Tier 2 SHS. This finding may indicate that the campaign to promote the sale of Tier 2 SHS to last mile customers during the project, was effective. Table 7 presents types of SHS purchased by the respondents surveyed.

Table 7: Presents types of SHS purchased

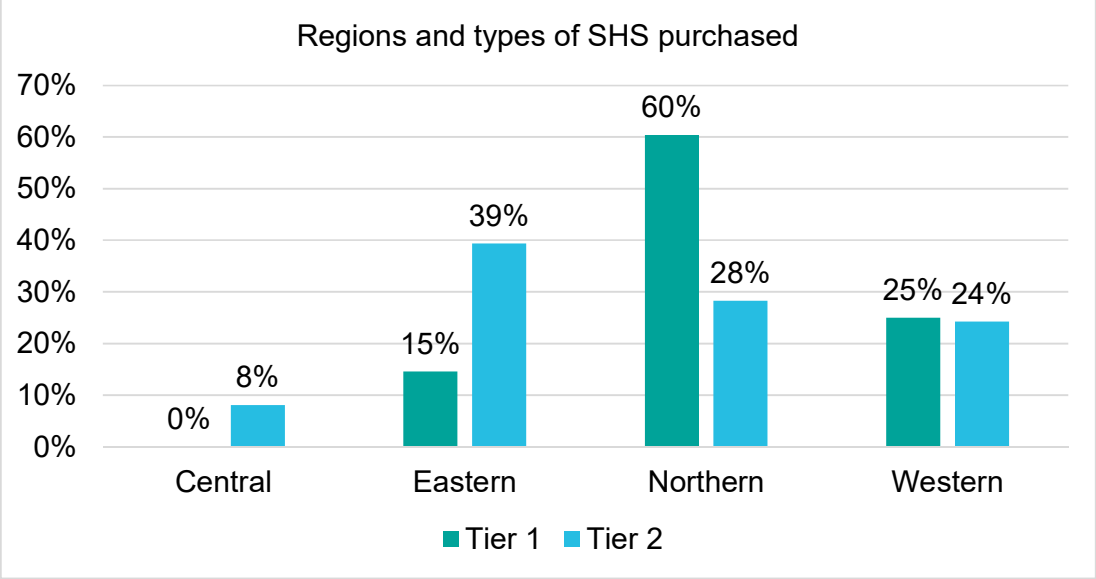
	Frequency	Percent	Cumulative Percent
Tier 1 (Lantern of basic lighting and phone charging)	48	19.5	19.5
Tier 2 (Lighting, phone charging, radio/TV; 4 hours at night)	198	80.5	100.0
Total	**246**	**100.0**	

The findings indicate variations in purchase preferences of last mile customers from different regions of Uganda regarding the type of SHS. In Northern Uganda, a larger proportion of customers (60%) reported purchasing Tier 1 SHS compared to Tier 2 SHS. This suggests that Tier 1 systems are more preferred among customers from Northern Uganda, who were

surveyed. On the other hand, customers from Eastern Uganda showed a higher preference for Tier 2 SHS, with more of them (39%) reporting the purchase of Tier 2 systems compared to 15% who reported purchase of Tier 1 SHS. In Western Uganda, the number of customers who reported purchasing Tier 1 (25%) and Tier 2 (24%) SHS was almost equal. This suggests a balanced preference for both Tier 1 and Tier 2 systems among customers in this region.

These regional differences in purchases of SHS are indicative of the importance of considering affordability and functionality when designing and promoting solar energy solutions. By understanding the specific needs and preferences of customers in different regions, solar companies can tailor their offerings to better meet the demands of each market segment. Figure 8 shows regions and type of SHS purchased.

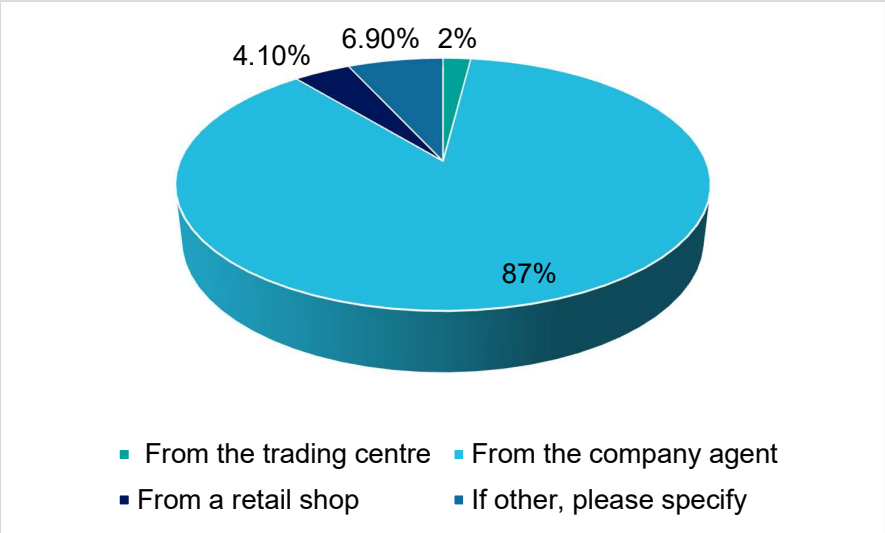
Figure 8: Regions and types of SHS purchased



Place of purchase of SHS

An overwhelming majority (87%) of end-users purchased the SHS from agents of solar companies. It can be argued that the Customer Remoteness RBF may have been a main factor which contributed to induce solar companies to recruit more agents to serve the last mile customers. Figure 9 shows place of purchase of SHS.

Figure 9: Place of purchase of SHS



Distance to the point of purchasing a SHS

The survey revealed that 17.5% of end-users purchased the SHS within a 5-kilometer distance, the project was able to bring SHS closer to such distant customers. This demonstrates the effectiveness of the LMRBF interventions in motivating solar companies to extend their reach to the last mile users. It can be argued that the incentives provided by the LMRBF project have effectively encouraged solar companies to venture into remote areas and make their products accessible to those in need.

Table 8: Distance to the point of purchasing a SHS.

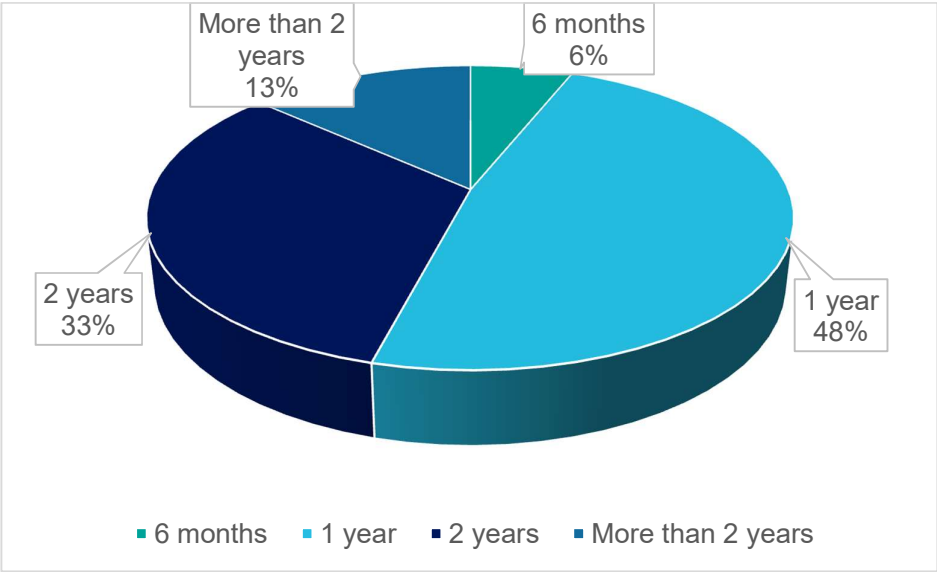
	Frequency	Percent	Cumulative Percent
Up to 5 kilometres	43	17.5	17.5
5 to 10 milometers	22	8.9	26.4
10 to 20 kilometres	23	9.3	35.8
More than 20 kilometres	24	9.8	45.5
Please specify	134	54.5	100.0
Total	**246**	**100.0**	

Length of time customers have owned SHS.

The survey results revealed that nearly half (48%) of surveyed customers had owned their SHS for only a year, indicating a recent increase in the adoption of SHS among last mile communities. In contrast, a small proportion (13.4%) of customers had owned their SHS for more than two years, suggesting that the majority of SHS ownership has occurred within a relatively short timeframe. This highlights the successful acceleration of SHS ownership

through the implementation of the LMRBF project. Figure 10 presents length of time last mile customers have owned SHS.

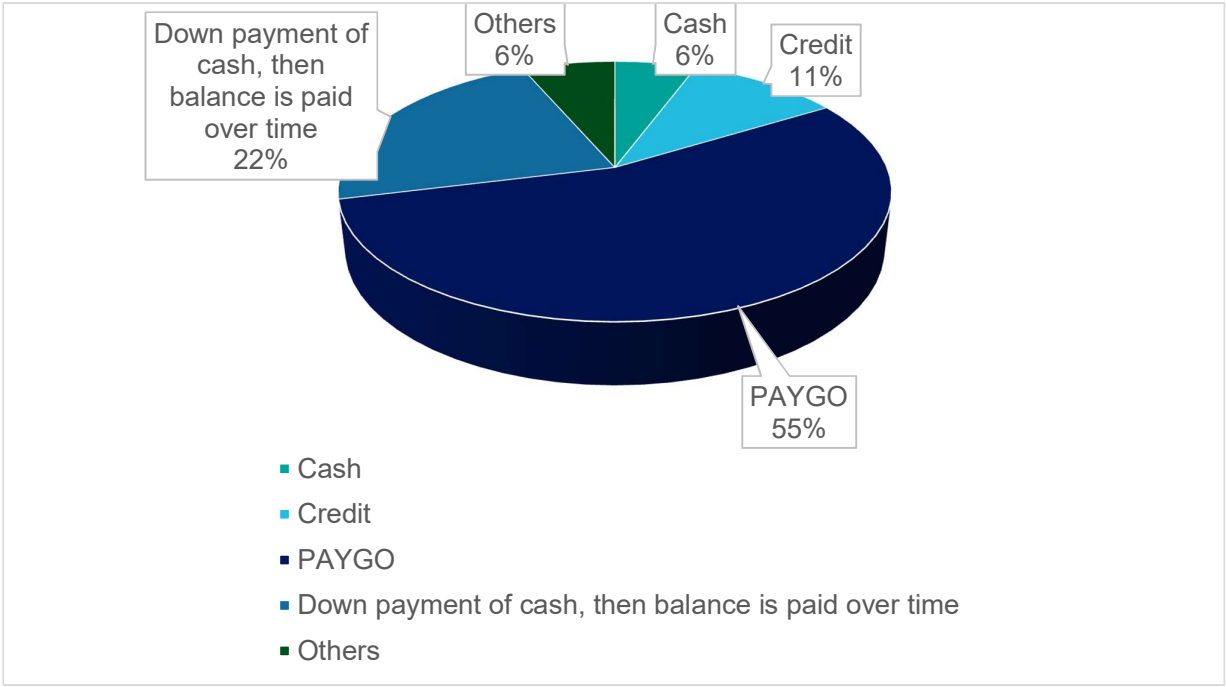
Figure 10: Length of time customers have owned SHS



Mode of payment, which last mile customers used to acquire SHS.

PAYGO is the mode of payment which most last mile customers used for acquiring SHS. According to the survey results, a majority of last mile customers (55%) reported using PAYGO as their chosen payment method. The second most popular mode of payment is hire purchase or leasing, where customers make an initial down payment and then pay off the remaining balance over a specified period of time. Leasing was reported by 22% of the surveyed last mile customers as the payment method they used to acquire SHS. Figure 11 presents mode of payment which last mile customers used to acquire SHS.

Figure 11: Mode of payment which last mile customers used



Cost and affordability of SHS.

The total costs of SHS reported by surveyed last mile customers vary significantly, ranging from 350,000 UGX to over 5,000,000 UGX. The majority of last mile customers (39%) reported the total cost of their SHS to be in the range of 2 million to 3 million UGX. Additionally, 28% of the surveyed end-users reported the total cost of their SHS to be up to 1 million UGX. It is worth noting that higher costs paid for SHS may be attributed to the fact that most last mile customers purchased Tier 2 SHS. This finding reinforces the notion that last mile customers are indeed capable of affording Tier 2 SHS products. Table 9 presents findings related to costs and affordability of SHS.

Table 9: Costs and affordability of SHS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Up to 1million	68	28	28	28
1 – 2 million	16	7	7	35
2- 3 million	96	39	39	74
3-4 million	51	21	21	95
4 – 5 million	14	6	5	100
Above 5 million	1	0	0	100
Total	**246**	**1**	**100**	

Ease with which last mile customers purchased SHS.

A significant majority (over 80%) of respondents reported experiencing ease in accessing and purchasing SHS. Among the respondents, 55% indicated that accessing SHS was very easy, while 30.5% mentioned that it was somewhat easy. This finding highlights the overall favourable experience and convenience of last mile customers in acquiring SHS. Table 10 presents ease with which last mile customers purchased SHS.

Table 10: Ease with which last mile customers purchased SHS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Very easy to access	136	55.3	55.3	55.3
Somewhat easy access	75	30.5	30.5	85.8
Neutral	3	1.2	1.2	87.0
Somewhat difficult access	27	11.0	11.0	98.0
Very difficult access	5	2.0	2.0	100.0
Total	**246**	**100.0**	**100.0**	

3.4.3 Affordability and default

By and large, last mile customers are able to afford SHS, of Tier 1 and Tier 2 and possible SHS of higher Tiers. This contrasts the LMRBF design assumption that last mile customers can hardly afford SHS. The fact that 74% of last mile customers have not yet completed repayment for SHS is consistent with the finding that they averagely clear their outstanding balances within 2 (Two) years. This study postulates that default rate is lower (at 41%), and repayment rates higher (slightly above average, at 51%). However, there could be other factors beyond affordability (i.e. ability to pay) that may drive default. There is need to investigate various factors that drive default – including willingness to repay, as well as factors associated with payment infrastructure such as the ease of using the existing payment infrastructure.

Amount of monthly payments.

Most respondents (52.2%) reported making monthly payments in the range of 100,000 UGX to 500,000 UGX. Additionally, 36.9% of respondents indicated that their monthly payments fell within the range of 10,000 UGX to 100,000 UGX. Table 11 shows amount of monthly instalments paid by last mile customers. This shows affordability of SHS among many last mile households.

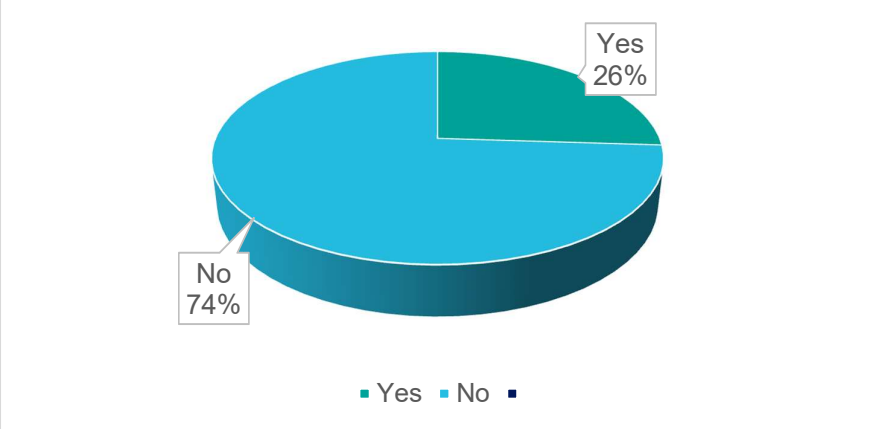
Table 11: Amount of monthly instalments paid by last mile customers

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 10,000	20	8.1	8.1	8.1
10,000 - 100,000	92	36.9	36.9	45
100,000 -500,000	129	52.2	52.2	97.2
500,000 – 1 million	3	2	2	99.2
More than 1 million	2	0.8	0.8	100
Total	**246**	**100**	**100**	

Whether last mile customers have already completed payments for SHS

A significant majority of last mile customers (74%) have not yet completed payments for the SHS, while 26% have successfully completed their payments. This could be a confirmation of and is consistent with the earlier finding that most last mile customers complete payment within a time frame of two years and above. However, studies on the topic of digital credit in East Africa (MicroSave Consulting, SPTF, Smart Campaign, and AFD, 2019) advanced alarming rates of indebtedness and the argument that many borrowers can easily get indebted due to behavioural traits of borrowers. Such studies call for responsible digital credit and a regulatory protection of borrowers. Figure 12 below present status of completion of payment for SHS of last mile customers.

Figure 12: Status of completion of payment for SHS



Length of time to complete payment for SHS.

Among the last mile customers who have completed payment for their SHS, 10% took two years to pay off the full amount. Additionally, 3.7% of last mile customers completed payment within 6 months, while 6.9% took one year to complete payment. A small percentage of customers required more than two years to fully pay for their SHS. Table 12 presents length of time it took last mile customers to complete payments for SHS.

Table 12: Length of time to complete payment for SHS

	Frequency	Percent	Valid Percent	Cumulative Percent
6 months	9	3.7	14.1	14.1
1 year	17	6.9	26.6	40.6
2 years	25	10.2	39.1	79.7
More than 2 years	7	2.8	10.9	90.6
I don't remember	6	2.4	9.4	100.0
Total	64	26.0	100.0	
System	182	74.0		
Total	**246**	**100.0**		

Amount remaining to complete payment for SHS

Among the last mile customers who have not yet completed payment for their SHS, 22.9% have a remaining balance in the range of 1 to 2 million UGX. Additionally, 16% have a balance of 500,000 UGX to 1 million UGX, while 12% have a balance of 100,000 to 500,000 UGX to complete. Table 13 presents outstanding balances of last mile customers.

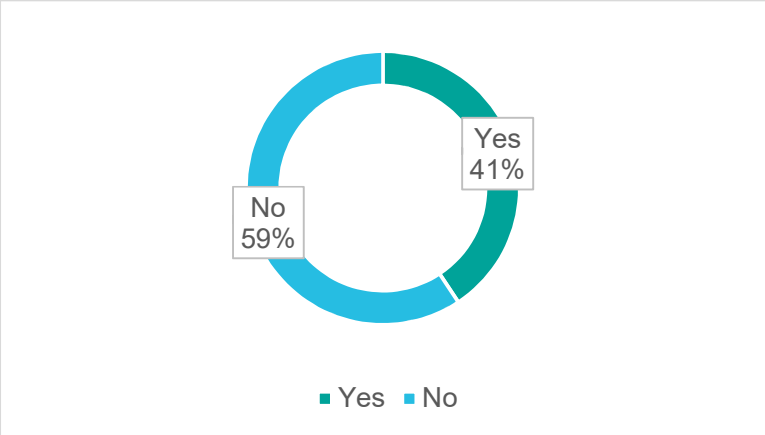
Table 13: Outstanding balances of last mile customers

	Frequency	Percent	Valid Percent	Cumulative Percent
Up to 100,000	35	14.2	18.9	18.9
100,000 to 500,000	31	12.4	16.2	35.1
500,000 - 1 million	40	16.2	21.4	56.5
1 - 2 million	57	22.9	30.7	87.2
2 - 4 million	17	6.8	8.8	96
More than 4 million	2	0.8	1	97
Total	182	73.3	97	
System	64	26.0		
Total	**246**	**100.0**		

Last mile customer default.

Default rate is lower than repayment rate as 41% and 59% of last mile customers defaulted and repaid respectively. This finding indicates that default rate is higher that repayment rate and therefore confirms the default assumption which underlies the design of the project and validates the relevance of Customer Default RBF. Figure 13 indicates default among last mile customers.

Figure 13: Status of default among last mile customers



Length of default period.

The highest default period is 3 months. This is reported by 15% of last mile customers surveyed. Also, 10% of last mile customers reported that they default for less than 3 months. This is presented in Table 14.

Table 14: Length of default

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 3 months	25	10.2	25.0	25.0
3 months	38	15.4	38.0	63.0
6 months	11	4.5	11.0	74.0
1 year	2	.8	2.0	76.0
More than 1 year	2	.8	2.0	78.0
I don't know	22	8.9	22.0	100.0
Total	100	40.7	100.0	
System	146	59.3		
Total	**246**	**100.0**		

3.4.4 SHS usage and improvement in livelihood

Primary usage of SHS are for lighting, watching Television (TV) and charging phones. Benefits derived from acquiring SHS are also consistent with these primary usages – improved lighting, and improved access to communication devices. Access to SHS opened up usage of appliances which were previously inaccessible for the last mile customers. Appliances powered are related to lighting, phone charging and TV. Usage, benefits from usage, as well as appliances which were previously not accessible, but are now being powered by SHS are presented in the paragraphs that follow.

Usage of SHS.

The primary usages of SHS among last mile customers are for lighting and watching TV, as indicated by the survey findings. The majority of customers (76%) reported using SHS primarily for lighting purposes, while 22% of customers reported using SHS primarily for watching TV. Table 15 shows usage of SHS among last mile customers.

Table 15: Usages of SHS among last mile customers

	Frequency	Percent	Valid Percent	Cumulative Percent
Lighting	186	75.6	75.6	75.6
Charging my personal phone	3	1.2	1.2	76.8
Charging phone for others, at a fee/business	2	.8	.8	77.6
To watch TV	55	22.4	22.4	100.0
Total	**246**	**100.0**	**100.0**	

Benefits, which customers derived from usage of SHS.

Usage of SHS has brought about various benefits for customers, with improved indoor lighting and enhanced access to communication devices being the most common benefits. A majority of customers (67%) reported improved indoor lighting as a significant benefit of using SHS, while 27% mentioned that enhanced access to communication devices was a valuable advantage they have derived from the usage of SHS. These benefits have contributed to improving the quality of life for last mile customers.

Table 16: Benefits from usage of SHS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Improved indoor lighting	166	67.5	67.5	67.5
Improved access to communication device (e.g. mobile phones, radios, TV, etc.)	67	27.2	27.2	94.7
Improved performance in school for the children	2	.8	.8	95.5
If others, specify	1	.4	.4	95.9
No Benefit	10	4.1	4.1	100.0
Total	**246**	**100.0**	**100.0**	

Use of SHS to power appliances previously inaccessible to last mile customers

The majority of end users (74%) have successfully utilized SHS to power appliances that were previously inaccessible to them. This highlights the positive impact of LMRBF in enhancing access to energy and also the impact of SHS in expanding the range of appliances that can be powered in last mile communities. Only a small percentage of respondents (25%) reported not

being able to use the SHS to power any new appliances. Table 17 presents whether last mile customer have been able to power appliances which were previously inaccessible to them.

Table 17: Use of SHS on appliances preciously inaccessible to last mile customers

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes.	182	74.0	74.0	74.0
No	61	24.8	24.8	98.8
If others, specify	3	1.2	1.2	100.0
Total	**246**	**100.0**	**100.0**	

Appliances powered using SHS

With regards to appliance powered, nearly a half (48%) of households surveyed use solar electricity to power lighting appliances. Whereas additional 21% use solar electricity to watch TV, 4.5% use solar electricity to charge their personal phones. Findings regarding appliances powered using solar electricity is presented in Table 18.

Table 18: Appliances powered using SHS

	Frequency	Percent	Valid Percent	Cumulative Percent
Lighting appliance	118	48.0	64.8	64.8
Charging my personal phone	11	4.5	6.0	70.9
To watch TV	53	21.5	29.1	100.0
Total	182	74.0	100.0	
System	64	26.0		
Total	**246**	**100.0**		

Undesirable impact of acquiring SHS

Fear that the SHS may be stolen, failure to pay instalments on PAYGO are among the undesirable effects of acquiring the SHS which end users reported. Up to 24% of end users reported that they are scared that the SHS may be stolen and 6.5% reported failure to pay instalments on PAYGO. Undesirable impacts of acquiring SHS is presented in Table 19.

Table 19: Undesirable impact of acquiring SHS.

	Frequency	Percent	Valid Percent	Cumulative Percent
I am scared it may be stolen by neighbours	59	24.0	24.0	24.0
I purchased the system on PAYGO and I failed to pay the instalments	16	6.5	6.5	30.5
It failed to work	16	6.5	6.5	37.0
I do not know how damaged or out of use components such batteries can be disposed of?	17	6.9	6.9	43.9
Other, please specify	138	56.1	56.1	100.0
Total	**246**	**100.0**	**100.0**	

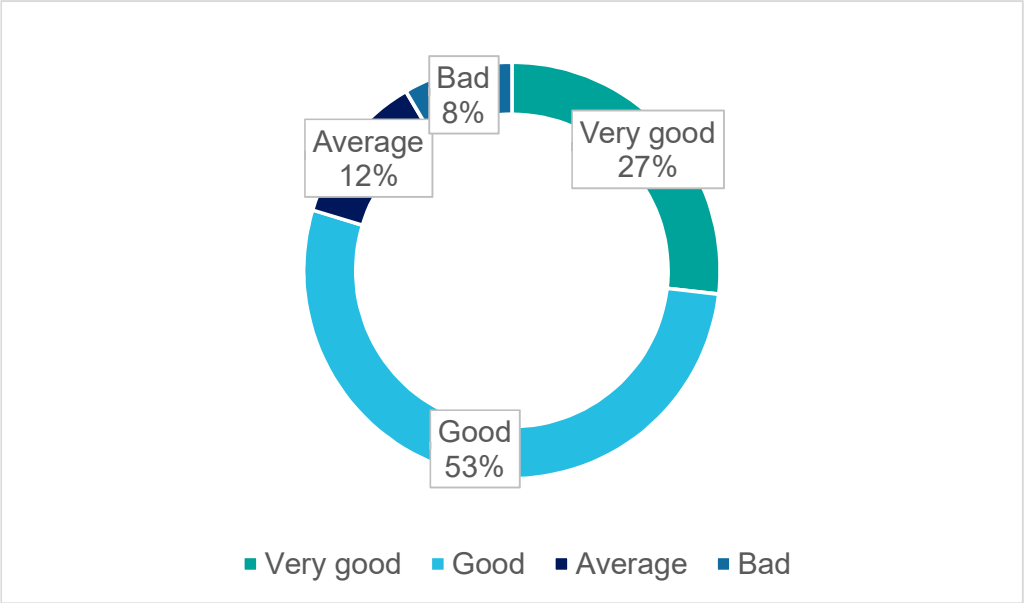
3.4.5 Quality of services

Largely, last mile customers exude positive perceptions regarding quality of services which solar companies provide to them. Most solar companies gave last mile customers warranties. Most warranties last up to 2 (Two) years. Solar companies, represented by their respective staff are easily accessible when last mile customers require their services. Customers' rating of quality of services of solar companies, details regarding warranties and accessibility of solar companies and their staff are presented in the paragraphs that follow.

Customers' rating of quality of services of participating solar companies.

According to the survey, customers generally have a positive perception of the services provided by solar companies. More than half of the respondents (53%) rated the services as good, while an additional 27% considered them to be very good. Only a small percentage, 11.8% and 8.5% respectively, found the services to be average or bad. Overall, the majority of customers expressed satisfaction with the services offered by the solar companies. Customers' rating of quality of services is presented in Figure 14.

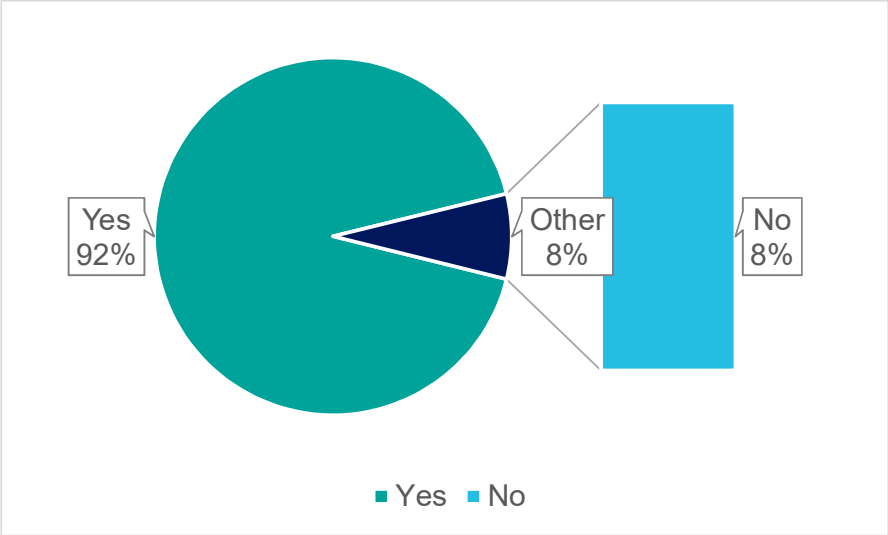
Figure 14: Customers' rating of quality of services of participating companies



Whether suppliers/solar companies gave last mile customers warranties

End users surveyed responded that most solar companies (92%) gave warranties for the SHS they purchased. Only 8% did not give warranties. Figure 15 presents responses regarding whether solar companies gave last mile customers warranties.

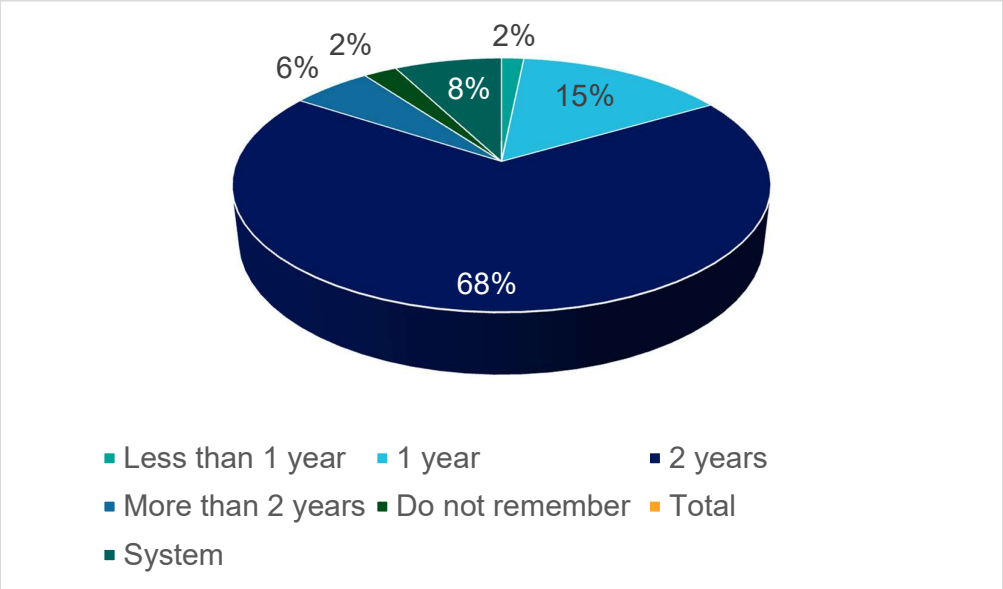
Figure 15: Whether solar companies gave last mile customers warranties



Length of time for warranties

Up to 68% of respondents reported that solar companies gave warranties lasting up to 2 years. Warranties lasting less than a year was reported by a mere 1.6% of the respondents. Length of time of warranties is presented in Figure 16.

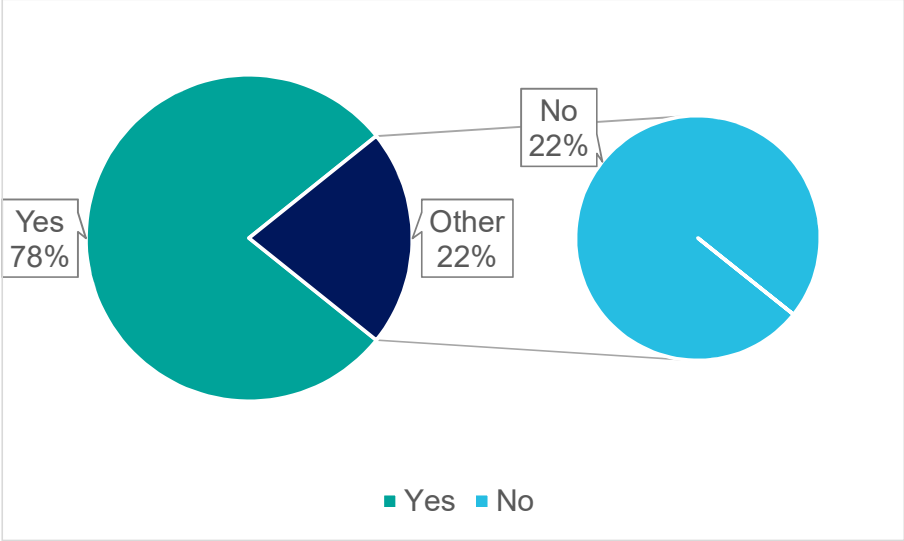
Figure 16: Length of time of warranties



Accessibility of supplier when last mile customers need their services

Most respondents (78.5%) reported that the supplier is readily available when they needed them. Only 22% reported that the supplied is not readily available when they need them. Figure 17 presents accessibility of supplier whenever last mile customers needed them.

Figure 17: Accessibility of suppliers



3.4.6 Challenges of last mile customers and making SHS more accessible

Challenges, which last mile customers experience include; systems breakdown and difficulties in making payments. Improving design by strengthening functionality and durability of SHS and upgrading SHS to higher Tiers are likely to attract last mile customers. Further, addressing

difficulties last mile customer encounter in making payments are likely to increase accessibility of SHS. Details regarding challenges and making SHS more accessible are presented and discussed in the paragraphs that follow.

Challenges, which last mile customers experience.

Last mile customers of SHS reported challenges which they experience. The most prevalent challenge reported by 30% of respondents is system breakdown. Difficulties in making payments were reported by 11% of respondents. Difficulties in making payments arises from either poor cellular network or technical shortcoming of not knowing what to do in making PAYGO payments. Additionally, 9% of customers mentioned facing challenges related to insufficient energy to power their appliances, while 7% expressed concerns about delayed support in rectifying system breakdowns. Table 20 present challenges which last mile customers experience.

Table 20: Challenges which last mile customers experience.

	Frequency	Percent	Valid Percent	Cumulative Percent
System breakdown	71	28.9	28.9	28.9
System does provide sufficient energy to power my appliances	23	9.3	9.3	38.2
Delayed support to rectify system breakdowns	16	6.5	6.5	44.7
Difficulties in making payments	28	11.4	11.4	56.1
If other, please specify	35	14.2	14.2	70.3
No challenges experienced	73	29.7	29.7	100.0
Total	**246**	**100.0**	**100.0**	

Making SHS more accessible to the last mile

End users' suggestions for making SHS more accessible to last mile customers include improving design of Solar Home System, upgrading subsidy to higher tiers, addressing after sale services to the customers and improving payment terms and conditions. Improving design of SHS was reported by 38% of respondents. Upgrading subsidy (incentives) to higher tiers/subsidize SHS for higher tiers was reported by 14% of respondents. Table 21 presents how to make SHS more accessible to last mile customers.

Table 21: Making SHS more accessible to the last mile

	Frequency	Percent	Valid Percent	Cumulative Percent
Improve design of Solar Home System	93	37.8	41.7	41.7
Improve/address payment terms and conditions to the solar companies	22	8.9	9.9	51.6
Address after sale services to the customers	28	11.4	12.6	64.1
Upgrade subsidy to higher tiers/subsidize Solar Home System for higher tiers	35	14.2	15.7	79.8
Address distribution of Solar Home System/ still, bring the services much closer/not close enough	15	6.1	6.7	86.5
Other, please specify	30	12.2	13.5	100.0
Total	223	90.7	100.0	
Missing System	23	9.3		
Total	**246**	**100.0**		

3.5 Systemic change

Findings regarding systemic change is summarised and presented in Table 22

Table 22: AAER and systemic change.

AAER Framework	Responses
Adapt	Companies that had eligible sales were previously mainly dealing in Tier 1 systems but since the project promoted mainly Tier 2 systems, they added them to their stock as new products. They purchased and certified these Tier 2 products as a new product line.
Adopt	These companies were able to penetrate further into the remote areas and they are still operating there since their customer base increased and they have to monitor the product warranties. In addition there have been a number of referrals from the new remote last mile customers reached due to the RBF project.
Expand	A market leader (Engie Energy Access) introduced solar TVs. Customers who previously purchased Tier 1 systems from other solar companies went on to purchase Solar TVs from Engie Energy Access. More customers have expressed interests in Solar TVs and Solar Fridges and are asking companies from which they bought previous products to stock TVs and fridges.
Respond	There is no clear evidence to support the argument that product or service, innovation sparked off by LMRBF triggered a secondary response from players in the wider Off-grid/solar energy, Pay-go sector sectors.

3.6 Impact, coherence, effectiveness, relevance, and sustainability

Impact

The project had positive impacts on participating companies as well as households and communities. Further the project also had unintended impacts. Intended and unintended impacts of the LMRBF project are elaborated below.

Positive impact

The project led to expansion of distribution channels and increased sales for participating companies. Such channels allowed the companies to reach new markets and increase their customer base. This expansion led to an increase in sales and revenue, indicating a positive outcome for the companies. Additionally, the project also resulted in improved operational efficiencies and the adoption of new technologies such as use of GPS in tracking sales.

> *"The project helped us develop robust database management systems and record-keeping mechanisms, improving our data capture and storage." (KII, Delight).*

> *"The customer remoteness incentive allowed us to penetrate remote areas that we wouldn't have reached otherwise, resulting in increased sales." (KII, Delight).*

"Our customers are now recommending our products to others, which has helped raise awareness and generate new sales opportunities." (KII, Delight).

"*By seeing colleagues with systems that had TVs, remote customers were induced to acquire Tier 2 systems. There is increasing customer preferences shifting from tier 1 to tier 2 through recommendations from customer peers."(KII, Delight).*

"Increased sales allowed us to replenish products on the shelves more quickly and generate higher income, particularly in tier 2 systems." (KII, Delight).

The project led to an increase in the adoption of off-grid solar systems particularly among rural communities in Uganda. For customers who adopted and used SHS, the project led to access to clean energy, which in turn had various positive impacts on the overall quality of life, such as better lighting and improved access to information.

The project had a positive impact at the community level. By expanding their operations and distribution channels, the participating companies created employment opportunities within the local communities. Sales agents were recruited from the local communities. Some companies fostered partnerships with local suppliers and businesses, further stimulating the local economy by way of sourcing various inputs from such local economies.

Unintended impacts

At the company level, unintended impacts include a likelihood for a few performing companies to monopolise the energy sector, financial losses to the company, caused by investment in implementing LMRBF, which went unrewarded and frustration, especially of management of companies whose claims were rejected. These are summarised in verbatim quotations below.

"We invested a significant amount of money in data collection, staff recruitment, and purchasing tier 2 products, but these efforts were not rewarded as we did not achieve eligible sales." (KII, KII, Reliefline).

…I was highly frustrated and disappointed, I worked on the project for over a year. I devoted my time to the project and coordinating people in the field in the COVID season looking for money here and there for them to execute because it demanded results, coz (sic) it was result based (KII, Perfect Multiple Engineering and Consultancy Services Ltd).

The effort we put in, first to participate, two to mobilise. I assured my team that this is going to work for us as a company, we are going to benefit …. I deployed people…. I can't participate in it coz you put in and they don't measure the effort, they don't measure my participation, don't monitor me when am working, they come at the last time when I have fed them with information.. We went in for a wrong project, the project that was not considering the smallest effort put in .. I made the company release money for the project utilised the money to sort the guys in field but none came back… (KII, Perfect Multiple Engineering and Consultancy Services Ltd).

.. I did not get anything, I did not benefit, I now decided with my team to pull out of the result based…(KII, EMFS Uganda Limited)

At the customer level, the undesirable impact is cognitive. These include; a) fear that the SHS may be stolen, and b) fear of failure to pay instalments on PAYGO.

Coherence

The project was aligned with the broader policy objectives of increasing access to clean energy and reducing poverty in Uganda. By incentivizing off-grid solar companies to expand their operations and provide clean energy solutions to remote customers, the LMRBF project directly contributed to achieving these objectives.

A range of stakeholders including USAID, PSFU, and MEMD were involved in implementation and monitoring activities through consultations, workshops, and engagement sessions. This involvement of stakeholders ensured that the project considered diverse perspectives, leveraged local knowledge and expertise, and fostered collaboration among different actors. Further, collaboration with partners in design and implementation of the project demonstrate alignment with existing initiatives to avoid duplication of efforts and maximize project impact.

Relevance

The project objectives were aligned with Sustainable Development Goals (SDG) 7, Uganda's Vision 2030 and 2040, Energy access targets in Third National Development Plan (NDP III), as well as the needs and priorities of the target population. SDG 7 calls for affordable, reliable, sustainable, and modern energy for all. The project objectives of eliminating risks and barriers of companies to invest in the last mile were directly related to addressing the identified needs and priorities of the target population and were also aligned with the stakeholder's strategic aspirations of extending access to solar energy to the last mile. By addressing pressing needs of the target population, the project demonstrated its relevance. Pressing needs of the target population include lighting, access to information and access to clean energy.

Effectiveness

Overall, the strategy deployed by the project (i.e. RBF) were effective in increasing sales for participating solar companies. More than 5000 sales were verified as eligible sales and were incentivised. However, the three RBFs has varying levels of effectiveness. Going by the sales and disbursement figures, it appears that the CR RBF was most effective. Disbursements for CR RBF was the highest, reaching UGX 377,507,909.50. The CR RBF was clear to understand and most companies participated in the CR RBF. The AF RBF followed the CD RBF in effectiveness. Disbursement for AF RBF reached UGX 265,475,524.71. No disbursements were made for customer default RBF. Therefore, there is no clear evidence to affirm or dispute the effectiveness of Customer Default RBF.

Over 5,000 households in remote areas across the country were connected to solar power. From the perspective of these end-users, the project strategy (i.e. the RBF and incentives) was effective to enable access to solar energy by the last mile. Access to solar energy led to improvement in quality of life for those who were able to purchase SHS. They were able to access information, lighting, and entertainment among others.

Sustainability

LMRBF incentives promoted solar companies to sell Tier 2 SHS. In the process the incentives stimulated market for Tier 2 SHS and hence opened new market frontiers for Tier 2 SHS. The

market has responded well and there is noticeable demand for some Tier 2 and higher Tier SHSs. Solar companies have remained in the last mile market and they continue to serve the last mile markets several months after the LMRBF has ceased. Further, solar companies show no signs or relenting in serving the last mile market. Referrals and word-of-mouth (WOM) continue to open up last mile market. Current and repeat customer radiate demands for higher Tier SHSs. Such demands will continue to sustain sales in last mile markets.

4. Conclusions and recommendations

4.1 Conclusions

4.1.1 LMRBF and energy market

Companies which made sales had the following features;

a) Had already established branches in remote markets;
b) Had already trained incentivised/ commissioned agents with training in data capture, marketing and installation;
c) Had already established data capture tools such as customer information systems and GIS and GPS coordinates capture (GPS devices);
d) Predominantly multi-national companies with access to funding to pre-finance activities. Such companies were incentivised. This was to be expected because by its nature RBFs are results driven and these companies were able to deliver the results.

Out of a 14 solar companies which were on-boarded, only 6 (Six) companies were able to make eligible sales and receive incentives. Furthermore, 1 (one) company made more than 80% of all eligible sales which was incentivised. In such cases where a few companies benefit, there is likely to be a market concentration and monopolies may arise.

PSFU provided business support to many companies. Such support has been applauded by a number of companies who participated. Some of the companies which benefited from such support were not able to report sales but they appreciate the benefit of such support. Further areas where companies had capacity challenges were identified. These include – Capacity to Remoteness Index, capacity for database management, capacities for records keeping and book keeping, GPS capacities and capacities for managing dealers. Best practices for design and implementing RBFs considers tailored business support featuring to be effective in building various capacities which the local companies need to have in order for them to participate in RBF schemes and benefit from their participation. Building capacities of local institutions is also consistent with arguments the postulate ecosystems strengthening and systems change in RBFs.

LMRBF was cognisant of the argument for localisation and inclusion of indigenous companies. During the implementation of the LMRBF, there were 2 (Two) rounds of on-boarding. The application process was conducted twice to ensure that a substantial number of solar companies had the opportunity to join the scheme. Localisation is relevant to build an extensive ecosystem of players with varying products and offerings, stimulating competition and eventually improvement in product and service offerings. Further, RBF programmes can enhance their additionally and sustainability by identifying promising local companies, and build their capacities. It is noted that the first round of applications took place in November 2020, and eight solar companies were selected from the 21 applications received. In the second round conducted in August 2021, seven companies were chosen from the 20 applications received. Although a number of local companies dropped off in the curse of the implementation of LMRBF, there were initiatives to inculcate considerations for localisation.

4.1.2 Project design and implementation

Project design and assumptions

Design is based on an assumption of costs and risks of serving the last mile customers. The assumption is that expanding access of solar energy to the last mile communities is impeded by high costs and risks associated with lower incomes, a lower likelihood of affording SHS, and a potentially higher rate of defaults. Findings of this study, regarding affordability posits that last mile customers are able to afford SHS, of Tier 1 and Tier 2 and possible SHS of higher Tiers. This contrasts the LMRBF design assumption that last mile customers can hardly afford SHS. Further, this study postulates that default rate is lower (at 41%), and repayment rates higher (slightly above average, at 51%), in contrasts to the design assumption that default rates are high among last mile customers.

4.1.3 Solar companies and incentives under the LMRBF

To what extent has the Remoteness Incentive contributed to offsetting the increased cost of customer acquisition and after-sale service for customers farther from city hubs?

Uptake of remoteness incentive was highest. The remoteness incentive was the easiest to understand and to implement. The Remoteness Incentive successfully incentivized solar companies to venture into remote areas that they would not have otherwise reached. This led to increased market penetration and access to last mile customers, who are located far from city or town centres. Further, companies reported an increase in sales of solar home systems (SHS) in remote areas due to the support provided by the Remoteness Incentive. The incentive motivated companies to overcome the higher costs and associated risks of operating in remote locations, enabling them to serve customers who were previously underserved.

Was the remoteness incentive used to address the high acquisition costs related to the last mile customers, or fund improvements along the distribution channels, such as improvement of agent structure, awareness campaigns, marketing activities etc.?

Overall, remoteness incentive was used to cover overhead costs related to operations. There is hardly any indication that the remoteness incentive was used to fund improvements along the distribution channels, such as improvement of agent structure, awareness campaigns, and marketing activities.

To what extent has Asset Financing Incentive addressed the underlying risks of longer shelf time and increased risk of unsold products for cash companies in the last mile.

Increased sales due to asset financing reduced shelve time of products hence leading to higher income for Tier 2 SHS sales. By providing financial support and incentives, such as asset financing, the Asset Financing incentive helped some companies improve their cash flow management by reducing the time and cost associated with holding inventory. This led to a positive impact on the inventory management for companies that benefited from the Asset Financing scheme. However, a conclusion cannot be made, regarding the extent to which the Asset Finance incentive led to profitability of participating companies. This is because selling more SHS does not automatically translate to profitability. A company may have to invest more in making such sales.

To what extent has the Asset Financing Incentive addressed the risk of delayed re-payments rates to PAYGO companies participating in the project?

The findings suggest that the asset financing incentive contributed to mitigating the cash flow challenges associated with longer repayment and shelf time. Participating companies were able to unlock capital by increasing sales and replenishing their inventory. This suggests that by increasing sales, the Asset Financing incentive played a role in improving cash flow and working capital management for the companies. However, it is inconclusive whether the Asset Financing incentive addressed the risks of delayed re-payments. This is because the improvement in cash flow appears to be driven by increased sales as opposed to improved repayments.

What barriers led to or caused the low uptake of the default incentive and what can be done to address such barriers?

The low uptake of the default incentive can be attributed to several barriers. These are summarised as follows.

- The Customer Default RBF model defined default differently from the way participating companies understand and operationalize default.
- Registering default, in the way that makes it eligible was costly and time consuming. The process of product recovery and inventory management was long and costly.

How many additional sales did the companies make in comparison to the sales year prior to the project? How much of that is attributable to the Last Mile RBF project?

Most companies reported increased sales, especially for Tier 2 SHS. In one case, the tier 2 sales increased from 100 systems per month to over 200 per month after participating in the RBF project. The increment in sales is largely attributed to the incentives obtained under the LMRBF project.

4.1.4 End-users and incentives under the LMRBF

How did the end-users benefit from the project, e.g., did the customers feel that high quality products and after sales services were more available for them?

The LMRBF enabled connectivity and resultantly access to clean energy to the last mile customers, who previously did not have access. Interventions of the LMRBF reduced the distance to the point of purchasing SHS to less than 5 kilometres for many last mile customers. Last mile customers primarily use SHS for lighting, watching TV and charging phones. Benefits derived from acquiring SHS include improved lighting, and improved access to communication devices. Largely, last mile customers exude positive perceptions regarding quality of services which solar companies provide to them. Most solar companies gave last mile customers warranties. Most warranties last up to 2 (Two) years. Solar companies, represented by their respective staff are easily accessible when last mile customers require their services. Customers' rating of quality of services of solar companies, details regarding warranties and accessibility of solar companies and their staff are presented in the paragraphs that follow.

Did the end users perceive any additional benefits from the SHS purchase that they did not have before e.g., access to information, improved access to energy, improved education through longer study time beyond the daylight hours etc.?

Access to SHS opened up usage of appliances which were previously inaccessible for the last mile customers. Appliances powered are for lighting, phone charging and TV. The end-users perceived additional benefits from the purchase of solar home systems (SHS) that they did not have before to include; improved lighting, access to information as well as access to entertainment.

What worked well and what were the main challenges that companies faced under the Last Mile RBF?

Support which was provided by PSFU was appreciated by most participating companies. PSFU's initiative to provide capacity support was beneficial to a number of local companies, which had capacity constraints.

Further, the design of the LMRBF project was well-suited to companies that already had an extensive network of branches and sales agents across the country. For such companies, the project successfully incentivized them to penetrate remote areas and reach last mile customers. Further, the project encouraged the sale of Tier 2 solar home systems (SHS) to last mile customers. This aligned with the strategy of diversifying product offerings and catering to different customer segments. Companies which were dealing in predominantly Tier 1 SHS struggled to make Tier 2 sales.

The main challenges that companies faced are related to capacities and expertise of companies, as well as COVID-19 and lockdown containment measures. Capacity challenges include; limited capacity to comprehend the last-mile concept and capacity to calculation Remoteness Index and calculation of other incentives; financial capacities to re-finance operations; limited capacities for database management, limited capacities for records keeping , inadequate skills to use GPS; limited capacities to manage dealers.

What should have been done differently in terms of project design to increase tier 2 solar energy access amongst last mile customers?

For all the participating companies, Customer Default RBF was complex and not aligned with the considerations of how companies defined default. Complexity of default incentives deterred companies from participating in the RBF. Customer Default incentive should have been designed to be easy to understand and implement.

Capacities of participating companies were strained. Taking into consideration capacities of participating companies at the design stage is important in order to enhance their effective participation. In the case of LBRBF, relevant capacities included capacity for database management, capacities for records keeping and book keeping, GPS capacities and capacities for managing dealers. Deign should have factored in an element of capacity building for solar companies.

Local companies highlighted resource limitations as a significant obstacle for them to make eligible sales to the last mile. Appropriate linkages to financing should have been facilitated or brokered.

The onset of the COVID-19 pandemic had a negative impact on the sales and revenues of all participating companies. It further strained their already limited resources, leading to financial losses for some companies and necessitating changes in product portfolios. Being a pandemic, little could have been done about COVID-19 at the project design stage.

4.1.5 Systemic change

There is evidence of adapt, adopt and expand. Evidence of adapting is observable in the aspect that companies which previously dealt predominantly in Tier 1 SHSs moved to supplying more of Tier 2 SHSs. Adoption is observable in the aspects whereby solar companies which penetrated in remote markets are continuing to independently serve such remote markets long after the LMRBF has already phased out. Customers have also responded positively. Markets in remote areas have continued to grow as a result of referrals. Such referrals continue to enhance growth for the markets of SHS from solar companies which participated in the LMRBF. Expansion in the market is observable. Market leaders (e.g. Engie Energy Access) introduced solar TVs. Customers of other solar companies have expressed interests in Solar TVs and Solar Fridges and are asking companies from which they bought previous products to stock TVs and fridges. However, there is no clear evidence to support the argument that product or service, innovation sparked off by LMRBF triggered a secondary response from players in the wider Off-grid/solar energy, Pay-go sector sectors.

4.1.6 Impact, coherence, effectiveness, relevance, and sustainability

In conclusion, the project has had a significant impact, demonstrated coherence and effectiveness, maintained relevance, and displays good signs of continuity, even after the project has closed. Summary explanations are presented as follows.

Impact
The project has had a significant impact on its beneficiaries – the last mile customers. It has increased access to clean energy for remote communities, improved lighting conditions, and enhanced the quality of life for beneficiaries. The expansion of distribution channels and the adoption of new technologies have positively influenced company performance and financial sustainability.

Coherence
The project demonstrates coherence with the broader policy objectives of increasing access to clean energy and reducing poverty in Uganda. It aligns with other development interventions and programs in the off-grid solar sector, avoiding duplication of efforts and maximizing impact. Collaboration with key stakeholders and partners has ensured coordination and coherence with existing initiatives, fostering a synergistic approach towards achieving common goals.

Effectiveness
The project has been effective in achieving its intended results and objectives. It successfully engaged solar companies and incentivized them to expand their operations, resulting in increased sales and adoption of off-grid solar systems. The project's outputs and outcomes were largely achieved as planned, with a significant number of solar systems sold and connected to households in remote areas. CR RBF was most effective because it was clear to understand and most companies participated in it. The AF RBF followed the CD RBF in effectiveness. No disbursements were made for customer default RBF. Therefore, there is no clear evidence to affirm or dispute the effectiveness of Customer Default RBF.

Relevance
The project is highly relevant to the needs and priorities of off-grid solar companies and the target population in Uganda. It has addressed the pressing needs of remote communities for clean energy solutions, improved access to lighting, and increased productivity. The project's objectives were clear, and stakeholder involvement in the design and implementation ensured alignment with local contexts and aspirations.

Sustainability
The project has laid the foundation for long-term sustainability in the off-grid solar sector. By strengthening local institutions, promoting market development. Capacity building initiatives and knowledge-sharing platforms have equipped stakeholders with the skills and knowledge needed for sustained operations.

4.2 Recommendations

4.2.1 Project design

1. Build capacities of local institutions as a way to build or strengthen the renewable energy of solar energy ecosystem.
   a) Conduct strategy and capacity assessments of potential participating companies during the on boarding stage.
   b) Strategy assessment should look for alignment between the company's strategies and the RBF. Assess the compatibility of the RBF model with different company business models before implementation. Business model include distribution channel, products and services, targeted market and geographic coverage.
   c) Capacities assessment should focus on those topics which have been highlighted in this report to be problematic for local companies as basic capacities and extend to other capacity areas, relevant to a particular RBF objective. Capacities highlighted in this report include capacity for database management, capacities for records keeping and book keeping, GPS capacities and capacities for managing dealers.
   d) Put in place parallel grants to support and provide BDS and capacity development of local companies and link such grants to the RBF scheme and allow for companies to graduate from a preliminary stage of capacity development to another stage where they can participate in the RBF grant.
   e) Develop partnerships with relevant actors in the ecosystem to allow for supporting capacity development.
   f) Consider a kick-off workshop to get feedback on the design of the project before roll-out of the project.

2. Enhance competition and avoid pitfalls of market concentration and incidences where monopolies may arise in the market and also to allow for localisation of operations.
   a) Solar companies/potential participants in RBF schemes are not homogenous. A tiered approach to on boarding is recommended. In this tiered approach companies should be clustered according to their capacities and support to them disaggregated according to their capacities.
   b) It is recommended that design allows for tailoring approaches to enable participation of multiple companies of varying sizes and scale of coverage.
   c) Design should allow for localisation of districts or regions of operation. This will enable smaller companies to identify and serve segments which are within their capacities.

3. Learn from best practices and use such learning to improve future design. Future design should follow and be consistent with best practices identified in literature on RBF and also best practices identified in this impact assessment. These include;
   a) Make RBFs and associated indexes simple to understand and compute and practically applicable and relevant to the participating companies
   b) Improve the clarity and understanding of the incentives and their requirements from the start of the project. Conduct comprehensive awareness and sensitization sessions with participating companies to ensure they fully comprehend the project scope, incentives, and the magnitude of work involved. Clear communication and guidance will help companies align their operations accordingly.
   c) Align with strategy of participating companies from the on-set.

4. Enhance access to finance for participating companies through leveraging on appropriate and strategic partnerships.
   a) Strengthen partnerships with financial institutions: Collaborate with financial institutions to develop customized financial products and services that cater to the unique needs of off-grid solar companies. This could involve designing flexible loan structures, offering financial literacy training, and providing technical assistance to improve financial management practices. By strengthening partnerships with financial institutions, companies can access the necessary financing and resources to overcome their limitations.
   b) Encourage participating companies to explore innovative financing mechanisms: Explore innovative financing mechanisms such as crowd funding, impact investment, or public-private partnerships to mobilize additional resources for off-grid solar companies. These mechanisms can provide alternative avenues for financing and attract investments from diverse sources.
   c) The project could act as a neutral broker between companies who want external financing and providers of financiers. Alternatively, the project could also act as a reference for companies who would wish to access external finance.

5. Establish platforms where no platform exists or leverage on existing platforms for knowledge sharing and exchange. This will drive systemic change elements such as AAER.

4.2.2 Implementation

1. Eligibility criteria: Streamline the eligibility criteria for the different schemes and simplify guidelines on what constitutes an eligible sale. Simplifying the calculations and requirements for incentive claims will help companies better understand and navigate the process, reducing the chances of falling off, mistakes and missed incentives.
2. Simplify the data compilation and entry process by developing user-friendly tools. The tools should be easy to understand and use, even for companies with limited experience in data collection and entry. Exploring digital solutions can also help improve efficiency and compliance.
3. Continuous Evaluation: Conduct regular evaluations of the project's impact and adjust incentives and schemes based on feedback and lessons learned.

4.2.3 Solar companies

Improve participation of the solar companies by improving the various RBF Schemes and incentives as follows

a) ***Remoteness Incentive:*** Expand coverage of the remoteness incentive to address high acquisition costs and after-sales service expenses in remote areas.
b) ***Asset Financing Incentive:*** Allocate funds to improve distribution channels, agent structures, and marketing activities to address risks associated with longer shelf time and unsold products for cash companies.
c) ***Default Incentives***: Align default incentives with how participating companies define and operationalize default and take into account the lengthy process of declaring a payment default, including product recovery, return, inventory entry, and bad debt write-off.

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6. Annexes

Annex 1: List of respondents for Key Informant Interviews

Institution	Name of respondent
GIZ EnDev	Rada Marsida
GIZ EnDev	Kyomugisha Hellen
PSFU	Damali Ssali
PSFU	Francis Kajura
MEMD	Julius Ochieng
CREEEC	Paul Asiimwe
CREEEC	Eileen Lara
Engie Energy Access	Beatrice Nabbanja
Village Power	Simon Peter Tumisiime
Finca Plus LLC	Laurynas Vaiciulis
D.Light Design Uganda Limited	Timothy Suuna
SolarNow (U) Ltd	Lydia Bawubya
Reliefline Uganda Limited	Nappe Rashid
Solar Aid Limited/ Sunnymoney	Harriet Nongoola
Kambasco Technologies Ltd	Kalyango Mohammad Kintu
Perfect Multiple Engineering and Consultancy Services Ltd	Nambi Kaweese Gladys
Sure Power	Martin Kivumbi
EMFS Uganda Ltd	Reginald Kafeero

Annex 2: List of respondents for on-site visits.

Institution	Categories of persons visited	Name of persons visited
Finca Brightlife	Last mile customer	Wawire Stephen
Finca Brightlife	Last mile customer	Gimono Logose
Engie Energy Access	Last mile customer	Kajuru Thomas Kabanda
Engie Energy Access	Last mile customer	Sam Khaluswa,
Engie Energy Access	Last mile customer	Watera Sania
Engie Energy Access	Last mile customer	Omoding Simon Peter
Engie Energy Access	Last mile customer	Nafuna Sumaya
Engie Energy Access	Team Lead and Technician, Mbale	Wasukira Alex Engie Energy Access Sales Team Lead, M

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Registered offices Bonn and Eschborn, Germany

Dag-Hammarskjöld-Weg 1-5
5760 Eschborn, Germany
E endev@giz.de
I www.endev.info