Gbamu Gbamu Mini Grid

Evaluating the socio-economic impacts of a pioneering solar mini grid

Originally a distributor of standalone solar systems in urban areas, Rubitec Solar diversified its operations in 2018 when it developed its first solar mini grid in the off-grid rural community of Gbamu Gbamu. The project was one of the first mini grids installed in Nigeria and, despite its current challenges, it continues to serve as a reference to the Nigerian government, private sector, and financing actors in the mini grid market in Nigeria. This case study focuses on socio-economic impacts and inclusion aspects of the mini grid, while describing the operational and business models, and the potential for replication.

Figure 1. Mini grid in the Gbamu Gbamu community (Source: Israel Faleye, 2022)

General information

Project name	Rubitec Gbamu Gbamu mini grid (2018-2023)
Developer	Rubitec Solar, www.rubitecsolar.com
Location	Gbamu Gbamu, Ogun state
Focus dimension	Understanding user needs
Type of action	Rural electrification intervention
Financing sources	Grant, debt (crowdfunding) and equity

Introduction

The Gbamu Gbamu mini grid was built in 2018 by Rubitec Solar, a Nigerian renewable energy company founded in 2004. This is one of the first solar mini grids developed in the country, and one of the longest-lived ones. Located in the Omo Forest Reserve, a preserved area of tropical forest in Ogun state, southwestern Nigeria, Gbamu Gbamu had developed in previous decades into an agricultural and trading hub centred around the key staple crops: cocoa and palm oil. The development of a solar mini grid at Gbamu Gbamu was therefore seen as an opportunity to further support the local economy, in particular agricultural processing activities (Okoro, 2021).

Technology and operational model

The solar hybrid mini grid was commissioned with a total generating capacity of 85kWp from more than 300 solar PV panels, and an annual electricity output of 275,000 kWh. The storage capacity was originally provided by OPzV batteries ranging from 395 kWh to 500 kWh and 9 off-grid inverters with 8kW AC-nominal output power each. An 80kVA diesel generator was used to complement the solar panels and batteries, usually during early mornings and late nights (Rubitec Solar, 2018; Allee and Sherwood, 2022). For the distribution system, poles and wires were installed in the village and connected to the generation unit. In total, 5.3 kilometres of distribution grid were installed, with 462 single-phase connections and 25 three-phase connections (Oredola, 2018).

Three years after project commissioning, the batteries became depleted and due to financial constraints were only replaced recently, with 80kWh of lithium battery storage capacity – much lower than the original capacity. Furthermore, Rubitec decommissioned the back-up generator in 2021 when diesel prices became unsustainable. As a result of these two adjustments, the time of electricity supply became limited to daylight hours, with the mini grid currently providing an average of 16 hours of power supply daily, down from 24 hours when it started.

Rubitec owns the mini grid and oversees its operations and maintenance, with initial technical assistance and training provided by the Renewable Energy and Energy Efficiency Project (REEEP) (USAID, 2018). One local technician or utility manager is permanently stationed on site and carries out routine and preventative maintenance. The system is also monitored by the Rubitec team remotely thanks to the presence of a strong telecommunication network which had been present in the community some years prior to the development of the mini grid. This, among other factors such as distance to the national grid, were key in selecting Gbamu Gbamu as a potential solar mini grid site.

Key figures

- 654 connections as of 2020
- 36 mid-scale commercial users
- 100 small-scale commercial and social users
- An estimated 7,000 people receiving electricity

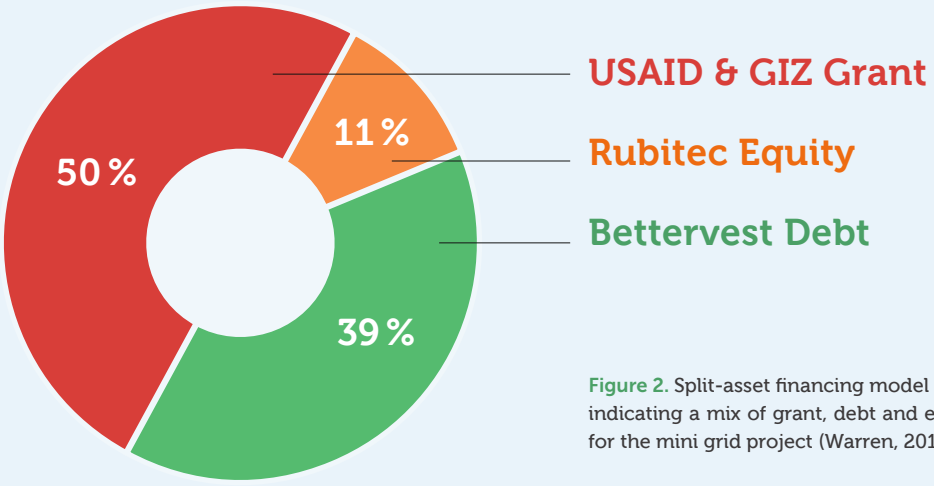

Figure 2. Split-asset financing model indicating a mix of grant, debt and equity for the mini grid project (Warren, 2018)

Business and financing model

The Gbamu Gbamu project was developed with support from the European Union and the German government (via the Nigerian Energy Support Program, NESP), the United States Agency for International Development (USAID), and Ogun state Government (Yee, 2018). The financing model of the project can be described as a 'split asset model' (Figure 2), involving the separation of distribution and generation costs. Distribution costs were covered by a EUR 500,000 grant, while EUR 224,000 was raised as a loan from Bettervest – an impact investment crowdfunding company –, and the rest was financed by Rubitec in the form of equity. Upon listing on the Bettervest platform, it took 106 days to raise the required amount, at an expected return rate of 10% (Warren, 2018; Anyaogu et al., 2019).

Rubitec recovers the investment through revenue collection, which is done through a mix of manual and mobile money payment systems, with smart meters measuring the energy used by customers. Recovery rates have in general been very high, close to 100% and very far from the collection rates for national grid electricity customers. Tariffs were initially set at an average of NGN 160 per kWh (equivalent to approximately USD 0.45 at the time), and later reviewed to NGN 190 per kWh (Sesan et al., 2022).

Energy demand remained low throughout the first year. In a bid to increase the grid's capacity utilization, Rubitec participated in an appliance financing program in partnership with the Mini Grid Innovation Lab. This allowed them to offer productive equipment such as DC water pumps for the purpose of farm irrigation and household appliances to customers on credit plans. After five months of participation, the customers who had purchased appliances on credit used 25 percent more electricity than before (Allee, 2019). Another such initiative to increase the utilisation capacity was the e-mobility program piloted in 2021 at Gbamu Gbamu in partnerships with MAX.NG (GET.Transform, 2021). The initiative has since been discontinued.

"Whenever I put on my freezer with the solar light, my fish starts freezing. I'm enjoying the solar light very well."

Olubisi Grace (Female trader, Gbamu Gbamu)

Social and environmental impacts

Since the development of the mini grid, the community has experienced an influx of residents. While originally expected to serve 500 households and small businesses, the mini grid now serves a community of 700 households. Productive users constitute a relatively small share of the demand, and are mostly service-oriented, such as hotels, betting shops, welders, frozen-food retailers, barbing salons, and tailoring shops (Sesan et al., 2022).

The development of the mini grid contributed to significant savings in fuel purchase for petrol generators for productive users. It is important to note that these savings and impacts were not homogenous for all types of users: businesses that have seen the most savings and growth as a result of the mini grid are those that are established enough to spend relatively highly and consistently on electricity (Sesan et al., 2022). These businesses are typically operated by men. Smaller businesses that are more typically run by women, such as hairdressing salons and cold drink stores, have also benefitted from the mini grid; however, given their minimal electricity demand, they have not seen much growth. Indeed, the availability of electricity in the community has had the effect of increasing competition in this market segment.

Figure 3. A tailor using power from the mini grid to iron clothes (Source: Israel Faleye. 2022)

The impacts on business growth did not extend to the myriad agro-processing activities in the community. Field researchers from the SIGMA project (Sustainability, Inclusiveness and Governance of Mini-grids in Africa) found that both the cocoa and palm oil value chains rely heavily on traditional methods and therefore benefit little from the mini grid. Mechanically dried cocoa, for example, weighs less than the traditional sun-dried variant, and this makes it less competitive in the local market. In the palm oil-processing business, there is a strong reliance on manual labour carried out by women who typically are employed by male firm owners. Further, Rubitec's efforts to facilitate the acquisition of electric motors to replace diesel for the few stages of processing that have traditionally been mechanically powered did not succeed.

The impact on social services was compromised by the lack of electricity supply outside of daylight hours. Key social services that need electricity to operate at night, such as the primary health care centre (Figure 4) – where staff attend births at all hours of the day and night – and the local security committee, have benefited very little from the mini grid to date (Sesan et al., 2022).

Replicability

Gbamu Gbamu offers a series of lessons towards the replication of mini grids in similar contexts. In particular, this case study sheds light on the interplay between demand stimulation, financial viability and socio-economic impacts of the grid.

The mini grid needs to be able to sustain demand in the long term. The replacement of costly battery storage equipment needs to be fully integrated into the business model and a sufficient share of the revenue needs to be directed towards the replacement of key components.

Demand stimulation is closely linked to the financial viability of the mini grid. Financing for productive appliances can help increase demand, but the impact on agricultural value chains should not be taken for granted. The technical and business solutions provided should be adapted to the needs of the local value chains to procure specialised equipment. Moreover, without a tailored and gender-sensitive approach, the benefits from the mini grid risk accruing to certain socio-economic segments and exacerbating existing gender inequalities. Finally, the needs of users of critical social services should be prioritised.

Figure 4. Social institutions like this government health facility in Gbamu Gbamu require reliable electricity supply during night hours. (Source: Israel Faleye. 2022)

These lessons are key to the success of interventions such as the Rural Electrification Agency's USD 19 million fund for results-based financing of productive appliances and equipment. This key component of REA's Nigeria Electrification Project aims to increase productive use of energy in rural communities by facilitating access to energy efficient productive use equipment (REA, 2021).

Rubitec has shared the experience from its pioneering mini grid with Nigerian solar off-grid developers and with a variety of practitioners, including through the Rubitec Academy where courses are provided in mini grid design and operation.

Lessons learnt

- The financing model must consider the replacement of components and in particular of battery storage equipment for solar PV installations
- An emphasis on the needs of small businesses and of agricultural processing activities in off-grid communities can potentially increase the economic inclusion of women
- Operational constraints greatly undermine benefits to key services such as health facilities

Future outlook

- Gbamu Gbamu mini grid revenues will be used to fund the replacement of battery storage equipment to ensure 24-hour operation
- Rubitec aims to develop 13 isolated mini grids and 2 interconnected mini grids in Nigeria by 2025

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Further resources

Watch: 360° video on Solar Hybrid Mini Grid in Gbamu-Gbamu by Nigeria Energy Support Program (2020) https://www.youtube.com/watch?v=t_eqY85BOLQ

Watch: short documentary about the Electric Vehicle (EV) pilot project at Gbamu Gbamu supported by the Nigerian Energy Support Programme (NESP) (2022) https://www.youtube.com/watch?v=RdB95g44zEw

Authors: Israel Faleye, Maria Yetano Roche, Kimberly Fahsold

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Find more information and case studies on the Nigeria Off-grid Solar Knowledge Hub:

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