Financing Models Considerations for the CEANGAL Project

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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 currently utilised financing mechanisms that can be used to ensure sustainable deployment of RES in Malawi and sub-Saharan Africa region at large. The report's introduction provides background of the role of financial models in accelerating deployment of RES in rural areas. Section 2 outlines various successful financial models which can potentially be employed to ensure the sustainability of renewable energy projects. Section 3 presents the recommendations of key considerations supporting sustainable financial models for decentralised renewable energy systems implementation. Section 4 finalises the report by providing the highlights of the key issues covered by the report.

Contents

1.0 Introduction

The use of renewable energy systems (RES) for electricity generation in sub-Saharan Africa (SSA) regions has enormous promise for reducing the consequences of climate change as well as improving energy access attainment. However, the costs and expenses associated with new RES projects are usually too high [1], especially with the considerations of the observed earning profile of the inhabitants. When used in community off-grid electrification schemes, the amount of revenue collected during operations have been generally observed to be small compared with capital costs, leading to long payback periods [2]. Similar to other SSA countries, potential RES community users and operators in Malawi, often depend on external (usually international) investors to finance a portion of initial costs of RES projects. This has however led to non-sustainability of RES projects since the longer-term financing of the operation and maintenance of such projects has not been adequately considered and covered [3].

Developing sound sustainable financing mechanisms for RE projects in low-income countries (LIC) is a prerequisite for increasing the use of renewables in energy supply to meet improvements in energy access. In principle, there are a variety of financing sources to support RE projects. Most LICs have developed market-based incentives and policies to boost RE project development and make it affordable to less privileged households. The incentives include subsidies such as tax incentives, credit guarantees, preferential financing among others. However, market uncertainties and the fact that these benefits are typically not incurred until after electricity production begins, these incentives alone often fail to overcome the inherent high capital costs of RE project development.

With the perceived susceptibility of SSA off-grid RE projects to delays, low returns on investment, lack of significant collaterals and technical performance risk, lenders may be reluctant to invest in them. Banks also frequently are hesitant to provide loans unless a long-term agreement is in place. Innovative financing mechanisms are therefore needed to reduce this risk and thereby encourage investment in RE technologies. An example of such mechanisms is the use of system performance insurance which guarantees the owner's debt service if the RES project cannot perform at the anticipated capacity due to deficiencies in the system's design, materials, or construction. The performance insurance policy provides the funds required to pay the debt service costs and may be modified to reimburse the insured for capital expended so that the project may be brought up to the expected performance level [4]. Innovative financing strategies like system performance insurance are being offered to lower this risk and hence promote investment in RE technologies.

The numerous financial and risk constraints that face RE project development have been explored in previous research, with several practical frameworks put forward to finance RE projects beyond incentives and policies. There are significant reviews of mainstream financial instruments in relation to financing RE project development especially focused on the roles of the available incentives, and guidance for financial instrument selection [5]. However, the implementation of such approaches in real world environments to afford an improved uptake of RES to meet sustained energy generation goals in low-income countries has been generally lacking.

This report investigates financing mechanisms relevant for low income SSA regions (with a focus on Malawi) that have successfully been applied to facilitate energy infrastructure ownership and operation. The report will also consider potentially useful financing, funding and ownership models from other sectors i.e., agriculture and health, which might be relevant for the renewable energy sector, and could hold the key to improved RES uptake by otherwise disadvantaged communities.

2.0 Financing Models for Decentralised Off-grid Renewable Energy Systems

2.1 Pay as You Go

The Pay as You Go, (PAYG) business model is an innovation that is aimed at providing electricity generated from renewable energy sources at an affordable cost by ensuring that customers do not pay the entire upfront cost of an off-grid energy system [6]. In this business model, an energy service provider, bears the overall costs of the RES bulk purchase and sells the products to the community consumers at regular payments. In cases of defaulters, the service provider can remotely disconnect the service. In additional to community or neighbourhood level i.e., mini-grids, PAYG models can be employed for individual level systems such solar home systems (SHS). Here a supplier bulk buys the SHSs, and the individual consumers intending to use such products can obtain them and make regular periodic payments for their use.

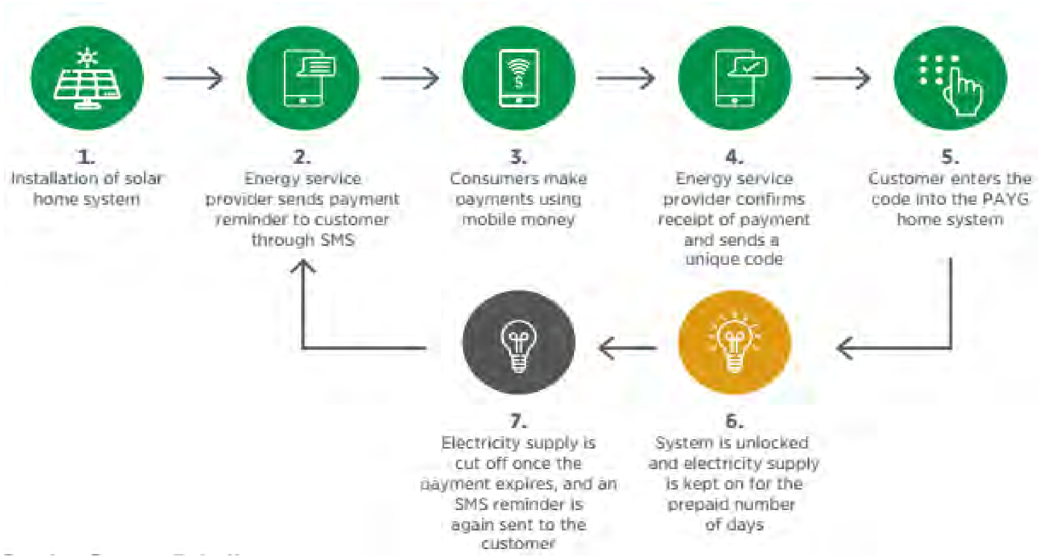

Figure 2.1: Pay as You Go Basic Concept, adapted from [6]

Currently in Malawi, the model is used in purchasing Pico lights and closed solar home systems. RE project implementers in Malawi, can also use the PAYG systems for large scale projects such as mini-grids. For example, SharedSolar, a PAYG mini-grids developer in sub-Saharan Africa, uses 1.4-kilowatt (kW) solar PV mini-grid systems to provide electricity for 20 customers, including households, small schools, and businesses within a 100-metre radius via underground cables. End users buy prepaid scratch cards from local vendors according to their needs and available budget. Each card contains a code that, when sent by text message to the electricity service provider (ESP) via a payment server, credits a smart meter located inside the premises of the solar PV power plant, which controls the electricity flow to individual end users. The smart meter monitors usage until the customer's credit is exhausted, at which point the circuit is switched off until more credit is added [6].

It is also worth noting that people in remote areas have difficulties accessing RE systems and products since most energy firms that supply and provide supporting services for the installation, maintenance and operation of decentralised renewable energy solutions are based in urban areas. To overcome this, such RE firms can set up booths as well as linking up with sales outlets and shop owners in rural trading centres where RE systems and products can be sold.

With regards to financing end users who cannot afford to pay through this model, government agencies can potentially liaise with financial lending institutions such as banks to provide soft loans to such household. The loan would be used to finance household's income generating activities and consequently enable the household to purchase the RE (i.e., solar) product as well as paying back the loan to the lending institution.

In terms of operationalisation, PAYG business models can be extended to incorporate other technology-enabled business models that will lead to an increase in renewable energy integration.

Several RE systems, for instance SHSs, can be inter-connected where feasible to form a micro-grid, which can further enable peer-to-peer energy trading. The excess generated electricity can be traded with other consumers within the same community at an agreed fee there by providing additional income to systems owners. Lessons can be learnt from Bangladesh's SOLshare project where a peer-to-peer trading network was established using PAYG as a preferred business model. SHSs for off-grid households were inter-connected to form a micro-grid. SOLshare's PAYG SHSs included a "smart metering" which enabled the systems to feed the generated electricity to a micro-grid that served other houses in the neighbourhood [7].

Additionally, PAYG models for solar PV (photovoltaic) systems may also be employed in productive agricultural income generating activities such as powering drip irrigation and crop processing. A solar PV powered energy kiosk can also enable communities to indulge in economic activities such as mobile charging business, power computers for digital business or power refrigerators for improved food or medical storage and icing making [8]. These activities in turn pay a charge for the consumption of the electricity consumed. Therefore, such productive uses of renewable energy systems can contribute generation of higher income for consumers. Furthermore, the payment data gathered through PAYG models can be analysed to assess the creditworthiness of customers, which can then be used in planning for other DRES projects in communities with similar economic profiles.

The major issue with PAYG mechanisms for enhancing electricity access if the fact that the energy service provider has to consider the potential location as being profitable enough for the implementation of the mechanism. Hence poorer communities might not have this service option at their disposal, with more urban or peri-urban areas favoured.

2.1.1 Pay as You Go Case Study

Through the PAYG Model, between 2013 and 2018, over 8 million people in sub–Saharan Africa were provided with clean and modern energy, mainly solar PV systems [9]. PAYG models have been also implemented in off-grid locations in other LICs in South Asia and Latin America. In 2016, global off-grid solar installations (including PAYG systems and standalone solar devices, such as solar lamps) totalled 34 megawatts (MW), and they grew by over 19% to 40.6 MW by the end of 2017 [10]. The entry-level solar home systems, used for providing basic lighting and mobile phone charging, accounted for approximately 36% of the total volume of systems sold.

In Malawi, Sunny Money, Yellow Solar, Solar Works, Zuwa Energy, are some of the most successful examples of solar energy films utilising PAYG model. Agents are responsible for regular bill collection from their customers and become the first point of call for maintenance issues [11]. For instance, within three years, Yellow Solar has expanded into all regions in Malawi and its sales network has grown from 5 to over 500 agents. In 2021, Yellow Solar sold 100,000 units and had a market share of 75% of the Malawi's SHS market. Yellow Solar currently sells smartphones and Biolite SHSs that are all-in-one kit that comes with a small 5W solar panel, four high efficiency LED lights that are installed around the house, and a console that charges phones and has a radio. Yellow's sales agents also install the device, thereby bringing electricity to many households for the first time. The SHSs cost MWK125,000.00 that can be paid at once or pay MWK22,000.00 per month for a period of 6 months or MWK14,500.00 per month for 24 months [12]. If the customer doesn't pay within the agreed period, the system automatically switches off until all the money is paid. There is zero default rate for customers who make late payments.

2.2 Fee-for-Service

In the fee-for-service model, 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 [13]. 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 acquire ownership of the system; instead, they pay as long as the energy service is provided. However, just as the national grid connections, the end-user usually owns the wiring, and appliances utilising the generated electricity.

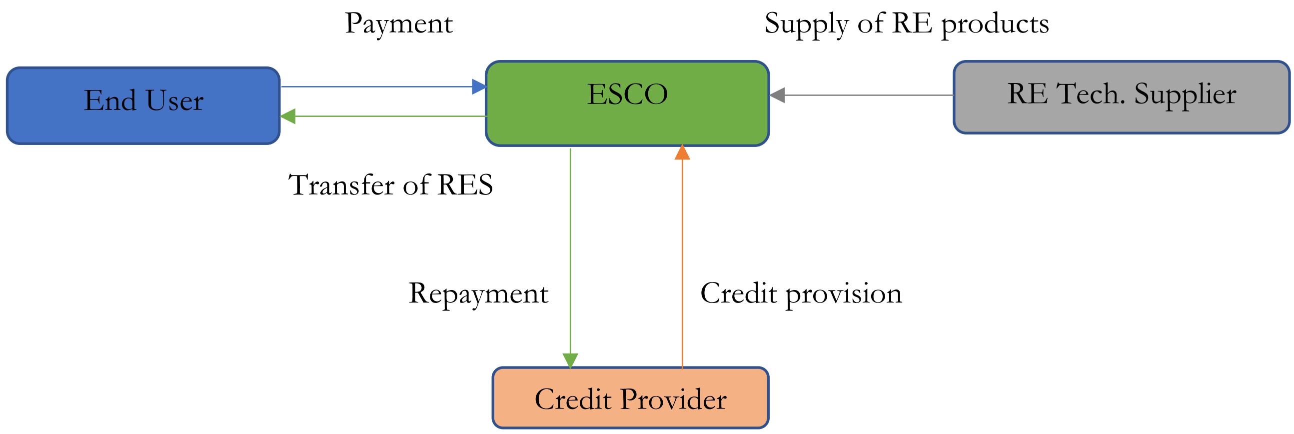

Figure 2.2: Fee-for-Service relationship diagram

One way of operationalising the fee-for service model is through establishment of Solar battery charging stations (SBCSs) in remote areas with no electricity grid coverage [14]. The primary benefit of SBCSs is that they provide electricity for domestic lighting, power radios, and other small scale domestic appliances and needs. The target consumers are rural residential users, generally with a low ability and willingness to pay. The main challenge to establishing SBCSs is the high investment costs and relatively low returns. SBCSs tend to target the poorest of users, most of whom could not afford a full-cost coverage tariff, including investment costs. Experience has shown that, even when the initial investment cost is covered by an outside agency (e.g., an NGO, a development agency, or the government), users have a difficult time paying tariffs sufficient to cover general maintenance. To counter this challenge, in some cases, SBSCs are therefore normally implemented in collaboration with government development programs targeting local cooperatives, which cover most of the capital and implementation costs, and the assets often remain in public hands i.e., owned by a municipality, a user cooperative, or other public entity.

Depending on the circumstances and scale of the project, there are several possible business model variations for SBCS projects, primarily: user cooperative, ESCO or village entrepreneur, or dealer credit sale [15]. A sustainable business model for SBCSs does not necessarily mean a financially profitable project. A sustainable business model in this case requires sufficient revenue to maintain the system in proper working order. Private sector charging stations have also been set up in areas where users were comparatively better off and were able and willing to pay for the service to meet a full-cost recovery tariff. Fee for service model is also popularly employed in mini-grid development where a developer will generate and supply electricity for specified community at a determined electricity tariff. End users pay based on their electricity consumption.

This model could be employed as a good mechanism in SSA countries where electricity generation and distribution remains nationalised, but where the grid does not extend to a significant size of its population, particularly those living in remote areas. Here the government utility companies could install, operate and maintain the decentralised RES hardware with the electricity service provided paid for by the users on a use basis.

2.2.1 Case Study

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 [16]. The Mini-grid supplies electricity to over 726 houses and 35 businesses with the base tariff for households is MK211/($0.20) per kilo-Watt-hour-kWh [16].

As indicated earlier, energy kiosks are another form of the fee for service model. A case study in Malawi would be that of Renew'N'Able Malawi's Rural Off Grid Energy Kiosks - Phase II which was launched in 2016. The two kiosks, are based at Mvumbwe Court in Thyolo District and at Dzenje Primary School in Phalombe District respectively [17]. The kiosks provide electricity to the communities, while also generating income for the kiosk staff and for covering maintenance costs. Additional products and services are also provided using such kiosks. Among the services provided include; phone charging, solar home system rentals, solar powered TV rental, solar lamp rentals, a solar powered barbershop, a popcorn making machine and a peanut grinding mill.

2.3 Dealer Credit Business Model

The dealer credit business model is an ownership business model, where the RE system supplier provides the initial credit for the system to customer. The financial institution i.e., micro-finance entity (MFI) or a bank, and the energy/technology company provide simple and standardised (accredited) energy products (e.g., solar [photovoltaic] systems), together with loans to the underprivileged consumers. The micro-financing institution is responsible for collection of down payments, monthly instalments and system/capital recovery in case of default. The technology and support functions provided by the RE supplier includes marketing, installation, customer training and after sales service [18]. Upon full loan repayment in an agreed period of time, the consumer has the full ownership of the RE system.

Generally, there are two main forms of the dealer credit model: in the "one-hand" model, a single company provides both the RE technology and the financing, and in the "two-hand" model, the technology company and the microfinance institution (MFI) are separate entities but work closely together in a long-term partnership. The two-hand form makes it easier to diversify and customise energy products, but at the additional risk that the MFI may need to take over the project if the technology company fails to deliver proper services or product guarantees that are essential for loan repayment [14]

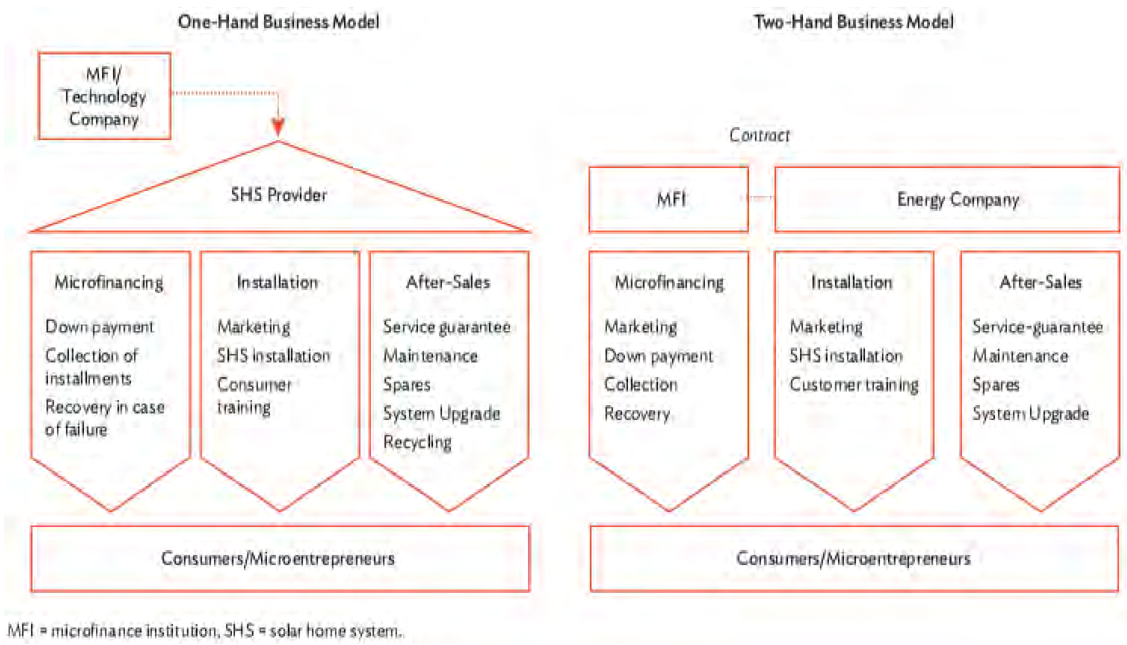

Figure 2-3: Relation diagram for one-hand business model and two-hand business model, sourced from [14]

2.3.1 Case Study

The dealer credit financing and ownership model as discussed by Zalengera [19] was successfully used for the distribution 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 in households (on the basis of kerosene lamp owned) which was determined from the project baseline survey. In addition, households were given business enterprise capital and management training and people could access funding from the community bank if they came up with a feasible business idea.

2.4 Result Based Financing

Results-based financing (RBF) is a mechanism suited for externally funded projects, i.e. international donor funded RES projects, whereby a donor provides funds to a recipient, in this case the RE project developer, once a pre-agreed set of results has been achieved. This approach involves three key principles: 1) payments are made only after the results have been achieved; 2) the recipient may independently choose how to achieve these results; and 3) independent verification of results is the trigger for disbursement [20]. RBF is form of co-funding approach where for instance the case of "Energising Development" (EnDev) result-based financing provides grants of up to 70% capital expenses (CAPEX) for solar or hydropower mini-grids upon commissioning [21]. RBF is therefore fundamentally different from more traditional approaches in development where funding is provided in advance to finance inputs and activities. It allows to increase the accountability of both the donor and the recipient by providing verifiable evidence that the agreed results have been achieved. RBF requires that the recipient align the actions of the RE project more closely with the objectives of the programme funded by the donor.

The funder delegates a certain task to an agent who receives payment from the donor for fulfilling that task. The agent, where in some cases can be a partner, government, implementer or the private sector, often has more information about the specific task and can use this asymmetry to further its own interest to the detriment of the funder's interest [22]. Due to their relative lack of information, funders have very few means of ensuring that their agents always act in their interest. Furthermore, the initial upfront capital necessitated by the agents before project commencement can be limiting in cases where small community developers with capital flow problems are concerned.

By tying funding to results, the focus and efforts of the agent shifts away from processes and towards results. This shift in focus requires the agent to address the bottlenecks and challenges that hinder the achievement of results and will thereby allow structural change to occur. Apart from the energy sector, the model is employed in other sectors such as healthy, agriculture among others. RBF can be applied to various DRES i.e., solar home systems, Mini-grids, Pico lights, energy kiosks and many others. Figure 2.4 presents the typical relationship diagram of RBF.

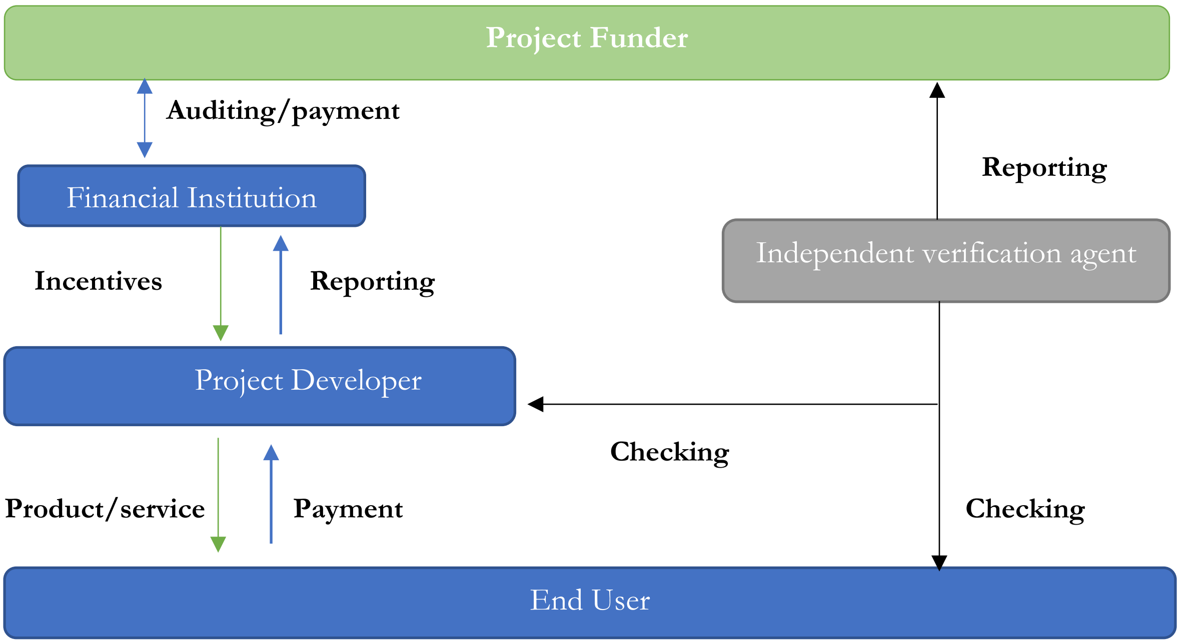

Figure 2.4: Relationship diagram for Result based financing

Meanwhile, also the financial risk associated with the non-delivery of results shifts from the donor to the recipient. The recipient, in return, is given flexibility in how to achieve the desired results, thus encouraging innovation [22]. Recipients' autonomy may also prompt them to improve their existing delivery infrastructure, which makes sustainable, long-term change more likely. In line with that logic, results-based approaches can help to address typical market failures such as externalities, information asymmetry, market power concentration, coordination failures and the failure to produce public goods.

2.4.1 Case Study

EnDev's RBF projects in countries like Kenya and Rwanda incentivise mini-grid project developers. Firstly, an initial incentive is paid upon commissioning of a mini-grid, while the second incentive is paid for each connected household and business [22]. With many different development actors supporting the sector in both countries, close coordination among them is essential to provide required capacity building, policy advice and financing tools (such as RBF) for successful mini-grid development. EnDev's mini-grid projects both benefited and suffered from other development partners' interventions.

EnDev's RBF project in Rwanda encountered a challenge of low quality proposals prepared by local project developers from the on-set [23]. They faced difficulties in making realistic basic assumptions, e.g., for demand estimation and tariff setting. At the same time, the viability gap that the project aimed to bridge through RBF was extremely high, with high financing costs making the suitability of the project doubtful. Eventually both challenges were addressed through close cooperation with other donors and programmes: weak proposals are now handed over to Energy for Impact (E4I) that works with project developers to improve proposals. In parallel, the Scaling Renewable Energy Program (SREP) is starting to offer loans for pre-financing to mini-grid developers at better lending conditions than those of commercial banks, thereby overcoming the access to finance challenge.

In Kenya, although the RBF project was embedded in a programme working on policy and regulations and building public and private capacity from the start, it still faced challenges [24]. While a slow start was primarily due to difficulties in identifying suitable financial institution as fund manager, once the project was ready to go two large donor initiatives for mini-grid development emerged. They have more ambitious connection targets, which they aim to achieve with higher subsidies and lower electricity tariffs. Mini-grid sites that EnDev had pre-selected became part of the support scheme of these two initiatives and EnDev's RBF had to select other sites in even more remote and less profitable locations (although with higher poverty impact).

Despite the shortcomings, the two EnDev RBF projects in Rwanda and Kenya registered significant policy impact, the high dependency on other stakeholders and initiatives limits the suitability of RBF as a stand-alone tool for transforming the implementations of DRES projects.

Both projects require significantly higher levels of management and coordination than planned and took off after significant delays [22]. To improve the effectiveness, it is therefore important that the RBF model is restructured based on the local context such that the local entrepreneurs/cooperatives have a central role in implementing the projects.

2.5 Lease-to-own model

The entire generation capacity (i.e., a solar home system) is paid in instalments by customers over an agreed period of time. This approach is also known as the "consumer finance retail" model. Ownership of RE system may be transfered to the lessee (sometimes for an additional fee) or remain with the lessor at the conclusion of the contract period, depending on the terms of the agreement. [6]. If a customer consistently fails to pay the daily, weekly or monthly rates, the the energy service provider can go to the customer's house and remove the systems. However, it has to been noted that lease-to-own model might be difficult to apply to RE systems aggregation i.e., community owned mini-grids where ownership responsibility is not as defined.

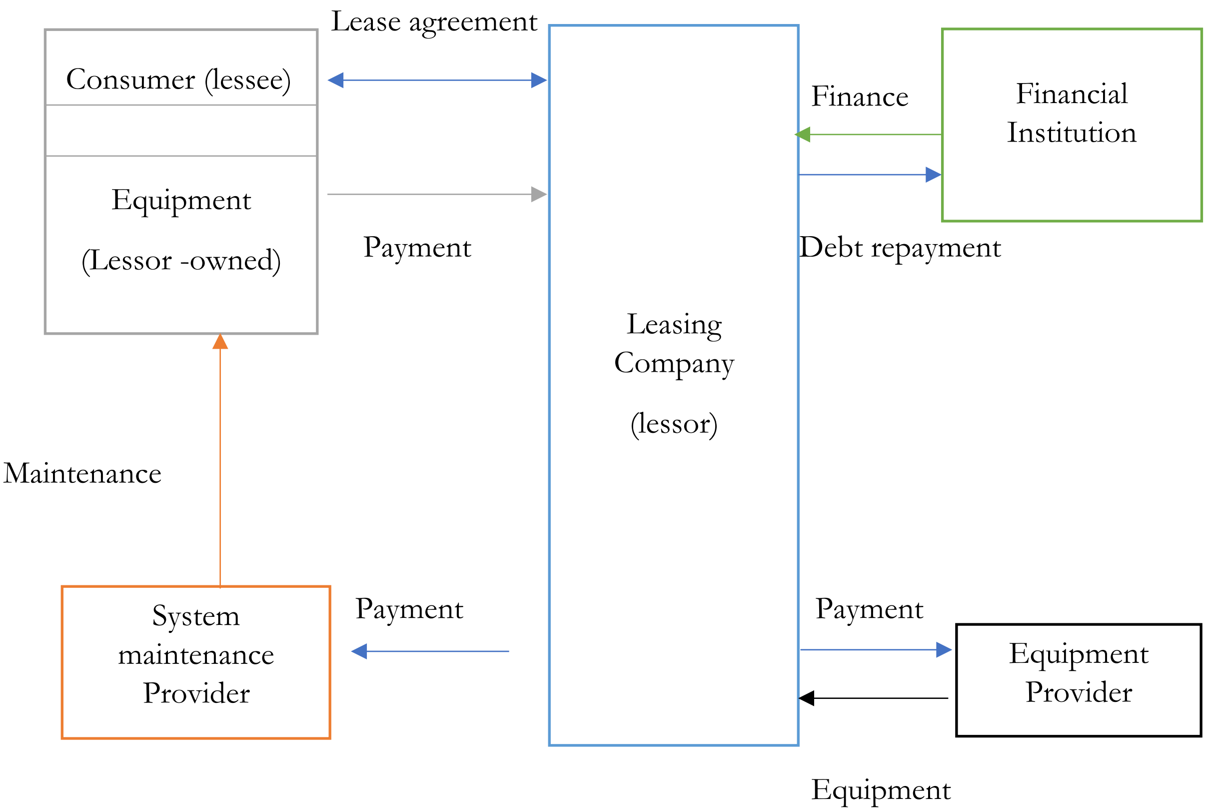

Figure 2.5: Lease or Hire Purchase Model Relationship Diagram

2.6 User Cooperative

Commonly applied in agricultural sector, a user cooperative business model or energy cooperative involves the establishment of a non-profit community organisation owned and managed by its members. Projects are funded by member contributions, with or without outside private or public support [25]. The cooperative handles all administrative and operational functions, including the installation, maintenance, and safe operation of RE projects, as well as financial management and payments between users, contractors, and operators, and the cooperative. The tasks are usually performed by managers selected from among the members. As the managers may be volunteers, a lack of commitment and appropriate management skills may hamper efficient management of cooperatives.

The user cooperative model provides a mechanism for governments or NGOs to support RE projects at the local level [14]. For example, an NGO or government could assist in financing such projects through up-front investment grants or interest-free loans to the user cooperative, allowing the system to be installed and reducing user charges. User cooperatives are well suited to the expansion of infrastructure services in developing economies and to rural electrification.

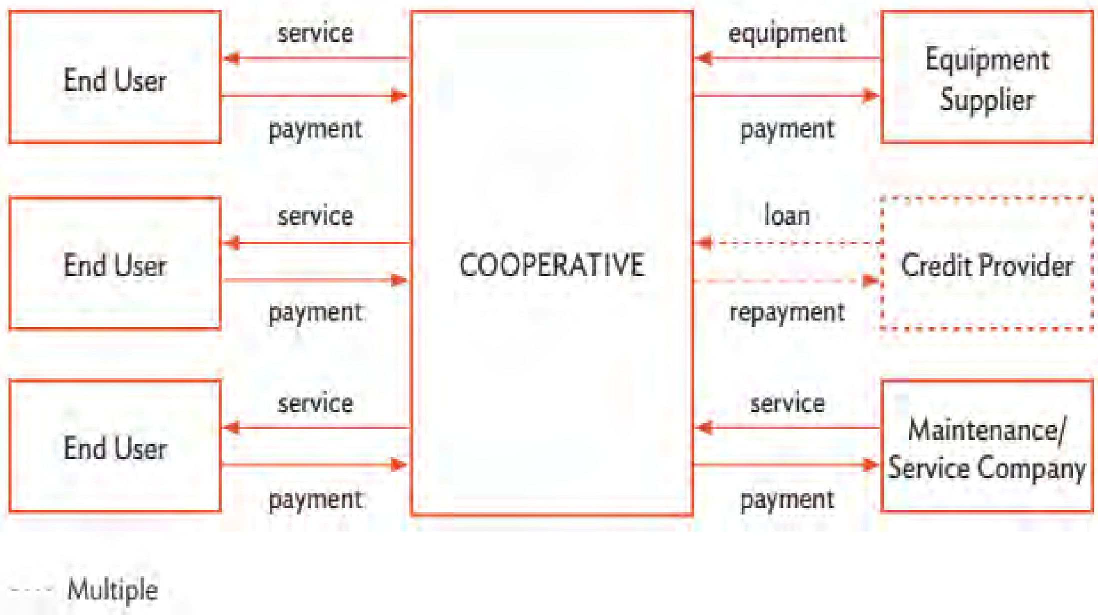

Figure 2.6: User cooperative Model adapted from [14]

There are a number of different types of cooperative active in the energy sector with some cooperatives being grouped by their technological solutions, others are categorised by their aims or coverage[26]. For instance, there are energy consumer cooperatives, energy producer cooperatives, energy producer and consumer cooperatives and energy service cooperatives.

Energy focused cooperatives can as well be classified based on the RE systems they focus on , for example solar cooperatives, wind cooperatives, cooperative bioenergy communities, and hybrid-renewable energy cooperatives [27]. Some cooperatives are categorised as electricity cooperatives, rural electricity cooperatives, community-led investment, consumer-owned utilities, farmer cooperatives, and trade associations based on the actors or owners and services offered. The different services or goods that energy cooperatives offer may also be different. Energy cooperatives, for instance, can produce energy and provide it to its customers both members and non-member clients or feed it into the national grid. For this purpose, they can either use fossil fuels or renewable energy sources.

In some countries, whole villages or the so-called "energy village"s, are organised using the cooperative model. Consumers may be team up and form energy cooperatives to purchase energy in bulk, as a means to obtain lower prices [28]. Cooperatives may organise the distribution of energy, for example by operating electricity distribution lines. Cooperatives may also provide services related to the provision of energy, such as advisory or training services.

User cooperatives are often set up for rural electrification projects such as battery charging stations, (mini-grids, and community solar systems. Experience has shown that one key to successful application of cooperatives is active participation by the community from the inception of the project. Proper planning and a clear plan of action are needed. Formal processes and a supervisory structure should be developed, and legal rules and binding contracts should be signed to secure payments with clear penalties in case of contract breaches [9].

2.6.1 Case study; UGANDA Energy Cooperatives

The Rural Electrification Agency (REA) is a Ugandan government institution established by the Ministry of Energy and Mineral Development with an aim of achieving the Government's targets for rural electrification access. The REA introduced the energy cooperative model to rural areas that other investors would not or did not serve, and where a large number of farmers, small industries, businesses and other rural dwellers had been left without access to electricity at a reasonable cost [26]. Pilot projects began in the districts of Bundibugyo, Pader and Abim (Bundibugyo Electric Cooperative Society; Becs) and Pader-Abim Community (Multi-purpose Electricity Cooperative Society; Pacmecs).

In the initial phase, a total of 36 centres were planned with 17 in Bundibugyo and 19 in Pader and Abim. Extended projects were implemented either by the cooperatives or through REA as community schemes, with the help of the Swedish International Development Cooperation (SIDA) [26]. These cooperatives operated under an interim board, whose responsibilities included mobilising people to buy shares in the cooperative and to pay for connection. These cooperatives adopted a prepaid meter system, which enabled consumers to easily manage their power usage and expenditure on electricity. As of 2013, 3,900 connections and the construction works were subsidised by SIDA by almost 90 per cent. The assistance given to the cooperatives included: developing a draft business plan; setting up interim boards, to give policy guidelines to the electricity cooperative management; providing training in financial and accountability management; establishing by-laws for the energy cooperatives; and providing training in governance.

2.7 Other Innovative Financing Models

2.7.1 OSUSU Micro-financing Model

An expansion of the "OSUSU" micro-finance capital accumulation mechanism, also known as "Chipeleganyu" in Malawi, is being practised in several African communities. How "Osusu" works is that a group of people contribute fixed amounts periodically, with one of the groups given an upfront lump sum, with the intention that they will keep contributions so that other members can enjoy similar benefits [29]. This model has been used in various sectors including agricultural and energy sectors, to promote access to finance for purchasing farm inputs and decentralised renewable energy systems components.

In Malawi, the mechanism can build on the cooperative model and would support the ability of individual households in low-income countries to have the large upfront capital resources to purchase home RE systems (i.e., SHS) or support the collective ownership of such systems using the shared funds.

For individual RES acquisition, a group of individuals interested in accessing RES solutions can form an OSUSU group. The group can consist of community members, entrepreneurs, or any individuals interested in investing in energy projects. Each member of the group can contribute a predetermined amount of money at an agreed regular interval i.e., monthly. The contributions form a basis of savings that can be utilised for providing loans or credit to members. Each member of the group can be given an upfront lump sum which can be used to purchase and install renewable energy systems such as SHSs. The borrower repays the loan through the regular contributions such that funds are reinvested back into the group, replenishing the pool for savings so that the remaining members can also access the funds to purchase and install the RES. Once all the members have accessed the loan of RES purchase and installation, the same principle can be applied to raise funds for repair and maintenance of the RESs.

For community scaled shared RES or mini-grids, the periodic collections from the group members can be pooled to afford the purchase and installation of the RES, including the consideration of the distribution aspects of such a system. The members can then decide on best ways to sustain and maintain the system i.e through the collection of bills. Penalties for defaulters can be agreed upon.

The groups can further be supported through technical assistance, training or sharing best practises for sustainable energy use. In cases of defaulters, group members can agree on what collaterals (equivalent to the amount of loan borrowed) can be provided a member. By utilising OSUSU micro-financing model in the energy sector, individuals and communities can overcome the upfront cost barrier associated with clean energy solutions. The mechanisms can empower individuals to access affordable financial options as well as promote sustainability of RES projects in Malawi and other low in come sub-Saharan countries.

2.7.2 Local or Community Energy Agencies

With this model, local energy agency tasked with electricity generation is formed, to provide valid verifiable business and operational plans, and in turn receives direct funding in the form of long-term soft loans from government or international agencies, with payback of the capital to a dedicated "energy access improvement facility fund". The repayment fund can be financed through the collection of electricity tariffs from their served communities. This "energy access improvement facility fund" can then be used to finance the future expansion of energy access and support of other local energy agencies in other communities.

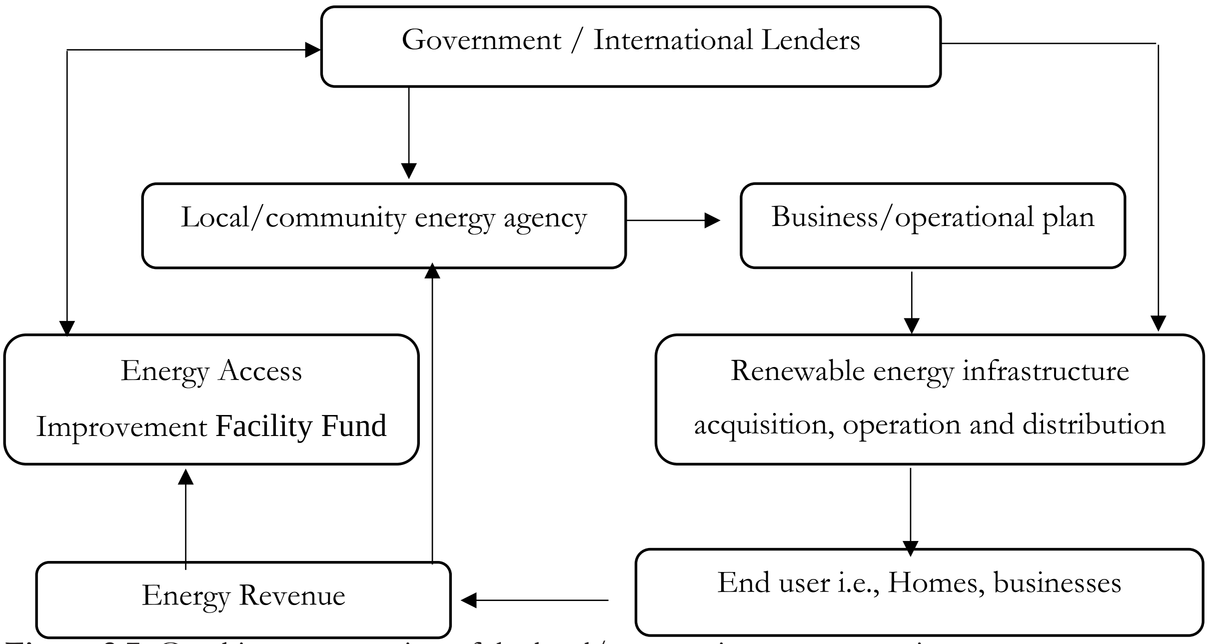

Figure 2.7: Graphic representation of the local/community energy agencies

2.7.3 Economy Activity Support

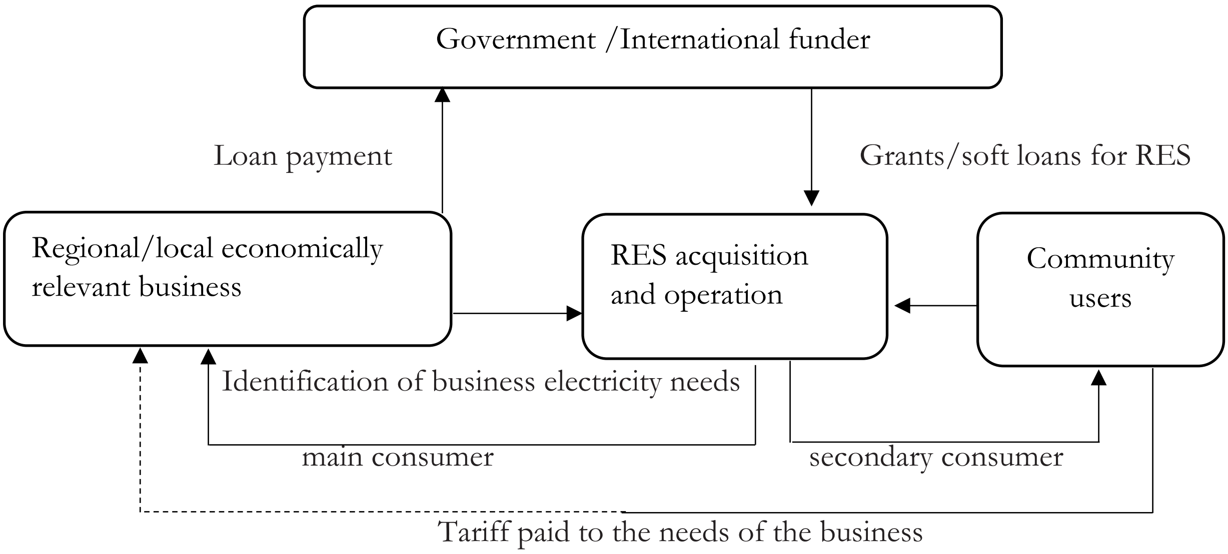

Figure 2.8: Graphic representation of the economy activity support mechanism

The economic activity support model is based on the fact intention that government, international or third party soft loan funding will be used to support the provision of energy (and electricity) important to drive the demands of a profit making economic activity i.e. food processing, manufacturing etc. This model sees the local economic activity provider(s) take charge of the renewable energy generation planning, installation, operation and maintenance using the obtained funds. The model will see the installed RES sized to surpass the specific needs of the business, with the intention that the energy outputs will have capacity to meet local community consumption. The loan or grant facility will therefore be hinged on the assurance of the receiving economic activity provider/business that the excess produced electricity will be distributed and consumed by surrounding community which previously had no access.

The economic activity provider operating the RES can subcontract the RES generation aspects to a third party, since this might not be considered a core function of their enterprise. There is the ability to further have charge the community consumers of the provided electricity, with collected funds used for maintaining and guaranteeing the sustainability of the installed system.

3.0 Considerations for Effective Financing Models for RES

Regardless of the financing models applied, customers are the number one priority for decentralised RES (DRES) projects. There is therefore a need of targeting a combination of different customer categories namely; households, small businesses, schools, hospitals, food processing facilities (i.e., maize mills) among others. Other important aspects to consider include; demand profile, social and economic development of the area. Setting of electricity tariffs also plays an important role in financing mechanism. Factors like ability and willingness to pay, projected demand, fixed costs and variable costs must be considered when designing tariffs. Simply put, there is a need of designing tariffs based on the local conditions of the sites as well as providing justification for different tariffs between different customer types i.e., households and business entities. Revenue collection approach is another crucial aspect that must be considered in developing a financial model. Metering technologies would include considerations such as ensuring accurate measurement of electricity consumed, anti-theft measures, good staff management, pre-paid or post-paid systems preferences among others.

The quality of electricity service by an energy service provider (ESP) plays a critical role if a household or community considers the adoption and use of RE systems. The quality of electricity services can be categorised in three ways:

1) Ability to serve different customer types,

2) Availability of electricity (hrs/day), and

3) continuity and sustainability of the project.

RE project developers must decide early what tier of electricity service they offer for different customer types and measure their willingness and ability to pay for such services. As such, successful financing models entails the energy service provider to serve users with higher levels of service thereby making the RE systems trustworthy by adopters. Further to this, meeting the growing electricity demand ensures sustainability of a financing model. Demand side management (DSM) actively influences electricity demand on DRESs to match electricity generation. It is generally cheaper to adjust demand than supply and therefor important for the project economics of DRESS, particularly for intermittent sources such solar mini-grids which generate electricity based on weather conditions. A common DSM strategy is to shift demand to times of higher renewable resource availability (e.g., high solar irradiation) and away from times of lower availability.

Productive use energy (PUE) is the most key factor for any successful financial model. Agricultural, commercial and industrial activities that generate income, increase productivity, enhance diversity and create social and economic value through the consumption of electricity which consequently enables households to afford DRESs and thereby reduce the dependency on donors for maintenance and operation of RE systems. PUE enhances social and economic impact, increase electrical sales for the energy service provider thereby making the financial models sustainable. Based on Malawi's implementation of RE projects, it is noted that most implementers design financial models with a focus on financing underprivileged customers to access RE systems/products. This has consequently resulted in constant or dwindling electricity demand thereby resulting in failed RE projects. However, demand can be stimulated through financing end users on productive income generating activities thus allowing them to afford the payment of upfront costs of connections and purchase of electrical appliances.

4.0 Conclusion

Financing rural electrification schemes in SSA would go a long way to increasing energy access in Africa. This report has identified different financing mechanisms and payment models adopted in SSA. The report further identified different successful stories of various financing mechanisms in LICs which could be replicated in the future RE projects. It is proposed that, for any financing mechanism to be successful in RE project implementation, key aspects such as customers, tariffs, revenue collection, service quality, and environmental sustainability must be considered. There is also a need of devising strategies to boost revenue generation by the RE project implementors. These may include; demand side management, productive use, and DRESs clustering i.e., building more than one RE systems in close proximity to another to allow interconnection hence creating more resilient power networks.

References

[1] E. A. Ehimen, P. Y. Sandula, T. Robin, and G. T. Gamula, "Improving Energy Access in Low-Income Sub-Saharan African Countries : A Case Study of Malawi," pp. 1–26, 2023.

[2] Claudia, and Knobloch, Christian Pirzer and Benjamin Hötzel, Rustam Sengupta, Komal Makkad, and A. Khurana, "Business Model INNOVATIONS ADDRESSING AFFORDABILITY : CASE STUDIES," no. March, 2021.

[3] EEP Africa, "EEP AFRICA TRUST FUND Annual Report 2021," p. 27, 2021.

[4] P. Frankel, "A helping hand: Part one: Could a new type of insurance help cutting edge renewable energy companies cross the valley of death?," *Renew. Energy Focus*, vol. 13, no. 1, pp. 46–49, 2012, doi: 10.1016/S1755-0084(12)70016-9.

[5] R. C. & S. H. Lindsay Miller, "Innovative agricultural SME finance models," *Glob. Partnersh. Financ. Incl.*, no. November, pp. 1–143, 2017, [Online]. Available: www.ifc.org

[6] IRENA, "PAY-AS-YOU-GO MODELS," 2020.

[7] B. F. Towler, "The Future of Energy," *Futur. Energy*, pp. 1–376, 2020, doi: 10.1016/C2013-0-19049-6.

[8] Green4Access, "Local Financial Institutions: A Major Untapped Source of Financing for Energy Access in Africa," no. September, 2020.

[9] X. van T. L. Würtenberger , J.W. Bleyl , M. Menkveld, P. Vethman, "Business models for renewable energy in the built environment," *Bus. Model. Renew. Energy Built Environ.*, no. April, pp. 1–182, 2013, doi: 10.4324/9780203083178.

[10] World Bank Group, "Off-Grid Solar Market Trends Report 20018 - Executive Summary," no. January, pp. 1–40, 2018, [Online]. Available: www.ifc.org

[11] Sunny money, "Solar lights at sunny money," no. Accessed on 01/02/2023, [Online]. Available: https://sunnymoney.org/solar-lights/

[12] USAID, "SUCCESS STORY USAID / Power Africa Grantee Households in Malawi," 2021.

[13] M. Pahle, S. Pachauri, and K. Steinbacher, "Can the Green Economy deliver it all? Experiences of renewable energy policies with socio-economic objectives," *Appl. Energy*, vol. 179, pp. 1331–1341, 2016, doi: 10.1016/j.apenergy.2016.06.073.

[14] Asian Development Bank, *Business Models to Realize the Potential of Renewable Energy and Energy Efficiency in the Greater Mekong Subregion*. 2015.

[15] UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA, "Study on innovative financing mechanisms for renewable energy projects in North Africa," 2020.

[16] Ministry of Energy, "Minister visit Sitolo Solar mini-grid," no. Accessed on 27/01/2023, 2022, [Online]. Available: https://www.energy.gov.mw/2022/07/29/the-minister-visited-sitolo-80kwp-solar-pv-mini-grid/

[17] Renew'N'Able Malawi, "Rural Off-Grid Energy Kiosks," no. Available online (accessed on 24 April 2023), [Online]. Available: http://www.renewnablemalawi.org/index.php/projects_field-projects_rural-energy-kiosk-2/

[18] S. Pelz, E. Brutschin, and S. Pachauri, “Conceptual and Institutional Prerequisites for Guiding Equitable Progress Towards Universal Rural Electrification,” *Econ. Energy Environ. Policy*, vol. 11, no. 1, pp. 5–25, 2021, doi: 10.5547/2160-5890.11.1.spel.

[19] Zalengera et al, “Delivery Mechanisms for Household-Based Renewable Energy Systems: Experie nces from Zatuba in Malawi,” no. poster presentation at the 1st low carbon energy development network conference, 4-5 April 2012, Loughborough, UK., p. 2012, 2012.

[20] M. Marco Hüls, GIZ; Marcel Raats, RVO; Josh Sebastian and Veen, “Results-Based Financing,” *World Bank Gr. A to Z 2016*, pp. 154b-154b, 2015, doi: 10.1596/978-1-4648-0484-7_results_based_financing.

[21] Energy for Impact, “Crowdfunding Energy Access State of the Market Report,” 2020.

[22] P. G. Elina Weber, Véronique Hirner, “Results-based Financing for Energy Access How to design and implement projects :,” no. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Registered offices: Bonn and Eschborn, Germany, 2018.

[23] M. C. Mukeshimana, Z. Y. Zhao, and J. P. Nshimiyimana, “Evaluating strategies for renewable energy development in Rwanda: An integrated SWOT – ISM analysis,” *Renew. Energy*, vol. 176, pp. 402–414, 2021, doi: 10.1016/j.renene.2021.05.104.

[24] B. Klagge and C. Nweke-Eze, “Financing large-scale renewable-energy projects in Kenya: investor types, international connections, and financialization,” *Geogr. Ann. Ser. B Hum. Geogr.*, vol. 102, no. 1, pp. 61–83, 2020, doi: 10.1080/04353684.2020.1729662.

[25] H. Barth, P. Ulvenblad, P. O. Ulvenblad, and M. Hoveskog, “Unpacking sustainable business models in the Swedish agricultural sector– the challenges of technological, social and organisational innovation,” *J. Clean. Prod.*, vol. 304, p. 127004, 2021, doi: 10.1016/j.jclepro.2021.127004.

[26] International Labour office Cooperative Unit, *Providing clean energy and energy access through cooperatives Providing clean energy and energy access*. 2013.

[27] M. D. Tarhan, “Renewable Energy Cooperatives: A Review of Demonstrated Impacts and Limitations,” *J. Entrep. Organ. Divers.*, vol. 4, no. 1, pp. 104–120, 2015, doi: 10.5947/jeod.2015.006.

[28] S. Soeiro and M. F. Dias, “Renewable energy cooperatives: A systematic review,” *Int. Conf. Eur. Energy Mark. EEM*, vol. 2019-Septe, pp. 1–6, 2019, doi: 10.1109/EEM.2019.8916546.

[29] H. Njie, “Community Building and Ubuntu: Using Osusu in the Kangbeng-Kafoo Women’s Group in The Gambia,” no. Accessed online on 14 June 2023, 2022, [Online]. Available: https://academic.oup.com/book/38811/chapter-abstract/337656201?redirectedFrom=fulltext