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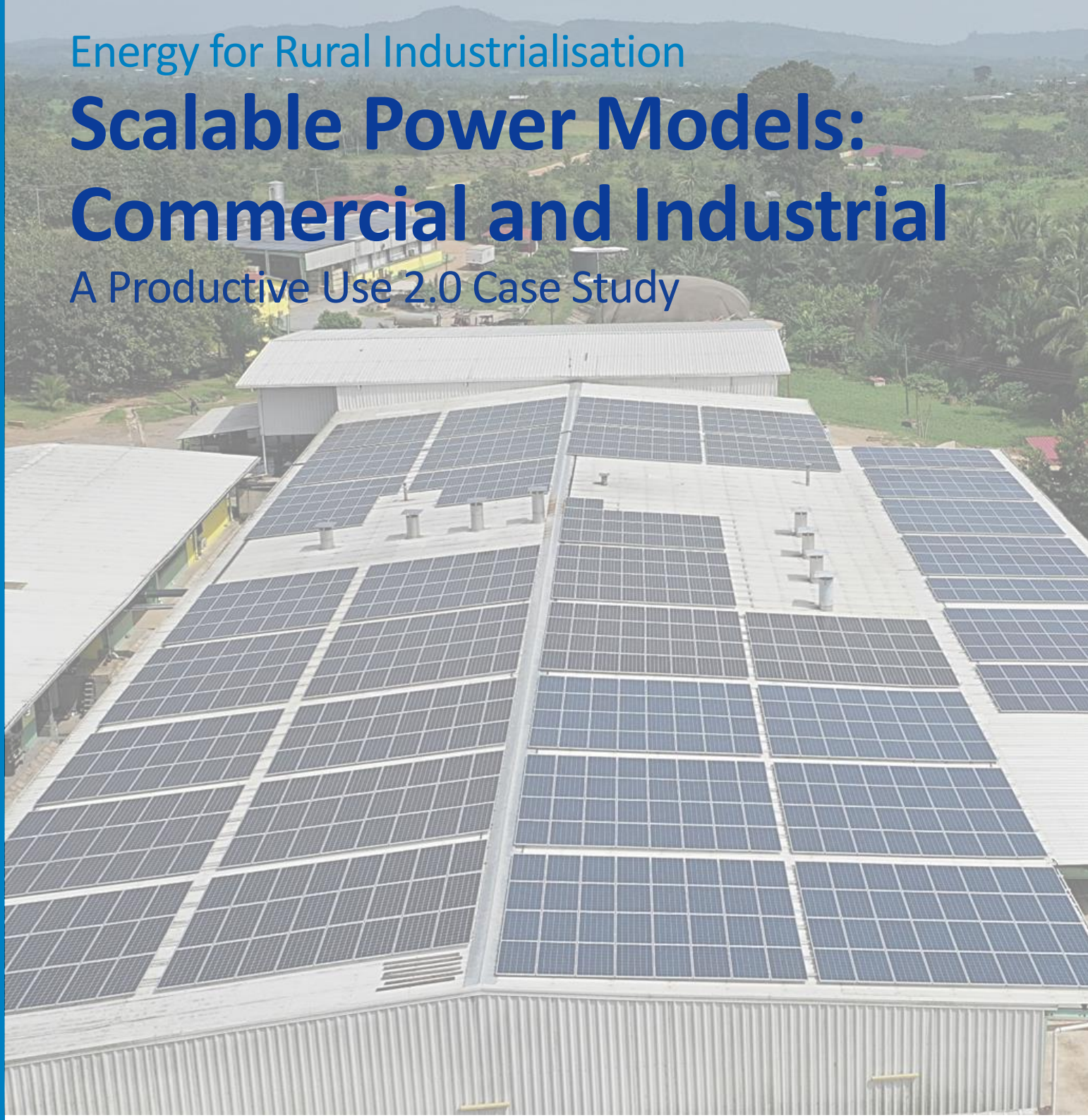
Energy for Rural Industrialisation

Scalable Power Models: Commercial and Industrial

A Productive Use 2.0 Case Study



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Introduction

This case-study is part of a wider series on **Energy for Rural Industrialisation** which looks at the synergies between electricity access and economic, commercial, and industrial activity. The focus here is on ***Scalable Power Models*** with a deep dive into replicable models leveraging renewable energy technologies to trigger growth and development in rural industry in Africa. The analysis strengthens the case for opportunities on competitive advantages that most African countries possess, or can obtain: an abundance of raw materials able to compete in domestic and world markets in terms of quality and price, in combination with a large workforce in agriculture and mining.

While limited value addition around the production-end of the value-chain has supressed rural industrialisation and development in the past, substantial reductions in the cost of decentralised renewables over the last 15 years are enabling production and processing industries to take-off. Numerous models following similar approaches are now mature enough to harness lessons from early-movers and assess replicable and scalable opportunities. We identify three off-grid Scalable Power-Models promoting rural industrialisation:

i) Commercial & industrial (C&I)-models
ii) Mini-grid-powered-models
iii) Isolated productive-use models

The focus of this case-study is successful and replicable C&I business experiences.

1 Commercial and Industrial PUE

C&I energy systems are the most viable power models we see for rural or off-grid industrialisation using renewable energy (RE) in the African context. Unlike the mini-grid market, and the stand-alone productive use of energy (PUE) appliance sector, C&I systems are already finding application in agricultural processing, manufacturing and more, often without need for subsidisation; moreover, unlike rural power grids, C&I systems are highly reliable.

HPW Fresh & Dry Ltd., Ghana.

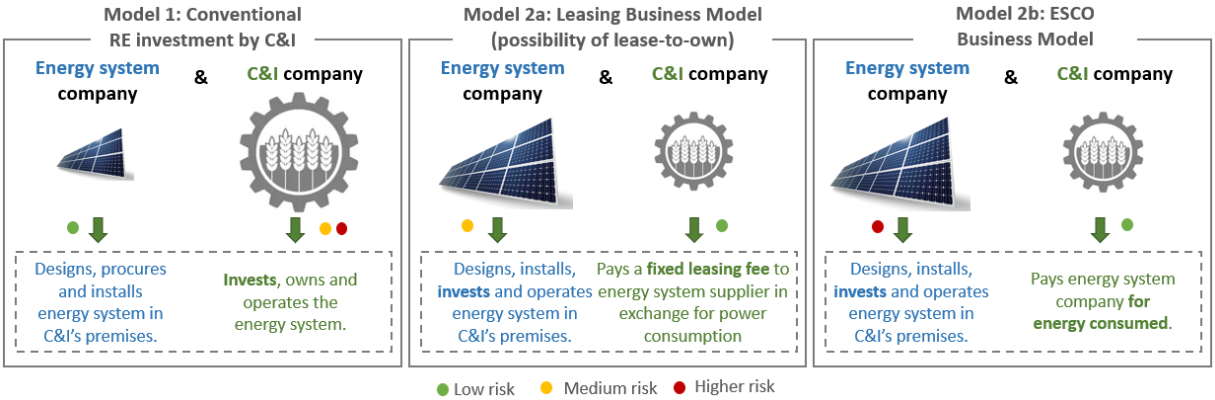
Defined as a generation system tied to a (single) commercial or industrial end-user, RE C&I systems are being employed on a profitable basis throughout Africa in industries, such as mining, concrete, tea and coffee, fruit and vegetables, meat and fish. **C&I systems generally make financial sense in off-grid regions, or areas of poor grid reliability, where raw materials can be processed before transport to urban and international markets**. They also have a place providing reliable services to rural communities, such as healthcare, public administration and education.

C&I systems are often located within reach of the national grid, and tend to display a stronger financial position than the small and medium enterprises (SMEs) making use of mini-grid and stand-alone PUE options. Such SMEs often employ diesel generators to compensate for unreliable grid supply, as power outages are costly to operation. However, diesel gensets tend to increase operational costs and carry environmental impacts. Recent cost reductions for solar photovoltaic technology and battery storage have led many companies to embrace these technologies, or make use of available biomass or wind.

Although there are no strict sizing definitions, C&I systems tend to range from 50 kWp to 1MWp. The term, *captive power,* is also used to describe these systems, as the electricity is not distributed further to other customers. However, this label does not define the user as commercial, industrial or productive.

Three key business models are observed in the deployment of C&I systems, essentially defined in terms of which actor (system supplier or end-user) finances the system upfront. With some variations regarding responsibility for operation, C&I business models generally fall under: 1) Investment model, 2a) Leasing model, or 2b) Energy Service Company (ESCO) model illustrated in Figure 1.

Figure 1. C&I Business Model Modalities and Risks for Parties



C&I customers with strong cashflows and access to affordable credit can benefit from lower upfront costs and purchase RE systems (and installation services) from a supplier via the Investment model. They will then either opt to outsource the operation & maintenance (O&M) of the system, or build internal capacity to operate independently. The investment's viability can be enhanced by selling surplus power through a Power Purchase Agreement (PPA) with the local grid operator.

Business models that have gained traction in recent years support C&I end-users who operate with smaller cash-flows and restricted access to affordable credit. In the leasing model and ESCO model, a system supplier finances, procures and installs on the end-user's premises, while retaining ownership of the system, at least until pay-back is achieved. Payment modalities differ slightly:

- Leasing: fixed regular fee per unit of time (month, year), with option of *lease-to-own*
- ESCO: agreed price per unit of electricity (kWh) consumed

Under a leasing model, system O&M can be performed by either the end-user or the system supplier (depending on the lease agreement); under the ESCO model, the supplier, or 'ESCO', generally provides O&M as part of the complete energy service, thereby removing any technical and financial risks to the customer. The leasing approach enables access to RE electricity and finance through the annual savings from previously substantial diesel-related expenditure. Often, the ownership of the energy system is eventually transferred to the customer once the accumulated lease payments balance out the system's upfront capital requirement and associated cost of finance.

The ESCO modality also has a valid business case to the extent that the electricity tariffs are set at a level which enables total expenditure to remain lower than past diesel-related utilities. It may also be more attractive to customers who a) cannot predict their future usage accurately and prefer to pay for each kilowatt hour used, or b) work on an annual budget based on grid power equivalent.

There is obviously no such thing as a guaranteed business model, and various challenges and risks prevail in rural African industries. However, we are now observing the emergence of ever more promising business models, some of which are critically assessed here, to seek replicable and scalable

options for continental promotion, analyse the enabling factors for success, and build strategies linking rural electrification and national industrialisation.

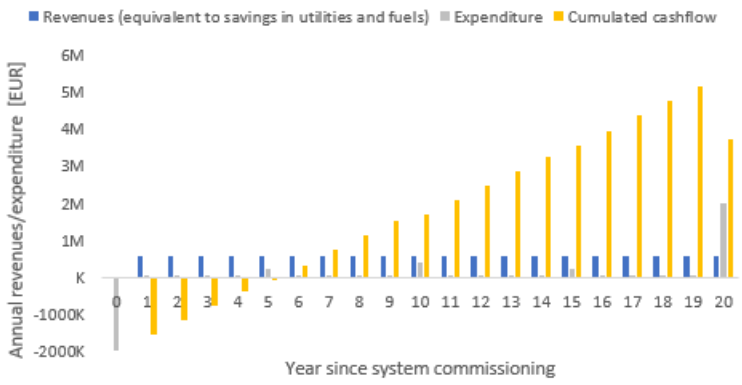
1.1 RE-Enabled C&I Projects: Lessons Learned and Success Factors

Investment Model. Founded in 2011, **HPW Fresh & Dry Ltd. (HPW)** is a Ghanaian company based 70 km from Ghana's capital city, Accra. Their well-established position in the fresh-fruit-drying and exporting business, and the proven sustainability (in financial and environmental terms) of their operations, place HPW amongst the best examples of C&I operators leveraging the benefits of RE technologies. After 11 years in the Ghanaian market, HPW now has around 1,000 employees, owns and operates 150 acres of farming land, partners with 1,400 smallholder farmers in Ghana and beyond, and currently processes around 2,000 tons of output per year.

HPW purchases fresh mangos, pineapple, coconut, banana, and papaya from local farmers, who receive training and support with agricultural inputs and finance, as well as quality control, giving the local agricultural community a reliable off-taker and improved value addition on their raw product. HPW processes all this fruit on-site for export to the European, American and Australian markets. The end-product is highly competitive with other international providers, both in terms of quality and price, and conforms to fair-trade principles.

HPW originally relied on a diesel back-up generator to complement the unstable grid electricity supply. However, in 2016, the company decided to invest in solar and biomass systems, both of which were expanded in 2019. At present, the factory operates a 470 kWp solar photovoltaic system, a biogas generator of 150 kW (which relies on the generated organic waste as input), and biomass boilers of 4.6 MW capacity.). The generated fertiliser, as a by-product, is given to pineapple farmers with which the company collaborates.

Figure 2. Cash-Flow Model Simulation for Energy Systems at HPW Ghana



The combined solar and biogas RE generators annually substitute around 470 MWh of diesel-powered electricity generation and 7 GWh of diesel-generated heat. This translates into a pay-back period of around 6.5 years on the system, and annual cost savings of 580,000 EUR in electricity bills and diesel. The biomass boilers and dryers enable the annual processing of 20,000 tons of fresh fruit, which translates into 2,000 tons of processed high-quality dry fruits being marketed every year. Introducing this technology was a significant undertaking for HPW, which also required staff training and the integration of systems.

While part of HPW's success rests upon the efficient value addition of high-quality produce, a further factor is the market linkage between what is a rural industry (agricultural product) and an urban and international market (dried exotic fruit). The company is a subsidiary of the Swiss HPW AG, which has been active since 1997, and is well-established in the trading business, with the largest portion of produce being sold for export.

Besides an initial grant of 850,000 EUR in 2010 to establish HPW Fresh & Dry in Ghana, HPW AG has been the main source of equity in order to undertake the above energy investments, which experience a 20-year project-IRR of 18%. Whilst the grant component was, in this case, substantial, we now observe that the reliability and costs of C&I renewables have improved significantly, and that the model of high-quality local products, matched with a value adding investment and linked to a larger urban or international market, is highly replicable, provided that certain risks are minimised. The achieved energy savings of approx. 580,000 EUR annually are transferred to customers by reducing the price of marketed products, thus enabling HPW to retain a solid position in the world market.

Lease-to-Own/ESCO model. Complementing the traditional upfront sale of renewable energy systems, the lease-to-own model (Model 2a) and ESCO model (Model 2b) are proving to enable a new type of rural investor to venture into RE investments. Convincing examples of these models are demonstrated by Kenyan **Equinox Horticulture**, a high-quality rose farming company employing 500 people, and Tanzanian **Shanta Gold**, a young and innovative gold mining company with operations across East Africa.

Equinox Horticulture

Equinox relied on the services of Kenyan energy system supplier, Ariya Finergy, to install and operate its 103 kWp solar plant; Shanta Gold has worked with German system supplier, Redavia, to procure its 674 kWp solar plant. This strongly implies the identification of skilled partners for the correct dimensioning and installation of the renewable energy systems, as well as local partners familiar with the local context; keeping an innovative, creative and flexible organisational culture which is able to adapt and find solutions to challenges on the ground, such as scarcity of inputs, accessing capital especially during the start-up phase, and dealing with regulatory requirements. The aforementioned systems generate, together with clean electricity, annual savings from diesel expenditure of five million Kenyan shillings (about 38,200 EUR), and 187,000 EUR for Equinox and Shanta Gol respectively. Both systems are estimated to generate a 20-year project IRR of 39% and 26% respectively.

These lighthouse projects highlight the following conducive factors for success:

- **Strong Partnerships**: Having the support of a large, strong back-up institution/mother company which has been able to provide finance, and a market in which to sell processed fruits, has also been crucial for HPW Fresh & Dry. For Equinox Horticulture and Shanta Gold, having the support of a highly skilled technical partner which not only correctly dimensioned and professionally installed, but also operates the RE systems, has proven fundamental.

  - The advantage of bringing an international company into a rural value chain, aside from the technology transfer, is the enormous additional absorption capacity for local produce generated by the international company's integration in a larger market, whether a domestic city, or international export. Farmers thus benefit from being able to sell as much as they can produce, receiving a better price per unit, and pulling the profit margins closer to their position in the value chain (i.e. from transport end to production end), through quality improvement, bulk reduction, preservation, etc.

- **Concessional Finance:** For energy system supplier companies opting for lease out systems, having access to concessional finance also proves to be a pre-requisite, especially at the early stages of the company's operations.
- **Accommodating Seasonality and Guaranteeing Off-Take**: Using the deployed processing machinery for multiple fruits/crops with complementary season cycles is another key factor for organisations active in the agro-processing sector. The case study of HPW shows that the investment in a decentralised solar PV can be profitable even in agro-businesses facing the challenge of seasonality. Risks of under-utilisation of the solar system (which would directly affect profitability) are low in the case of HPW, as the investor is not only a rural producer, but also has a guaranteed take-up of produced products through its parent company, HPW AG.
- **Skilling Measures and Benefits**: The skilling measures were successful in the case of HPW which boasts a dedicated Ghanaian workforce which is equipped and qualified to operate all the equipment, with minimal need for external services. The plant runs in a highly systematic manner, with standardised hygiene and safety procedures in place. The provision of additional services to employees, such as a canteen, a kindergarten for employees' children and a company bus facilitating transport, further enhances a climate of loyalty between staff and the company, particularly important given the substantial investment undertaken in capacity-building.

The identified projects' profitability, with project IRRs of between 18-39%, and pay-back periods of 2-7 years, prove that several positive precedents exist in the market which encourage expectations of a thriving renewable energy based captive power sector. Further technology cost-reductions, and walking-up the learning curve, will favourably impact upon achieved returns. Overall, the identified case studies highlight the fact that profitability strongly depends on the total energy costs of the C&I consumer in the baseline scenario throughout the year, not just in consideration of the specific costs per kWh, or litre of fuel, but also of the total annual consumption as a result of the operation mode (hours per-day and week, operation days per year, as well as whether the energy consumption takes place only in daylight or also during night hours).

1.2 Scalability and Promotion of the C&I Models

The assessed case studies make the case for private sector led rural industrialisation in Africa. It is, however, of importance to assess the prevailing challenges and how these can be mitigated to ensure the sector's scalability and promotion.

System sizing. The profitability in decentralised renewable energy systems, such as solar PV, strongly depends on the consumption of the highest possible share of the locally produced power: the less solar power consumed, the lower the profitability of the system will be (especially when the option to feed excess power into the national grid is not available, or electrical storage is not a viable solution. The importance of correctly dimensioning the energy system cannot be underestimated in order to allow for maximum utilisation, in consideration of the load profile of the C&I consumer.

Lack of access to inputs, in terms of raw material and skilled labour, is an additional challenge. Unproductive or low-yield farmlands can pose a real risk when it comes to sourcing the required fruit to operate the processing factory on a scale that ensures profitability. Furthermore, lack of skilled labour to operate agro-processing machinery, as well as maintain the deployed energy systems, is a source of risk which the companies have had to manage, especially in the early stages of the respective projects.

Challenging business environments, in the form of unclear legal and regulatory frameworks combined with poor trade infrastructure, add an additional source of risk which rural entrepreneurs must consider, and that African governments can nevertheless positively influence. This may include, for example, having favourable import duty (tax) regimes, smooth customs clearance procedures and processes that facilitate the delivery of equipment on site, etc., to enable steady learning curves and thus ensure a socio-economic stability which enables the investments to be recovered in good time. For this purpose, international donors can provide invaluable support to local governments in the framing of strong industrial policy and regulations.

At the field-level, an **underdeveloped road infrastructure and lack of proper storage facilities** along the value chain is an additional challenge, especially so when the project sites are remotely located. In this regard, suitable site selection for the project implementation is a strategic decision on the side of rural entrepreneurs which must take place with sufficient field knowledge and, ideally, with the support of a reliable local partner who is well acquainted with the context.

Difficulties with accessing affordable finance, and identifying the right partners are consequences of the above outlined challenges. For instance, Ariya Finergy has acknowledged the initial difficulty of entering new markets in the African context and consolidating its position. On the other side, the high-risk reputation of rural investments in Africa initially challenged Redavia to access the required amounts of credit to finance deployment of the systems. The players manoeuvred their way into their respective African markets by initially accessing either a grant which financed part of the market-entry costs, or accessing patient capital via concessional finance. In this regard, it remains fundamental for governments to develop and enforce conducive policy environments that substantially reduce the risk of investing in RE systems in the rural industrial & commercial sector.

2 Recommendations

Based on the findings of the undertaken analysis in terms of lessons learned, conducive factors for success, challenges faced and prevailing risks across the three outlined PUE sectors in Africa, a set of recommendations, aiming to guide future policy efforts, have been developed.

2.1 Incentivising the Engagement of Larger Players to Accelerate PUE Investment in Rural Areas

The profitability of businesses, such as mills, cold storages, irrigation systems, etc., require upfront investments, which rural small-scale entrepreneurs and/or cooperatives can usually not finance. Their ability-to-pay is low, access to finance is limited, and management capacities are often weak. In contrast, **large players** from both agriculture value chains, and energy service companies are endowed with stronger balance sheets, the capability to access affordable finance and (often) already well-established networks in the country. Thus, putting incentives in place to ensure the engagement of larger players in the rural PUE sector can effectively contribute to the economic development of rural areas. Smallholders and local businesses would benefit from stable partnerships, especially in terms of knowledge transfer and access to finance. For larger players, such partnerships can enable access to high quality raw inputs and expansion of their market base.

'Go rural' programmes could be put in place which promote and offer advantages (for instance, via tax exemptions for agro-processing activities in remote rural areas) for larger players willing to venture into such partnerships. The engagement of larger players from value chains could include:

- Investment in the decentralised businesses in rural areas (alone or in collaboration with energy service providers),
- Providing credits to rural entrepreneurs/cooperatives or
- In-advance contracts with farmers/ cooperatives for off-taking the products, so that these contracts can be used as a form of guarantee to the loan providers/finance institutions.

2.2 Strengthening Small-Scale Rural Investors (SMEs, Cooperatives)

Effective policies necessarily entail the development of mechanisms to strengthen small-scale rural investors. This can be achieved through the promotion, in terms of awareness creation and capacity building, of establishing and managing revolving funds based on the principle that, with the profit of one business, a credit for another business can be provided.

When cooperatives and SMEs are the investors in the PUE project, a lot of support, in terms of governance and management, marketing of products and services, etc., is often needed. Programmes should be developed which facilitate the interlinking of market players across the value chain and know-how transfer/exchange, also for those located in remote communities. Furthermore, cooperatives can be strengthened and supported in bulking the procurement of equipment, such as solar irrigation pumps, combined with social guarantees.

2.3 Developing Public Promotion Programmes

Achieving sustainable socio-economic development in remote rural areas in Africa necessarily requires a **Nexus approach** between the energy, water and agriculture sectors. Government entities of different sectors need to collaborate. For instance, the Ministry of Energy and Ministry of Agriculture could join forces in organising national events that mobilise larger players of value-chains, especially where these are highly vertically integrated and where the relationships between the various actors (farmers, processors, traders, etc.) are already quite strong thus indicating a serious interest, on the part of the aggregators/processors, in strengthening the upstream stakeholders. To further foster sector synergies, governments could also promote and fund private sector events, organised in collaboration with the countries' renewable energy and agro-business associations.

As mentioned earlier, such programmes could also be centred in the provision of tailored extension services to PUE projects. This could be enabled by making funds available for advisory services on good farming practices to maximise the benefit of (solar) irrigation pumps, or of (solar) cold rooms, subsidising the costs of project development which are generally substantial in remote rural contexts – and, where necessary, partially subsidising sectors/appliances considered of strategic importance for the economic development of a country's agricultural and agro-processing sectors, (such as affordable irrigation and cold storage rooms).

2.4 Dialogue with the Local Financial Institutions

Risks, especially of investments in rural areas, are often over-estimated by financial institutions due to a lack of data and information. Energy service companies could be supported to get improved access to local finance by collecting and processing data about the payment behaviour of customers (e.g. in supplier credit schemes, PAYG-schemes, etc.). Data from remote monitoring of the usage of PUE systems (e.g. of solar irrigation pumps) could be used to build up the confidence of the finance sector in the generation of the cash flow necessary for serving any debt.

Strengthening the capacities in asset and project financing, including coaching in due diligence, whilst working together with financial institutions on mechanisms to minimise the loan operation costs (including digitalisation of data), can support the mitigation of the high-risk perception of rural investments. Essentially, choosing an approach of **dialogue** with the finance sector can strongly support the dismantling of the wall which prevents the financial inclusion of several potential PUE projects, and this rather than falling-back on the idea that the sole challenge lies in a knowledge gap on the part of financial institutions which can be easily filled by training and capacity-building measures. Finally, it is also the responsibility of contributors, and their implementing agencies, to understand the financial institutions' loan policy, to listen to their concerns, and have discussions on how these concerns can be addressed.

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