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

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Catalysing Africa's Solar Markets

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1. 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. 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 455,000 solar powered televisions and fans sold over the same period[1].

While the cost of solar panels has been reducing, many PUE technologies are still in the early stages of development. The business models to get them to the target market, mostly small-scale farmers and MSMEs are also evolving. To speed up progress on PUE technologies and business models, some of the 50 plus members of the Household Solar Funders Group (HSFG) are supporting related projects or programmes. While evaluations may have been done individually for these projects, there has been no sector-wide synthesis of that information. Therefore, the objectives of this analysis are to determine why PUE has not scaled, and what can be done to address the problem. These objectives are addressed as shown in the table below.

Objective	How addressed
To determine why PUE has not scaled	Insights, challenges, and lessons learnt
What can be done to address the problem	Key success factors and recommendations

The analysis covers results, impact and success factors from income generating PUE projects supported by HSFG members. The analysis also complements a similar study being carried out by the World Bank covering about 40 projects funded by the Bank worldwide, and with a PUE component. The Bank's analysis includes past and ongoing projects in electricity access, agriculture, and water.

1 GOGLA and Lighting Global (2021) Global off-grid solar market report: Semi-annual sales and impact data

2. FINDINGS

HSFG members were requested to submit information on the PUE projects and programmes in their portfolio. The following sections highlight key findings from that information. The first part presents the nature of support being provided and the countries covered. The second part has insights shared by members and others that emerged from the analysis.

2.1 Type of support and geographical coverage

The projects mainly covered India and Sub-Saharan Africa (SSA) as shown in Table 1. Most of the projects have also focused on agriculture and the supply side.

Table 1: Type of support delivered and geographical coverage

Key: Eastern Africa | West Africa | Southern Africa | Central Africa

Donor/ Investor	Type of support	Sector	Supply/ Demand side	Amount invested/ committed by June 2021	Countries	Achievements/ Publications
Shell Foundation	Technical Assistance, Grants	Agriculture	Supply		India, Mexico, **Kenya**	
Shell Foundation – Promotion of Women in Energy Related Enterprises for Development (POWERED)	Grants, Technical Assistance	Agriculture Livelihoods Clothing/Apparel	Supply	6million Pounds	India	Market information Gender inclusion – it is mostly women working in the apparel industry
Shell Foundation – Powering Livelihoods	Grants, Technical Assistance	Agriculture, Livelihoods, Gender Inclusion	Supply		**Ethiopia**	
Shell Foundation – Ethiopian Energy Market Accelerator	Grants, Technical Assistance	Agriculture – Dairy and Poultry Value Chains			**Ethiopia**	Developing the National Agriculture Energy Program to unlock $10 million grant funding
Shell Foundation – Nigeria Off-Grid Market Accelerator Program	Grants, Technical Assistance	Agriculture Micro and Small Enterprises	Supply and Demand		**Nigeria**	

Donor/ Investor	Type of support	Sector	Supply/ Demand side	Amount invested/ committed by June 2021	Countries	Achievements/ Publications
Shell Foundation – Uganda Off-Grid Market Accelerator	Grants, Technical Assistance	Agriculture	Supply		**Uganda**	Reports: Productive use of energy in Uganda Promoting productive uses of energy in Uganda – status and potential
Power Africa Water and Energy for Food (WE4F)	Technical assistance, investment facilitation, capacity development, enabling environment	Agriculture	Supply	TBD	**Senegal, Gambia, Mali, Burkina Faso, Cote d'Ivoire, Ghana, Togo, Benin, Niger, Nigeria, Ethiopia, Somalia, Kenya, Uganda, Rwanda, Tanzania, Malawi** (also MENA and S/SE Asia regions)	Four regional hubs launched, and innovation calls for proposals launched in East Africa, MENA and S/SE Asia regions
Power Africa USDAF	Call for proposal, Grants, Technical Assistance 2014 – present	Agriculture Health	Supply and Demand	$ 6.8m for PUE (larger programme $ 15.5m	**Kenya, Nigeria, Uganda, Tanzania, Somalia, Burkina Faso, Mali, Malawi, Mauritania, Rwanda, Senegal, South Sudan, Zambia, Zimbabwe, Ethiopia, Ghana**	Over 40 enterprises funded. Another 40 cooperatives integrated renewable energy
Power Africa Off-Grid Project	Technical assistance, Market Assessment	Agriculture	Supply	$49.9M (includes activities in the SHS, mini-grid and PUE sectors,	**Kenya, Tanzania, Uganda, Rwanda, Ethiopia, DRC,**	Productive use catalogues for 10 countries. Access to finance for 3 companies.

Donor/ Investor	Type of support	Sector	Supply/ Demand side	Amount invested/ committed by June 2021	Countries	Achievements/ Publications
				and is not limited to PUE only)	Cameroon, Niger, Ghana, Cote d'Ivoire, Liberia, Senegal	Supporting sale of 12,495 off-grid systems in 2020
Energy and Environment Partnership (EEP), Africa	Grants, Repayable Grants, Concessional Loans, Business Development Support 2010 - present	Agriculture Transport - motorcycles	Supply	Since 2010, EEP Africa has invested close to EUR 50 million in 250 pioneering projects across technologies. Since 2018 12 million EUR committed to 35 ongoing PUE-related projects	**Botswana, Burundi, Eswatini, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, Seychelles, South Africa, Tanzania, Uganda, Zambia, Zimbabwe**	Report: Powering productivity: lessons in green growth from the EEP Africa portfolio
Endev	Funding	Micro enterprises	Demand		**Uganda, Kenya, Rwanda, Nigeria, Burkina Faso**, Jordan, India	Report: Humanitarian energy: energy for micro-enterprises in displacement settings
Endev	Analysis of PUE projects by Endev, SNV, Practical Action, AVSI, CLASP. Research - desk study, mapping and in-depth interviews	Agriculture	Supply		**Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zimbabwe, Senegal,** Bolivia, Nepal	Report: Productive use of energy: moving to scalable business cases
Acumen **Pioneer Energy Investment Initiative, Energy Access**	Technical assistance – market assessments Equity and debt investments	Agriculture	Supply		**East Africa, Nigeria,** India,	

Donor/ Investor	Type of support	Sector	Supply/ Demand side	Amount invested/ committed by June 2021	Countries	Achievements/ Publications
Relief Fund (EARF), Housing Kawi Safi Ventures (KSV) and the Acumen Resilient Agriculture Fund (ARAF						
Beyond the Grid Fund for Africa	Call for proposal funding				**Burkina Faso, Liberia, Zambia, Mozambique, Uganda**	
DOEN Foundation	Grants, Loans, Equity 2017	Agriculture, Development organizations	Supply		**East Africa, Nigeria,** India	
Africa Clean Energy Technical Assistance Facility	Research, Desk review	Agriculture	Supply and Demand	N/A	**Ethiopia Uganda, Kenya, Rwanda**	Reports: Job creation through off-grid energy access in Ethiopia, Uganda solar water pumping report, Optimizing solar for social economic development in Kenya's Counties, Covid-19 briefing: Solar technologies address food insecurity

2.2 Insights

Analysis of the information received, and other insights shared directly show that:

- Focus is on the agricultural sector – possibly because the more mature technologies are suited for agriculture.
- Almost all the support is on the supply side.
- Geographically, there are more organizations covering Eastern Africa than other parts of Sub-Saharan Africa. Level of support (most to least) - Eastern, West, Southern, and Central Africa.
- Grants are the main PUE capital source with over $60M in grants committed to launching the PUE ecosystem since 2017.
- Investment capital is lagging. Among the 30 Efficiency for Access Investor Network members (a collaboration between Acumen and CLASP), only four have made investments into PUE companies to date. Less than 10% of all energy access funding has gone to PUE companies. However, 80% of Investor Network members plan to invest in a PUE company 2021 but require earlier stage investors to pave the way for increasing deal flow.
- An overwhelming majority of the money invested in the off-grid solar market is going to companies selling lighting products or solar home systems.
- High-risk, early-stage capital can fuel the next generation of innovations at the intersection of energy access, livelihoods, and climate resilience.

2.3 Key consumer insights on solar water pumps (SWPs)[2]

Coverage: Kenya, Rwanda, Senegal, Tanzania, Uganda, Zambia

Sample: 1193 customers – 84% from Kenya, 8% Uganda, 6% Tanzania. Remaining countries 1% each.

- Up to 89% of those who purchased solar water pumps are men with an average age of 46 years.
- At least 76% of those who bought SWPs were irrigating their crops before. Majority of the farmers at 35% and 31% were previously using fuel pumps and watering cans respectively. Most farmers (20%) irrigate tomatoes, with maize at 13%, which is a staple in the region.
- Main source of water is borehole, hence pumps that go up to 25 meters in depth are ideal.
- Studies by Efficiency for Access Coalition have shown that over-extraction is not a near-term problem for East Africa. However, water availability and quantity has been cited as a problem by farmers.
- Consumer awareness of SWPs is improving but still low.
- Eighty-three percent of customers purchased the SWP on credit with 86% making the initial deposit from their income or savings.
- The additional items SWP customers would like to purchase are: 63% improved cookstoves, 61% solar radio, 43% - solar fan, 40% - upgrade/additional SWP, 38% - solar TV, 38% - additional /upgraded SHS.
- Top sales channel for SWPs is through word of mouth (45%) followed by social media (17%).
- The top motivation to purchase the technology was saving money (45%)
- Price is the key driver for choice of SWP – therefore financing models and price affect up-take.
- The Net Promoter Score (NPS) is a gauge of customer satisfaction and loyalty. Anything above 50 is considered very good. The NPS for SWPs stands between 46 -55. However, customers rating for value for money decreased to 65% in 2021, from 82% in 2019.
- Durability and reliability of SWPs are key concerns for users. Most complaints were on the valves and battery.
- Fifty-four percent of customers have had to make unacceptable sacrifices to make repayments. 50% were feeling burdened by the repayments, mostly in Zambia. The second part of the survey was conducted during the Covid-19pandemic which could have influenced some of the responses on repayments.
- Eighty-six percent of customers admit their quality of their life has improved due to increased access to clean water and increased farm productivity.

2 *From the 60 Decibels report on Uses and Impacts of Solar Water Pumps – July 2021*

3. KEY CHALLENGES

The key challenges affecting the scale of PUE technologies include:

- **Awareness:** the level of solar PUE awareness among the target market is low especially in rural areas. On the other hand, distributors do not have sufficient information on what technologies are appropriate for different regions.
- **Affordability:** most of the technologies target small scale farmers and MSMEs who have limited disposable incomes, and limited access to credit facilities. The consumer survey by 60 Decibels and Efficiency for Access Coalition shows that 54% of customers have had to make unacceptable sacrifices to make repayments for SWPs, and 50% were feeling burdened by the repayments, mostly in Zambia. Covid-19 may have further affected the affordability of PUE products 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, durable and do not require significant adjustments or extensive training. 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 in the near future.
- **Limited collaboration:** There are many stakeholders supporting different PUE technologies and business models but operating in silos and with limited links to relevant sectors like agriculture, health, and livelihoods.
- **Lack of an enabling market environment to facilitate the scaling of PUE.** The technologies are mostly new and governments will need evidence to update the relevant national strategies and policies.

4. LESSONS

The lessons 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 SWPs have attained some level of market maturity many others are still new in the market and require different kind of 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 the potential for productive use in 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.
- Developing partnerships to draw on institutional strengths could accelerate progress in the PUE sector. Micro-finance institutions, private sector associations, end-user associations/ cooperatives, financial institutions 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 could be 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. Innovative end-user financing mechanisms for appliances are therefore critical.
- Adapting product design to the local context as different sizes of appliances and approaches are needed for different markets.
- Companies need to assess the economic impact of products to their customers to develop a strong value proposition that resonates with them.
- Creating awareness on the benefits of the product over existing alternatives and on how customers can use the PUE technology 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 with excellent customer service and reduce performance related PAYG customer default.

Gender and social inclusion (GESI)

- PUE technologies present 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.
- Integrating GESI in national PUE policies. For example, Senegal could use solar powered PUE to stem the tide of illegal youth migration[3].
- Country-specific or regional studies mapping the potential demand for different PUE products should include gender.

3 *ACE TAF (2021) Senegal: With adequate support, stand-alone solar could address illegal migration and youth unemployment.* Link

5. KEY SUCCESS FACTORS

Project implementers identified the following success factors:

- Detailed analysis of demand will be needed for PUE to scale. It will be more beneficial if such analysis also includes the level of demand concentration.
- Addressing end-user constraints will unlock new markets for PUE. The key constraints include awareness, affordability, training and after sales service.
- Implementing an integrated market development approach that also includes enabling policies.
- Continued support to businesses adopting PUE
- Detailed monitoring using tailored PUE indicators: a framework for monitoring PUE technologies is needed.

6. 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.
- Including PUE in project designs from the beginning. 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.
- • 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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ANNEX 2: CONTRIBUTORS

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