Switching On Finance for Off-Grid Energy

BERTHA CENTRE FOR SOCIAL INNOVATION & ENTREPRENEURSHIP

GRADUATE SCHOOL OF BUSINESS
UNIVERSITY OF CAPE TOWN

BERTHA FOUNDATION

CONTENTS

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WHO?

With support from the Wallace Global Fund (WGF), The Bertha Centre for Social Innovation and Entrepreneurship partnered with the Worldwide Fund for Nature South Africa (WWF-SA) to assess the landscape of efforts to bring clean, affordable, and distributed energy to the energy poor in East and Southern Africa. We have been exploring answers to the following question: What type of capital would it take to move the needle on access to energy in East and Southern Africa?

Simultaneously, the Wallace Global Fund has been working with Arabella Advisors to conduct a similar global study and the Bertha Centre has been part of the global steering committee.

HOW?

The study explores the issues and opportunities related to the financing of off-grid energy provision in Africa, primarily focusing on the provision of small home systems for individual households or through village microgrids. It is based on:

- Initial desk research and literature review, including interviews with WWF country offices.
- Interviews with key stakeholders, spanning international NGOs, impact investors and energy access enterprises, which led to a draft report in early February 2016.
- The draft report was shared with more than 100 industry experts in Nairobi, Kampala, Pretoria and Cape Town at roundtable discussions during February and March 2016.
- A second draft report was reviewed by these industry experts and culminated in this final report.

The report is created for, and by, the industry. The Bertha Centre and WWF would like to thank all who have contributed their time and insights to the research.

WHAT IS INNOVATIVE FINANCE?

Innovative Finance is an approach to funding enterprises and interventions that create positive social and environmental impact. It looks to use all available financial and philanthropic tools to support the growth of these enterprises and when the existing tools do not work, it promptly creates new ones.

WHAT IS IMPACT INVESTING?

Impact investments are "investments made into companies, organisations, and funds with the intention to generate social and environmental impact alongside a financial return"

Impact investments check four boxes:

1. The investor must have the intention to make a positive social or environmental impact.
2. The investment is made with the expectation of generating returns on capital.
3. The range of possible returns is wide and investments are not limited to a particular asset class.
4. The investor must be committed to measuring and reporting the impact created by their investment.

Source: The GIIN, 2016

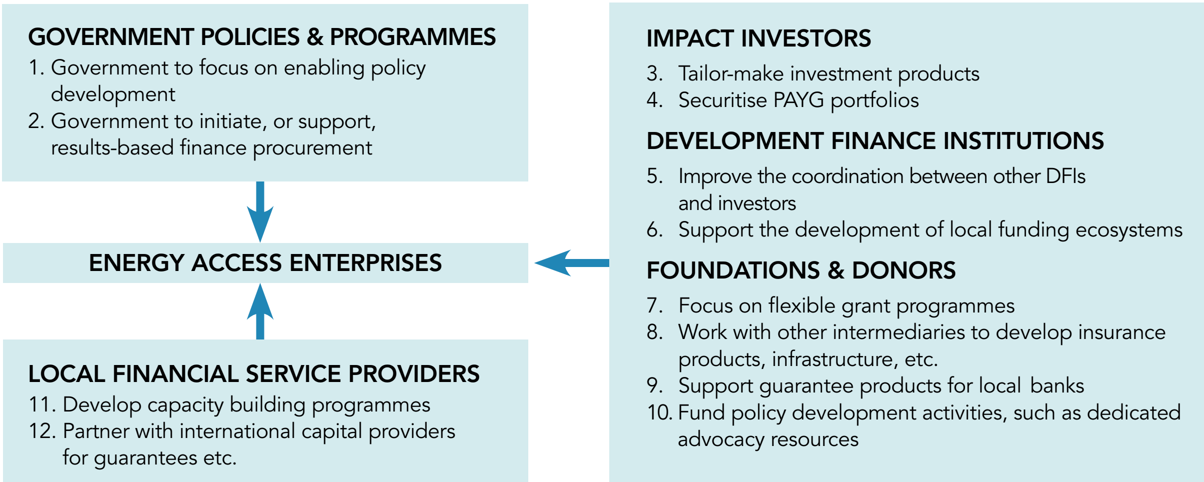
INTRODUCTION

"On current trends it will take until 2080 for every African to have access to electricity" (Africa Progress Panel, 2015).

In spite of this rather gloomy prediction, lights are switching on across the continent thanks to the ingenuity of energy entrepreneurs and their funders. Large initiatives, such as the US government's *Power Africa* and the African Development Bank's *New Deal for Energy*, are working towards universal access to electricity by 2025. Reaching that target will require innovative strategies and improved financing of the off-grid energy industry's relatively high capital needs. So how do we increasingly build linkages between private and public investors, as well as commercial and philanthropic capital? And how do we further financial product innovation to help the industry scale efficiently? That is the focus of this report.

The research team's conservative estimate suggests that a minimum of USD 30 billion in capital has been committed to the energy access sector in Africa over the next five years. How could this capital be used to leverage additional private sector capital? How can it be used to mitigate industry challenges? This paper looks at different innovative finance models that are ready for implementation and those that could be tested further. It concludes with a working concept of a blended finance vehicle that could front some of the capital needs of energy access enterprises as well as facilitate job creation, industry infrastructure innovation and investor coordination.

Photo: Steven Sinofsky, 2015. Recode



Key take-aways

From Nairobi to Cape Town, interview respondents and roundtable participants urged the industry to come together to increase coordination and develop innovative finance solutions.
The ideas presented above provide a high-level snapshot of the ideas that were brought up during the conversations with key industry players.

Government

1. To reduce the risk for local and international investors as well as supporting entrepreneurs, policy-makers could increasingly create policies that build an enabling, stable environment for energy access enterprises, potentially in partnership with foundations.
2. Local governments could partner with local and international capital providers to fund innovative procurement measures, such as results-based finance.

Impact Investors

3. Tailor-make investment products to suit the unique needs and capabilities of energy access enterprises.
4. Support the development of innovative securitisation of pay-as-you-go (PAYG) portfolios.

DFIs

5. Improve the coordination between DFIs and investors for mutual benefit.
6. Support the development of the local funding ecosystem by working alongside local banks to develop capacity, (lending) products, and by providing guarantees or first loss capital. This could ultimately also support DFIs in deploying capital faster.

Foundations and donors

7. Improve the flexibility of grant programmes to increasingly fit the needs of local and international energy access enterprises.
8. Potentially work with other stakeholders such as insurance companies to design and seed insurance products for customers with unpredictable income and unstable employment. For instance, a product that insures against short-term employment and a subsequent payment default – in order to lower the risk of a PAYG portfolio as well as access new customer segments.
9. Catalyse more local capital by partnering with local banks – for instance, by providing guarantees or similar de-risking tools.
10. Fund policy development activities, such as dedicated advocacy resources.

Local banks and other financial service providers

11. Local financial service providers, especially banks, could put efforts into gaining a better understanding of the green sector and the off-grid energy space in particular, in order to gain an appetite for the sector as well as design the right investment products.
12. Local banks and financial services providers could seek out international partnerships to reduce their risk exposure as well as increase capacity and understanding. This could be in the form of guarantees, fee reductions, etc.

MARKET OPPORTUNITY IN OFF-GRID ENERGY

The connection between access to energy and economic development is widely acknowledged and an integrated part of the newly established Sustainable Development Goals.

More than 600 million people in Africa lack access to electricity, which is half of the global population estimated to have no access to electricity. In fact, the continent's entire installed capacity totals 90 GW of power, which is roughly the same as Spain's (Africa Progress Report, 2015). Africa's grid electrification rate[1] stands at 43% of the population, with an urban electrification rate of 70% and a rural electrification rate of 28%. The urban population in Sub-Saharan Africa is projected to increase from 38% in 2010 to 52% in 2040, indicating that urban energy poverty is likely to grow as well (Scott et al., 2016).

Photo: Jennifer Burney, 2015. Future Solar

Although the majority of mainstream efforts focus on large-scale infrastructure development, much of Africa's potential lies in the off-grid space, which is currently being tapped by so-called energy access entrepreneurs. These entrepreneurs leverage the current momentum behind local, decentralised, renewable energy solutions, particularly solar technologies such as microgrids, solar home systems (SHS), and intra-household or 'pico-solar' systems.[2] Pico-solar systems typically light a few rooms, can charge multiple phones and power a small appliance such as a radio. SHS are larger than pico-solar systems, typically power up to 10 lights and can power appliances such as refrigerators and televisions. For solar home systems and pico-solar products, Kenya, Tanzania and Ethiopia made up 66% of the sales in Africa in 2015. With a penetration of 30% of off-grid households, Kenya is currently the most significant market, with Rwanda and Uganda generally regarded as the next emerging frontiers (Scott et al., 2016).

Although the industry is young, with sales of predominantly entry-level products, consumers are starting to upgrade their systems by adding capacity or functionality, such as upgrading from a system that can power a radio to one which can power a refrigerator or television. Estimates suggest that the market could be worth USD 3.1 billion by 2020 – reaching almost 100 million households (Bloomberg, 2016).

Geographic opportunities

The optimal energy access technology for a given community depends largely on the scope of existing infrastructure and the geospatial characteristics of the community: for those living close to reliable grid infrastructure (generally in urban and peri-urban areas) extending the grid is usually the most economically efficient; for those living far from the grid in sparsely populated areas (generally in rural areas) solar home systems make the most sense; and for those living at least a moderate distance from the grid in densely populated areas (generally in peri-urban areas and certain rural communities) microgrids are generally most efficient.

The majority of the capital cost of a microgrid is made up of the cost of generation, storage and distribution lines. In densely populated areas far from the grid, microgrids can deliver cheaper energy than the alternatives: compared to grid extension, the higher investment in storage is more than offset by the lower investment in distribution; and compared to solar home systems, the higher investment in distribution is more than offset by the lower investment in storage due to the benefits of balancing load across all users. Even with projected declines in storage costs, microgrids are expected to maintain an advantage over solar home systems in appropriate communities.

However, microgrids are inherently less scalable than solar home systems. For a solar home system, you only need to convince a single household to commit to the service. For a microgrid, not only do you need to simultaneously convince a significant proportion of a community to sign up, but you also need to target sales efforts at communities which fit a specific criteria, such as, distance from the grid, socioeconomic level, existence of anchor tenant, etc.

It is possible to streamline the process through technology and thereby significantly reduce development costs and timelines. For example, by simply overlaying grid infrastructure and population density maps, it is possible to use geospatial analysis to create a target list of communities.

This process can also reveal some interesting patterns about the potential for the technology in various countries. For example, according to a global technology company, despite the fact that some of the most significant microgrid activity in Africa at the moment is in Kenya, there are only about 20 villages in Kenya which are (1) more than 2km from the grid; (2) have a population density of more than 20 people per 100m x 100m; and (3) have a minimum population of about 100 people. The limited potential of microgrids in this country is largely a reflection of the effectiveness with which Kenya Power and the Rural Electrification Authority have expanded the footprint of the grid, partly to fulfill the ambition of connecting every school in the country. Uganda, by contrast, has more than 500 villages, which fit the same characteristics.

However, even 500 potential microgrid sites is small and will not lead to the scale which the industry needs to encourage the level of investment and innovation required to develop community-appropriate business and financing models, and drive costs down to their full potential. Rather, in order for microgrids to contribute significantly to energy access in Africa, they need to scale in the markets with the greatest potential: Nigeria, Ethiopia and the Democratic Republic of Congo, where there has been limited microgrid development activity.

[1] It is important to note that although the shortage of electricity has been identified as a major challenge for the continent, Africa needs base load power to drive industrialisation. This base load power can only be achieved through the grid. (Peo, 2015 & 2016 and Scholtz and Gulati, 2015). The majority of grid based electricity demand will continue to come from industrial and commercial users. Energy access for large and medium industries and commercial consumers does not fall within the scope of this research.

[2] The report focuses primarily on the emerging small home solar powered technology sector, although there is a demand for energy for cooking and transport as well.

BUSINESS MODEL INNOVATIONS

The market opportunity has spurred innovative business models, such as M-Kopa and Off-Grid Electric, that allow people to pay-as-you-go (PAYG) for their solar products.

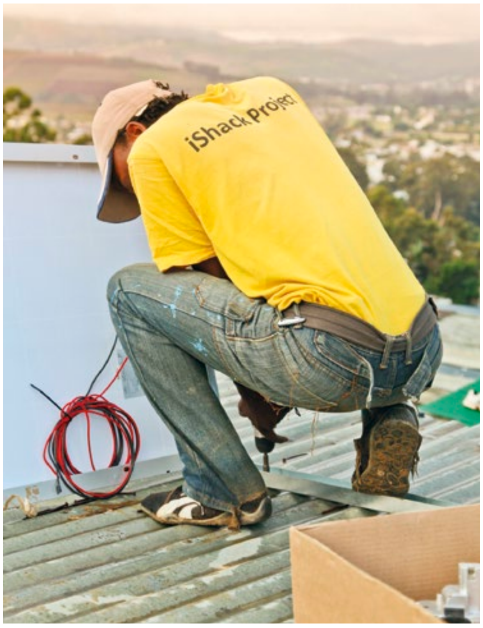


Photo: Francis Mouton, 2014. My Stellenbosch

Mobile technology is one of the key drivers of these disruptive models, as it reduces the transaction costs of coordination between small-scale energy users and producers.

The emergence of new business models has largely been driven by innovation in distribution and end-user financing. The five main distribution models identified by Lighting Africa in 2012 continue to dominate. These are: (1) partnerships between companies and institutions (Nova Lumos & MTN); (2) distributor-dealer channels (Azuri Technologies); (3) proprietary distribution (M-Kopa); (4) franchise models (SolarNow); and, (5) renting or leasing systems (SolarKiosk).

A large number of the energy access enterprises work in close collaboration with existing retail networks, NGOs and community-based associations, such as savings and credit cooperatives, to unlock markets and build local capacity.

Over the last five years, the PAYG model has become the popular end-user financing model. With PAYG, customers pay a small deposit for a solar system to be installed in their homes. They then make smaller regular payments over time, usually through a mobile payment system, to pay for either the energy used or ownership of the system. Within the PAYG model, there are two main business-to-customer models; the energy-as-a-service and the rent-to-own model.

In the energy-as-a-service model, the enterprise charges for electricity service in the same way traditional utility companies do. The roof-mounted solar system is perpetually owned and maintained by the enterprise. Companies such as Off-Grid Electric use this model.

In the rent-to-own model, on the other hand, ownership of the system is transferred to the user after a limited period of time, usually 18 – 36 months. Companies using this model include Azuri Technologies (see box 1), M-Kopa and Nova Lumos.

The PAYG models demonstrate that the core business of energy access enterprises is not always primarily solar technology provision, but instead credit provision to customers.

Beyond PAYG models, other companies are thinking creatively about the consumer financing component by tapping into either government resources or collaborating with corporates. The iShack project in South Africa builds their model to be in sync with existing national energy access strategies. The emerging iShack model integrates the mandated Free Basic Electricity subsidy into their end users' payment model (see box 2).

Another interesting business model, which Solarus is testing in South Africa, involves working with employers as the end-user finance providers for installation of off-grid solutions in their employees' homes (see box 2).

BOX 1. PAYG BUSINESS MODEL INNOVATION

Azuri Technologies: using PAYG and machine learning

Azuri Technologies in Kenya produces solar home systems that incorporate a PAYG controller. Azuri sells its solar home systems to dealers who install the system, provide after-sales support and sell the scratch cards, which can be physical cards or scratch card numbers bought using a mobile payment system. After 18 months, users can pay a fee of about USD 5 to take ownership of the system or they can upgrade to a larger system. To date, the company has sold over 80 000 units in 12 countries through partners over the last 4 years.

Azuri recently launched HomeSmart, the first use of intelligent automation in small solar home systems designed to provide light every night, even in cloudy daytime conditions.

Source: Azuri Technologies, 2015

BOX 2. EXAMPLES OF NON-PAYG BUSINESS MODEL INNOVATIONS

iShack: Working with local government in South Africa

iShack is an energy utility social enterprise that provides a PAYG solar electricity service to residents of informal settlements in South Africa. Initially rolled out in October 2013, the project had delivered their service to almost a thousand homes by 2015. Local residents from the communities are trained as iShack Agents to market, install and maintain their Solar Home Systems.

Through active engagement with the local municipality, iShack's model has integrated the government's monthly ZAR 50 Free Basic Electricity subsidy into their users' payments.

Source: Sustainability Institute, 2016.

Solarus: End-user financing as a way to MPower employees

Solarus is an international renewable energy (RE) technology company, which has developed the PowerCollectorTM, a hybrid concentrated photovoltaic and thermal (C-PVT) collector. The company typically services clients with high-energy requirements such as large apartment blocks, hospitals and hotels.

To extend their solution to lower income customers who may not be able to afford the installation cost, Solarus is collaborating with a hotel in South Africa to roll out the Hotel Staff MPower Project. In this project, the hotel will finance the up-front installation costs of the systems to up to 600 employees' homes. The employees repay the cost of the installation at an affordable monthly rate to the hotel. Thus, the hotel is taking the role of an end-user financier as a benefit to their employees.

This pilot initiative is the first of an envisioned series of Solarus MPower projects to be rolled out with other partners on the continent. Should the Hotel MPower pilot achieve its anticipated success, this initiative can also serve as a living, measurable example for others seeking to achieve alignment between clean energy access objectives and successful implementation at scale.

Source: Brand, 2016.

LIMITS TO INDUSTRY SCALE

As off-grid energy provision is an emerging industry operating in a challenging environment, the industry roadblocks and bottlenecks go beyond access to finance. These challenges are often referred to as the 3 As: Affordability, Access and Awareness.

Affordability

Even with end-user financing innovations, the upfront costs of energy products and services such as solar home systems, improved cook stoves and even solar lanterns remain beyond the means of the majority of end-users. As most African countries have small microfinance sectors with limited coverage of rural areas, and interest rates as high as 50-60%, credit from this sector is often unaffordable (Scott et al., 2016). Additionally, the customer segment often belongs to the unbanked and underbanked, which makes them unable to access financing from traditional sources. One distributor in Uganda highlighted that only 30% of the rural population can afford their services.

Access

Providing access to energy in areas with limited infrastructure makes distribution a key challenge. The absence of adequate supply chains, long travel distances, and poor transportation and communications infrastructure in rural areas add to the cost of doing business. This also includes access to data about a customer segment that has previously not been tapped into by formal value chains and therefore has no financial or electrification track record. On-going services such as repair and maintenance, provision of spare parts and after-sales are also capital intensive as the generation and distribution equipment must be regularly maintained to operate efficiently and comply with the lifetime guarantee expected.

For end-user financing models which depend on mobile money, the mobile money infrastructure is pivotal.

While mobile money has a significant footprint in East Africa, its footprint is limited in some of the markets best suited as the next frontier, such as Ethiopia, Nigeria, and the Democratic Republic of Congo.

Awareness

Distribution and infrastructure cannot stand alone. Energy providers also need to create awareness of the benefits and the business model, often supported by NGOs and similar intermediaries. This should especially focus on the uptake of products from customers, which has been hindered by low-quality products in the past, and limited understanding of the potential.

The call for political roadmaps

A consistent theme of the interviews and roundtables, was the need for enabling policies and regulatory frameworks that will assist in addressing the perceived risks of investing in small-scale renewable energy solutions across the continent. One of the significant ways of reducing policy uncertainty and thus investment risk is by including off-grid electrification through independent energy enterprises in national electrification strategy, policy and regulation (Scott et al., 2016).

Most countries on the continent are working on models for coordination between the public and private sector using donor funding, under an overarching energy policy objective to increase both energy access and the share of renewable energy in energy consumption. However, these advances in prioritising and setting policy targets for energy access and renewable energy have not yet been able to create the much required breakthrough for energy access.

The challenge lies in 'second order' policy settings such as lengthy permitting and licensing processes involving high transaction costs, taxation of distributed energy products, absence of programmatic approaches for firms interested in developing multiple sites, and even tariff setting. For example, countries often adopt standard processes that aim for one-size-fits-all approaches. This impacts the sustainability of business models and can restrict new market entrants. Because microgrids share some characteristics with utilities, tariffs are regulated and often not granted the flexibility to set different tariffs depending on consumer profile.

This impairs their ability to recover costs or compete on an even footing with alternatives such as diesel generators, however, examples of enabling policies are emerging. In 2015, Powerhive East Africa became the first private company is Kenya to receive a utility concession as a small-scale electricity generator and distributor (see box 3).

The need for off-grid electrification to be incorporated in national energy access maps was consistently emphasised in all of the roundtable discussions. A recent PwC report echoes these discussions and recommends that 'policymakers mix centralised top-down grid extension with decentralised demand-driven bottom-up strategies'. The report offers the guidelines shown in box 4. Recommendations from the roundtable consultations also included dedicating more resources to advocacy as well as an identification of the industry players or industry associations best positioned to take on this role. Some of the larger foundations active in the sector expressed an interest in playing a more active role in the funding and coordination of policy development.

BOX 3. MICROGRID REGULATION FOR ENERGY ACCESS IN EAST AFRICA

Powerhive is a solar-powered, PAYG microgrid provider with a proprietary technology platform that streamlines microgrid development and customer management.

To test Powerhive's business model and technology, the first pilot project of 1.5 kW was commissioned in August 2012, catering to a small cluster of residential customers in the village of Mokomoi, Kenya. Customers in Mokomoi use the electricity for indoor and outdoor lighting, mobile phone charging, and to power small appliances such as radios and televisions. The next three sites, serving approximately 1,500 people, were built in 2013 in the villages of Nyamondo, Matangamano, and Bara Nne.

At 10, 20, and 50 kW, they are capable of supporting larger clusters of users, which include smaller commercial loads from customers such as welders, carpenters, and millers. To scale its solution more broadly in Kenya, Powerhive began the process of seeking concessionary capital in 2014. By leveraging data gathered through its technology platform from its pilot projects, Powerhive was able to demonstrate the costs and benefits of rural electricity provision to the Energy Regulatory Commission of Kenya (ERC). In February 2015, the ERC granted Powerhive's wholly-owned subsidiary in East Africa, concessions to operate as Kenya's first privately held utility company.

Powerhive is looking to construct 100 microgrids in the coming years – powered by First Solar's solar PV technology and operated with Powerhive's control technology, ultimately serving 100,000 residential and small business customers. The ERC's actions illustrate how regulators can unlock private-sector scalability through policy instruments.

Source: ACORE, 2015

BOX 4. GUIDELINES FOR DEVELOPING A NATIONAL ENERGY ACCESS PLAN AND MAP

- Clear identification of territories where extensions to the national grid are viable prospects, with realistic and binding timelines to grid rollout.
- For communities not included in grid rollout, mechanisms should be worked out to determine if they could be served by microgrids or standalone solutions.
- Plans should include an understanding of the role of different stakeholders and the opportunities available for off-grid companies to deliver electrification solutions to off-grid areas.
- Clearly defined protocols should be agreed upon in advance, to avoid technologies becoming stranded in cases where grid extensions become available to areas previously served by microgrids.
- Plans should be reviewed on an annual basis to reflect changes in technology development, speed of grid extension and deployment of off-grid solutions.

Source: PriceWaterhouseCooper, 2016.

COMMITTED CAPITAL

The industry has seen combined committed capital of at least USD 30 billion over the next five years from public and private funders – all focused on Africa for access to energy. However, access to finance remains the number one restriction to scale, according to energy access enterprises.

The UN's Sustainable Energy for All (SE4All) initiative, which works towards universal energy access by 2030, estimates that annual investments of USD 48 billion are required to reach universal access.

USAID's Power Africa initiative has identified more than 43 private sector investors and practitioners who have committed USD 1 billion to emerging energy access enterprises over the next 5 years through the Beyond the Grid initiative. Power Africa launched Beyond the Grid in June 2014, a sub-initiative focused on unlocking investment and growth for off-grid and small-scale energy solutions on the African continent.

While the industry has attracted significant amounts of public and private capital, from innovation grants to large equity investments, the need still outweighs the amount of capital committed. But beyond capital commitments, funders find that deploying capital is currently hindered by: ...small project and ticket size of transaction, limited track record of the enterprises, lack of working capital, limited understanding of off-grid projects among financiers and investors and uncertain policy (threat from extension of grid in the case of micro grids) and subsidy disbursal regime (Council on Energy Environment and Water (CEEW), 2015: 9).

PAYG companies have attracted the most funding, followed by vertically integrated manufacturer-distributors. A full services solar company usually provides and installs solar systems, and even takes care of the financing and maintenance; a vertically integrated solar company would perform the abovementioned services in addition to manufacturing the solar systems. Larger companies have raised the majority of the funding, with most deal sizes above USD 4 million.

This is clearly illustrated by the cases of M-Kopa and Off-Grid Electric's capital raises in 2015. Having demonstrated both demand and customers' ability to pay, M-Kopa in Kenya raised USD 32 million in debt and equity, with over USD 20 million of that as equity.

Similarly, Off-Grid Electric in Tanzania raised USD 40 million of debt, USD 25 million in equity and USD 5 million grant from USAID's Development Innovation Ventures (DIV) facility. Both exemplify an increased interest from investors, driven by the decreasing costs of solar technology, promising demonstrations of the customer base and a payment model matching the needs of the customer base.

CAPITAL CONSTRAINTS?

While momentum is building and large amounts of capital have been committed, energy access enterprises find that the types of capital and investment terms often do not match the enterprises' needs and capabilities. In other words, if available capital is not always the issue, deploying it effectively might be.

Energy access enterprises' capital needs

Traditional financing through commercial banks or commercial lending institutions has not been a viable option for many of the energy access enterprises. The inability to predict future cash flow from sales, the actual return on investment per product sold, the lack of customers' credit history and, often, the informal economy within which these businesses operate mean they struggle to access finance. The points below highlight the key feedback from the enterprises and entrepreneurs consulted:

- There is an increasing need for **local capital** for (local) entrepreneurs. International entrepreneurs tend to raise proof of concept grants and early-stage investment through their networks from investors and donors overseas due to limited local infrastructure.
- **Seed funding** remains a challenge, limiting the ability of locally owned SMEs to develop and flourish.
- **Working capital** is one of the most significant financing gaps, particularly for enterprises offering PAYG solutions to their customers. These companies need to maintain adequate inventory to service their consumers and therefore need less equity and more lines of credit that they can collateralise with their PAYG loans. However, as demonstrated in the business model innovation section, PAYG companies essentially operate as credit providers, making it difficult for investors to determine risk. Acknowledging this challenge, Persistent Energy Capital published a discussion paper detailing a Borrowing Capacity Model that PAYG companies can use to assess their working capital borrowing capabilities (Aidun and Muench, 2015). The interviews and roundtables identified a need for a dedicated working capital facility with specialised knowledge of the off-grid solar industry, especially local facilities that can offer debt in local currency.
- The market leaders, such as M-Kopa and Off Grid Electric, have, however, begun to encounter a different problem – the clean technology **funds are often too small** for the companies looking to raise debt above USD 50 million.
- In the absence of local manufacturing, much of the continent relies on import and distribution systems that are inadequate. The benefits of global price reductions on renewable energy technologies are negated with the addition of **logistics and transportation costs** that are amplified by the poor infrastructure on the continent. Funding for such logistics and distribution often goes ignored.

The findings of this report resonate with recent research by Bloomberg New Energy Finance, Arc Finance and Persistent Energy Capital. These findings are summarised and aggregated in figure 1.

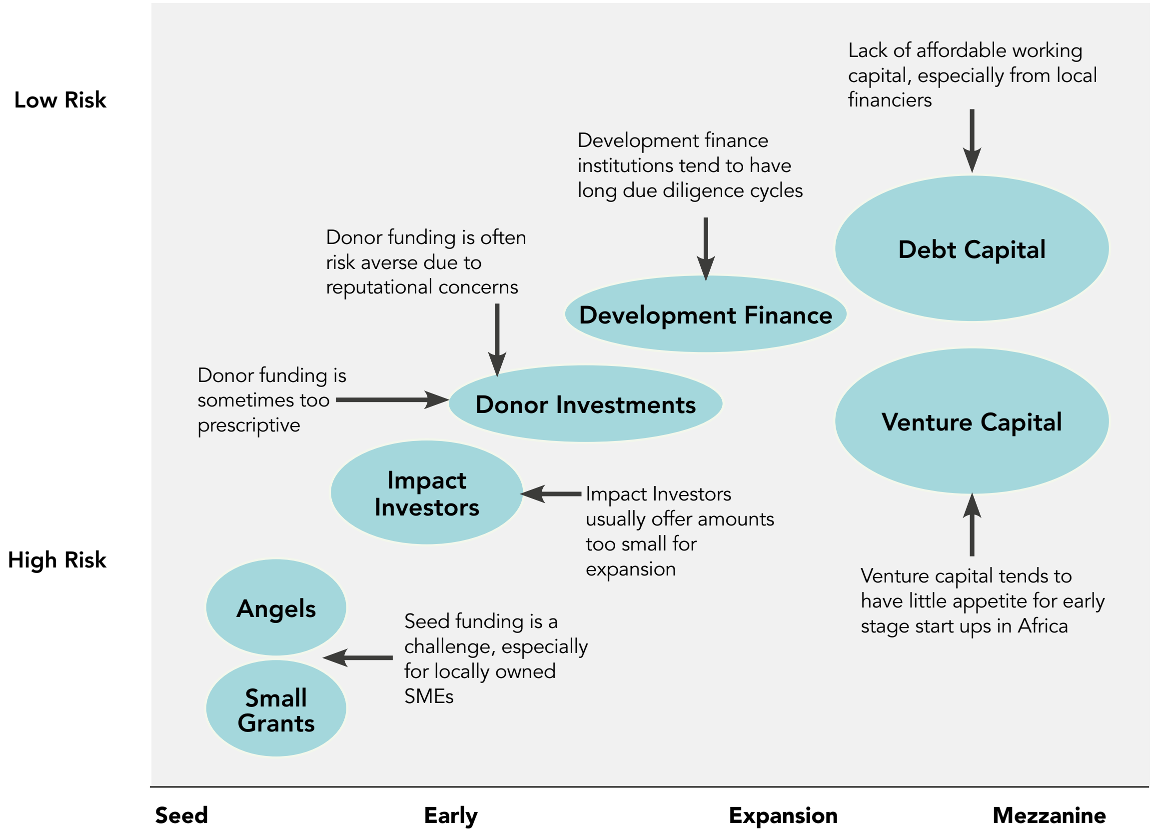


FIGURE 1: INVESTOR RISK APPETITE VS. COMPANY NEEDS
Source: Adapted from Bloomberg New Energy Finance and Lighting Global, 2016

CAPITAL PROVIDERS: CHALLENGES AND INNOVATIONS

Similar to the vertical integration path that many companies have embarked upon, some funders are aiming to combine multiple financial instruments, such as grants, subsidies, guarantees, concessionary debt, convertible debt, working capital, and private equity to invest along a broader continuum of enterprises and address some of the current market failures.

Key capital providers include foundations, academic institutions, development finance institutions, impact investors, venture capitalists, corporations and governments, all of whom support the value chain at different stages and through different instruments. As the industry grows, there is an urgent need for coordination and cooperation between these players. Based on the stakeholder interviews and roundtables, we have included feedback and recommendations for different capital providers on page 16.

FIGURE 2: OFF-GRID SOLAR FINANCIERS ACROSS THE START-UP DEVELOPMENT CYCLE
Source: Authors

Grant providers; foundations, donors, etc

As can be seen from the overview of funders in figure 2, there are a number of soft funders providing grants or seed capital from concept to growth stage. In order to scale, the industry will need continued grant funding and concessionary capital along with better integration into the investment cycle. This concessionary capital will likely be necessary for proof of concept for early-stage ventures, as well as opening up new, untested markets for the larger energy access companies. For the latter, concessionary capital is used to increase the expansion pace and provide incentives to go into harder to reach, high impact areas. One of the most impactful Proof of Concept Grants that was highlighted in the research is USAID's Development Innovation Ventures (DIV), which funds enterprises from innovation to scale. Stakeholders called for local grants and seed funding to echo pieces of this model (see box 5).

Grants could increasingly be:

- **Flexible:** grants could allow companies to experiment with different approaches (financing, distribution, customer segment experimentation and customer feedback etc). Some companies found that seed capital and proof of concept grants are too prescriptive. Enterprises gave examples of grant funders prescribing either geographic areas or market segments that were not suitable to their business model. In such a dynamic market, donors should get more comfortable with risk and flexibility.
- **Market-building:** grants could focus on opening up new markets and creating distribution networks faster.
- **Focused on distribution:** grants could broaden the traditional focus on technology, to include distribution innovation. They should focus on building strong public-private partnerships to overcome key industry challenges related to distribution, maintenance and after-sales services.
- **Focused on building cross-sectoral partnerships:** grants could work with other stakeholders such as insurance companies to design, and seed, insurance products for customers with unpredictable income and unstable employment.

BOX 5: USAID'S DIV: FUNDING INNOVATION IN STAGES

DIV uses a three-tiered staged finance model to maximize cost-effectiveness and minimize the risk of testing new ideas. Off-Grid Electric is an example of an off-grid company that has accessed the different stages of support as they scaled up.

Investment timeline, Off-Grid Electric

2011: Company founded

2013: DIV Stage 1 (Proof of Concept) for USD 100 000 grant and Overseas Private Investment Corporation (OPIC) Africa Challenge Enterprise Fund

2014: Raised USD 7 million in equity round

2014: DIV Stage 2 (Testing and Positioning for Scale) for USD 1 million grant

2014: Raised USD 16 million in equity

2015: DIV Stage 3 (Scale) for USD 5 million, and raised USD 7 million in debt, and USD 25 million in equity

DFIs

DFIs could work to adopt more flexible terms in terms of speed, scale, and specificity; although rapidly changing, the energy access enterprises report that the DFIs' due diligence cycles are often too long, minimum deal sizes too high and use of investment funds too specific or restrictive. DFIs could tailor their offerings to match the needs of energy access enterprises by lowering investment size and, potentially, return expectations. There is a need for greater coordination between the DFIs.

Local banks and other financial services providers

One of the key potential solutions highlighted in the roundtables discussions, and echoed by the recent Bloomberg (2016) analysis, is the need for a dedicated working capital facility with specialised knowledge of the off-grid solar industry, especially local facilities that can offer debt in local currency. Local banks potentially have a catalytic role to play in deploying much needed debt financing to energy access enterprises. However, local banks are relatively hesitant to lending based on cash flows, especially to early stage companies in a sector most banks are not familiar with. Several stakeholders have acknowledged these concerns from lenders, and, as suggested in the Bloomberg report, structured credit enhancement products such as guarantees to incentivise local banks to lend to energy access enterprises.

While these guarantee facilities were expected to catalyse increased lending by banks to energy access enterprises, the results have been somewhat underwhelming. The main challenge has been lenders' perception that the pipeline of bankable deals of a significant size is small, hence not a compelling business opportunity considering the transaction costs. This lack of confidence in the pipeline of opportunities, coupled with high up-front fees for guarantees have been the stumbling blocks preventing the uptake of off-grid specific guarantee facilities by banks.

Beyond uptake of guarantees, one needs to consider what it takes to incentivise banks to build relationships and lend to the sector in the long run. In one example, a development finance institution provided a guarantee fund to a local bank in Uganda to fund biogas companies. The goal was to de-risk the investment for the bank and support it in building capacity and knowledge around lending to the biogas sector going forward. However, as soon as the guaranteed amount of funding was invested, the bank ceased lending to biogas companies.

In the face of hesitance from traditional lenders such as banks, energy access enterprises have been looking to other funders including foundations and family offices to raise funding. However, this does not imply that the local debt markets do not have a role to play. For large enough deals, individual transactions or portable guarantees can be facilitated (as USAID currently offers). On the other hand philanthropic capital could consider funding the upfront commitment fees for portfolio guarantees, lowering the cost hurdle for lenders. There is ample opportunity to continue engaging with lenders and borrowers on which credit enhancement structures could be more effective.

Impact investors

Not surprisingly, investors generally did not second the notion that access to finance is the key challenge. For impact investors targeting market-rate return, the key challenge reported is a lack of investable deals, i.e. not enough companies are able to absorb the size of capital they are looking to deploy (generally USD 15–40 million for private equity investors).

Another key challenge is how much investors allocate to debt and equity in their portfolios; most investors operating in the space make use of debt and equity interchangeably, but prefer a smaller exposure to debt, especially due to the risk-profile of the deals. This leads to enterprises sometimes being 'forced' to take equity instead of debt. According to investors, they often do not have the right financial instruments on shelf to design tailor-made solutions for the needs of the energy access enterprise. This is a sentiment echoed by energy access enterprises, who stated that the terms are not tailored to their needs, for instance debt is often primarily restricted to financing purchasing systems and nothing else.

Energy access enterprises are increasingly testing new models such as securitising their PAYG portfolio through bond structures and raising revenue-based debt. These are elaborated upon in box 6. A key recommendation from the roundtable conversations was for funders to increasingly explore receivable/revenue based debt, as an alternative to equity, especially because exit opportunities are limited in the space. One such approach is using quasi-equity structures such as flexible redemption preferred stock, which some companies are already experimenting with.

'Flexible Redemption returns capital to investors through a pre-negotiated percentage of cash-basis revenues. Each quarter the Return Pool is used to pay dividends to shareholders and then redeem a portion of the outstanding stock. The net effect is that investors get an equity return that is linked to the performance of the company, providing flexible capital for the social entrepreneur'
(Berger, 2016).

Companies also expressed a need for impact investors to approach the traditional due diligence metrics (positive cash flow, 5 year track record, etc) in more creative ways by using, for instance, microfinance metrics.

Furthermore, impact investors can play a role in developing and financing local entrepreneurship development, for instance by securing anchor load consumption for energy access interventions such as microgrids. Anchor customers are customers that require a continuous delivery of energy service for productive use. They are typically reliable and credit-worthy customers who are bound to contracts and are therefore, bankable. Using such anchor customers as the main off-taker from a project not only guarantees energy purchase and secures commercial viability of the project, but also provides scope for scaling up the project. Such a deal would have to ensure benefits were shared equally between industry and households. Potential anchor customers could include the telecommunications industry, mining companies and agro industries, but also smaller local businesses, as in the case of Solarus.

Photo: Bboxx, 2016.

BOX 6: BOND-ING WITH SMALL HOME SYSTEMS

BBOXX is a London based solar innovator, which sells solar systems on a monthly plan. The company entered the African market in 2013 with only GBP 45 000 (USD 63, 850) and started as a pay-as-you-go solar energy provider. By 2015, BBOXX had managed to raise USD 15 million through a number of equity investments and debt funding from investors including Bamboo Finance, Khosla Impact Fund and Synergy Energy alongside Oikocredit and Persistent Energy Capital LLC.

BBoxx is replicating the US solar bond model of securitisation for Africa's off-grid solar market. The first issue of bonds in rural Kenya raised USD 500,000, the company aims to raise USD 2 billion over the next five years to turn solar into an asset class and creating contracts for thousands of solar roof top arrays to sells as bonds to investors – ultimately demonstrating that it is possible to lend on the basis of future receivables from the solar home system contracts and the securitization of the unbanked. The first issue in Kenya was based on 250 active solar contracts, with an average maturity rate of two and a half years and an interest rate of 21%. BBOXX's target for 2016 is to raise USD 16 million through the issuing of bonds every 90 days, proving that there is a market for solar bonds, one which results in the increase of funding to energy through providing a solution that is a lot more marketable to investors.

Source: Clover, 2016

WORKING CONCEPT: A BLENDED FINANCE MODEL FOR ACCESS TO ENERGY MARKETS IN EAST AND SOUTHERN AFRICA

The multiple public initiatives, such as Power Africa and the New Deal for Africa, which have also secured significant private sector commitments, suggest that money is indeed not the core constraint to industry growth. The key challenges relate to the deployment of capital to energy access companies as well as industry infrastructure. The model shown in figure 3 aims to mitigate both of these constraints and puts forward a framework for coordination between multiple funders.

The facility would have two components, one aimed at providing working capital for energy access companies, and one supporting distribution and infrastructure innovation. For the Innovation Facility, the research made evident that there is a significant need for capital to act as a lever for scale, whether to support market expansion or infrastructure innovation. For the working capital facility, the disbursements would either support energy access enterprises directly or through local financial services providers, such as banks.

The components of the facility are driven by the following key imperatives:

- Working capital shortfalls for energy access enterprises.
- Using concessionary finance for market expansion; developing the distribution infrastructure, especially in peri-urban and rural areas.
- Reducing maintenance and service expenses for energy devices.
- Boosting skills development within the energy sector.

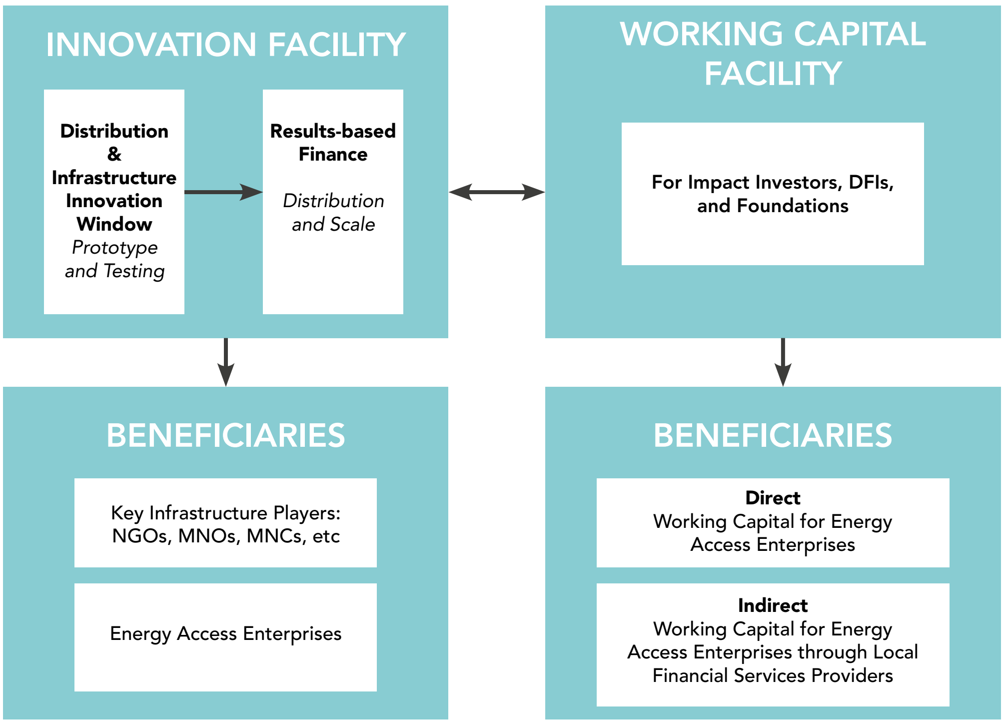


FIGURE 3: A BLENDED FINANCE CONCEPT FOR ACCESS TO ENERGY
Source: Authors

Working capital loan facility

For companies that rely on cash sales and provision of devices to end customers on a PAYG basis, working capital is a critical component to operating and scaling a business. According to one interviewed energy access enterprise: "The financial models don't yet exist to provide debt capital, and the companies can only fund operations out of their equity for so long. So there is a need for debt instruments to enable this to be funded at scale"

There are a number of players currently providing working capital, such as SunFunder, offering working capital and scale finance between USD 30 000 to USD 2 million with a few traditional lenders such as the Commercial Bank of Africa (CBA), Barclays and HSBC having provided financing ranging from USD 400 000 to USD 10 million. The commercial-grade syndicated debt facility fronted by CBA was secured against the energy company's future cash flows from its customer payment plans (Arc Finance, 2014).

The working capital loan facility would allow energy providers to access the working capital necessary to implement programmes whilst forming a portfolio of clients that are paying off their energy devices over time.

There are various examples of working capital structures or emerging investment platforms that include some of the elements outlined in figure 4. Sunfunder is an example of both an investment platform and a frontline capital provider, which has invested over USD 7 million in off-grid solar companies.

Another example is Convergence, which launched in January 2016 as the first global deal-sourcing platform that helps public and private investors find and connect with each other for blended finance investments in emerging and frontier markets. Conceived during the World Economic Forum and Organisation for Economic Co-operation and Development Assistance Committees's (OECD-DAC) ReDesigning Development Finance Initiative, Convergence was designed and launched by the Global Development

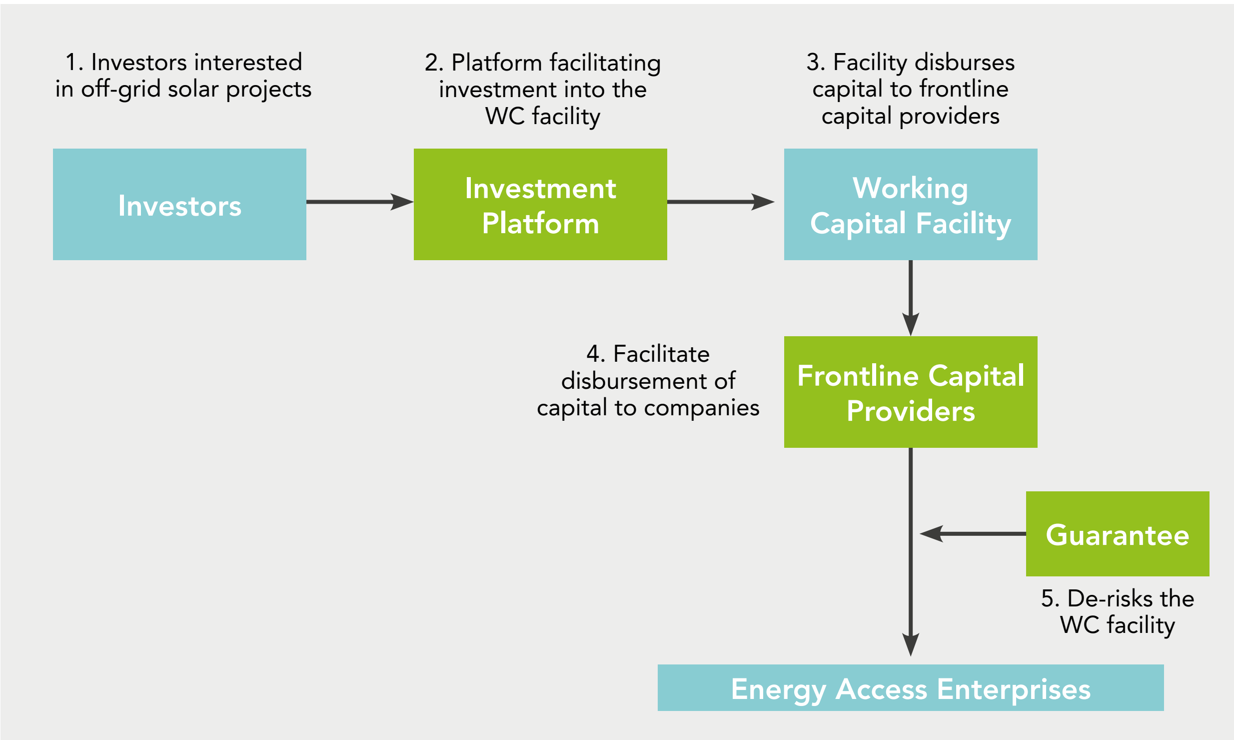


FIGURE 4: POTENTIAL WORKING CAPITAL LOAN FACILITY STRUCTURE
Source: Authors

Incubator and Dalberg Global Development Advisors and is an independent organisation headquartered in Toronto (Convergence, 2016). Such a platform would be optimal to facilitate investments not only to the working capital facility above, but the entire blended finance model.

Beyond institutional and accredited investors, there is potential to crowd in funding from retail investors through peer-to-peer (P2P) lending platforms. One such platform that is blending institutional and retail investments is Rainfin, launched in 2012 as South Africa's first online lending marketplace.

Institutional ('anchor') funders provide Rainfin with a set of criteria for the businesses they are interested in funding. During the application process for the online platform, the businesses undergo a credit check based on current order invoices and other characteristics. Once placed on the platform, the anchor funders create a "first bid" for the loan, following which other lenders (either individuals, businesses or other institutional lenders) also have the opportunity to bid on the loan. The bids with the lowest interest terms win and fund the business. Rainfin also acts as a secondary market by providing potential liquidity for the P2P lenders during the life of the loan. Although currently working with South African companies, the model this platform uses has great potential to further leverage capital from institutional and retail investors. In relation to figure 4, a platform such as Rainfin would be able to play three roles:
(1) provide an investment platform for institutional and retail investors,
(2) host the working capital facility and,
(3) be the frontline capital provider.

The final component of the working capital facility could be a partial credit guarantee to de-risk the working capital facility. In October 2015, USAID's Development Credit Authority (DCA) announced a USD 75 million loan portfolio guarantee to support off-grid companies across sub-Saharan Africa. This facility is poised to bring debt financing to manufacturers, distributors, retailers, and installers of renewable energy technologies, in addition to PAYG solar companies for the first time, demonstrating their commercial viability and helping to meet the enormous demand for distributed renewable energy across the continent (The White House, 2015).

Potential funding sources: Development Finance Institutions, Private Equity Funds, and Debt Funds

Photo: Panafricavisions.com

Innovation facility

The grant-funded innovation facility arises from the need to deploy more capital to infrastructure developments to support the scale of energy access enterprises. It would be divided into two independent, yet overlapping windows; one dedicated to testing and prototyping innovations and one dedicated to proven innovations that would be comfortable with results-based finance.

1. Distribution and Infrastructure Innovation Window

As mentioned above, the 3 As, affordability, access and awareness, are currently limiting industry growth as the energy access enterprises work in markets with limited infrastructure and support systems. The distribution and infrastructure innovation window would go towards funding innovative partnerships and service delivery. To illustrate:

- Data capture via geographical information systems services.
- Building cross-sector partnerships. The off-grid energy sector could be relevant to established corporates in other sectors such as utility companies, mobile operators, financial services providers and insurance companies. These organisations could, for example, design and seed insurance products for customers with unpredictable income and in unstable employment. One investment advisory company expressed interest in a product that would insure customers against short-term employment and a subsequent payment default – in order to lower the risk of a PAYG portfolio as well as access to new customer segments.
- Increased mobile money infrastructure in new markets.
- Green job creation related to maintenance, for example. Similar to distribution, servicing of existing devices remains a challenge as most consumers are geographically dispersed. Additionally, most companies provide a warranty period during which they cover maintenance and repair costs. Those who use solar as a service model could cover the service costs over the life of the devices.

All projects funded by the innovation window would operate under creative commons licenses. This means that the knowledge captured would be open-source and would contribute to industry development. Ultimately, projects with a demonstrated impact would be able to graduate into the results-based funding window.

Potential funding sources: Foundations, High Net Worth Individuals (HNWIs), and international donors

2. Results Based Funding (RBF) for distribution of existing products

As mentioned earlier, PAYG models and end-user financing can make solar products more attractive to customers, but building out strong distribution channels that reach the customers doorstep efficiently remains a key challenge. Most PAYG companies generate sales leads and deliver products through a network of commission-based agents, often with some form of physical presence in or near target off-grid areas, such as retail shops, supermarkets, cafes, and mobile phone shops. Given the logistical challenges of reaching deep into rural areas, it's common for PAYG solar companies to establish partnerships with for-profit and not-for-profit organisations to facilitate sales and product distribution.

This funding would be dedicated to compensating non-profit organisations for distributing products for energy companies (these could be the same energy access enterprises, which are funded through the working capital facility). This facility would be raised as grant funding but would be disseminated to organisations on a 'pay for success' basis for the devices distributed, connected and/or utilised. Payments could be paid in tranches to encourage sales of products to consumers who are likely to continue device usage.

Potential funding sources: Development Finance Institutions, Foundations, HNWIs, and International Donors

Case Study: RBF for pico-solar PV lighting application in Tanzania

Netherlands Development Organisation (SNV) is among the first organisations world-wide piloting Results Based Financing (RBF) in the energy sector.

Photo: SNV Netherlands, 2016.

SNV aims to overcome market failures constraining private sector delivery of modern energy services to isolated communities. In Tanzania, the RBF initiative was launched for pico-solar PV lighting applications in the Lake Zone, which is considered to be the first operational RBF fund functioning under the global Energising Development (EnDev) programme managed by the German Federal Enterprise for International Cooperation (GIZ) and Netherlands Enterprise Agency (RVO) and funded by the United Kingdom's Department for International Development (DFID) (SNV, 2016).

Market intelligence research by SNV for the Lake Zone shows a particularly strong demand for solar systems, with more than 35 - 40% of rural households indicating solar as their preferred energy technology option for immediate purchase, while an average of only 3.5% indicates to have access to these products.

Considering this specific market context, the RBF scheme is designed to encourage pico-solar companies to increase their investments in solar distribution chain development by offering incentives (grants) based on how many products the companies sell. In order to assure quality, only Lighting Africa approved products are considered under the RBF.

The value of the RBF incentive applied to each unit of pico-solar products is calculated annually by SNV based on the performance of each pico solar product (brightness and run time) and an annual product incentive cap. As the market develops and economies of scale are achieved, the annual product incentive value will decrease by 25% at the outset of each year in which the RBF Fund is available to the private sector.

Launched in February 2014, out of 11 applications from the private sector, five companies were selected in the first round of the RBF: Ensol, Global Cycle Solutions (GCS), Off Grid Electric, Sunny Money and Zara Solar.

Feedback from the private sector has been very positive:

"This incentive is exactly the kind of support we need to rapidly expand energy access to the customers who need it most. We believe it is an ideal model because it accelerates the market without distorting it, and will do our best to demonstrate its effectiveness in practice"
Xavier Helgesen, CEO of Off Grid Electric.

Within three months of operation, four out of five suppliers initiated RBF qualified sales activities, three of them not being present in the Lake Zone previously and self-investing to open zonal offices to capture this new market. For companies like Off Grid Electric, GCS and Ensol, the RBF was the trigger to actually start operations in this new market.

The active presence of the newly established business operations in the Lake Zone has led to 11 new pico-solar product-service options being available to rural consumers, while 111 new employments (25 full time by supplier jobs, 86 new sales agents) have been generated. Total sales for the first 6 months of the program were estimated to benefit close to 14,000 rural Tanzanians by extending access to modern energy services of lighting and communication to Lake Zone families.

The RBF played a crucial role in leveraging commercial loans and/or investment financing for the five participating enterprises, both for pre-financing RBF sales activities as well as for further scaling of their business operations. GCS used the RBF to leverage a USD 70,000 loan for scaling its operations.

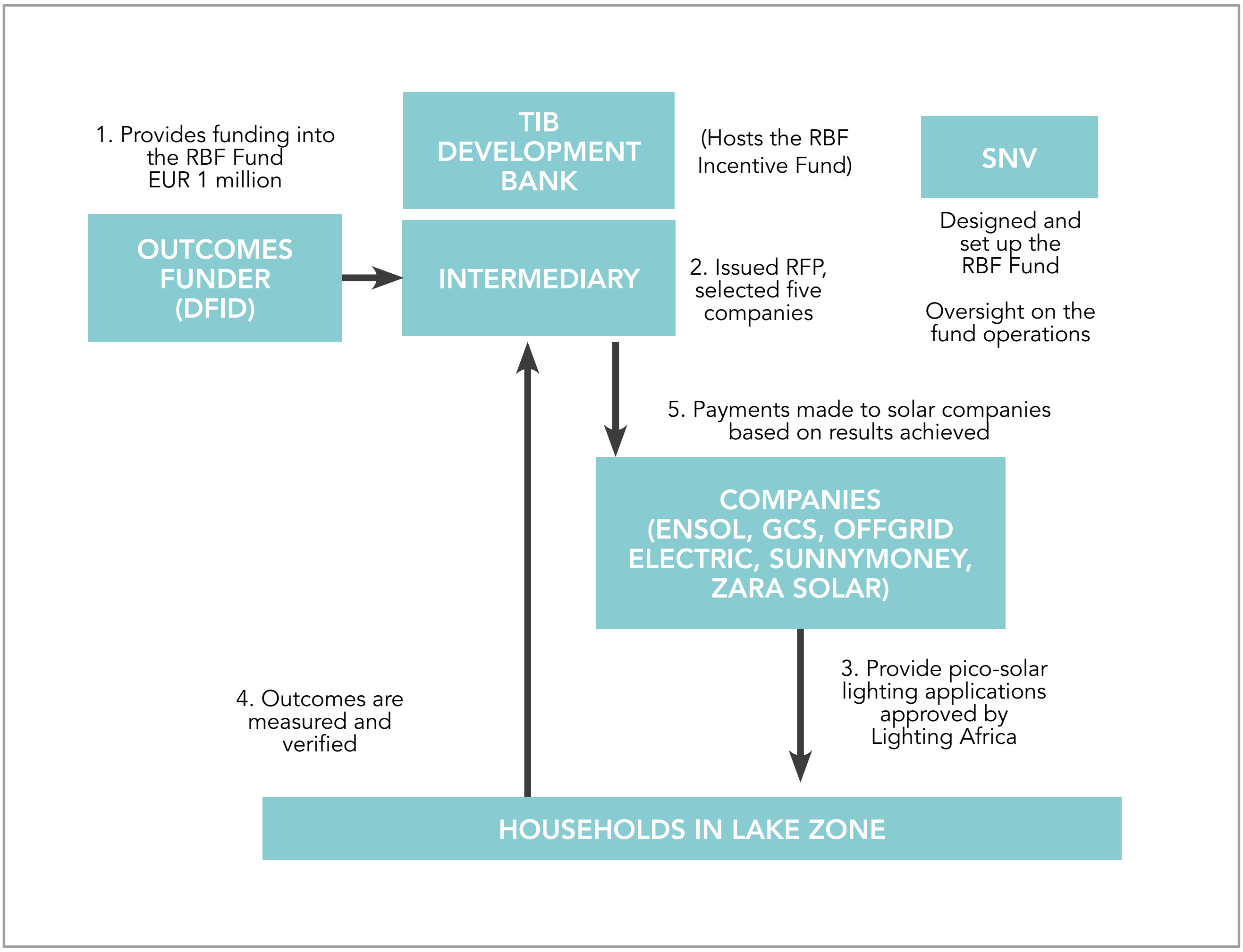


FIGURE 5: RBF INCENTIVE FUND, TANZANIA

Source: Authors

BACKGROUND RESEARCH: ACCESS TO ENERGY IN EAST AND SOUTHERN AFRICA

Introduction

More than 600 million people across Africa lack access to electricity (see figure 6), which is particularly disconcerting in view of existing research that demonstrates a clear correlation between human development and electricity consumption (Alstone et al., 2015). The grid electrification rate in Africa stands at 43% of the population with urban electrification at 70% while only 28% of the rural population has access to grid electricity.

Whereas increasing access to energy in rural areas has historically been a major challenge, Africa's rapid urbanisation will also impact existing levels of electrification. With the urban population in Sub-Saharan Africa projected to increase from 38% in 2010 to 52% in 2040, residential demand for electricity is projected to increase fivefold. This dramatic increase in electricity demand in the prevailing situation of inadequate and ageing transmission and distribution (T&D) infrastructure and shortage of generation capacity means that urban energy poverty is likely to grow.

The other facet of sub-Saharan Africa's energy shortage is the lack of energy for cooking. More than 700 million people rely on traditional biomass-based cooking fuels such as wood, charcoal, dung and agricultural residues (Lambe et al., 2015). This number is projected to increase to 880 million by 2020 (IEA, 2014). In the East African countries of DRC, Tanzania and Ethiopia the reliance of the population on biomass is above 90% (United Nations Economic Commission for Africa, 2014). Reliable data on access to thermal energy on the continent for productive uses is not available. This may be partly because industries and enterprises in the formal sector usually rely on oil, while those in the informal sector, particularly those in rural areas, rely mostly on wood fuel. However, it is well known that shortage of electricity also poses a significant challenge for the continent's industrial production. Poor system reliability by way of service interruptions and the duration of interruptions result in high costs for industries in the form of diesel-based back-up generation capacity and lost sales. In 2008, manufacturing enterprises experienced power outages on an average of 56 days per year (Eberhard et al., 2009). It is further estimated that losses by way of forgone sales and damaged equipment are as high as 6% of turnover on average for firms in the formal sector, and as much as 16% of turnover for informal sector enterprises that lack their own backup generation (ibid).

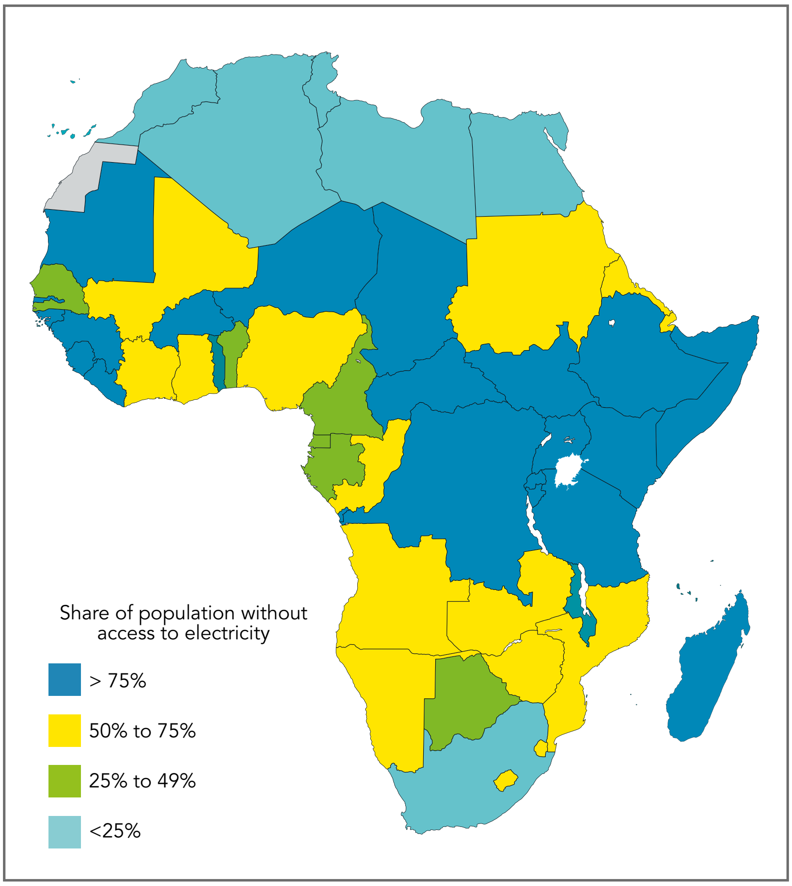


FIGURE 6: NUMBER AND SHARE OF PEOPLE WITHOUT ACCESS TO ELECTRICITY IN AFRICA, 2012
Source: IEA, 2014

The scale of the challenge is known and multiple initiatives at both multilateral and national level are working to address it. However, the current pace of providing grid access is not in keeping with the growth in population, urban migration and the amount of energy required for socio-economic transformation (Embassy of the Kingdom of Netherlands, 2015).

It is increasingly acknowledged that grid extension efforts will be inadequate and that de-centralised solutions such as distributed small scale RE, in particular solar, have a role to play in addressing access challenges. Based on data from the Innovation Energie Developpement (IED), Sustainable Energy for All (SE4ALL) expects that reaching universal access will require grid extension for all new urban connections and 30% of rural populations.

The remaining 70% of rural people will only gain incremental access through a variety of decentralised solutions such as mini-grids (65%) and solar home systems and intra-household or 'pico-solar' products (30%) (Alstone et al., 2015).

It is increasingly acknowledged that grid extension efforts will be inadequate and that de-centralised solutions such as distributed small scale RE, in particular solar, have a role to play in addressing energy access challenges.

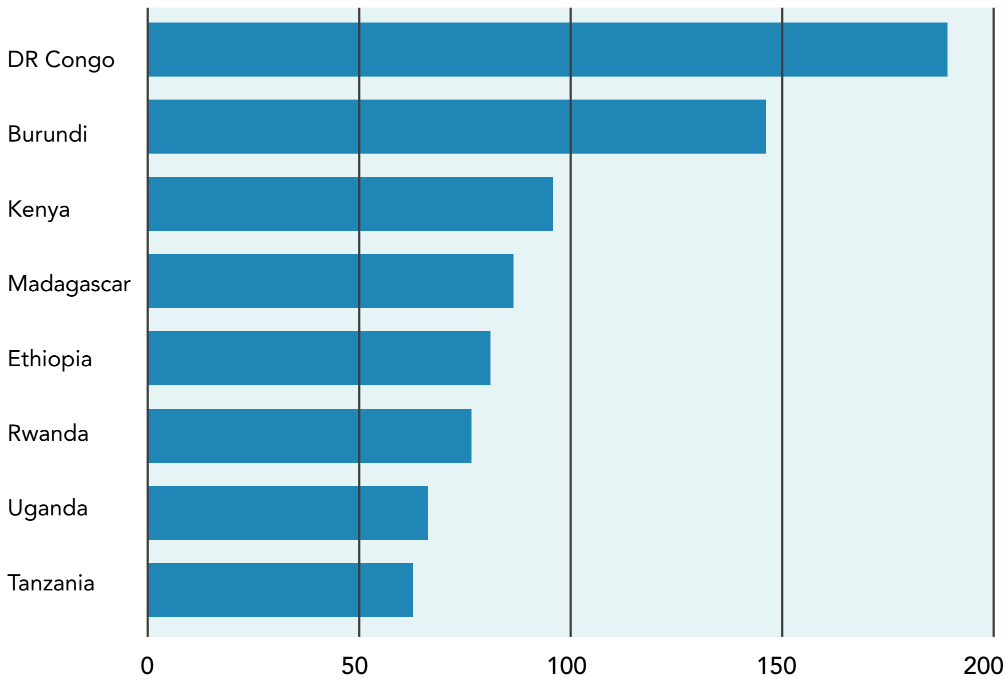


FIGURE 7: POWER OUTAGE DAYS IN SELECT EASTERN AFRICAN COUNTRIES

Note: Data is for the following years: DRC (2010); Madagascar (2009); Uganda (2006); Burundi (2006); Tanzania (2006); Kenya (2007); Ethiopia (2011) and Rwanda (2011)
Source: United Nations Economic Commission for Africa, 2014

Table 1 below sets out the basic characteristics of electricity access technology options with descriptions of the typical range of generation capacity, fuel mix, services available, and the degree to which economic, geographic, and political isolation is a barrier to adoption.

Technology	Generation Capacity (Watts)	Services Available	Energy Isolation Barriers
Incumbent technology bundle, fuel-based lighting, dry cell batteries, fee-based mobile phone charging	N/A	Lighting, radio communication reception, two-way mobile communication.	**Economic:** Very low barrier. Day to day payments for increments of energy. **Geographic:** Low barrier. Requires distribution to remote areas through normal supply chains with some mark-up. **Political:** Low barrier. Gov't and institutions can support market or hinder depending on policies.
Pico Power Systems	0.1 - 10	Lighting, radio communication reception, two-way mobile communication.	**Economic:** Low barrier. Market-based dissemination. Retail cost USD 10-100. **Geographic:** Low barrier. Requires distribution to remote areas. **Political:** Low barrier. Gov't and institutions can support market or hinder depending on policies.
Solar Home Systems	$10 - 10^3$	Same as above plus television, fans, additional lighting and communication, limited motive and beat power.	**Economic:** Medium barrier. Market-based dissemination. Retail cost USD 75-1,000. **Geographic:** Low barrier. Requires distribution to remote areas. **Political:** Low barrier. Gov't and institutions can support market or hinder depending on policies.
Microgrid	$10^3 - 10^6$	Same as above with opportunity for community-based service with higher power requirements e.g. water pumping or grain milling.	**Economic:** Medium to high barrier. Requires financing or investment aggregation for large capital outlay but offers relatively low marginal cost electricity to users. **Geographic:** Medium barrier. Requires critical density of population. **Political:** Medium barrier. Requires community support and local political decisions.
Regional Grid	$10^6 - 10^9$	Depending on the quality of connection, same as above up to a full range of electric power appliances, commercial and industrial.	**Economic:** Medium to high barrier. Often high initial connection costs, but low cost power after connection. (Cost of power lines **Geographic:** High barrier. Requires nearby transmission and distribution infrastructure **Political:** High barrier. Depends on ministerial and departmental decisions about extension.

TABLE 1: CHARACTERISTICS OF ELECTRICITY ACCESS TECHNOLOGY OPTIONS AND BARRIERS TO ADOPTION
Source: Kammen et al., 2014

Non-technical barriers to the large-scale uptake of off-grid electricity present the biggest hurdles. These include the lack of investment capital, and complex and perverse policy environments inhibiting new entries, with subsidies for liquid lighting fuels an obvious example , and lack of accurate knowledge about the quality of technologies that leads to 'market spoiling' (Alstone et al., 2015: 310).

This seems set to change with a rapid increase in the uptake of off-grid RE systems. Cheaper technologies, in particular solar panels, batteries and related distributed technology and enabling policies have led to an increase in the uptake of small scale RE by users in Africa (Roberts, 2015). Kenya, Tanzania and Ethiopia, which collectively have the largest penetration of small scale RE, all have comparatively supportive policies for solar household solutions.

Consumers are also becoming more aware of the financial and health benefits of RE (Scott et al., 2016). In Kenya, M-Kopa's household solution replaces kerosene, which emits acrid smoke that burns the eyes, irritates the throat, and slowly turns walls and ceilings black. Kerosene is also expensive. According to a 2014 survey, an average off-grid household in Kenya spends about 75¢ a day on energy, or USD 272 a year—USD 164 on kerosene, USD 36 on charging their mobile phone, and USD 72 on batteries. M-Kopa estimates a customer saves about USD 750 over the first four years by switching to its basic solar kit (Farris, 2015).

The single most important change, however, is the 'emerging continuum of technology systems that provide access to electricity by harnessing now ubiquitous information technology' (Alstone et al., 2015: 305), in the process addressing challenges relating to end-user financing.

In the past, the inability of consumers to access finance was the result of various factors; the paucity of financing options that spread consumer investment over a time period that is aligned to the person's budget; a lack of appetite shown by finance providers to develop products for the energy poor; and the inability of energy product and distribution companies to directly finance end-users (CEEW, 2015: 9). The new models referred to above allow people to pay as they go rather than 'muster large chunks of capital upfront' coupled with information technology that enable the reduction of the transaction costs of coordination among small-scale energy users and producers (Roberts, 2015). Key to note is that a critical success factor of this model is cell phone access, which makes it less suitable for areas with low cell phone coverage such as Ethiopia.

Energy access is a multi-dimensional challenge

The International Energy Agency (IEA) observes that there is no single internationally accepted and internationally-adopted definition of modern energy access (World Energy Outlook, 2014). Others have pointed out the existence of a number of definitions, ranging from numerical minimum requirements to social and economic criteria (Modi et al., 2005). The World Bank observes that in the past, access to energy was synonymous with household access to electricity (Bhatia and Angelou, 2015: 1). More generally, energy access was referred to in the context of rural and remote areas. This traditional interpretation of energy access ignores the multidimensional nature of energy access. Moreover, electrification alone is unlikely to resolve the energy access problem because of low penetration of electricity in the energy mix of those that currently lack access to electricity. It is not surprising then that the definition of energy access has undergone several changes in recent years and that the net has been wider.

The World Bank has redefined energy access as the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, legal, convenient, healthy, and safe for all required energy applications across households, productive enterprises, and community institutions (Bhatia and Angelou, 2015: i). The IEA points out that energy access includes: household access to a minimum level of electricity, household access to safer and more sustainable cooking and heating fuels, access to modern energy that enables productive economic activity, and access to modern energy for public services (World Energy Outlook, 2014). The United Nations Secretary General's Advisory Group on Energy and Climate Change (AGECC) defines energy access to mean access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses.

Who needs access to energy?

Given the context of Africa's energy challenges, this research makes use of the more advanced and holistic definitions outlined below to identify the market for energy access (see Table 2). The understanding of the market by way of who needs energy and for what service is important to design effective interventions. Moreover, the level of energy provided by different technologies and the potential impacts are different.

NEEDS	BASIC NEEDS		PRODUCTIVE NEEDS		
	Lighting	Cooking	Heating	Water pumping	Mechanical power
Users					
Households					
Rural					
Urban					
Urban poor					
Peri-urban					
Suburban					
Communities					
Healthcare					
Schools					
Manufacturing					
Small and micro enterprises					
Agriculture					

TABLE 2: MARKET FOR ENERGY ACCESS
Source: Authors

As illustrated by Table 3, there is no single solution to energy access. While grid extension is the most suitable option for urban households as well as communities based in urban areas, mini-grids and off-grid devices will play a greater role as far as needs such as lighting, cooking and productive uses of electricity are concerned. As compared to off-grid devices, mini-grids can help to improve the reliability of supply, and can provide more energy and three-phase electricity, thus making it possible to meet additional loads. They also fulfil multiple energy needs.

NEEDS	**BASIC NEEDS**		**PRODUCTIVE NEEDS**		
Users	**Lighting**	**Cooking**	**Heating**	**Water pumping**	**Mechanical power**
			Households		
Rural	Solar lanterns, Solar home Systems, mini-grids powered by solar PV, small hydro or wind	Biomass improved cook stoves, solar cookers, biogas	Solar water heaters and combined solutions		
			Urban		
Urban poor	Solar lanterns, Solar home Systems, grid	Liquified Petroleum Gas (LPG) cooking fuel and stoves, solar cooker	Solar water heaters and combined solutions		
Peri-urban	Grid	LPG cooking fuel and stoves	Solar water heaters and combined solutions		
Suburban	Grid	LPG cooking fuel and stoves	Solar water heaters and combined solutions, grid		
			Communities		
Healthcare	Solar home systems Mini-grids powered by solar PV, small	Biomass improved cook stoves, LPG cooking fuel and stoves, solar cookers	Solar water heaters and combined solution		
Schools	Solar home systems Mini-grids powered by solar PV, small hydro, wind, biogas, waste, Grid	Biomass improved cook stoves, LPG cooking fuel and stoves, solar cookers	Solar water heaters and combined solutions		
			Manufacturing		
Small and micro enterprises	Solar home systems, Mini-grids powered by solar PV, small hydro, wind, biogas, waste		Solar water heaters and combined solutions		Solar dryers, solar refrigeration, biogas from small- and medium-sized digesters,
			Agriculture		
				Solar PV based pumps, mechanical wind pumps	

TABLE 3: POSSIBLE INTERVENTIONS FOR ENERGY ACCESS FOR IDENTIFIED MARKETS
Source: Authors

STAKEHOLDERS CONSULTED

Jack Radmore, *Greencape*
Zukisani Jakavula, *SouthSouthNorth*
Paul Zille, *Self*
Mohamed Saliem Fakir, *WWF*
Henning Brand, *Solarus*
Connor Friesen, *JP Morgan*
Max Pichulik, *Impact Amplifier*
Nikita Mfenyana, *Business Partners*
Lesley Williams, *Impact Hub*
Lana Lovasic, *Simanye*
Lwazi Wali, *ANDE*
Katrina Pielli, *USAID*
Nidhi Nepaul, *FCO-UK*
Alessandra Pardini, *Webber Wentzel*
Henry Lombard, *Energy1 W2E*
Louise Scholtz, *WWF*
Nan Tian, *WWF*
Graeme Wilkinson, *Tshikululu*
Christian Olesen, *N/A*
Thobeka Poswa, *TLP Services*
Sibusiso Zungu, *Allen & Overy*
Ernest Shongwe, *Austrailian Trade Commission*
Brian Scallan, *ASBC Global*
Paivi Lehtonen, *Ministry of Foreign Affairs - Finland*
Derik Coetzer, *Greencape*
Christopher Steinbach, *Yingli Solar*
Jason van der Poel, *Allen & Overy*
Manisha Gulati, *WWF*
Rebecca Szrama, *GIZ*
Ashley Wearne, *GIZ Uganda*
Joyce DeMucci, *SNV World*
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