

# RESILIENT OFF-GRID POWER SUPPLY

## BUILDING SUSTAINABLE MINI-GRIDS FOR RURAL COMMUNITIES IN UGANDA

### Introduction

The electrification rate in Uganda currently stands at 18.9%<sup>1</sup> with the rural communities at a low level of 5.2%<sup>1</sup>. The high costs in infrastructure required to improve access in rural communities coupled with the low levels of demand would lead to prohibitively high electricity prices charged by energy suppliers. This significantly impedes the realization of SDG 7 with regards to energy access for all. In such cases, off-grid electrification based on sustainable energy sources is the only viable solution.

Rural households are mainly managed by women, their day-to-day livelihood, quality of life, education for their children and access to critical services is highly dependent on their ability to access reliable and affordable energy. Empowering these women through the provision of sustainable energy solutions not only supports SDG 5 to increase equality but also provides a platform to improve their livelihood and those of their children immensely contributing to the eradication of poverty (SDG 1).

While the adoption of renewable energy sources is key in achieving SDG 7, resilient systems require careful design that includes flexibility from a mix of suitable generation resources and load mechanisms to realize the benefits. This approach ensures improved access to clean energy and sustainability in meeting the needs of rural communities for future generations.

### Key Findings

1. Availability of adequate, reliable and resilient energy services is vital for improving quality of life and access to critical services for rural communities.
2. Where the expansion of the national electric grid to rural communities is not economically feasible, adopting a mix of locally available primary resources can result in affordable and sustainable energy.
3. Economic empowerment of rural communities to increase productive activities is vital in improving available demand for energy services and drive down the costs to the different consumers.
4. Government subsidies and public-private partnerships are vital in ensuring adequate funding is available for the high initial costs required for resilient mini-grids in rural communities; which would also contribute driving down the costs per kWh.
5. Government regulatory bodies need to provide technological guidelines and standards to be ensured in the operation of mini-grid systems to protect both infrastructure and consumer equipment as well as ensure ease in future integration to the national grid.
6. Empowerment of the local technical expertise and community participation during the mini-grid design is necessary to ensure that service provision aligns with the needs of the community.

### EXECUTIVE SUMMARY

Mini-grids are stand-alone electrical networks that designed with the aim of enabling access to a reliable and sustainable source of electricity in off-grid remote communities. They are vital in the acceleration of rural electrification, boosting access to critical services, local economies and standards of living. Thus, providing a significant contribution to the sustainable development goals (SDG) on poverty eradication, quality education and health services.

The success in ensuring accessibility to clean and affordable energy to meet SDG 7 depends on the design and building of resilient systems that consider local needs, allow for community engagement in the design process and extensively rely on locally available primary energy resources and human capital. Building such systems is however a challenging task that relies on aspects including availability of adequate funding, present and future demand assessments to ensure feasibility, and the availability of comprehensive technical standards. This calls on policy transformations in aspects of financing to rural energy projects, local productivity and technical guidelines to ensure the benefits of mini grids are realised.

## Policy Recommendations

The success of rural electrification projects requires that policy takes a holistic approach that supports technical, financial and consumer-related aspects in developing strategies that will provide a suitable environment to foster increases in energy access. Policy reviews should thus be aimed at:

1. Policy makers should ensure that financial support, incentives and initiatives are set up to sustain the development and initial operation of energy projects such as mini-grids to ensure affordability.
2. Energy policy should increase priority awarded to setting up rural energy access initiatives and utilize geographical specific information in setting up projects that are inclined to the primary energy resources widely available in each locality.
3. National policy should support the involvement of women in economic and productive activities aimed at improving their level of financial support and thus ability to access critical services and building rural energy consumer capacity.
4. Energy policies should re-think the grid operating standards to ensure that they entail the differing operational characteristics of the renewable generating units to support their incorporation into networks with the traditional generating units.
5. Enhancing holistic development of local expertise and capacity in social, financial and technical skills in the management mini-grids and off-grid energy access solutions.

## Audience

A policy brief for central governments in developing countries, universities and research institutes, funding agencies, community organisations, non-governmental organisations, the United Nations and its agencies.

## Implications

1. Rural energy access can be improved by utilizing hybrid electricity generation technologies to ensure reliability, resilience and sustainability when connected into mini-grids to better support communities.
2. Lack of clear technical grid standards providing guidelines for the operation of mini-grids will result in both early degradation and diminished adoption of these systems reducing their benefits.
3. The upscale of productive demand in rural areas is vital to the reduction of the consumer charges per kWh enabling the fast adoption of energy services.
4. The adoption of cleaner, sustainable energy resources significantly reduces the costs per kWh to the consumer providing an affordable solution and faster access to energy given that significant levels of the primary resource are locally available.
5. Flexibility of the energy system is key in ensuring 100% adequacy and security of the network, a combination of both generation and demand flexibility mechanisms is necessary to ensure that lights are always kept on especially for the critical services.
6. Mini-grid design requires detailed analysis of the locally available primary energy resources, current and future load demand, customer engagement and local expertise to ensure continuity and longevity.

## Sources

1. The Uganda National Household Survey 2019/20

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