Scaling Productive Use of Energy Technologies in Sub-Saharan Africa: Learnings and Recommendations

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Prosperity House, Westlands Road,
P.O. Box 4320, 00100, Nairobi, Kenya.
Tel: +254 (0)20 271 0485

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Introduction

Solar powered productive use of energy (PUE) technologies show potential to solve widespread challenges across Sub-Saharan Africa (SSA). Some of these challenges include limited access to energy among micro, small and medium enterprises (MSMEs), food insecurity, access to clean water, postharvest losses and limited mechanization of agricultural value chains[1,2]. However, the uptake of these technologies has been sluggish. According to GOGLA, globally, only 12,100 units of solar water pumps and refrigerators were sold between July-December 2020, compared to 457,000 solar powered televisions and fans sold over the same period[3]. Between January and June 2021 decreased sales were noted for all appliances, mainly attributed to the Covid-19 pandemic. Only 10,000 refrigerators and solar water pumps were sold over the same period. Refrigerators and solar water pumps recorded 2% and 25% decrease respectively, compared to the second half of 2020. Meanwhile, a total of 410, 000 televisions and fans were sold in January -June 2021. While fans remained relatively stable and represent 51% of all the appliance sales, television sales decreased by 18%.

Over the last two years, a few studies have been done on job creation by PUE and the potential demand for PUE[4,5], while for a few countries product catalogues have been published[6]. The market study by Power Africa in Liberia found high potential demand for agro-processing PUE technologies but limited availability of the same. In Uganda, the Off-Grid Market Accelerator estimates high potential demand for solar refrigerators, water pumps and coffee pulpers though more research needs to be done to quantify the demand[7]. In addition, Uganda has significant opportunities for small and medium to large solar cooling units for the dairy value chain[8]. In Ethiopia, deploying PUE technologies in the horticulture, dairy and wheat value chains could create up 190,000 jobs[9] . Another survey by EED Advisory and VeraSol[10] on the projected demand for off-grid solar appliances in Kenya found 209,200 solar pumps and 148,300 refrigerators could be needed by May 2022. The survey also showed promising results regarding consumer perspectives on quality. Up to 91% of the consumers reported that the performance of their appliances had not changed over time, though most of the appliances had been in use for only three to four years.

While the cost of solar panels has been reducing, many PUE technologies are still in the early stages of development and have therefore not seen associated cost reductions[6]. The business models to get PUE technologies to the target market, mostly small-scale farmers and MSMEs, are also evolving. To understand the progress on PUE technologies and business models, a high-level analysis of PUE projects in sub-Saharan Africa was conducted between June and July 2021.

The objectives of the analysis were:

- To determine why PUE has not scaled
- To find out what can be done to address the problem

Methodology

Information was collected from some of the donor programmes implementing PUE activities in SSA. The focus was on PUE technologies used for income generation. A tool capturing salient features of the projects was shared with the respondents for them to fill out. This enabled us to collect insights from projects that being implemented but have not put out any publications. In addition, published and unpublished reports were obtained from the same programmes. Using content analysis, key findings, challenges, lessons learnt, and recommendations were drawn from all the information that was received.

Findings

The key findings from the information analysed were:

- Most of the PUE projects are focusing on **agriculture**, partly because the more mature technologies such as solar water pumps are suited for that.

- Almost all the technical assistance and financial support is on the **supply side**, and there is limited support on the demand side. This could be one of the key reasons why uptake has been sluggish.

- Geographically, there are more organizations covering **Eastern Africa** than West, Southern, and Central Africa. Though, West Africa comes second and there is very minimal support in Central Africa.

- Most of the money invested in the off-grid solar market has gone to companies selling lighting products or solar home systems (SHS). However, some of the companies offering SHS have added PUE to their product portfolio.

Key Challenges

The key challenges affecting the scale of PUE technologies include:

- **Awareness:** market research shows that the level of solar PUE awareness among small holder farmers and MSMEs is low, especially in rural areas. On the other hand, distributors do not have sufficient information on what technologies are appropriate for different countries and regions.

- **Affordability:** most of the technologies target small scale farmers and MSMEs who have seasonal and limited disposable incomes, and limited access to credit facilities[11]. A consumer survey by 60 Decibels and Efficiency for Access Coalition[12] shows that 54% of customers have had to make unacceptable sacrifices to make repayments for solar water pumps, and 50% were feeling burdened by the repayments, mostly in Zambia. Covid-19 may have further affected the affordability of PUE technologies due reduced incomes and the economic decline in many countries.

- **Appropriateness of products in the market:** Manufacturers of PUE technologies will need to work closely with the end-users to design products that are tailored to their needs, that are durable and do not require significant adjustments to the current end-user routines or extensive training. The extent to which PUE technologies blend into the way farmers and MSMEs operate will be critical for their success. For some of the more mature technologies, evidence shows they may need to be adapted to different local conditions or needs e.g., solar water pumps that can pump more water over longer distances.

- **Finding replicable models:** Unlike solar lighting that has realized success with the Pay-As-You-Go (PAYG) and partnerships with microfinance institutions, so far that has not happened for PUE. However, different manufacturers, distributors, development partners and research organisations are testing various models, and this could change soon. Nevertheless, the replicable models for each technology and/or market could be different.

- **Limited collaboration:** There are many stakeholders supporting different PUE technologies and business models but operating in silos and with limited linkages to sectors like agriculture, health, and livelihoods where the technologies are used.

- **Lack of an enabling market environment to facilitate the scaling of PUE:** The technologies are mostly new, and governments will need information and evidence on how to update the related national strategies, policies and regulations, in a way that accelerates their uptake. Interventions on PUE technologies should also be linked to climate action. Frequent droughts and floods have severely affected agriculture and food security in SSA, with the Horn of Africa being worst hit. Technologies that enable climate adaptation are needed in this region and national/ sub-national governments could be keen to support such technologies.

Lessons Learnt

The lessons learnt have been segmented into cross cutting issues and those that are relevant for investors and development partners, companies, specific technologies, and gender considerations.

Cross-cutting

- **Mature and nascent technologies:** While technologies like solar water pumps have attained some level of market maturity many others are still new in the market and require tailored support. Technologies for solar milling, cold storage and drying may require different business models for scale to be achieved.

- **Adapting to local context:** The PUE technology needs to be suitable for target customers, without expecting them to make significant changes so that the technology can be beneficial e.g., asking maize farmers to switch to high value crops because of purchasing an irrigation pump creates two learning curves, one on using the technology and another on cultivating new crops they are not familiar with. Additionally, the technology should meet the performance requirements of the target market e.g., most ground water in Kenya is about 30m deep. Do the existing solar water pumps in the market perform well given the depth?
- Batteries make some of the technologies more reliable and economically viable: When compared to pumped storage, battery packs are low cost, more portable and easier to install. For example, a 5,000 litres water tank with stand and installation costs approximately US $500 compared to a US $50 deep cycle lead acid battery which stores sufficient energy to operate the pump for 4 hours under cloudy conditions.

Investors and development partners

- **Minimal financing is going to PUE compared to solar for lighting:** Financing is needed for the different appliances, identifying suitable distribution channels and asset finance. Currently, there is more progress on distribution channels than the other two areas.
- The need to expand early-stage financing to test productive use applications and innovations.
- **Scalable business models:** while the PAYG business model has been successful with solar lighting, it may not be appropriate for all PUE technologies. Companies are taking time to identify business models that work for their target market and the products they are selling.
- There are opportunities to support PUE along the agricultural value chain – production, post -harvest, storage and processing.
- Supporting organisations need to commit to longer timeframes for the PUE businesses they are working with, and also deploy more patient capital.
- There have been challenges for investors to justify an investment in a PUE company in cases where they use funding that has a primary objective of increasing energy access and supporting local development
- Developing partnerships to draw on institutional strengths could accelerate progress in the PUE sector. Micro-finance institutions, private sector associations, end-user associations/ cooperatives, local commercial banks and local governments should collaborate to address the key challenges.
- Mapping areas with concentrated demand for PUE technologies is one of the strategies to achieve scale. Concentrated demand reduces the cost to serve remote customers and contributes to the sustainability of the business.

Companies

- Early observations indicate the performance of solar home system (SHS) companies is improving because of adding PUE appliances to their product portfolio. The specific observations are:
- Improved viability of the SHS companies making them more investable.
- Companies pivoting towards PUE due to better returns and lower default rates among this customer segment.
- Some SHS companies are using their last mile distribution networks to upsell PUE, and some level of success has been noted.
- End-user financing remains one of the greatest barriers to scaling PUE due to the low and seasonal incomes of the target market[13]. Innovative end-user financing mechanisms for appliances are therefore critical.
- Adapting product design to the local context because different sizes of appliances and approaches are needed for different markets.
- Companies need to assess the economic impact of products on their customers to develop a strong value proposition that resonates with them.
- Creating awareness on the benefits of the PUE technology over existing alternatives (for example diesel powered water pumps), and their usage is necessary. The survey by 60 Decibels shows word-of-mouth as the top sales channel. Therefore, companies can benefit from champions who promote the technology within their communities.
- After sales support is crucial for customers and could increase revenue streams for companies. It also creates relationships with customers that encourage them to move up the energy ladder.

Technology specific

Pilots in India and Kenya on cold storage and solar irrigation respectively, showed that:

- **Cold storage:** Smallholder farmers are interested in using but not owning a cold storage facility to improve their income.
- **Solar irrigation:** When the pump breaks down, payments for Pay-As-You-Grow are affected. Built-in predictive maintenance technology helps to streamline costs, build brand value through customer service and reduce performance related customer defaults.

Gender and social inclusion (GESI)

- Productive use of energy technologies presents an opportunity to strengthen the role of women and youth as agents of change in society e.g., using models that empower them to be micro-entrepreneurs.
- The need to integrate gender and social inclusion (GESI)in national PUE policies. For example, Senegal could use solar powered PUE to stem the tide of illegal youth migration[14] .
- Country-specific or regional studies mapping the potential demand for different PUE products should include gender.

Recommendations

For PUE technologies to scale, more attention needs to be paid towards end-user constraints especially awareness and affordability. Other recommendations include:

- More consumer insights for other technologies that are gaining traction in the market, with focus on areas with concentrated demand.
- Greater geographical inclusion in PUE support – Central Africa is currently receiving the least support.
- Adopting an 'ecosystem approach' for PUE interventions to enable market growth, stimulate demand and increase supply[15].
- Including PUE in project designs from the beginning[16]. Not just energy access projects but also in adjacent sectors like agriculture, livelihood, health etc. This can also be enhanced through:
  - Collaboration with adjacent sectors. Are we engaging stakeholders in agriculture, and health to better understand their needs?
  - Establishing multi-disciplinary project teams with experts from different sectors and backgrounds to increase cross-sectoral understanding and effectiveness of interventions. This will address challenges of appropriateness.
- PUE project designs need to be tailored for scalability.
- Closer collaboration between PUE funders, to understand who is doing what and to harmonize reporting requirements for projects/programmes and PUE companies
- Collaborative approach to addressing market barriers like the collaboration accelerator in Uganda. The accelerator brings together the Ministry of Agriculture, Ministry of Energy, non-governmental organisations, development financial institutions, private sector, research institutes, civil society and farmers. These organisations worked together to identify and sequence barriers hindering market adoption of decentralised PUE technologies among smallholder farmers in the country. The priority barriers were identified as policy, limited finance and capacity gaps, and working groups set up to address the barriers.
- Exploring innovative ways of scaling PUE technologies. For example, the 'Entrepreneur in Residence' scheme by Access to Energy Institute that combines local knowledge with access to international resources to test possible business models from the user perspective[17].
- Considerations for gender and social inclusion in PUE projects and programmes.
- The adverse effects of Covid-19 present an opportunity for PUE to be included in the 'build back better' national and sub-national strategies.

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Fourth Floor, Prosperity House, Westlands Road |
PO Box 19084 – 00100 | Nairobi, Kenya.