Deploying Solar Microgrids in Malawi

Lessons Learned and Implications for the Malawian Microgrid Ecosystem

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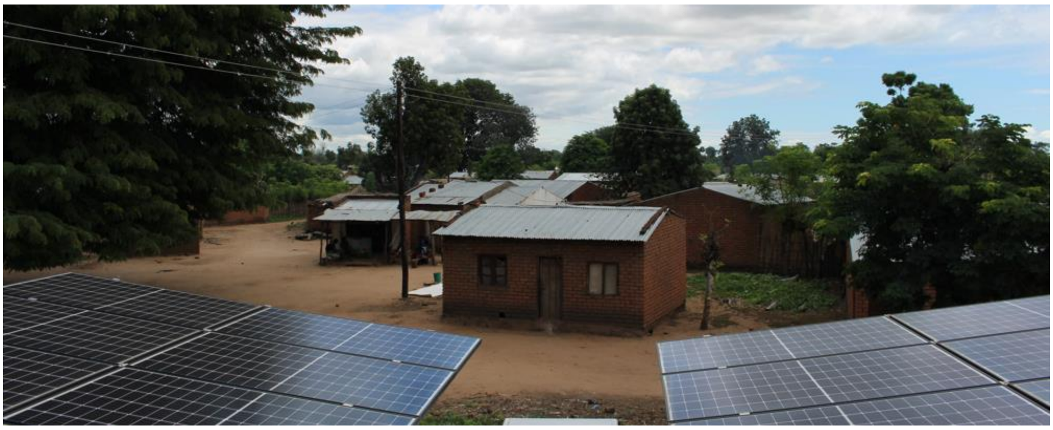


EASE Policy Brief

Energy poverty constrains economic growth and livelihoods, a significant challenge for Malawi where 82% live without access to electricity. Solar PV microgrids offer a cost competitive, low carbon solution to addressing SDG 7 whilst enhancing socio-economic wellbeing through improved quality of life, access to public services, job creation and entrepreneurship opportunities. As a relatively new technology in Malawi, there is a recognised lack of proven business models, field experience and data on microgrid performance and impact, which is stymying their wide scale deployment.

Through the Rural Energy Access through Social Enterprise and Decentralisation (EASE) project (funded by the Scottish Government, two solar microgrids have been installed in the rural villages of Mthembanji and Kudembe in Dedza district, generating and distributing power for domestic and productive customers. The systems are owned and managed by United Purpose (UP) through a social enterprise framework, with technical support and research activities provided by the University of Strathclyde (UoS). Detailed monitoring and evaluation and analysis of microgrid performance is being carried out by UoS to inform the Malawian renewable energy and off-grid sector. The motivation for the project is to pilot and demonstrate a social enterprise ownership model for solar microgrids in Malawi, with aims to use this project as a platform to set up further microgrids at other identified sites across Malawi.

The microgrids installed in Dedza offer reliable, renewable electricity to over 500 people through solar PV generation, low voltage distribution networks and smart meters. Performance monitoring through robust data collection is highly beneficial to multiple stakeholders in the microgrid sector including system operators, donors, investors and policy makers seeking to increase the scale and impact of the sector. A key aim of EASE has been to capture operational data through remotely monitored smart meters, and social impact through surveys to inform positive interventions in the microgrid ecosystem.

The purpose of this policy brief is to disseminate EASE project learning through sharing first hand experiences and primary data on technical, economic and social impact from two solar microgrids.

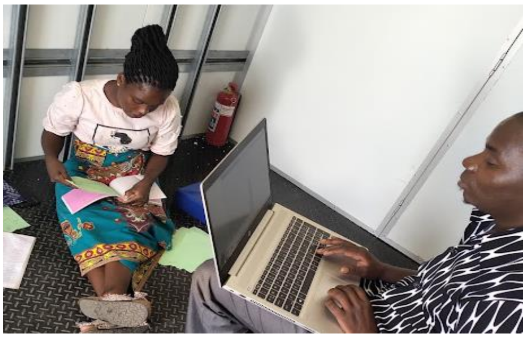
Deployment and installation

As the first project of this type implemented in Malawi, the deployment of the micrograids faced significant challenges including supply chain and regulatory uncertainty, inflation, foreign capital constraints and Covid-19. The need to build local capacity for microgrid project development and implementation (e.g. site prospecting, stakeholder engagement, coordination of local and international organisations and new administrative processes) also contributed to long deployment timelines. Skilled local technicians and field staff with international remote support allowed for rapid commissioning during the installation phase. Learning from the first microgird helped streamline the deployment of the second; however, the external constraints still caused significant delays.

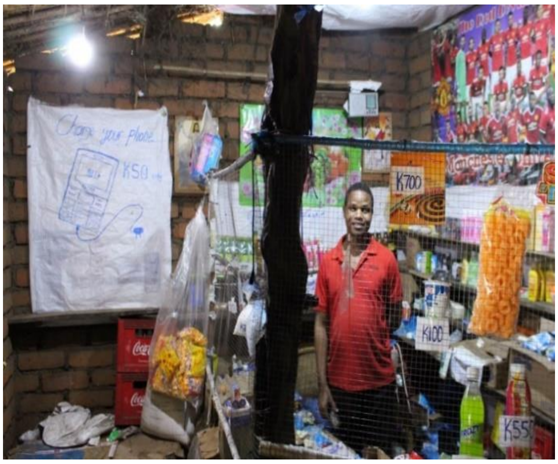
Technical experiences

Solar PV with Lithium-ion batteries offer low maintenance generation and storage, with effective remote monitoring assisting in troubleshooting. The systems have generally performed efficiently and effectively, providing reliable energy to communities and demonstrating resilient energy delivery in areas vulnerable to climate shocks. SteamaCo smart meters offer innovation in remote switching, digital payment platforms, and real time data on consumption, revenue and system downtime; however, challenges arose with technical faults and unreliable mobile signal causing blackouts, necessitating frequent call outs for maintenance engineers. Overall, the microgrids' performance demonstrates that decentralised renewable energy infrastructure can offer increased resilience and security of supply over centralised generation, attributes expected to become increasingly desirable as Malawi faces more extreme weather events as a result of climate change.

Economics



Capital and operational costs have been found to be high compared to Sub-Sahara African benchmarks, reflecting the nascent market of microgrids in Malawi. Revenue from electricity sales covers site based operational costs for maintenance contracts, data costs and site agents, but doesn't cover wider organisational costs such as transport, replacement of main system components and management staff salaries. This is being addressed through stimulating demand with more connections and fostering daytime productive uses of energy, while looking to reduce OPEX costs through more efficient operation and maintenance strategies.

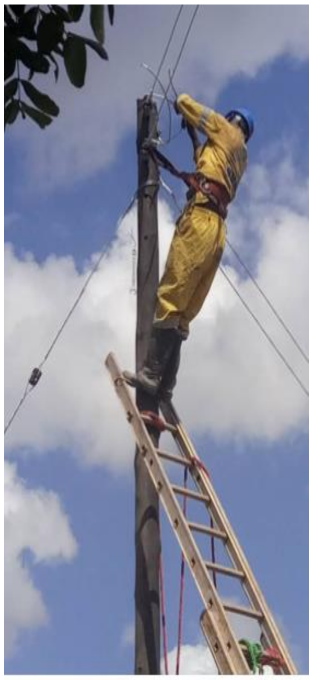


Social impact

Social impact data collected through surveys shows that energy access directly correlates with participants' expectations for happiness, opportunities, and economic development. Improvements are noted in availability and convenience of electricity supply, with environmental and health impacts experienced. Households are much more satisfied with their home lighting and can entertain, work and study in their homes at night. Customers are generally satisfied with the quality of the service and the project; they consider it a good development, transforming community life and bringing an urban feel. However, some customers found the service was not conducive to pursuing their business venture ideas due to cost and reliability issues.

Recommendations for policy makers and the regulatory ecosystem

Designate space for microgrids in rural electrification planning



Despite a draft rural electrification plan in place and the newly published Integrated Energy Plan for Malawi, uncertainty exists regarding future plans for grid expansion, putting microgrid developers at risk of grid encroachment leading to stranded assets. This threat can be alleviated through clearly defined geographic areas or zones that are demarcated for microgrid development, de-risking the sector and attracting more investment. Additional confidence can be gained through clear understanding of what happens when the grid does arrive, with procedures set in place for microgrid to grid interconnection.

Implement pro-poor subsidies to reduce tariffs and improve microgrid financials

The high costs, low revenue and associated vulnerabilities in matching microgrid operational expenditure with income from electricity sales demonstrates the need for smart subsidies to enable solar microgrids to scale. Subsidies for grid connected electricity supply in the Global North are universal, and expecting the poorest communities to bear the full cost burden of electrification with no support is both unsustainable and unfair. This is evidenced in other African countries where subsidies are underpinning SDG7 progress. By sharing and aggregating key financial data across multiple active microgrid projects, appropriate subsidy levels can be quantified and a case made to the relevant authorities outlining the requirements for sustainable microgird services in rural customers.

Design and operationalise a sector wide Environmental and Social Management Framework for microgrids

Environmental and Social Management Plans are recognised as necessary for ensuring microgrid developers actively reduce their environmental impact and increase the social impacts of the project. However, the requirements to produce an ESMP were found to take up significant resources relative to the size of the microgrids. A proposal to reduce these overheads is the implementation of a sector wide Environmental and Social Management Framework for micro and mini-grids in Malawi, allowing microgrid developers to streamline development timelines.

Remove barriers from VAT and FOREX

Allowing the current VAT waiver for solar products to be expanded to all components associated with microgrids, including shipping containers, distribution equipment, house wiring, overhead cables and ancillary devices, would further reduce CAPEX costs and improve financial sustainability of microgrid projects. Significant challenges and delays were faced with lack of foreign capital to purchase microgrid components. This could be overcome by central banks designating a set amount or percentage of foreign capital towards the purchase of renewable energy equipment.

Invest in research and capacity building

A shortage of skilled technicians, system designers and business expertise in the Malawian microgrid sector is stymying wide scale deployment and efforts are required to address this through targeted capacity building. This can include government support for technical short courses, degrees offered through local universities, online training and internship opportunities both local and international. Although augmenting existing training is important, perhaps more vital is to ensure that local skills are utilised and microgrid investment creates opportunities for local companies and engineers (as demonstrated in the EASE Project). Investment in microgrid research and development in partnership with local academia e.g. through providing research funding or innovation challenges will further accelerate microgrid deployment.

Recommendations for microgrid developers:

Seek collaboration and partnerships with multiple development players

For sustainable and accelerated microgrid deployment collaboration is necessary across all initiatives, between community members, local NGOs, the local government, and agencies working on the project. Coordination and consolidation of donor led initiatives in the microgrid sector is needed to avoid duplication; microgrid developers should network with all levels of energy-related organisations, such as NGOs, the government, the commercial sector, and research institutes. They should also be a part of actor networks and coordinate stakeholder interactions, including networks both local (e.g. REIAMA) and international (e.g. African Mini-grids Developers Network).

Improve financial sustainability through innovative business modelling

Proven microgrid business models with a positive cash flow are yet to emerge in Malawi. This can be addressed through reducing costs or increasing demand. For CAPEX, bulk purchasing can achieve economies of scale while gaining efficiency in maintenance operations and fieldwork activities to minimise transport and labour costs can reduce OPEX. Demand can be increased through promoting daytime productive use anchor loads, reducing wasted generation and increasing revenue. Microgrid developers need to innovate in pricing and payment methods through PAYG tariffs and mobile money, while adopting consumer financing business models for provision of appliances to customers will further foster uptake in electricity use and associated revenues for the microgrid operator.

Invest in technological innovations

Technical innovations for solar microgrids for data capture, monitoring and control need to be embraced by microgrid developers to offer efficient, technically robust and sustainable systems resulting in reliable electricity provision for their customers. The value of remote monitoring has been demonstrated in terms of reducing maintenance costs and providing better understanding of system performance, as well as a tool for troubleshooting and providing early warnings when issues are about to occur. Similarly, the value of smart meters is clear, through remote access to customer data, remote switching and application of dynamic tariffs.

Allocate resources for impact measurement and community engagement

Social impact measurement should be conducted to inform business strategy, but also shared with government and other key stakeholders to make better informed decisions on resource allocation and have clearer understanding of solar microgrid services. A collaborative community is needed where projects can draw on the knowledge base of ongoing or completed projects and share or lend expertise or experts, including local social scientists. Local capacity building and community engagement needs to be prioritised for effective microgrid enterprises to function and grow sustainably, with a budget allocated to support these interventions. Community engagement should be a key focus embedded in the service offering of a microgrid developer, with financial and human resources set aside in the business plan to cater for these social requirements.

Research agendas

Collaborating with academic and research institutions for data analysis, research and knowledge exchange allows much needed insight and understanding into microgrid performance and planning. Research themes to progress the microgrid sector in Malawi are proposed below:

- **Business modelling: techno-economic analysis, tariff setting and financial modelling**
- **Microgrid performance monitoring through data acquisition and analysis**
- **Understanding demand: customer segmented load profiles and load growth**
- **Geospatial analysis, site prospecting and porfolio planning for scale up**
- **Asset management and maintenance frameworks for multiple microgrid sites**
- **Microgrid distribution grid design and optimisation**
- **Interconnection of microgrids and the national gird**
- **Productive Use of Energy in agricultural value chains**
- **Measuring and understanding microgrid social impact**