CEANGAL

Demand side issues considerations and approaches for successful RES uptake

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Executive Summary

Atlantic Technological University Sligo in collaboration with the Department of Electrical Engineering at the Malawi University of Business and Applied Sciences (MUBAS) is implementing the "CEANGAL Project". The project aims to connect underserved communities to sustainable electricity, by connecting such groups to mechanisms and tools to ensure ownership and sustained operation of Renewable Energy Systems (RES). The CEANGAL project puts forward an ambitious adaptable and replicable model to support activities and know-how relevant to the selection, procurement, installation, and ownership of renewable energy systems (RES), as well as providing support structures to ensure the continuous local operation and maintenance of these RES.

To significantly improve the framework characteristics being proposed by the CEANGAL project, this report explores the demand side issues affecting electricity uptake and accessibility in Malawi. The report examines the current connection requirements and charges to gain access using current electrification programmes. There is also an interest in knowing why households are not connected. The report further provides recommendations on what incentives might be put in place to connect people.

The report begins with the introduction which gives the background of the initiatives aimed at accelerating electricity uptake in Malawi, particularly in rural areas. Section 2 outlines non-technological factors affecting the successful uptake of such electrification measures. Section 3 presents the grid and off-grid connections financing mechanisms that have been so far applied in Malawi. Under section 4, the report draws lessons from case studies of successful electrification schemes from other low-income countries. Section 5 finalises the report by providing potential measures and incentives that could be considered for facilitating improved electrification uptake and project sustainability in Malawi.

Contents

1.0 Introduction

Malawi ranks among the least electrified countries in Sub-Saharan Africa and the world at large, with only 18% of the population having access to electricity, of which 11.4% is from the national electricity grid. The access rate in rural areas is even lower at 3.9% [1]. The country's total installed capacity is 485MW, with an available capacity of 354MW which is against a demand of approximately 700MW [2]. There have been efforts to accelerate access to electrification, especially in rural areas. Some of the major initiatives include; Restructuring the electricity market by allowing the private sector to invest in power generation, promoting decentralised energy systems i.e., mini-grids, and solar home systems as well as the establishment of the Malawi Rural Electrification Program, (MAREP). The subsequent sub-sections provide initiatives that have been undertaken by the Government of Malawi (GoM) to improve electricity uptake in Malawi.

1.1 Malawi Rural Electrification Program

In 1980 the government established the Malawi Rural Electrification Program (MAREP) to increase electrification access for people in peri-urban and rural areas [3]. The program is managed by the Ministry of Energy (MoE) and the Electricity Supply Corporation of Malawi (ESCOM). The Programme is financed by 4.5 percent of levies charged on retail energy sales. Since its inception, eight phases of the programme have been implemented. This involves extending power distribution lines to district administration centres, major trading centres, tobacco growing areas, and the development of the 4.5MW Wovwe Hydroelectric Power Plant in Karonga district, in the Northern part of Malawi. Under MAREP, over 836 district administration and trading centres in rural areas were electrified as of 2019. Much as the combined efforts of ESCOM and MoE have resulted in an increased expansion of the national grid, these efforts have however not achieved the access rates needed to deliver the 2030 target of meeting 60% electricity access [3]. This implies that the main objective of the programme is far from being fully accomplished.

As a way of addressing this challenge, MAREP has expanded its activities to connecting households through off-grid solutions in areas where grid extension is economically deemed expensive. However, it was noted that after bringing electricity close to households in peri-urban and rural areas through MAREP, most households were still not connected to the grid due to the inability to meet the required connection fees. The MoE in collaboration with ESCOM decided to launch the NDAWALA project with the aim of increasing connectivity in rural areas. The project is aimed at assisting low-income households with wiring services and connections through a soft loan of $67.57. The loan is deducted over a period with the customers buying energy units, with 40% deducted from every purchase made [4].

The NDAWALA scheme mechanism is as follows: Potential customers are identified by the contractors and certification of the customers is done by ESCOM. Customers to this scheme are required to pay a $6.14 commitment fee. The list of certified customers is submitted to contractors for the execution of works. Contractors are involved in the electrical installation to the houses while meter connections are done by ESCOM.

Since its commencement in 2019, NDAWALA Project has connected 9,156 households across the country out of the planned 12,982 households in the first phase of its two years. Since the inception of the project, the verification exercise carried out by the MoE observed that the project is faces two major challenges;

i. Some energy meters have not yet been activated to enable customers to buy electricity units.
ii. Some transformers were vandalised.
iii. ESCOM is yet to extend Low Voltage (LV) powerlines to customers who are far from Medium Voltage (MV) networks despite having electrical installation done to their houses.
iv. Some contractors only wired households but did not do service connections despite the contracts comprising electrical installation and service connections.

From these findings, it can be observed that the NDALAWA Project has done little in accelerating electricity uptake by households within the proximity of the national grid powerlines. The project was initiated on premise that the main challenge affecting the uptake of electricity is a lack of finances. As such, there is a need of addressing this gap by looking at other major demand side issues affecting the uptake of electricity in remote areas.

1.2 Malawi Electricity Access Project (MEAP)

The GoM, with financial support from the World Bank, is implementing the Malawi Electricity Access Project (MEAP) to improve electricity access to households both in urban and rural areas with a major focus on connecting customers who previously applied to be connected, but are yet to be connected to due to ESCOM's failure to procure materials. The proposed project aims to connect 280,000 households, small and medium enterprises, schools, administrative buildings, and health facilities within proximity to the existing grid network upon its completion in its operating period from 2022 to 2024 [4]. This will increase the electrification rate from the current 11 percent to 20 percent by the project's completion. Additionally, part of the project funds will be used to connect less privileged households in rural and peri-urban areas across the country. The following prescribed selection criterion will be used in identifying beneficiaries [5].

i. The prospect beneficiaries will be those who apply for a single-phase connection.
ii. Furthermore, potential beneficiaries must reside within a transformer connection range of 500 metres radius.
iii. A household whose monthly income is aligned to the minimum PAYE tax-free band as applicable from time to time qualifies to benefit from the free electricity connection.
iv. The structure of the dwelling unit must be solid (strong walls which can support electrical installation) house thatched with either grass or iron sheets.
v. The following marginalised groups will be accorded priority; disabled headed households and female-headed households.

The difference between MAREP and MEAP is that MAREP focuses on expanding the grid through construction of powerlines to remote areas. On the other hand, MEAP aims to connect customers who had previously applied for electricity connection but were yet to be connected. Additionally, MEAP aims to connect underprivileged households based on the above-mentioned criteria.

1.3 MERA Registered companies

The government of Malawi, through MoE, formulated enabling policies aimed at bolstering private sector involvement in electrification programs across the country.

Mini-grids, Solar home systems (SHS) Pico lighting systems, energy kiosks, and other off-grid energy solutions are offered by commercial companies registered with Malawi Energy Regulatory Authority (MERA) at a cost to customers thus supporting the efforts of accelerating electricity access in the country [6]. Only such registered companies have the ability to provide such services in the country.

2.0 Non-technological factors affecting the successful uptake of electrification measures in Malawi

2.1 Level of Income

The level of household income is a consistently significant predictor of uptake. However, not only is the average level of income important but its flow and predictability also correlate with households' willingness to connect to electricity services, where available. According to Kyriakarakos [7], income is the major factor in electricity adoption with a strong correlation between income increase and the adoption of electricity. This resonates with studies by Tewathia [8] whose findings indicate that there is still low adoption despite friendly payment modes and subsidies suggesting that price policies may not fully explain the observed low levels of electricity adoption.

Malawi has one of the highest rates of poverty in the world, with 73.5% of the population making less than $1.90 per day, which relates to earning less than $60 a month [9]. It has to be noted that 84.4% of Malawi's population lives in rural areas where the electrification rate is very low (3.9%) [1]. This clearly indicates that the majority of the said 73.5% (living below the poverty line) are in rural areas and cannot afford to pay for costs related to electricity connection via the national electricity grid due to low-income flows. For instance, the standard charge per single phase which is mainly for households is currently at MWK93,200.00 ($89.96). Additionally, household owners are supposed to pay the costs related to the electrical installation of their houses. Household owners in rural areas with small two- or three-bedroom houses are supposed to pay between $300 - $600.00 for electrical installation works. This cost is therefore quite prohibitively expensive for most households, being five times and over the average monthly earnings.

2.2 Connection Charges and High Upfront and Maintenance Costs of Renewable Energy Systems

Connection charges are the fixed, upfront amount that new customers pay to connect to the distribution network. A customer submits an application and after a thorough site investigation has been conducted by ESCOM, a quotation will be generated upon which payment will be based and the quotation is valid for 30 days [10]. Details of actual charges will be based on standard charges per connection or tailor-made charges depending on the scope of work, type of connection, and location. Standard charge per single phase which is mainly for households is currently at MWK93,200.00 ($89.96). Additionally, household owners are supposed to pay the costs related to the electrical installation of their houses.

For off grid solutions, the high upfront and maintenance cost RESs are a significant barrier to adoption of electricity through off grid solutions by households in rural communities. For instance, a 1KVA solar home system (which powers 10 bulbs, 1 phone and laptop) will cost a consumer a sum of MKW2,250,000.00 (using an exchange rate of 1 USD = MWK 1036 (as of 22 February 2023)). This is considerably expensive when compared to the monthly earning of people in rural and peri urban areas [11] . Further to this, RESs require ongoing maintenance and repair i.e., replacement of batteries after 2-5years. This adds to the overall cost of the system and makes it less appealing for underprivileged households. To address this challenge, there is a need of providing financing options such as grants and loans to help low-income households cover for the aforementioned costs. To make renewable energy technologies more affordable, government can as well come up with incentives such as tax breaks for firms in renewable energy industry. Additionally, there is a need of implementing effective maintenance and repair plans to help reduce the maintenance and repair costs.

2.3 Quality of the Dwelling Unit

According to NSO [12], 36% of the houses in Malawi are deemed traditional units, i.e defined as dwelling units with mud walls and grass-thatched. About 41% of the houses are permanent i.e., made with concrete, stone, or burnt brick walls and iron sheet, concrete, or asbestos roofs. Nearly, 23% lived in semi-permanent dwellings built described as a combination of concrete, stone, mud brick, and grass thatched as presented in figure 2-1. Some of the traditional houses are made of materials such as cartons, reeds, and unburnt bricks that have weak wall structures and not suitable to support electrical installations. Furthermore, in addition to their unsuitability for electrical installation, a study by Blimpo [13] has shown that a significant share of households, especially in rural areas of sub-Saharan Africa, live in precarious housing and would prioritise housing improvement over electricity services when they have budget constraints.

Figure 2-1: *From top left; Traditional, semi-permanent, and permanent house*

2.4 Lack of Awareness and Education

Lack of knowledge and education has a significant impact on the uptake of electricity from both the national grid and off grid solutions. For instance, some people in remote areas are not aware of the ESCOM's electricity connection procedures and processes. As such people engage electricians to help them facilitate the connection processes. Mostly these electricians inflate the charges thereby making it more expensive for the applicant. Additionally, some people are sceptical about the reliability of renewable energy systems such as solar systems as they think such systems may not meet all their electricity needs. Furthermore, people are not aware of the need to care or performing basic maintenance and repair of the RESs since mostly there is no skills transfer when the systems are being handed over to clients.

According to report by NSO [12], Malawi has one of the highest illiteracy rates (68.6%) in Southern Africa with most rural districts registering rates below the national average. This significantly affect people's awareness on modern energy sources and its benefits as stated by Inglesi [14] that electricity adoption and use is associated with education level of an individual. Educated individuals are conversant with the importance of using modern sources of energy such as electricity as compared to less educated or individuals that never attended school. Education opens up opportunities for wage employment and other economic activities outside farming, therefore providing extra income which is used in acquiring modern energy sources such as electricity among other necessities. To address these challenges, there is a need of investing in public awareness programmes on electricity education procedures as well as educating consumers on how they can take care of RESs and perform basic maintenance and repair of such systems. There is also a need of intensifying civic education on the benefits of using renewable energy systems.

2.5 Consumer Preferences and Cultural Factors

Consumer preferences and cultural factors have an impact on the adoption of electricity from renewable energy sources in Malawi. For example, some people believe that solar powered systems are not reliable and cannot meet all their energy needs. There are cases where poor performance of a solar powered system emanates from poor installation works and or fake solar products and result in system failure. This creates lack of trust as people think the problem is the renewable energy system itself. Instead, people indicate preference and opt to connect with the national grid instead, once the powerlines are extended to their locations. People also have negative attitude toward the use of biomass technologies i.e., for electricity generation and cooking, as they think that it's not safe and reliable [15]. Understanding local customs, traditions specific household needs can therefore help tailor electrification solutions to better suit consumer preferences.

3.0 Financing Grid and off-grid connections in Malawi

3.1 Electricity Grid-Connection policy and Tariff

According to ESCOM's connection policy, for every new electricity consumer within the radius of an existing secondary (LV) substation in the urban, peri-urban, and major rural centres, ESCOM will fund the construction of LV lines at its own costs and the consumer will pay a standard connection charge of MWK 93,200.00 (US$89.) [16]. The current average cost to connect residential customers is roughly MWK520,000.00 ($501.93). This means the rest of MK426,800.00 ($411.97) is borne by ESCOM to make the connection affordable. For new electricity consumers connected to MAREP centres, the capital contribution charge is MWK17,475 ($16.87).

The average connection cost is estimated at MWK305,570 ($294.95) and MAREP subsidises the balance of the connection fees. As already indicated, 73.5% of the population in Malawi earns less than $60 per month. This consequently means that the majority of the population especially those in rural areas cannot afford to pay for such costs related to electricity connection via the national electricity grid. However, the monthly electricity bills for households in rural areas are relative cheap as customers pay approximately MWK2000.00-MWK5000.00 per month with consumption range of 15kWh to 50kWh per month depending on the electrical appliances used. With regards to electricity tariff, single-phase connected households pay MWK104 ($0.10) per kWh. However, ESCOM has proposed a electricity tariff hike to be spread over four years, from 2022 to 2026 [16].

3.2 Payment Structures for decentralised off-grid renewable energy systems

3.2.1 Pay as You Go

The PAYG business model is an innovation that emerged to address the energy access challenge and to provide electricity generated from renewable energy sources affordable by ensuring that customers do not pay the entire upfront cost of an off-grid energy system [17]. Under the Pay as You Go, business model, an energy service provider rents or sells solar PV systems in exchange for regular payments through mobile payment systems. For instance, Solar Works Malawi charges a sum of MWWK195,000.00 for a solar system with 12W solar panel, 4 lights, and a radio. Through pay as you Go, customer pays MWK23,500.00 per month for 12 months or MWK16,000.00 per month for a period of 24 months [18]. In cases of non-payment, the service provider can remotely disconnect the service.

Figure 3.1: *Pay as You Go, Payment Model*

Sunny Money is one of the most successful examples of solar energy films utilising PAYG energy in Malawi. Agents are responsible for regular bill collection from their customers and become the first point of call for maintenance issues [19]. The major challenge for the consumers is that products sold through this model are for lighting and phone charging (Pico lighting systems) purposes only, and as such do not meet all their electricity needs. The users are also charged a premium by business owners for any system on a PAYG basis, to account for the associated risk.

Other enterprises using this model include; Yellow Solar Malawi, Solar Works Malawi, and Zuwa Energy.

3.2.2 Direct Cash Sales Model

This is the simplest implementation model: a PV supplier distributes PV systems directly or through a dealer network to the end-users, who usually, but not necessarily, do the installation themselves. The end-users pay in cash for the system components or, and installation costs. This model is most prone to the 'initial investment barrier' such that low-income households do not afford to access renewable energy systems through this arrangement. The average cost of a 1kW solar home system that can provide electricity for lighting, entertainment, and phone charging in a typical village household setup range from $500.00-$1000.00 depending on the quality of the solar products of the system. This shows that the majority of potential users in rural areas cannot afford to pay for costs related to electricity connection via off-grid energy solutions.

Using this model, commercial companies registered with MERA offer grid energy solutions such as solar home systems, SHS, Pico lighting systems, and energy kiosks, to customers. The mini-grid regulatory framework [20] allows local innovators who a developed mini-grids to sell power to consumers on condition that at least one supervisor has valid MERA permit for both renewable energy installations and power lines.

3.2.3 Fee-for-Service

In the fee-for-service, an energy company invests in PV hardware - usually decentralised individual systems on individual houses - and starts selling an energy service for a fee. The energy service company (ESCO) remains the owner of the hardware and is responsible for the installation, maintenance, repair, and replacement of the RE system [21]. The end-user is responsible for paying a connection cost as well as a regular price, which is typically paid monthly but may also be charged per kWh. The end-users never acquires ownership of the system; instead, they pay as long as the energy service is provided. However, the end-user usually owns the wiring, lights and appliances, which are covered by the connection fee.

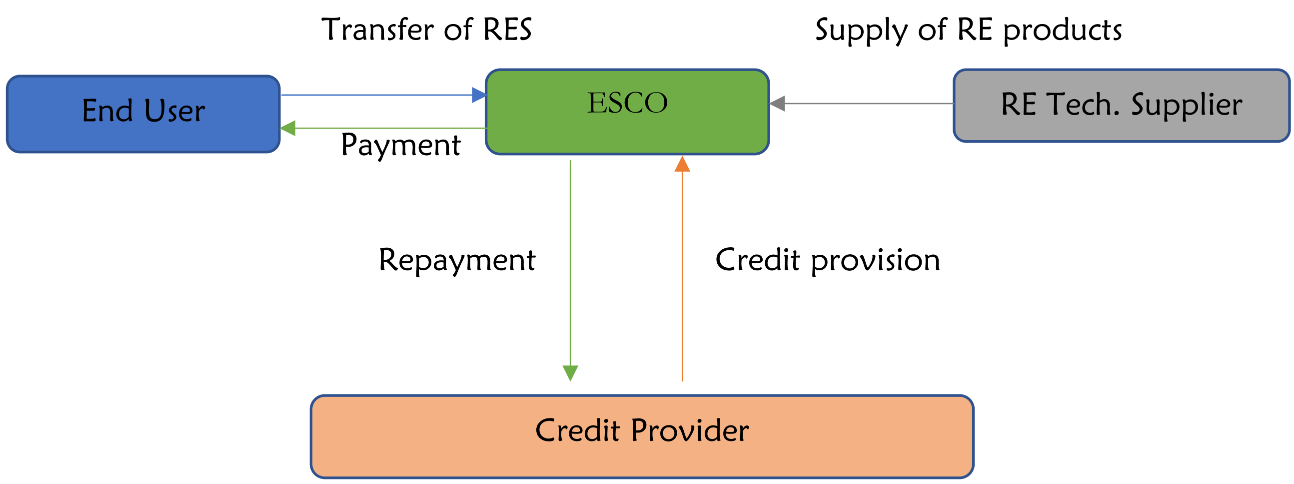

Figure 3.2: Fee-for-Service relationship diagram

Some of the active RE projects which adopted the fee-for-service model in Malawi include; The first-ever mini-grid in Malawi, Mulanje Electricity Generation Agency (MEGA). The 100KW hydro scheme mini-grid supplies power to 740 households, 5 schools, and 24 teacher houses. The other mini-grid is the 80KW Sitolo solar mini-grid in Mchinji, commissioned in 2020, which was developed by Community Energy Malawi [22]. The Sitolo mini-grid supplies electricity to over 726 houses and 35 businesses[22]. The electricity tariff is MWK201.00 ($0.19) per kWh for single-phase customers and MWK211 ($0.20) for three-phase customers. With a typical household using 10-40kWh per month depending on the electrical appliances used.

3.2.4 Microfinancing coupled with renewable energy technologies (RET) funding

Another financing mechanism for renewable energy systems in low-income communities is discussed by Zalengera [23]. The approach combines philanthropic donations with innovative enterprising approaches to establish a revolving fund. Figure 3-3 presents a summary of such a financing model. The financing model in Figure 3-3 was used for the dissemination of solar lanterns and mini-PV systems in a low-income village, Zatuba, in Malawi. The repayment plan was on a monthly basis and the instalment was calculated based on the average monthly expenditure on kerosene for lighting by households per kerosene lamp which was determined from the project baseline survey. In addition, households were given business enterprise and management training and people could access funding from the community bank if they came up with a feasible business idea. Based on the latter approach, it can be seen that holistic measures are essential for making renewable energy technologies sustainable in low-income communities.

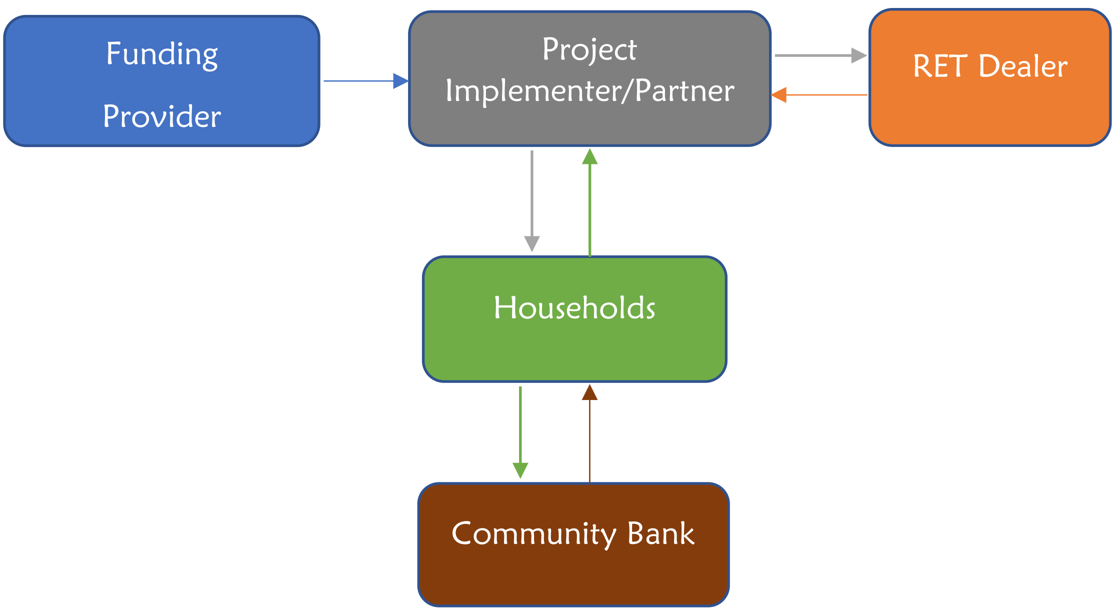

Figure 3-3: Microfinancing coupled with RET funding

4.0 Case studies of successful electrification schemes in low-income countries

4.1 Rwanda

From 6% on-grid access in 2000 to 73% improved access in 2022 either through the grid expansion or using off-grid energy solutions, Rwanda has achieved notable strides toward its objective of ensuring universal access to electricity as presented in figure 4.1 [24]. The Rwanda's national electrification plan (NEP), has been instrumental in driving the electrification efforts and several strategies have been implemented to increase access to electricity for rural and urban areas. Regarding electricity provision through the national grid, the NEP focused on extending electricity grid to remote areas. This involves the expansion of transmission and distribution infrastructure to connect households, schools, health centres and businesses among others. The grid expansion approach resulted in 51% of the households nationwide being connected to the national electricity grid [25]. Additionally, the NEP brought about institutional reforms aimed at strengthening the energy sector governance and improve service delivery. This includes the establishment of Rwanda energy group (REG) responsible for optimising electricity generation capacity, enhancing operational efficiency, increasing investment in the development of electricity generation projects, and the planning and execution of energy access projects The all sector ring-fenced approach is aimed at enhancing accountability of development resources with various stakeholders while at the same time opening space for increased private sector participation.

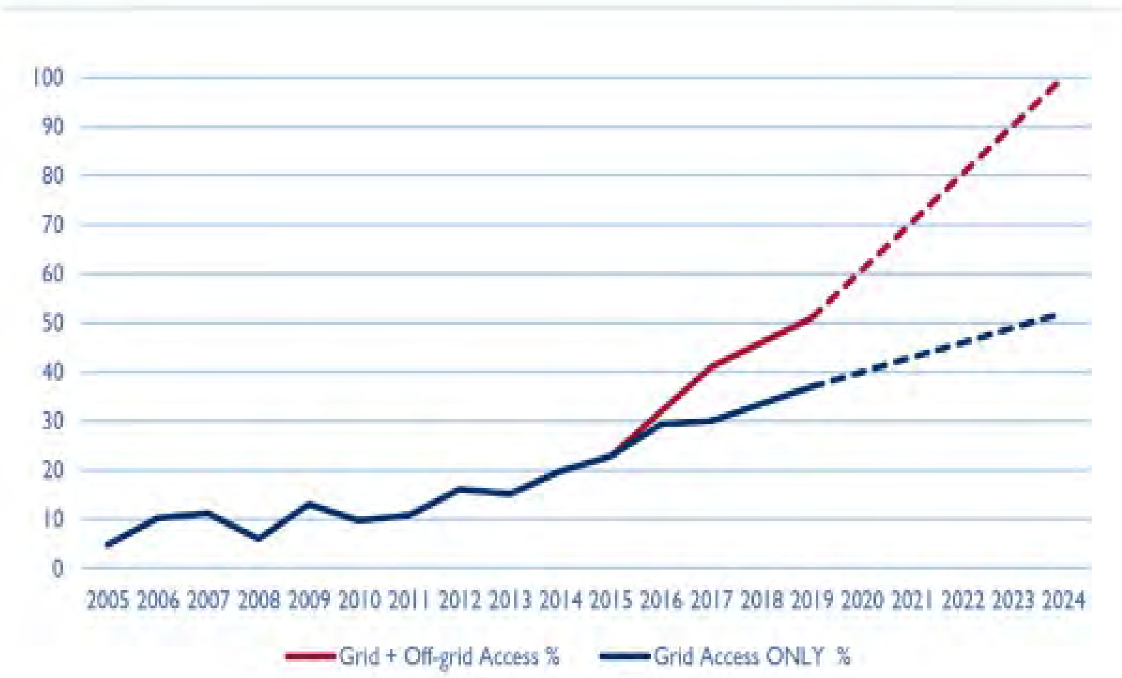

Figure 4.1 Electricity access trend and projection in Rwanda

Recognising the challenges of extending the grid to rural areas, NEP also promoted off-grid electrification solutions. The Government of Rwanda (GoR) committed to the off-grid industry and aimed to connect 48 percent of the population up from the previous 22% through off-grid energy solutions by 2024 [24]. These include development of mini-grids and solar home systems and other decentralised renewable energy systems (DRES). For instance, Solar home systems (SHSs), offered under a pay-as-you-go (PAYG) model, have dominated the off-grid sector in the country. However, a poll by the National Institute of Statistics of Rwanda [26] found that Rwandans ability to pay for such systems was quite low. According to the poll, 75% of off-grid families typically spend less than $1.67 on lighting and phone charging each month (as their main electricity requirement). To address this challenge, GOR is developing a subsidy scheme with its development partners that will enable low-income households to have access to more affordable off-grid energy systems.

There are several mini-grid programmes currently being implemented in Rwanda to complement the grid extension and other off-grid energy solutions. The World Bank sponsored “Energising Development” (EnDev) programme, is one of the successful electrification schemes in Rwanda [27]. The programme uses the result-based financing (RBF) approach with an objective of increasing energy access through establishment of mini-grids powered by renewable energy sources. This is achieved by incentivising local mini-grid operators. Operators are invited to submit proposals based on technical feasibility, financial sustainability, and social impact. Successful mini-grid operators are provided with funding based on pre-defined results or outputs. EnDev provides grants of up to 70% capital expenditure (CAPEX) for solar or hydropower mini-grids upon commissioning [28]. Furthermore, approved projects receive significant technical assistance, including on the business model and technical design. This support is intended to ensure that the mini-grid is completed and that it is a viable, long-term business.

The project has registered a number of successes since its inception. For example, when EnDev's first mini-grid RBF was launched in 2014, no privately-owned mini-grids, developed through formal channels, existed in Rwanda. By 2020, the EnDev VG RBF project was able to reach 10,641 people by supporting four companies in building one hydro mini-grid, two solar AC mini-grids and 22 nano-grids (1kW each). The mini-grids supply electricity to over 364 enterprises and 24 social institutions and thus creating over 100 jobs in the process [29]. The programme not only helped raise the awareness of benefits of mini-grids, but also provided funds which enabled some of the first mini-grids in Rwanda to be built. The programme developed key partnerships to support access to finance, working closely with companies on their proposals, building capacities of its fund manager to ensure smooth implementation of the fund.

Key lessons learnt from these case studies highlight the crucial role of effective collaboration among stakeholders when implementing renewable energy projects. The strong collaboration between the government, private sector, communities and local entrepreneurs and other stakeholders in all the stages of the project, ensured long term success of the project. Furthermore, providing technical assistance and capacity building enhanced technical skills and operational efficiency of the operators leading to improved performance.

4.2 Ghana

Between 1989 and 1991, Ghana conducted a thorough National Electrification Planning Study, including all feasible electrification possibilities, including grid and off-grid extensions as well as renewable energy-based solutions (biomass, solar, wind, and hydro) [30]. This endeavour resulted in a master plan with six implementation phases of five years each spread over thirty years (1990–2020). As part of the broader objective of providing everyone with access to electricity by 2020, the National Electrification Scheme planned to connect all communities with a population of more than 500 people to the national grid. At that time, only 478 (11%) of Ghana's 4,221 settlements with a population of over 500 had access to electricity[13].

One of the most successful electrification schemes in Ghana is the self-help electrification scheme (SHEP) which was introduced by the government of Ghana. The initiative is aimed at extending electricity access to rural communities that were not covered by the national grid [31]. The project focuses on encouraging community participation with local communities actively involved in planning, implementation, and financing of the project. This allows communities to have a sense of ownership and control over the electrification process. SHEP utilised decentralised approach, employing appropriate technologies for each community's needs. Depending on the feasibility and cost-effectiveness of an electrification project, the project incorporated various electrification methods including grid extension and off-grid solutions. In terms of funding, government was responsible for providing technical and financial support whereas the community was supposed to contribute financially as well as providing labour for the construction works of the projects. A village electrification committee, which is in charge of raising finances, and assisting homeowners with electrical installation of their homes, help communities carry out the work.

To boost consumption and maintain the sustainability of utilities, a new component for credit support for income-generating applications of electricity was included in 2000. Recently, homes have received help paying for their wiring thanks to the same credit program [13]. A lifeline rate was established for customers who use up to 50 kWh per month to help with affordability for residential consumers.

The project was a success as it made significant progress in expanding electricity access in rural areas of Ghana. For instance, the project contributed in increasing electricity access rate from 25% in 1989 to 85.9% in 2022 [32]. Ghana's rapid success in eradicating poverty appears to be linked to improvements in access to power, which could ease affordability difficulties along the way. For instance, between 1991 to 2020, the poverty rate fellow from 52.7% to 45.6% with 2012 registering the lowest poverty rates i.e., 21.4% [33].

Major lessons learnt from SHEP case study has shown that community involvement and financial contribution toward a renewable energy project fosters sense of ownership and that the project meet the specific needs and preferences of the communities. Training and empowering local technicians and entrepreneurs to maintain, operate and manage the RESs, is essential for sustainability of the project. The policy and the regulatory framework for the rural electrification also ensured compliance, consumer protection and effective oversight of electrification programmes. Finally, considering factors such as resource availability (i.e., solar, wind), infrastructure requirements, and maintenance needs helps ensure the long-term functionality and effectiveness of RESs. Utilising appropriate and proven technologies reduces challenges and improves the overall success of the programme.

5.0 Potential measures and incentives for facilitating improved electrification uptake and project sustainability.

The electrification process must prioritise the economy and equity. The best strategy to make rapid progress while tackling the major sectoral concerns is to concentrate on increasing the economic capacities of communities. As shown in Table 5.1, there are several overarching policy implications for expanding access, boosting adoption, enhancing dependability, and expanding benefits.

Table 5.1: Demand side issues and mitigation measures

Demand Side Issue	Mitigation Measure
Quality of the dwelling unit and level of income	Creation and enhancement of income-generating activities i.e., productive use of energy, can increase uptake and enable households and businesses (income generation), government (through taxes), and utilities (via revenues) to overcome financial constraints in a sustained way. Further to this, providing credit facilities that bundle access to electricity can also foster economic activity.

Connection charges and High Upfront and maintenance costs	Payment flexibility is particularly important to overcome credit constraints for connection fees. Productive use of energy is also critical for generating high income for households, enabling them to pay for the connection charges and tariffs. Additionally, increasing funds for the NDAWALA initiative (a project aimed at assisting low-income households with wiring services and connections through a soft loan) as well as resolving the challenges the programme face, would allow more underprivileged households to benefit from it. Regarding off-grid energy solutions, there is a need of providing financing options such as grants and loans to help low-income households cover for the aforementioned costs. To make renewable energy technologies more affordable, government can as well come up with incentives such as tax breaks for firms in renewable energy industry. Additionally, there is a need of implementing effective maintenance and repair plans to help reduce the maintenance and repair costs.
Lack of awareness and Education	Investing in public awareness programmes on electricity education procedures as well as educating consumers on how they can take care of RESs and perform basic maintenance and repair of such systems is essential. There is also a need for intensifying civic education on the benefits of using renewable energy systems
Consumer preference and cultural factors	Public awareness programmes as well as understanding local customs, traditions and specific household needs can help tailor electrification solutions to better suit consumer preferences.

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