



BARRIERS & OPPORTUNITIES WITH APPLIANCES, PUE AND ACCESS TO FINANCE



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Cover photo credit: Agsol



Managing Entity for a financing program aiming at the promotion of private initiatives in green mini-grids improving access to electricity in Kenya



IMPLEMENTED BY:



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Introduction

Private mini grid developers (MGDs) go where governments struggle to go, providing critical access to energy- and increasingly, other value-added, life improving products and services. The opportunity for rural enterprise and economic development has only begun to be explored with growing funding for productive use of energy (PUE) and complementary products and services. Rolling out well-run, commercially-viable private mini grids

continues to be a challenge with delays due to regulatory, operational, financial and technical challenges. This report outlines the latest findings on the state of the African mini grid sector, with a focus on barriers and potential solutions relevant to productive use of energy (PUE) and energy demand management challenges, access to asset or consumer financing, and rural economic development. This analysis includes insights from over 50

interviews; 25 recent industry reports; and participation in a series of calls and webinars between March and November 2020. Through the analysis, a longer list of over 200 relevant funders, investors, and potential financing, rural enterprise and productive use/appliance partners were uncovered and tracked in a separate database.

Why Mini Grids Matter

Mini grids serve the highest proportion of low-income families (51%) when compared to other energy access solutions (solar home systems, cookstoves, solar lanterns, and appliances). However, there are also complexities to the mini-grid business model including the high cost of power, high infrastructure cost, and less flexibility to recover assets if customers don't pay. [60 decibels](#) found that mini-grids serve the highest proportion of low-income families, attributing it to the business model that requires a high density of connections to cover the fixed costs of setting up a localized grid. Because of this, mini grids need to play an important role in the off-grid energy sector if we are to succeed in achieving SDG7: clean, safe, and affordable energy access for all.

Mini-grid systems can be stand-alone, operating independently of the national grid, or grid-connected, feeding some of their power into the national distribution network. Stand-alone systems are currently more common in Africa and also more feasible due to lengthy and often difficult negotiations needed to secure licensing and power purchasing agreements (PPAs) with the national

utility, according to [EEP's Opportunities and Challenges in the Mini Grid Sector Report](#).

Mini grids provide value by offering longer-term solutions for more stable energy access, and larger more powerful energy systems and solutions to rural communities, in particular. Decreases in PV and storage costs and operational efficiencies in recent years have paved the path for mini grids to deliver energy to a larger subset of underserved communities at least cost. In particular, mini grids are unique and important because:

- Economies of scale allow mini-grids to provide reliable electricity 24/7 at a lower cost than solar home systems, and can move rural and peri-urban communities from a dependence on unsafe, unclean and expensive fuels such as diesel and kerosene. The International Energy Agency (IEA) considers mini-grids and other distributed renewable energy solutions the least cost option for three-quarters of all new connections needed in Sub-Saharan Africa. Furthermore, EEP found that mini grids can create annual savings up to EUR 93/year/household across its East and Southern Africa portfolio, 63% higher savings than the average solar home system solution.

- Mini-grids fill an important gap between individual solutions, such as solar home systems, and extensions of the national grid. As such, they can help national governments to achieve their goals of 100% electrification faster.
- Utilization of renewable energy sources – including solar, wind, hydro and biomass—reduces pollution and combats climate change, while also promoting national energy security, de-risking from fuel price fluctuations and reducing demand for fuel imports.
- Mini grids can generate sufficient electricity to support commercial and agro-processing operations and thus, stimulate local economic development in more robust ways than smaller solar home systems. Successful introduction of agro-processing and similar value-added activities can allow low-income, disenfranchised communities to earn greater income from a larger buyer market and build decentralized hubs of economic opportunity.



Photo Credit: Cold Hubs

- Mini grids can contribute significantly to national and rural food security by incorporating energy intensive agricultural and processing equipment to reduce post-harvest losses (e.g. cold storage, ice making, drying, milling), increase farming yields (e.g. irrigation and automated equipment), increasing local and domestic production of value-added products. UNEP estimates that every 10% increase in farm yield has led to a 7% decrease in poverty in Africa.
 - Introduction of a mini grid shows strong potential to electrify villages and transform them into vibrant local business hubs, or tied to larger, more lucrative value chains.
 - Well-built mini grids have a productive life span of 15-25 years, which far exceeds many other clean energy technologies being offered such as cookstoves and home solar systems. Those built to national standards have the option to connect with the national grid, and feed-in clean energy supply as the grid expands into the project area.
 - As the technology and data become more standardized, there will be a better understanding of how to reduce capital expenditures, operations costs, and facilitate competitive, rapid replication and dissemination.
 - The International Energy Agency (IEA) predicts that mini-grids offer a EUR 170 billion investment opportunity between now and 2030, representing at least 40% of new power connections in the region during the next decade. Many countries are increasingly including mini grids as core to universal and rural electrification, recognizing that while it is expensive (and will most likely need Capex subsidies), it is still less costly than building full grid extension to hard-to-reach areas. For example, in the new draft of their national energy strategy, Rwanda plans to provide nearly 50% of the country's electricity supply through off-grid solutions, with a large focus on mini-grids in their National Energy Plan (NEP), recognizing that it is still less costly than building full grid extension to hard to reach areas. The plan calls for over 300,000 new mini grids by 2024 to meet this goal.
- Mini-grids offer an increasingly appropriate and cost effective way to provide electricity for rural and low-income communities, and back-up clean energy systems in other areas with unreliable grid or other power sources. Yet, the sector is still nascent, requiring additional focus on breaking down restrictive barriers to scale.

Ongoing Barriers to Growth & Financial Sustainability

Despite the possibilities, the mini grid sector is rife with challenges that threaten timely roll out of new projects and connections, as well as growth to a profitable or financially-sustainable models. The next section lists key barriers that threaten Africa's mini grid sector, in particular Kenya. Many of these challenges are known and have persisted for years now, requiring continued support and funding to catalyze the sector past a critical tipping point.

Ten Barriers to Sustainable Mini Grids

1. High Cost Structure

- High capital expenditures (Capex) with long-term repayment period
- High costs due to fragmented sourcing and imports, then transportation of materials to last mile locations
- An assumption of significant increase in energy demand on the grid is built into design, whereby developers must invest in driving up ARPU (average revenue per customer) and grid utilization from a base load of ~30% to over 60% to achieve commercial viability
- High costs to provide battery storage/back-up power during off-peak (thus growing focus on driving up day-time grid demand via PUE strategies)

2. Focus on Low-Income, Underdeveloped and Hard-to-Reach Locations

- Mini grids go where national utilities will not go because of challenging economics/low demand; Kenya's Ministry of Energy spoke to these challenges in the 2019 GMG-facilitated PUE Workshop, citing a near-term increase in energy demand, then plateau in growth that makes the financial case for rural electrification challenging
- Locations tend to target services to very low-income households in locations with underdeveloped industry or strong market linkages; they are not tied to key trade routes for agri-value chains, nor part of an organized aggregator or supplier network linked to big buyers
- Enterprise development initiatives focus on increasing local income through micro-businesses that depend on local consumption by a low-income population, rather than on finding linkages to buyers along larger, more lucrative value chains that could attract significant additional wealth to mini grid communities ("a larger, more liquid economic pie")

3. PUE and Enterprise Development are Not Built in Mini Grid Model DNA

- Developers have typically only fully planned and tested for PUE and other revenue lines once sites are selected and funding secured
- PUE and non-core energy revenue models or business plans often focus on supply-driven (what is already locally produced) vs. demand-driven (what the market wants/needs) assumptions
- Agriculture actors see value in aligning with mini grids, yet have struggled to uncover how to do so due to geography, poor access to water for irrigation, remote locations, lack of developed suppliers who understand buyer expectations for quality, consistency, volume or product needed

4. Mini Grid Sites are Unattractive or Unknown Partners to Large, Mature Commercial Companies

- Large equipment companies are unaware of MGD partners or see sites as challenging, small buyer markets.
- Large lending partners are often ill-equipped to partner for last mile/rural contexts, requiring capacity building, new systems (last mile distribution/customer service/proactive promotion of a new loan product) and de-risking funds. Commercial banks interested to partner have struggled to de-risk the loan product to meet bank standards, get internal buy-in on the value proposition, develop an optimal new loan product/application/approval process, or implement due to training and structure changes required. Equity, Cooperative and other banks are exploring new models, yet a truly optimal outcome is yet to be seen.
- Many appliance and agri-equipment companies are eager to partner with MGDs, but have struggled, citing barriers in securing pilot funding,
- aligning on feasibility due to regulatory complications and consumer financing schemes, geography/demographic difference of priorities, and partnership
- discussions that lose momentum (due to lack of funding, limited staff focus over other priorities).

5. Complex Technical & Business

Model Makes Everything Harder, More Time Consuming

- Void of government subsidy, building a sustainable mini grid model is the most complex of off-grid solutions, requiring careful collection/monitoring of rich data and a plan to drive up energy demand or other revenue to account for higher capital and operating expenses
- An MGD wanting to integrate appliance sales into their model to drive up and regulate peak/off-peak energy demand must manage R&D/product testing, procurement, inventory, price/promotion testing, consumer education, consumer financing, loan portfolio management and related data analytics, debt recovery and post-purchase customer service. Additional challenges include product and financing fit in relation to high-energy cost (requiring energy efficient products and better financing to ensure consumption), identifying appliances that perform better on-grid vs. diesel, maintenance of PUE equipment to optimize performance on grid.
- Many startups in e-vehicles to off-grid agri-solutions view partnering with mini grids as complex, logistically burdensome opportunities with a greater
- 'headache' than potential financial upside; optimizing will also require close sharing of data that parties often want to keep confidential.

6. Willing Off-Grid Appliance and Financing/Distribution Partners are Early Stage, Not Locally Present and Limited

- Appliance, distribution/financing innovators cited as strong potential partners (AgSol, Rent-to-Own, Energrow) are early startups with less access to flexible capital (grants and impact capital) than even mini grids. These too rely on grants and small RBFs to pilot and perfect their models, and a small pool of funders
- Locally present microfinance banks are may not have the internal systems or capacity to effectively partner with developers on a new loan product, distribution and customer service/education of products wile larger lenders e.g. Kiva do not have local presence; as such, partnering requires the MGD to manage full appliance sourcing/procurement/inventory/loan application support/customer service/customer education elements of the value chain.

Ten Barriers to Sustainable Mini Grids

7. Dependence on Narrow Focus and Narrow Funding Pool

- Developers rely on a small group of less than 20 DFI and foundation funders for early capital, all with similar criteria and few with dedicated mini grid focus; these funders determine early business model drivers with only recent, growing focus on PUE for scale or agri sector alignment
- Most early grants are RBFs tied to connections with less focus on other success metrics for rural economic stimulus that could drive up energy demand and foster sustainable models—e.g. increase in average household income (that drives increase in household energy consumption and ARPU)
- The philosophy of mini grid role/impact has changed to one of rural electrification that can go anywhere and perhaps should go to the more remote, low-income areas to stimulate local economic development, greater energy demand, job creation and improved livelihoods. Void of strong local partners, pressure to be much more than a utility has risen yet MGDs can typically only access limited resources to prove they truly can stimulate significant rural enterprise development or wealth creation- a costly pursuit.
- Developers might access broader funding for 1) Rural Enterprise Development, 2) Agricultural Value Chains/Inclusion, 3) Rural SME Growth (for their own business or others), if related, known experts were engaged as partners or more early funding incorporated success metrics to attract these other sector funders.

8. Funder-Investor-Developer Mismatch

- Developers have attracted debt and equity investors for growth, yet most commercial to impact investors are designed to target 3-7 years return on investment, while rural electrification/utility models can take 10-30 years to be profitable. This mismatch and investor bias toward products/services revenue models with early and rapid growth, pushes developers into PUE, rural enterprise and other demand stimulation business lines they do not want to take on and are unfamiliar with.
- Some believe grant and RBF funders focus too heavily on impact metrics such as # of connections and rural electrification of the lowest income populations, which pushes developers farther from focus on commercial viability and to unattractive site locations. This then causes a mismatch with other industry linkages and complicates commercial viability.
- Grant funding is gradually shifting to recognize and fund the need for PUE/rural enterprise pilots, data collection and diversified business models, yet pilot funding is still relatively small (typically \$150k or less), leaving a continued gap in larger funding to collect sufficient data to run sophisticated pricing and demand analysis or gain critical mass to successfully scale new PUE and appliance introductions. Because pilots are costly and partners skeptical of partnership potential, many potential partners do not see incentives to test collaboration.
- Many equity (and debt) investors have limited their portfolio to 1 mini grid investment to-date-for strategic reasons or because the sector is nascent with a profitability model that is yet to be proven. Meanwhile, there is no dedicated PUE-focused impact fund to offer a de-risked investment opportunity to attract corporate VCs or investors who might be interested to invest in this scenario.

9. Limited Debt & Equity Investor Appeal; Few Infrastructure Investors Focused on Smaller Scale

- Funds other than large infrastructure funds who see mini grid and investment size too small- are structured with a longer-term investment horizon of 10+ year pay-back on investment fit mini grids best
- Few investors or funds have a strong focus on mini grids, while those who invest want to see healthier cash flow, near-term break-even toward profitability and a return on investment under 7 years. Many off-grid energy funds will not invest in mini grids due to the asset intensive, profit-light, and long build-to-profitability factors that their funders are not comfortable with.
- Unclear policy on what happens upon grid encroachment, feed-in tariffs, tariff pricing and government licensing continues to be a leading barrier to attracting private investment in clean energy around the world, but also in Africa.
- Few debt and working capital investors (e.g. SunFunder, Lendable) find the mini grid sector appealing due to challenging unit economics, unclear path to profitability, weak/nascent PUE or alternative revenue lines. For example, Sunfunder has only extended 1 loan to an MGD because of a guarantee from a GMG RBF. The PUE sector is more attractive, and yet, investors cite these parties as still too early.

10. Rural Electrification and Development Has Never Succeeded At-Scale without Government Support

- The US and many other countries failed at rural electrification until government pumped substantial funds and subsidies toward infrastructure and aggressive marketing campaigns into stimulating demand; New funding from the World Bank and others pose an opportunity to shift this if funds are deployed more effectively and in a timely manner
- Favorable tariffs and feed-in tariff are needed
- Faster licensing process, longer-term lease to operate and proof of government's commitment to partner in their actions is needed



Photo Credit: CLASP/PowerGen/MECS

Early Pilot Results & Insights from COVID

Since beginning this research, early pilot results from Crossboundary Labs and CLASP have come in, as well as relevant findings from covid surveys that shine further light on needs and pain point of still fragile sector that can be addressed to build greater resilience and long-term financial sustainability.

Recent Findings:

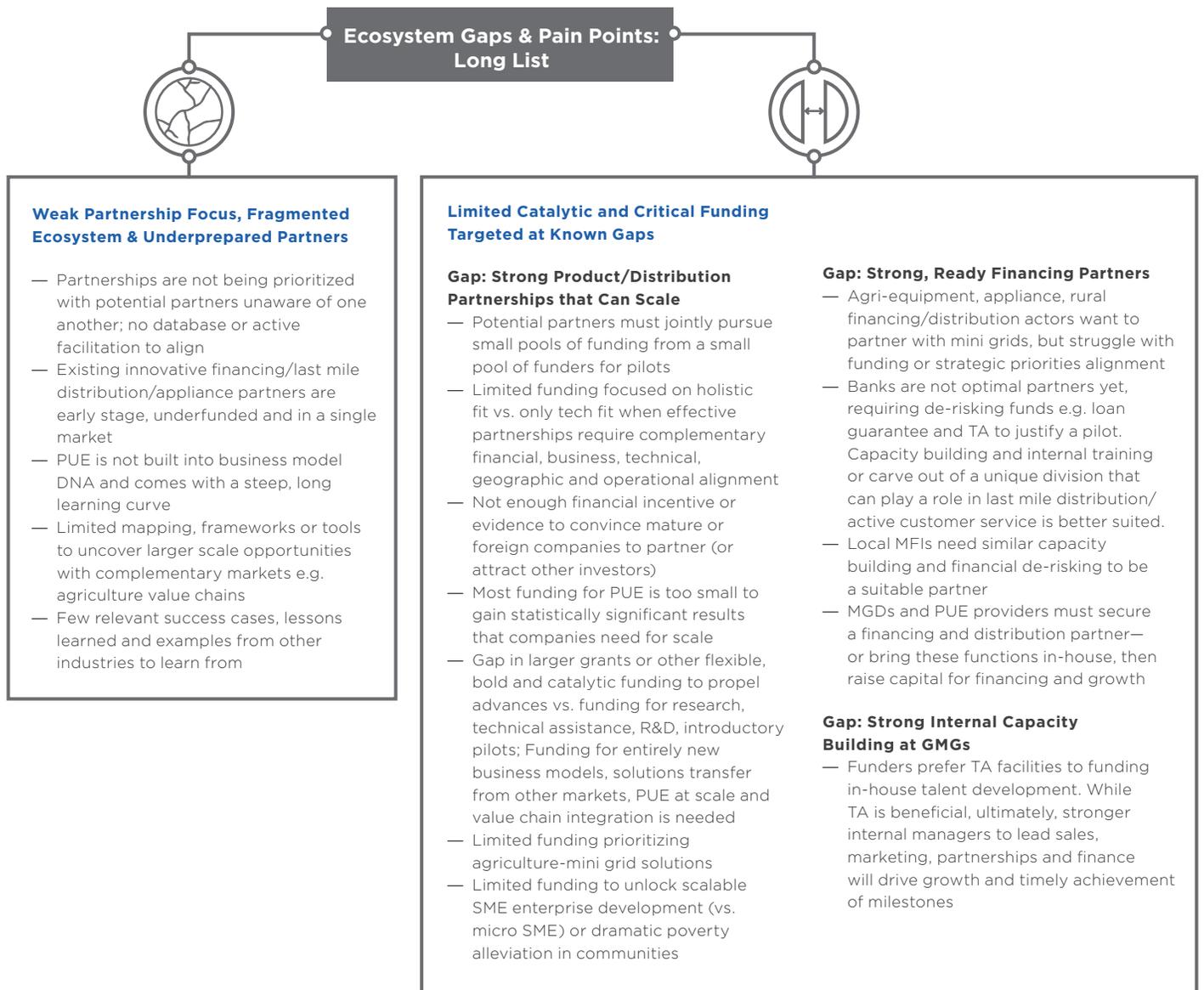
- **Covid has uncovered a need for more resilient models, built upon a stronger cash and business model foundation.** Endeavor found that 29% of its COVID-19 survey respondents (670 respondents, making it the largest survey for the sector) had already closed operations as a result of recent restrictions and their impact on business, while the remaining 71% will not be able to cover for financial losses over a period beyond 3 to 4 months, if the lockdown continued. They also noted that “midsized and larger companies in the PAYGO solar and mini-grid sectors express a severe financial vulnerability. 50% expected a staff lay-off within 3 months, on average up to half of original staff volumes, equating to a sector loss of over 4,000 jobs. The GOGLA COVID-19 survey of 49 off-grid players including MGDs had similar conclusions (March/June 2020). Meanwhile, GET.Invest reported in early July that the key need of all companies is access to capital to keep the lights on and buy time to evolve toward a more resilient, lean and COVID-19/post-COVID-19 reality.
- **Household appliances alone will not solve energy demand management or cash flow constraints of mini grids.** CB Labs’ appliance financing pilots trialed TVs, radios and electric pressure cookers (EPCs) found that these appliances can increase energy demand by 18%-25% over the long-term; yet continue to be used mostly during evening hours, leaving an ongoing gap in total demand increase needed and during daytime.
- **PUE equipment such as mills show great promise in driving up daytime energy demand, yet installation, onboarding and financing can be more complex.** CB Labs’ recent pilots with maize mills found that identifying the appropriate equipment, sourcing/product testing/product installation and set up took far longer than anticipated, yet posed greater potential to correct for energy demand management and cash flow constraints of mini grid models. JUMEME and other pilots have also shown as much, cited in the GMG case studies 2 and 3.
- **CLASP and Global LEAP research found that introduction and use of energy efficient appliances can cut lifetime costs of purchase/usage by 64%; therefore, with appropriate awareness raising and strong consumer or asset financing models paired with quality energy-efficient appliances, mini grid communities can gain more income with lighter spend.** See GMG Case 2.



Photo Credit: CLASP

Barriers Related to PUE, Rural Enterprise and Access to Finance

Effective focus on design, proper assumptions and partnerships related to non-utility revenue streams is the greatest gap for which additional talent, tools and resources are needed. A stronger ecosystem of known partners, greater funding to catalyze scale and innovative win-win models, and greater transparency on potential partners and partnership capacity/alignment are key.



Barriers & Opportunities

with Appliances, PUE and
Access to Finance

Key Side Effects & Potential Solutions

Non-funding Solutions

Funding Solutions



Limited Information or Funding Resources to Facilitate Effective Solutions to:

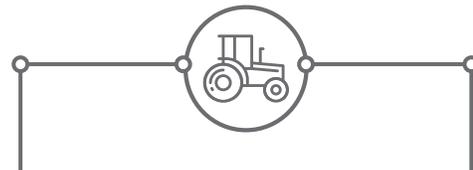
- Increasing energy demand via meaningful rural enterprise & economic stimulus
- Matching peak supply to peak demand;
- Building partnerships for scale that de-risk, boost and diversify revenues



- Provide improved partnership tools and resources: 1) roadmap for identifying, selecting, building strong partnerships, 2) database of partners with business/technical/financial/operational/ field capabilities, 3) case studies highlighting lessons learned/ how-to guides
- Programs that attract and cultivate top business talent in partnerships, finance and revenue growth
- Support AMDA or others to aggregate cross-sector data results critical to understanding how modular grids and industry wide cost savings/ efficiencies can be realized
- Inform potential lenders on growing positive data results



- Larger funding for 3-5 year build-out and testing of catalytic innovations (e.g. industrial/commercial villages or hubs or more group models, such as Crossboundary's group model or Engie's roll up of off-grid actors)
- 'Pilots at Scale' funding (\$300k and up per) to continue where pilots by CLASP, CB Labs, Innovate UK, E4I POP Hub, Global Distributors Collective and others leave off, leveraging models such as Clean Cooking Alliance's Spark Fund or USAID's Development Innovation Ventures models for catalytic, investment-ready outcomes.
- More funding dedicated to realizing strong partnerships between MGDs, last mile distributors and rural finance including home solar companies.



Underdeveloped Agriculture-Mini Grid Models



- Funders, investors and actors in agriculture & energy must collaborate to align on success metrics that drive mutual win-wins
- Database of agriculture partners, core expertise, capabilities and interests
- Broker effective agri-aggregator and buyer partnerships with mini grid communities (leveraging parties already doing this, or learning from those who have tried e.g. Farm Concern International, Technoserve, AGRA)
- Support MGDs on demand-driven market mapping exercises so highest growth-potential agricultural value chains are prioritized in PUE business planning, beyond subsistence and micro or MSME opportunities



- Incentivize agriculture sector- mini grid partnerships through dedicated funding such as challenge funds, RBFs, partial upfront grant funds etc.; and larger funding pools of over \$300k-\$1M to attract mature partners who are skeptical of the opportunity
- Funding to costly R&D on PUE and agri-equipment actors to optimize for alignment with value chains that could link to mini grid communities

Key Side Effects & Potential Solutions

 **Non-funding Solutions**  **Funding Solutions**



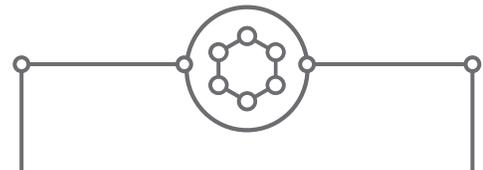
Underdeveloped Rural Enterprise-Mini Grid Models



- Database of enterprise development and African entrepreneurship partners, core expertise, interests and capabilities – and needs to create win-win solutions
- Broker effective partnerships, ideally those that create community access to a larger non-local buyer markets. Include rural poverty alleviation and Africa entrepreneurship, incubator and accelerator-type operators so that MGDs do not take learning/building alone (e.g. Africa incubators/accelerators, Village Capital, Solar Sister, Village Enterprise, World Vision, etc.)



- Incentivize agriculture sector- mini grid partnerships through dedicated funding such as challenge funds, RBFs, partial upfront grant funds etc.; and larger funding pools of over \$300k-\$1M to attract mature partners who are skeptical of the opportunity
- Funding to costly R&D on PUE and agri-equipment actors to optimize for alignment with value chains that could link to mini grid communities



Underdeveloped Ecosystem of Strong Partners to Realize PUE Success



- TA for smaller actors (e.g. last mile distributors or MFIs under \$250,000 annual revenues) on internal optimization of business plan for a more innovative, digital, and lean operational approach better suited to partner with MGDs or PUE appliance companies
- Encourage new build (or new market entry) of PUE, last mile distribution and consumer financing innovators, led by experienced founders; provide sufficient business support and funding to implement well



- Increase funds (paired with TA support) toward internal optimization of business plan for a more innovative, digital, and lean operational approach for early stage but high potential partners
- Provide working capital, product inventory, and opex capital on favorable terms such as concessionary debt with 1.5 year grace period



Photo Credit: CLASP

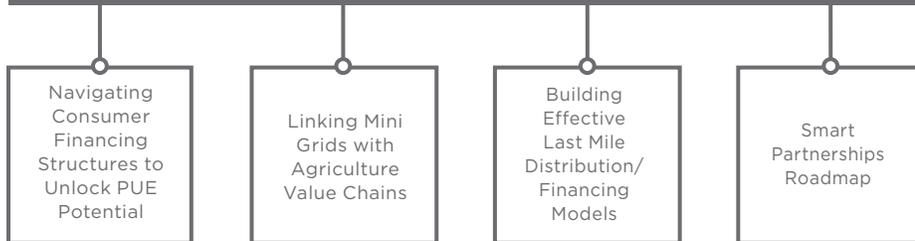
Our Analysis

Below is a shortlist of priorities GMG analyzed that resulted in the case studies and detailed initiatives that are further detailed in documents on the GMG Kenya resources page.

Immediate Objectives for this Analysis



1. Case Studies to Inform & Facilitate Collaboration



Objectives:

- Showcase potential partners and examples of strong partnerships- or challenges to anticipate
- Provide insights and a guide for navigating solutions



2. New Initiatives to Catalyze the Mini Grid- Greater PUE Sector to Investment Ready



Objectives:

- Provide flexible funding to take pilots to scale and build a path to profitability
- Make mini grid sites and developers attractive, priority opportunities for appliance and agriculture entry
- Enhance business and non-energy PUE expertise- in-house or via TA

Barriers & Opportunities

with Appliances, PUE and
Access to Finance

Mapping of Key Funders, Implementors and Partners

Over 200 parties were mapped in our research and interviews from March 2020 to November 2020. The following chart showcases key actors identified as particularly relevant to the focus of this analysis.



PUE Partners (Product-Financing/Distribution/ Product Only)



Commercial Banks (Interested or Pilots)



Other Partners (Potential & Current)



Case Studies

FOR PRACTITIONERS



Agsoil Maize Mill, photo courtesy of CLASP

Three case studies were developed by GMG to help mini grid and productive use of energy (PUE) actors navigate some of the common challenges and opportunities uncovered through recent research, interviewing 50 sector actors.

All three cases highlight areas identified by the GMG Facility as opportunities for strengthening the African mini grid sector by realizing the full potential of PUE partnerships, business models and cross-sector collaborations with sectors where significant win-wins can be achieved. Several key themes emerged. One was the need to **strengthen PUE business units** to effectively diversify revenue and risk, generating the near-term cash flows needed to pave a clearer “path to profitability” while simultaneously addressing the energy demand challenges of mini grids and low-income nature of target beneficiaries. Another is that **stronger partnerships** are vital to creating mutually beneficial

business models, including in the **appliance** and at the **agriculture-energy nexus**, which represents a challenging but promising opportunity. Furthermore, in the absence of greater government or other support that results in more favorable tariffs with paired subsidy, **consumer financing** is particularly critical **to making the purchase of PUE equipment affordable and attractive to low-income consumers**. Consumer financing helps unlock the potential of PUE models that generate greater household income for mini grid communities, and the partnerships to drive solutions are required. The full length cases can be found on the GMG Kenya resources page.

Case 1

Navigating Consumer Financing for Productive Use: A Guide for Appliance and Mini Grid Companies

When it comes to small-scale consumer asset financing and equipment leasing, no well-developed ecosystems currently exist. In order to incorporate such structures into their businesses, minigrid developers and last-mile product distributors must therefore choose between keeping their consumer financing services in-house, or outsourcing them to a third party. This case presents some transparency around opportunities to form stronger, lasting partnerships to unlock the potential of consumer financing to solve the mini grid-productive use challenges.

Both approaches have their advantages. In-house operations allow a company to maintain full control over the customer relationship and the data that financing can generate, while the financial upside of consumer loans can be quite lucrative. On the other hand, outsourcing to an experienced third party can often reduce costs, improve predictive analytics and allow a company to focus on core operations without the added complexity of building their own consumer financing systems. In-house data intelligence and loan management platform is expensive, and hiring a third-party can save money and allow a company to focus on other competitive strengths. An effective pricing strategy is also crucial; more expensive PUE products sell at lower volumes, and it is worth examining techniques used by large off-grid cold chain companies to offset the higher costs these products represent for consumers. Regardless of which option a company chooses, there are certain best practices to keep in mind. Even with a partnership model, a dedicated manager at the company or the lending institution should be appointed/designated in order to ensure focus and quality control.

Regarding appropriate structure of loans that are offered, some key lessons learned are proposed to ensure a consumer financing facility is structured well, driving up demand for productive use and electricity, while also ensuring healthy repayment rates by low-income consumers. For example, cash down payments can minimize a company's losses, but these should be combined with flexible repayment plans that align with household budgets, and a pre-pay option to allow for customers' changing cash flow cycles. Hiring and training local community members improve both local incomes and community relations, while using repayment history as an alternative form of credit scoring can give customers access to a larger pool of lenders.

In deciding to embark on developing a consumer financing facility, raising funds to support any model is always a challenge and can take several years to secure the necessary capital. Many early investors shy away from lending or investing in consumer financing for last-mile appliances, but other types of development funders can help de-risk a consumer financing model with loan guarantees. However, these guarantees typically come at a fee, and they do not generally guarantee more than 50% of the loan. They can also take up to 18 months to approve, so companies should plan accordingly.

A number of lessons can be learned from the ways different companies in the sector have managed to raise funds to implement their own consumer financing facility. One is that crowdsourcing can be a useful way to secure working capital, inventory or receivables financing before institutional investors step in. Bank lenders have often also been sought

as the consumer financing lending partner; however, commercial lenders still require a lot of security, and companies wishing to partner to unlock a working capital or inventory financing line of credit must often look to development finance institutions or other creative solutions to offer an attractive de-risked model. Various work-arounds that others have used to gain traction are discussed, including securing a loan guarantor from a guarantee facility or approaching the bank where the company's accounts are to propose cash flows be treated as collateral, in case of default on the working capital loan repayment.

Crowdfunding has become a popular alternative method of raising funds in recent years; the amount raised through crowdfunding for energy access projects grew from \$3.4 million in 2015 to \$24 million in 2018. This comes mostly from peer-to-peer lending platforms, which account for over 90% of crowdfunded cash secured in 2018. However, the amounts raised through these platforms are still relatively small and are insufficient for a company's long-term or exponential growth. Fortunately, there is also growing interest in the minigrid and appliance sector among commercial banks. There are ways to make such relationships more successful; one is for the financing partner to have a team dedicated to promoting last-mile products, operating under separate performance metrics and protected from the core bank model. As barriers to these partnerships between mini grids and financiers are broken down, it is only a matter of time before commercial banks and local MFIs start to engage more heavily in the off-grid energy sector.



TaTEDO EPCs, photo courtesy of CLASP

Case 2

Partnerships for Productive Use of Energy for Mini Grids: Building Stronger Partnership Models

Although appliances and PUE have enormous potential to increase the productivity and electricity consumption of mini grid customers, partnerships between mini grid developers and appliance, PUE and cold chain companies are often necessary in order to realize this potential. This case examines three examples of such partnerships and provides a framework for navigating stronger partnerships based on lessons learned and early findings.

In the first, Agsol, who make solar-powered mills, partnered with mini grid developer Powerhive to test maize mills in Kenya. The two companies hope to develop some rules of thumb to help others in the sector understand what is needed to make their business cases work. Key ingredients they have identified so far include: careful customer selection, a location with a client base of at least 100 households, and diversifying use cases to include maize for animal feed as well as for human consumption. Still, consumer financing for mills has been problematic; with banks unwilling to extend asset loans for an untested product. Powerhive has had to take on the risk itself, which both companies agree is a sub-optimal solution.

In the second example, Equatorial Power is working to develop a cold

chain on Idjwi Island in Lake Kivu in the DRC to boost demand for its mini grid. Using a “hub + spoke” system, EP hopes to create a central location for the storage of fresh fish, dairy and meat for export, as well as a network of chest freezers and iceboxes for fishermen and farmers. A number of different partners have been involved in this venture, including a local women’s cooperative for training local entrepreneurs; China Impact Ventures to select an appropriate ice maker and ship it from China; and SustainSolar to help with the logistics of shipping multiple pieces of large equipment together, thus reducing costs. EP also used Global LEAP testing data to identify the lifetime costs of different freezer models, underlining the fact that more efficient appliances can lead to considerable long-term savings for consumers. The company sees such partnerships as crucial to scaling up PUE and lowering prices on their mini grids across East Africa, and this project provides an example of how integration of energy-efficient appliances can create greater value for communities.

In the third example, PowerGen partnered with Tanzanian company TaTEDO to pilot electric pressure cookers that would increase load on its mini grid. Through SMS notifications,

surveys, cooking demonstrations and consumer financing, enough pressure cookers were sold to increase electricity consumption by nearly 20%. This was a partnership that allowed PowerGen to focus on its core business, while TaTEDO took care of the sales, marketing, last-mile distribution and post-sales servicing of appliances that is particularly important for more advanced products beyond TVs and radios.

There are lessons that can be learned from these partnership examples. One is that it can be worthwhile to work with third parties to select, vet and ship equipment, and working with local NGOs can reduce the cost of customer selection, training and after-sales service. Although they come with higher upfront costs, energy efficient appliances can result in considerable long-term savings for the consumer, though public education is required to make these savings clear.

The examples also highlight the challenges of consumer financing; with financial institutions hesitant to extend loans to mini grid and PUE customers, consumer financing must typically be provided in-house, by one of the partners, until better commercial lending models are developed. This is often where issues arise that can limit the effectiveness of a partnership.

Case 3

Agribusiness & Rural Enterprise Development to Strengthen Mini Grid Models

Nearly all mini grids are operating among low income, rural communities where both agriculture and off-grid energy offer the potential for increased incomes and social improvements. Yet there is still little connection between the two. This case explores the mutual wins that could be created by combining the agribusiness and mini grid sectors, and the challenges such partnerships often face. One common misalignment is due to geography; with mini grids mostly located in lower-income, hard-to-reach areas, MGDs are forced to both supply energy and stimulate the market to drive up demand among poorer populations. Another challenge is the lack of focus among MGDs and funders on engaging these communities in regional and international value chains, which would boost incomes and significantly increase energy usage. Poor infrastructure in off-grid areas also drives up costs for MGDs, many of which suffer from constant cash flow constraints. Meanwhile, on the agriculture side, entry into lucrative agri-value chains for smallholders and rural communities can be challenging due to a misalignment in quality, quantity and consistency that is demanded by larger buyers vs. that being produced locally, or ability to produce product at low cost to compete with lower cost import substitutes.

This case features several examples of MGDs that have pioneered value-chain linked models to stimulate rural economic development, higher household incomes and that pose great opportunities for integration with the greater mini grid sector. Our focus is on one example from the mini grid

sector, followed by two more examples of professional rural agribusiness and rural economic development experts who are eager to partner with off-grid energy providers to create mutual win-wins for low-income, rural communities. The first example is Tanzania's JUMEME, a joint venture with 23 active minigrid sites, whose pilots in fishing communities have led to diverse business lines including maize milling and tilapia aggregation, chilling and sales. This diversified business model has proven particularly resilient and relevant in light of recent tariff changes in Tanzania that require mini grid energy rates be capped and lowered to match public utility rates, despite mini grid consumers' willingness to pay more. JUMEME is able to still operate smoothly and with healthy cash flows that are bolstered by the aquaculture revenues, while temporarily reducing mini grid energy services; meanwhile, fishermen benefit from higher prices from fish sales to Dar es Salaam. JUMEME also financed 15 maize mills among local businesses owners and is powering a private restructuring of a local water treatment facility, both which have increased daytime electricity demand. Seven grains mills use more energy than 250 households; meanwhile, mills pose an opportunity for greater income generation through fish feed production.

In the second example, Farm Concern International (FCI) has developed "commercial villages" (CVs) to act as trade and aggregation units that connect communities to larger, more

lucrative agri-value chains. The model incorporates everything from strong demand-driven market mapping, a focus on diversified production to de-risk from a single crop focus, development of active market linkages and access to finance, among other factors. Successes have included linking rural farmers to a former leading supermarket chain in Kenya, Uchumi, to establishing high-quality cassava and sweet potato production for sale to One Acre Fund and a regional fortified flour producer. This model presents an opportunity to build mini grids at CV sites, or stimulating CVs at mini grid sites, thus promoting local value addition and economic wealth. Even with examples where increased energy capacity is not required, agribusinesses are generating greater income for communities, which will allow low-income individuals to increase their discretionary incomes and thus demand more energy to improve their lives.

The third example is WeConnex, a startup agri-value chain builder that launches local entities through a cross-subsidy business model, offering improved basic services alongside income-boosting local value chains. NEMACO, their successful Madagascar social enterprise, is set to achieve profitability in only 2 years. NEMACO is 50% local community owned and connects hubs of fishermen across 45 communities by investing in ice-making machinery, providing working capital to buy fish and transporting fish to larger buyer markets, where consumers will pay higher prices.



Photo courtesy of the GMG Facility Kenya

WeConnex is committed to providing affordable basic services of clean water and energy and thus seeks to partner with off-grid energy providers. Facilitators who can introduce value chain builders such as WeConnex and off-grid energy players such as the MGDs, combined with funders to provide risk-tolerant and significant funding for capital-intensive 'greenfield' value-chain building could realize win-wins for rural enterprise development, off-grid energy and rural agriculture goals.

Any design of an agri-energy win-win model must include careful mapping of the broader market opportunities and value chain dynamics to which rural communities could be linked. Examining the local context is also crucial to understanding the costs and complexity of building a local supplier

base, including analyzing the need for technical assistance and affordable agricultural inputs for smallholder farmers, and loans both to farmers and aggregators. Our case provides a framework for properly mapping the opportunity.

Several structures for agricultural and energy partnerships are worth considering in business model and partnership design around agriculture and energy solutions. These include:

i) A mini grid developer group model, in which the MGD is responsible for stimulating local household income and driving the scale of operations in-house, thus taking on full burdens of complexity and costs. This is the most common model due to the complexity in finding strong and locally-available complementary partners;

ii) A mini grid and agri-value chain partnership, in which MGDs focus on their core expertise while the partner manages productive use and agricultural value chain. This is the most sought after model if the right partners existed and could scale in parallel; and

iii) A mini grid and agri-value chain joint venture, in which a separate legal entity conjoins and yet protects various partners from any future downside while formalizing the mutual partnership and upside. Examples and considerations for each model have been discussed in the reports.

While numerous challenges still exist, there are clearly great opportunities for MGDs, communities and agricultural sector players to better align to create win-win solutions to the problems of PUE, energy demand management and economic stimulus.

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