



IMPACT ASSESSMENT

ENERGY FOR RURAL START-UPS PROJECT

Prepared by Altai Consulting for Caritas Switzerland | Ethiopia – May 2024

EXTRACT OF KEY FINDINGS

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Background and objectives of the Energy for Rural Startups Project

Caritas Switzerland (CACH) and Power-Blox AG piloted the Energy for Rural Startups (EneRSU) project in Oromia region. EneRSU has three outcome areas: a) provide electrification for rural communities to improve lives, livelihoods and promote diversified income; b) enhance renewable energy curriculum in collaboration with local universities and TVETs and c) networking and scaling the project. The project was implemented over two and a half years, implementing 87 installations for 24 productive use cases (PUC) and public schools and health centres (PIs) in Borana, East Borana and Bale zones. Some PUCs had installations in multiple locations. Curriculum enhancement with the University of Borana, was completed in March 2024, and the training of trainers (TOT) delivered in mid-to end March 2024.

As part of the pilot, EneRSU worked with other CACH projects in an integrated manner:

Green Rural Entrepreneur Access Project (Green REAP): A graduation out of poverty project implemented in Borana Zone, Oromia. The project supports ultra-poor women and youth through climate change adapted and an evidence-based poverty graduation model that trains, coaches, and mentors project participants to shift out of extractive livelihoods and to get into environmentally sustainable micro-enterprises. EneRSU worked with one group of ultra-poor women of the Green REAP project providing one PBX cube at 25% of its original cost, with no advance downpayment.

Entrepreneurship for Market Inclusion and Transformation (EMIT): This is also based on the graduation model, EneRSU integrated with one group of EMIT project participants from Moyale, Ethiopia. The project applies a push and pull approach. The push approach involves training, capacity building, grant disbursement, monitoring, and providing mobile phones and cash boxes. The pull approach involves establishing market linkages for 1,000 business groups (each group has 3 members). The project also manages 147 self-help savings groups. The EneRSU project worked with one EMIT business group, providing the PBX at 50% of its original cost (thus at same conditions as other PUCs/PIs), with an advance downpayment amount of ETB 20,000.

The impact assessment conducted by Altai Consulting is the first under this pilot phase. Therefore, the assessment is directed at understanding the extent to which the pilot project proved concept against intended objectives. Understanding which use cases show signs of success, highlight lessons from the integrated projects, and how EneRSU and similar future projects can be scaled. Also central to the impact assessment was identifying emerging outcomes and EneRSU's contribution.

Approach and methodology of the assessment

The impact assessment applied an outcome harvesting approach to identify intended and unintended outcomes as well as the extent to which EneRSU contributed to identified changes and the level of significance of those changes to project participants and stakeholders. The assessment team built a framework based on the impact assessment objectives and the OECD-DAC criteria¹ (relevance, effectiveness, impact and sustainability), and added scalability as a criterion. The framework enabled the design of the evaluation criteria and data collection tools.

The assessment drew from EneRSU's monitoring data and primary data collection as follows:

- An outcome harvesting workshop with EneRSU staff to identify emerging outcomes, intended and unintended.
- 22 mixed methods interviews with a sample of 15 PUCs (others in multiple locations) and 4 PIs.

¹ The criterion 'Efficiency' was not included in this study as it largely focused on the pilot phase of EneRSU.

- 17 qualitative interviews with stakeholders, including PBX-Ag, Ministry of Water and Energy and Ministry of Health at national level, signatory offices² at zonal and regional level, participating TVET and Universities, one private sector actor in the renewable energies space and CACH project staff.
- Five Focus Group Discussions (FDGs), three with community members, one with PUC members in Hora Kore, and one with GreenREAP business group.

Overall, the assessment found that EneRSU generated significant positive change at the outcome and impact level for project participants and their communities. It also provided an understanding of factors to consider in future similar access to energy projects in terms of scalability and sustainability of change.

Relevance: *The extent to which the PBX technology, the project approach and interventions, are relevant in their ability to respond to community, PUC and PI needs and priorities.*

Observations:

The EneRSU project pilot strongly aligns with national and regional priorities for productive use of energy. The pilot strongly aligns with the National Electrification Plan (NEP 2.0) strategy targeting 35 percent of planned connections in rural remote areas in Ethiopia through off-grid means³. It also aligns with sectoral plans. For the health sector, EneRSU aligns with the Health Ministry's objective of ensuring improved provision of medical services and that health facilities are not affected by power fluctuations and outages. The pilot also demonstrated potential for enhancing livelihoods generation and rural development through the productive use of energy, aligning with the objectives of the job creation and cooperatives office, particularly for empowering youth and women.

There is growing interest in the PBX in communities in which the pilot was implemented. Anecdotal evidence from interviews with participating PUCs and PIs, as well as signatory offices suggests that there is rising demand for the PBX. For MSMEs, there is demand for energy sources that have low to no operation and maintenance costs, lasts long hours in a day, and can support income generating activities. For households, there was interest in affordable light sources that can illuminate the entire house and last more than two hours in the evening. These qualities were associated with the PBX in comparison with locally available energy sources that could not adequately meet these demands such as dry cell batteries, solar lanterns, solar home systems, diesel and benzene powered generators. PUCs and signatory offices also mentioned a gap in the availability of suitable power sources for agricultural use such as irrigation, value addition, and cold storage, which were not targeted use cases for EneRSU.

Conclusion: EneRSU's alignment with national and regional government objectives across various sectors and the demand for renewable energy sources that the PBX responds well to, compared to other available energy sources in the targeted communities makes the pilot relevant, now and in the future, before rural communities can connect to the national grid. Focus on specific use cases such as MSMEs and public institutions providing education and health care services seemed the best use cases for the pilot, compared to agriculture – where a number of organisations are already investing off-grid technologies for. The developers of the PBX did not recommend use of the PBX for purposes such as irrigation, where other alternatives would be more suitable. However, the PBX can be used with other energy sources or irrigation mechanisms for these use cases. In the case of use of refrigerators, the developer advised that they designed a different technology, PBX-400 which has higher capacity that can support kick-starting fridges. To ensure the power lasts longer, use of energy efficient fridges is necessary.

² Oromia Water and Energy, Oromia Bureau of Skills and Job Creation, Oromia Region Co-operatives, Sinana Agricultural Office , Borena Zone Water and Energy, Borena Zone Finance and Development Bureau

³ Ethiopia Customs Handbook, 2022.

Recommendation: EneRSU's objectives are relevant to the context. The focus on productive use of energy to stimulate rural livelihoods development and public service delivery is well matched with the energy needs of off-grid rural communities and government stakeholders. Further, engagement with relevant government ministries, has ensured buy-in for the objectives of the project, which provides an enabling foundation for a scale up.

Observations:

The curriculum enhancement and training component will remain relevant in the expansion of the pilot and if the technology supply increases. During the pilot, EneRSU supported renewable energy curriculum enhancement in collaboration with Borana University. They also provided training of trainers (ToT) to 20 participants from Water and Energy and Job Creation and Cooperatives offices from the three targeted zones on renewable energy including solar energy. While this component of the pilot is still in its early stages, the assessment found that investments made in engaging with local TVET and the university to build local capacity in renewable energy technologies and learning about the PBX will be crucial in the future for scale up and sustainability. Government stakeholders participating in the assessment particularly felt that it was necessary that any new technology should have skills available locally to respond to any repair and maintenance needs. PBX-Ag is working on a smart-phone application that will connect end-users with developers to help troubleshoot technical issues. These components are important in a future scenario that foresees increased distribution of PBX cubes.

Conclusion: It was not clear how the training component would be sustained or scaled, as it was still very new at the timing of the impact assessment. While the content was considered sufficient, there were recommendations to include practical lessons on how to repair and maintain the PBX and deeper technical know-how to promote local capacity to provide such O&M services in the future.

Recommendation: Continuously engage with relevant stakeholders to strengthen handover of the training component. Relevant government ministry is best placed to drive the agenda, provide financing for ToT movement and mentoring of PUCs and PIs. In a scale up of the pilot, the curriculum revision should also reflect CACH's intention for local capacity building in the maintenance and repair of the PBX. As the intervention may reach scale in the future, adjust content and make it repetitive to build capacity. There is potential to create jobs for the local community should a market for the PBX expand, in the next eight years when the PBX need to be serviced/replaced/renewed.

Effectiveness : The level of contribution of project activities towards intended outcomes and the interventions that are most effective at delivering change for PUCs, PIs and local communities.

Observations:

Project participants identified strongly with outcome statements⁴, all of which were considered of high significance. There were slight variations in experiences, for instance, participants who felt that they were able to make savings on their consumption of fuel/energy were likely to have switched from sources with expensive O&M such as diesel generators compared to participants who were using simpler, less expensive options such as Pico lanterns. Health facilities and businesses earning on average above ETB 1,000 monthly and conducting mobile charging services were more likely to have invested in new electrical appliances. When PUCs were asked about their plans for expansion and challenges, they mentioned plans to expand services, that were either limited by access to more PBX cubes, or access to more accessories such as quality phone chargers and connection wires.

⁴ EneRSU project team identified outcomes that the pilot may have contributed to. The assessment team engaged with project participants to establish the extent to which they experienced identified changes. Annex A contains outcome harvest database.

Outcome change statements	Percent of PUCs and Pls that “strongly agree” to change	Percent of PUCs and Pls that rate the change as “high” significance)
I was able to electrify my household	90%	90%
The quality of my personal life improved	86%	90%
I benefited from starting a new business using the PBX	81%	90%
I extended the hours of operation of the business	81%	86%
I benefited from increase in income generation using the PBX	76%	90%
I benefited from diversifying in new income sources using the PBX	76%	86%
I made savings on my consumption on fuel/energy	62%	71%
Increased investment in electrical appliances	48%	67%

Public health centre use case: EnerSU aimed to reduce the cost of operation and maintenance for health facilities while contributing to improved service delivery. Health centres reported substantial savings in terms of monthly fuel costs at average of ETB 8,500, and maintenance and repairs at average of ETB 5,000 per diesel generator malfunction, when they started using the PBX. Although in reduced frequency, health facilities were still using diesel powered generators alongside the PBX cubes. This suggests that they may have required more PBX cubes to adequately cover their energy demands.

The health centres also reported extending services to 24-hour service provision for the community and expanded diagnostic and laboratory services. The consistent power with low or no downtime enabled better service provision and reduced wait time for patients. They reported that their staff seemed motivated by the improvement in equipment and being able to charge their phones at the health facility.

Schools use case: Installation of the PBX in the schools contributed significantly to teaching and learning. The PBX contributed to improved teacher’s approach to teaching by enabling access to new curriculum textbooks and teaching material using their phones. The PBX further increased opportunities for revenue generation for the schools where public schools rely almost entirely on the government budgets to operate. Schools provided additional education services using the PBX, such as free adult literacy classes in the evening. The schools were also able to extend library operating hours up to 9pm that allowed learners to conduct evening studies. This was considered particularly beneficial for female students who had to balance schoolwork with household chores in the evening. Schools generally consumed much less power than the available capacity because of the limited uses of energy within the school itself. School directors added that they wished to generate more income from the PBX through connecting more households to power and offering mobile charging services, but the schools were located far from households, limiting income generation opportunities.

Micro and small businesses: EnerSU strongly demonstrated the potential of off-grid energy in livelihoods development and economic empowerment. All PUCs reported new and increased income generation and diversified income sources. When asked about the most significant change they have experienced, PUCs mentioned the ability to generate income from providing light to households, usually charged between 100 ETB – 250 ETB per lamp per month, and providing mobile charging services, usually billed at ETB 20-30 for smart phones for six hours of charging. PUCs also used the PBX for businesses such as barber shops, and in one case, medical services. The private health provider for

instance, was able to increase his daily income from ETB 600 before the PBX to ETB 1,500-2,000 on acquisition of the PBX. Businesses extended their hours of operation using the PBX, from 6pm to 11pm, leading to increased revenues and increased access to services for community members. Businesses that used diesel or benzene generators in the past, or battery cells saved on their daily consumption on fuel, in addition, shifting to a cleaner form of energy. PUCs reported that the project had significantly contributed to an improvement in their lives through the increase in income and business opportunities. They also felt that lives of the communities around them improved through access to services like mobile charging and lighting closer to their households and at less expensive cost⁵.

Integration with EMIT and GreenREAP demonstrated the potential models in which the technology can be extended to reach ultra-poor households and enhance their income generating activities. Project participants from EMIT and GreenREAP, similarly benefited from diversifying income and expanding their businesses as other EneRSU participants. Participants from these integrated projects reported that they were able to afford meals three times a day from the income generated using the PBX, they were also able to buy uniform, exercise books and pens for their school going children. Integrated project participants reported increased savings post PBX installations, about 1.7 times what their counterparts under EMIT/GreenREAP were saving without the PBX.

MSMEs varied in their system utilization dependent on the number of PBX cubes they were able to afford and power demands of their businesses. Businesses in locations that seemed to have higher customer traffic reported that they experienced power shortages on busy days such as market days, when the volume of customers increased. Some businesses also reported that they sometimes ran out of power and had to cut short supply to households before the agreed daily cut-off time at midnight.

Conclusions on effectiveness: The pilot achieved its intended outcomes, demonstrating the potential of using the PBX to provide electricity to rural communities for public service improvement, generation of new income and diversification of income sources. Integration with other projects supported potential models⁶ that could be used for inclusion of ultra-poor households to facilitate access to productive use of energy and economic empowerment. PUCs and PIs required better guidance on gauging their energy needs and better predicting how many PBX cubes they required.

Recommendations: To increase outcomes for participants, more guidance or support can be provided to PUC and PIs in more accurately estimating the amount of power they need. The PBX design makes it easy to adjust by increasing or reducing the number of cubes as needed. The purchase model should perhaps consider ease of redistributing cubes based on usage and demand, in a way that the owners of the cube can benefit from the option. Integrating with livelihoods projects or projects targeting community members who would otherwise be disadvantaged in accessing similar technologies through the open market contributes towards inclusion. The pilot also demonstrated that a lease-to-own model, that is flexible on downpayment requirements, can reach the poorest in the community and provide an opportunity to change their lives.

⁵ Community members accessed mobile charging services at less than half the cost before the PBX powered businesses. They also saved on transport money used to access these services from nearby towns, and the time it took to travel there. Households paying for light also saved on the cost, paying 100-250 ETB monthly, when they would have spent about ETB 1000 monthly on dry batteries for torch light for instance.

⁶ The GreenREAP business group were not required to pay an upfront downpayment, rather they paid back for the PBX in instalments. Although they were provided a further subsidized cost (25%) they were able to payback, expand their business and save.

Impact: *The type of change or outcome that has been observed in the targeted communities that relate to the intended objectives of the EneRSU (positive and negative).*

Observations on impact:

The assessment applied different sets of metrics⁷ to understand impact of the PBX on project participants as follows:

Impact at PUC/PI Level: Impact was measured by PUC and PI assessment of the impact of the PBX on the quality of their lives. The majority of PUC participants (83%) felt that the PBX had “*very much improved the quality of their life,*” while public institution respondents felt that the PBX had ‘very much improved their lives and the lives of teachers/ health staff’. None of the PUC or PI respondents felt indebted by the PBX payback or negatively affected by the cost of acquiring the technology. In comparison, in a performance assessment report by 60_Decibels on why off-grid energy matters, the benchmark stands at 62% users reporting significant life change for using the solar home systems.

PUC and PIs were satisfied with the quality of power, functionality and ease of using the PBX. The PBX has a Net Promoter Score⁸ of 86, within this score, 86% of PUCs and PIs rated 9-10 that they would recommend the PBX to a friend and 14% rated 7-8 out of 10 that they would likely recommend the PBX. The global benchmark for NPS is 43, and for solar home systems, in comparison, is 50 in the 60_Decibels⁹ report. PUC and PI experience of the PBX was mostly positive related to power consistency, capacity and ease of use.

PUCs and PIs faced few technical and external challenges with the PBX. There were five instances reported of PBX technical malfunction out of 87 total installations, all of which were resolved, and in one case, the PBX replaced. External factors such as cloud cover affected the charging rate of the PBX (two instances reported). PUCs were also concerned over the lack of quality electrical supplies in the local market such as extension cables and connection wires that they required. There were reports of mobile chargers that got over heated or wires that burnt up, difficulties in connecting households that were further away. Participating PUCs and PIs also seemed to have mismatched expectations of the PBX. In three cases, PUCs said that they expected the PBX to support their use of refrigerators.

All 22 PUC and PIs interviewed said that they could not find an alternative source of power that was comparable to the PBX in the local market. Respondent comparisons were based on qualities attributed to the PBX, no maintenance and operational costs, long and consistent uptime, what is available such as solar lantern and battery cells which could not support productive use, diesel and benzene powered generators which had high maintenance and operational costs, and solar home systems which respondents associated with poor quality and high malfunction rates.

Conclusions on impact on PUC and PI: The PBX was rated highly transformative to the general wellbeing of PUC owners and strongly compared over other off-grid energy sources on specific metric. Within the targeted communities, available alternative energy sources fall short of meeting demands for sources that can support multiple productive uses, provide long hours of power supply at no operational and maintenance costs. Recorded issues and downtime related to use of the PBX was very low, making it suitable for off-grid rural communities. PUCs and PIs provided challenges that they faced while using the PBX including external factors and mismatched expectations. EneRSU responded well to emerging needs for electrical wiring and accessories by providing and supporting participating PUCs and PIs.

⁷ The assessment used similar metrics used by 60 Decibels in their report: 60_Decibels, 2024, Why off-grid energy matters

⁸ The Net Promoter Score is worldwide as a proxy for gauging customer loyalty and satisfaction by assessing the extent to which a customer/end-user would recommend the product/service to a friend on a scale of 0-10. The NPS is calculated by percent of users rating 9-10 out of 10, minus percent of users rating 0-6 out of 10 that they are likely to recommend the product.

⁹ 60_Decibels, 2024, why off-grid energy matters: an impact performance report.

Recommendation: If the pilot is scaled, PUC and PIs would require more sensitization and training to a) manage mismatched expectations b) to provide an understanding of the external issues and potential solutions. It would be beneficial to train users on how to use the PBX efficiently to avoid any risks of wastage/long term damage to the PBX. Future projects should keep consideration in their design for electrical appliances required for connection to the PBX and PUC and PI access to them. This could be through partnership with private sector suppliers who may provide an incentive for participants and offer quality products at discounted prices.

Observations on Impact at community level: The pilot contributed to community access to affordable and clean energy source, particularly for light and mobile phone charging. Households living in close proximity to participating PUCs and PIs were able to access light at ETB 100-250 monthly for powering one lamp between 6pm to mid-night. This was a significant improvement for the household which probably relied on dry cell batteries, kerosene or solar lanterns for their lighting needs. Compared, they felt that the PBX light cost less compared to these other alternatives and gave brighter light, illuminating the entire house for longer hours. Having light for longer hours in the evening meant women could do their evening chores in well-lit areas, students could study longer in the evening. Other households accessed enough power to also conduct new businesses such as tailoring businesses. Households also used the power for TV and to charge their mobile phones, leading to an improved quality of life. Some PUCs also managed to hire new employees because of the PBX. However, there was no standardization of what to charge for light supply, which may expose community members to over-charging, especially in the initial months when the PUC/PI is raising funds to payback for the technology.

Community members accessed services within their villages at reduced cost. Participating PUCs provided mobile charging services at 20-50% less compared to providers using diesel generators because they had no operational costs. Community members also saved between ETB 50 - 400 in transportation costs to access the same services.

Improved education and health service delivery. Some of the benefits to community members was accessing 24-hour health services and laboratory and other diagnostic services because participating health facilities were able to expand operating hours and invest in more equipment. In addition to improvement in delivery of teaching, adults interested in literacy classes were also able to access them for free during the evenings from participating schools.

Increase in communication and entertainment. Generally, there was a feeling that the PBX enhanced communication through increased mobile charging services, DSTV and TV.

Conclusion: The pilot demonstrated the significant outcomes that access to renewable productive use energy sources can provide for rural off-grid communities. These significant outcomes and low operational and maintenance costs of the PBX justify investing in the technology.

Recommendations: The impact achieved for participating PUCs and PIs was significant enough to warrant replication of the pilot, or its expansion. Should the pilot be scaled, careful consideration should be taken for guidelines on tariff setting for off-grid energy supply in an energy-as-a-service model currently provided by PUC and PIs. Setting up a cost-benefit approach to gauge the amount of benefit in monetary terms that is generated from the amount invested will be a useful indicator for the expansion.

Sustainability: *The extent to which the program interventions and results are likely to be sustained after the completion of the program; the financial viability of the technology and the operating model in the local context.*

Observations:

PUCs and PIs were able to generate income from the PBX and payback subsidized cost of the PBX¹⁰. All¹¹ project participants were able to payback (50% of subsidized cost of the PBX at 44,800 per PBX) within 10 months and were reporting gross profits. However, project participants expressed the need to extend the payback period to at least two years to enable easier payback. Although schools struggled to payback monthly, they managed to raise over ETB 80,000 in downpayment representing between 50% - 80% of the required amount. The schools also may have purchased more PBX cubes than they required for their energy needs.

The greatest concern among PUCs, PIs and stakeholders was the lack of spare parts and maintenance services. The PBX is designed to have a lifespan of eight to 15 years. Participating PUCs and PIs were worried about how easy it would be to access maintenance services and spare parts when it is required in the future given that the technology was imported. In addition, the lack of quality electrical accessories in the local market affected mostly mobile charging businesses.

Community members were difficult to convince to purchase the PBX as they are used to associating NGOs with a grant model. Stakeholders agreed that it was more sustainable to apply the current lease-to-own purchase model, even though it has subsidy. The required downpayment in some cases may have been a deterrent in purchasing the PBX. EneRSU was accommodative of participating PUCs and PIs, allowing between 10% to 30% downpayment, and in one case, waived downpayment for ultra-poor women in the GreenREAP project. Suitable mechanisms should be used to make the technology affordable to rural households without distorting the market.

Conclusions on sustainability: The pilot provided sufficient evidence that the technology works and is technically suitable for off-grid communities where access to technical know-how and costs of operation and maintenance significantly impact on the cost of doing business. At the same time, it is impressive that the participating PUC and PIs were able to payback for the technology, with majority providing an upfront downpayment, with no reported feeling of indebtedness. The performance of different PUC and PI cases based on ability to generate income, payback and utilize available power, suggests that MSMEs maybe the obvious anchor load customers for the pilot, closely followed by health facilities. Schools benefit greatly from the technology but should be engaged strategically to ensure power demand matches supply and the school's community is not overly burdened/benefits from the PBX.

Recommendations: Any plans to scale the pilot or replicate should maintain flexibility in downpayment options and a lease-to-own model with extended payback periods. It is essential that participating PUCs and PIs do not get into debts as the businesses/income generating activities are still heavily dependent on prevailing market conditions. The next phase of the pilot should also continue finding ways for stimulating demand for the PBX, whether it is in linking to electric accessory supplies, facilitating expansion of business growth through links to finance.

¹⁰ EneRSU provided 100% subsidy on solar panels and electrical supplies, and 50% subsidy on the cost of each PBX cube. In addition, EneRSU covered for the cost of importing the PBX, transportation, training and installation.

¹¹ One school paid upto 90% of the cost as a downpayment and did not complete the remaining 10% due to challenges in raising the funds.

Scalability: Identifying what types of PUCs/PIs have most successfully adopted the PBX; what project activities have been crucial towards achieving intended change/outcomes. Aim to identify what approaches can be used to efficiently scale future iterations of the project

Observations:

EneRSU subsidies on solar panels and electric appliances and lease-to-own options made the technology accessible for PUCs and PIs. The subsidy was necessary during the pilot because of the limited quantity of PBX that were purchased for the proof of concept. However, the lack of foreign currency in Ethiopia and substantial differences in parallel forex exchange rates would increase the landing price of the product if a purely commercial model with distributors is used. These factors currently necessitate a blended financing approach with a first-loss partner, to reach rural off-grid communities.

	Cost (ETB)	% Subsidy extended to EneRSU participants
PBX purchase	89,600	50%
Solar panel	12,040	100%
Electric appliances	25,000*	100%
	Total cost per PBX 126,640**	Subsidized cost per PBX: 44,800***

* Average based on total amount EneRSU contributed to electric appliances over total installations.

** Assuming one PBX, one solar panel and average cost in electrical appliances. Cost of importation, transportation and installation is not included in this estimated landing price.

The EneRSU project envisioned engaging with financial institutions who would support access to finance of the PBX for rural off-grid communities. There is low access to financial services at the targeted areas, with nearest access at woreda capital centres. Microfinance institutions in Ethiopia operate by region. The MFI present in the Oromia region since became a bank leaving a gap in access to micro-finance loans. Only two PUCs accessed downpayment finance through a loan, and it was from friends and relatives. Since PUCs and PI's need for financing would be for the downpayment for the technology, it is recommended to test a model where the technology can be installed without the need for a downpayment, and PUCs and PIs would payback in tranches, with a grace period, to allow them to start generating income from the PBX. This can also be guaranteed by the first-loss partner or government partners, depending on the use case.

MSME and healthcare use cases are potentially anchor clients for the technology. Both in terms of load demand and ability to generate income using the PBX, MSMEs and health facilities seemed better fit for the PBX. Health facilities compared to schools had more expensive energy sources at baseline- fuel and benzene generators compared to Pico solar systems with batteries that the schools were using. Public health facilities participating in the project also benefitted from partner financing which schools participating in the project did not have. In the case of MSMEs, location of the businesses determined the amount of revenue the business could generate. Businesses that were closer to households had more customers. Schools said that they struggled to generate revenue from the PBX because they were located far from where most houses were.

Integrated projects demonstrated the pilot's potential in empowering ultra-poor households and catalyse business growth.

Conclusions on scalability: EnerSU will require ‘first loss’ investors to scale up. CACH financed administrative and logistical costs of the pilot, its implementation, 100% solar panel and electrical appliances costs and 50% of the cost of the PBX for the pilot phase to prove concept. These costs could not yet be sustainably transferred to rural off-grid communities, who have a right to affordable clean energy. However, applying a grant approach will create community dependency and distort the market. With controlled foreign money exchange rates, lack of forex and a parallel black market dollar rate twice the bank rate, a private sector supplier model is highly unlikely to work in Ethiopia. It will only make the product less affordable for the community and not lucrative for potential suppliers.

Recommendation: The assessment proposes a public-private-partnership.

Government stakeholders: Play the role of facilitating an enabling environment, including interpretation of relevant policies and guidelines, facilitating negotiations with local finance institutions to enhance access to financing for interested project participants, lead in Outcome 2 component on curriculum enhancement, training and capacity building on renewable energy and related technologies, extend incentives for stimulating demand, including applicable taxes and tariffs on technology spare parts, and electrical appliances. In the case of rural hospitals and schools, contribute towards fund raising and budget lines for acquisition of technology. Connect to other partners, donors working on similar or complementary projects for potential collaborations.

First-loss partner(s): Cover administrative costs, logistics and implementation, as well as set up of post-sales support mechanisms. The First-loss partner may also take on downpayment risks to enable inclusion of ultra-poor households, or start-ups that may not have the finances for a downpayment but demonstrate capability for paying back with their business proposal/business opportunity.

Financiers: Willing to advance downpayments for the cost of the PBX technology, solar panels, and whatever capital is required for the businesses. These could be financial institutions, other granting partners (as with the case of health institutions and livelihoods projects). The financier partners would provide suitable financial products targeting PUCs and PIs with the aim of reducing/meeting capex. It is important that interest rates are zero to very low to avoid plunging PUCs into debt. A payback period of two years is advisable in comparison with other projects and recommendation from PUC and PI respondents.

Electrical appliances suppliers/solar panel suppliers: Potentially with local presence, should be able to provide these appliances also on a lease-to-own basis, or at discounted prices, and importantly guarantee quality products and sustainable after-sales services.

Project management: project management would connect various stakeholders and ensure smooth implementation. Project management would also be responsible for identifying and enrolling anchor load clients. If the next phase of the pilot can generate demand for 2000 plus PBX cubes, then the cost of a cube significantly drops reducing the final price to the end-users.