# Off-grid Solar in Africa & European Start-ups

5 questions to reveal challenges & opportunities

Silvia Binet

Europe

YES

Author Silvia Binet, Director of Analytics Silvia.binet@yes-energy-europe.com LinkedIn @SilviaBin20

Design Alejandro Nuñez-Jimenez, Advisory Board member LinkedIn @anunezjimenez

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# **Executive Summary**

This report explores the present and future of the off-grid solar private sector from the perspective of entrepreneurs. By answering the classical five W questions: "*Why? Where? When? What? (How?) Who?*" this study reviews the emergence and dynamics of the start-ups that have shaped the field of energy access field for the past decade. In the first section, the question "**Why** off-grid matters?" serves as an introduction to our study. Next, we analyse **where** and **when** off-grid solar start-ups have emerged, and we continue with **what** are their main activity areas and **how** these start-ups connect developed and developing economies through this new market. To conclude, we address the "**Who?**" question in order to understand the people behind these organizations and which path led them to work in this sector.

This report highlights the key geographical spots that gave birth to the off-grid solar sector, both in Europe with Germany and UK playing a leading role, and in Africa. There, Eastern countries have been the pioneers, especially Kenya and Tanzania. Likewise, it describes how

the sector has expanded across the two continents in the past decade reaching the western states of Africa through the action of several central European countries (France, The Netherlands). The diversification of the firms' focus area emerges as a recent trend, and seems likely to increase within the next years, which could possibly affect the geographical distribution of the

*This report highlights the key geographical spots that gave birth to off-grid solar* 

companies. The heterogeneity in country and study backgrounds of the founders point out to the key role of combining expertise for addressing all the challenges of the off-grid solar market.

To collect different perspectives, this report includes two interviews with experts in off-grid solar. The first one with Farouk Maate Kibaba, Executive Director at the Green Lake Peace Centre, who provides unique insights into the Ugandan Energy sector and the role of solar installations in this promising African market. In the second interview, we talk to Sebastian Weida, Product Manager at Mobisol (the first and best-established distributor European company of off-grid solar products), explains the challenges and motivations for working in the off-grid solar private sector.

# Why off-grid solar matters?

The UN 2030 Agenda, adopted by 193 countries in 2015, includes as the seventh of its Sustainable Development Goals to "provide clean access to energy to all". To date, about 16% of the world's population lives in areas where the electricity grid has not arrived yet, which severely affects their living conditions and their chances to improve them through economic growth.

However, recent advances in renewable energy technologies and their drastic cost reductions have dethroned the grid as the only viable option to gain access to reliable and affordable electricity [1]. Small-scale installations of renewable energy generation (most commonly solar photovoltaics and wind) are carving out a foothold across very different contexts. According to our previous report, *decentralisation* is a key trend defining the Future of Energy [2]. Furthermore, decentralised energy systems are a promising tool for moving toward the goals set by the UN 2030 agenda, especially in the rural areas of developing regions, where the lack of electricity significantly hinders the local economic development [3].

Non-governmental organisations, foundations and governmental development programs are the actors who have traditionally worked in the diffusion of decentralised energy systems. More recently, the private sector has joined them and has started playing a bigger role in such game - bringing a different pace, new rules and fresh inputs to the field.

In the past decade, entrepreneurs from all over the world have founded firms with the aim of combining new technologies with innovative business models in order to sell and distribute high-quality products directed to low-income customers.



According to the 2018 Global Off-Grid Solar Market Trends Report, in 2017, solar technologies provided electricity to 73 million households. In other words, small solar installations allowed 360 million people to have light at night and charge their mobile phones without the need of burning expensive and polluting kerosene [5].

The off-grid solar market has grown considerably and the offered products have dynamically adapted to customers' needs



over time. Solar lanterns and pico-system (< 10 W) were the first products launched in the market, followed by standalone solar PV systems able to provide several Watt-hours per months of clean electricity to households in rural locations [4]. These products formed the basis for the emergence of a vibrant ecosystem of start-ups that are bringing many other innovations and is now heading towards the deployment of full mini grids. We explore in this report how these advances may contribute to achieving the SDG 7.

### Methodology

Among the various stakeholders of the off-grid solar sector, this report focuses on the role of **European companies and start-ups in the African continent**, in line with the goals of YES-Europe to promote young professional engagement in the efforts to achieve affordable and clean energy for all.

The start-ups of the Global Off-Grid Lighting Association (GOGLA) are the main source for the analysis. I collected the data by desktop research and complemented it with two expert interviews. Out of the full dataset, the analysis focuses on European companies.

In this work, "Where" and "When" off-grid solar start-ups emerged is first outlined, to continue with a brief analysis of "What" are their different areas of activity and their different geographical presence. The "How?" section addresses in which manner European countries are connected to African countries through their operations in off-grid solar - with specific attention on firms working in last-mile distribution with presence on the ground.

The report allows the reader to get to know two entrepreneurs in the field in order to inspire further young Europeans professionals and concludes with a description of young entrepre-

neurs' profiles - their study backgrounds and location to understand "Who" the main European actors in the sector are.

The author's intention is to give a snapshot of the European based private sector and not to a comprehensive description of the common global efforts towards rural electrification.



# Off-grid solar start-ups: Where, When?

This section reviews the geographical origins of start-ups operating in the African off-grid solar sector as well as a timeline of their development during the past decade.

The data collected includes 67 global start-ups, out of which about 70% are headquartered in Europe and North America, with the remaining 30% in Africa, Australia, Asia and South America (Figure 1). Further analysis is carried out on those companies whose headquarters are located in Europe, or whose founders have studied in a European university, covering approximately the half of the organizations.



**Figure 1.** Geographical origins of start-ups working in off-grid solar PV sector globally. Source: Companies data.

In Figure 2, the different colour intensities across European countries represent the number of companies active in off-grid solar based in each country. Within Europe, the United Kingdom has the highest number of start-ups (6) followed by Germany and The Netherlands. These countries were also the earliest European players to enter the game, after the tracks of the pioneers from the United States a couple of year before (the first American company entered the off-grid solar market in 2005).



Figure 2. European countries active in the off-grid market

Colour intensity represents the number of company headquartered in that country. Source: Companies data. The emergence of the sector until 2017 (Figure 3) shows when the different European countries got involved in offgrid solar. A gradual growth took place in the last decade, with a major role of Germany, UK, and the Netherlands initially, followed by France, Switzerland, Norway and Italy only after 2014.

The countries of operations of these Europe based companies are represented in Figure 4. The stronger presence in Eastern Africa (mainly Kenya, Tanzania and Uganda) stands out. The reason behind this pattern is the higher penetration of internet and mobile networks and, with them, the availability of digital money - that worked as a business enabler and catalyser across the African continent. Favourable energy policies from local government were also essential as in the contrasting cases of Ethiopia and Kenya. The government-driven economic development in Ethiopia, along with its preference for large on-grid projects, ex-

plains the smaller deployment of off-grid installations in the country. Oppositely, in Kenya, the private sector operated with more freedom, which contributed to a stronger growth of off-grid solar [3].



**Figure 3.** Growth of the European Off-Grid sector in the time-period 2007-2017. Source: Companies data.



Figure 4. Evolution of the number of off-grid solar start-ups with on-the-ground presence in African countries between 2011 (left) and 2017 (right). Source: Companies data.

While Eastern Africa has been the main focus of off-grid businesses since the beginning of the industry, it is only more recently that start-ups have reached the western region - with the primary role played by French entrepreneurs.

Over time, not only the sector has evolved from a geographical perspective, but also the business models have dynamically adapted to the understanding of customers and their willingness/ability to pay for such products. In the next paragraphs the main focus area of different companies are explored and new trends are put in evidence.

# The expert opinion: Off-grid solar in Uganda

**By Farouk Maate Kibaba** 

Farouk Maate Kibaba, currently the Executive Director of Great Lakes Peace Centre, has been recognized as one of the 100 most positively inspiring youth in Africa in 2017. In 2018, Farouk was shortlisted for the United Nations SDGs awards and he is currently an international SDGs Trainer.

How does Uganda's electricity sector look like in terms of generation and distribution? Are independent solar installations popular in Uganda?

The main electricity sources in Uganda are renewable: the most important is hydropower, followed by smaller shares of thermal power and cogeneration, summing up to 820 MW. Uganda's electricity market operates under a liberalised setup and is split into three segments: generation,



**Figure 5.** Power generation mix in Uganda in 2017 as percentage of total installed capacity. Source: Energypedia.

transmission and distribution. The biggest challenges are faced in the distribution sector, thus solar independent installations have become more and more popular in the last years.

## How do local institutions react to the presence of foreign companies (e.g., European start-ups) in the energy market?

Foreign companies are positively regarded by Ugandan institutions. The strong market demand for electricity distribution contributes to the development of such businesses, which are mostly not hindered by the fact that they are European as long as they operate with respect to local communities, with strong attention to environmental and social responsibilities.

## Is there any support for the development of local companies operating in the off-grid solar sector?

Yes, the government often supports organizations, especially when local directors constitute the board of the company. In the same way, as for foreign companies, a strong attention to environmental and social concern is required.

# Focus areas of off-grid solar start-ups: What?

Jacob Winiecki, co-founder of Simpa Network, commented on a recent online post that an interesting "unbundling" phenomenon is taking place in the off-grid sector: as the sector grows, so are the challenges it faces [6]. Stakeholders from both the public and the private sector are becoming more actively engaged with varying roles. Within the private sector, very different needs are emerging, from hardware engineering to last-mile distribution or additional software services to support the operations of companies on the field.





Among the companies we focus in this work, the largest number (76%) put their efforts into developing new technological products, spanning from lanterns, to solar home systems and solar powered appliances, until solar pumps or battery charging stations. Not all of these start-ups are directly present in the African countries but they eventually sell their products to the companies involved in last-mile distribution. A large intersection between technical and distribution companies exists - and it is constituted, mainly, by the oldest companies in the sector. These firms could not rely yet on other actors taking over some of its operations and were obliged to develop vertically integrated cradle to grave solutions: from product design to its distribution and post-sale customer service.

Distribution is the focus of 57% of all start-ups, highlighting how distributions remains the biggest challenge in off-grid solar due to numerous difficulties such as reaching remote areas or communicating with far apart and dispersed customers.

Interestingly, a small yet increasing number of start-ups (15%) work exclusively on a variety of additional services. These include financing, training systems for human resources or monitoring solutions for after-sales operation and maintenance.





In Figure 7 the main focus of the start-ups is shown with respect to their geographical location (top) and their year of foundation (bottom). It is important to note that each start-up can be active in one or more categories depending on the core activities in its business model. Two interesting observations emerge from these analyses. First, the tech subsector and distributors have grown in parallel over the years while service-focused companies appeared only from 2014. Second, the latter have not emerged in countries with a well-established off-grid solar sector, but rather in countries holding a side role (with the only exception of France).

It is challenging to predict what lies ahead for the off-grid solar sector and which European country will further invest in this market. However, from the present state and the latest trends it can be envisioned a divergence of value propositions, with an increase of B2B (business-to-business) models over customer-centric approaches. In such a scenario, the only B2C (business-to-customer) model would be those of last-mile distribution start-ups, with all the other stakeholders acting as a service provider for them. Figure 8 provides a qualitative description of this concept, showing an increasing amount of services-oriented start-ups - giving birth to a more fragmented sector but most likely also to a set of more specialized firms - overall increasing the quality and efficiency of the full ecosystem. According to experts' opinion, this phenomenon will increase firms' profitability and drive further investments in the sector.

It is clear that, while new trends in the sector are emerging through the development of new business models, the role of last-mile distributors will remain crucial, and so will that of all the challenges linked to it. In the next section we look at firms working in last-mile distribution through a systemic analysis of the off-grid sector, aiming at identifying and visualizing the connections built among countries through the sales of solar-off grid systems and related services.



Figure 8. Foreseen scenario for the evolution of the off-grid solar start-up ecosystem.



# How? The Europe-Africa off-grid solar connection

18 countries in Africa, spreading across the Central, Western and Eastern regions of the continent, are home to one or more start-ups trying to bring off-grid solar solutions to the nonelectrified areas of their countries. Eastern Africa is the preferred market for a large number of European companies, with a strong presence of start-ups from the UK and Germany.

More specifically, European entrepreneurs entered into Kenya, Tanzania and Uganda considering the readiness of their local markets. From the technology acceptance to the customers' ability to bear the costs of solar installations, to the penetration of mobile network and the local regulatory framework, every single element is crucial to enable the successful distribution of solar products and is taken into careful consideration by market analysts.

Interestingly, while the UK is the country with the highest number of off-grid start-ups (Section: Where?), those firms from Germany, France and the Netherlands play an essential role in spreading the distribution of off-grid solar over the whole African continent, connecting each European country with six different African countries.



#### PV Off Grid network: Europe and Sub Saharan Africa

**Figure 9.** Off-grid system analysis. Arrow thickness is representative of the number of startups on a specific connection.

Even though still a minority, European entrepreneurs that headquarter their companies locally in the country of operation are interesting new players (represented in Figure 9 with dotted arrows). The advantages of this approach are the deeper understanding of their company's customers, and most importantly, the ability to employ a local workforce, which positively impacts local economic development from day one of their operations. In parallel to the *unbundling* of core values of the business models, described in the previous section, a strategic relocation of firms' headquarters according to the key activities of each start-up can be foreseen in the next years.

Country-level analyses provide interesting insights into the sector, yet behind each start-up there are young entrepreneurs, investing time and motivation into such businesses. The next section gives a closer look at the profiles of the founders to understand better the roads that led them to the off-grid solar sector.

### **Colonialism 2.0?**

The strong intervention of foreign "developed" countries in the African continent opens room for reflection and discussion among the experts in the field. Exploiting natural resources such as solar energy for a non-local profit is perceived by someone as a modern version of colonialism, pointing out how European efforts should be rather directed towards the support of local enterprises.

Undoubtedly, there is a fundamental difference between the traditional cooperation programs well known until now and the more recent raise of proper companies. On the other hand, the electrification obtained by the presence of proper businesses improves local communities' life conditions and in the best cases is exploited for the development of local productive activities, ultimately creating local profits as well.

The considerable challenges that European entrepreneurs face give all reasons to believe that it is not a mere quest for money what brings them to the African continent, but rather a strong intrinsic motivation to contribute to the achievement of a fair and sustainable development.

# Young professional perspective: Who?



Figure 10. Background of entrepreneurs in the off-grid solar sector.

This section reveals key features of the main off-grid solar entrepreneurs. We aim at understanding what they studied, where and how long they took since graduation until they found their company.

Slightly more than the half (53%) of the founders of the start-ups in this study have a technical background, with a 10% specialized in energy studies. Another big share of founders have studied business or eco-

nomics with expertise in project management and business development. The remaining 8% are graduates of law. This produces a multi-disciplinary sector that undoubtedly benefits from the contributions coming from each background. In, start-ups often have several co-founders, with different backgrounds, which allows them to combine their skills and experiences.



Many entrepreneurs studied in a British university, reflecting the fact that the largest number of start-ups headquartered in the UK. In contrast, while a large part of the start-ups founders

Figure 11. Country of study and background of the off-grid solar entrepreneurs

graduated from a French university, the second and third country per number of headquartered start-ups are Germany and the Nether-lands, indicating a considerable mobility within continental Europe. Aggregated under the label of "others EU countries" are represented graduates from other European states, namely Italy, Norway, Denmark and Serbia. Remarkable is also the presence of graduates from extra European universities, while within Europe southern and eastern countries are almost completely absent, with the only exception of Italy.

The distribution of backgrounds among different countries does not change significantly. It reflects an overall balance between technical and non-technical backgrounds.

Entrepreneurs follow different paths before founding a company. In the off-grid solar sector, very different profiles take on the challenge of achieving a financially sustainable business with positive social impact in a developing country. 20% of the entrepreneurs started his or her business within one year after completion of university. It is within the first five years of their professional careers that 37% of founders undertake such challenge. Interestingly, the entrepreneurs that start an off-grid solar start-up in the early stage of their career are those coming from an engineering or energy background, while the largest number of entrepreneurs with a background in business comes to the off-grid sector in a second stage of its career (more than 14 years after graduation).

This possibly reflects how the specific challenges in the off-grid solar market are related to the development of functional business models, calling for the need of expertise in business to be properly tackled.

Most importantly, the cooperation of young and experienced professionals from different backgrounds has been key in the off-grid solar sector, acting as catalyser for star-ups creation and for the growth of a promising new market.



**Figure 12.** Time between graduation and start-up foundation for entrepreneurs with different backgrounds.



## In the words of a founder Sebastian Weida

Sebastian Weida, Product Manager at Mobisol, has worked to establish the Mobisol Innovation Lab in Tanzania.

#### What is the concept behind the Innovation Lab?

The Mobilab is an inclusive tech space, Mobisol's eyes and ears to its customers and market in Tanzania, a space for innovation that brings together different cultures and professions, designers, engineers, operations experts with consumers, to ideate, build and test cuttingedge products and services for underserved communities in Tanzania. It is all about building stuff, creating prototypes as images that show the world what tremendous potential off-grid solar has and how our customers can benefit from it.

#### What was the reaction of the locals to the ideas you were bringing from Europe?

The key challenge in innovation is to think out of the box and actively get out of your little tech bubble, and go and confront the daily challenges and frustrations of your customers. The geographical distance between our Berlin HQ and our customers and colleagues in the field is huge. Creating an inclusive space not only for customer research and rapid proto-typing but also for skill exchange, learning, and communication was super important to us. So local experts, together with American start-uppers, German design thinkers, Kenyan fintech specialists, and Tanzanian engineers can now all work together on the next big thing. An innovation melting pot.

#### What is the main motivation that led you to work (and stay working) in off-grid solar?

I studied engineering and design and I love working with physical products that make a difference. Engineering is all about finding the right solution. However, it often leaves the most crucial part left out: what is the actual problem to solve? The off-grid sector is still in its infancy, no one has totally figured it out yet or cracked it commercially. This creates a wonderful playground that forces us to turn everything upside down, to change our perspective, and to try out things differently. What else do you want?

#### Which ones you think are the greatest challenges of the off-grid solar sector?

Last mile distribution and loan risk management are the main ones I see. Also reaching down and including more people lower in the pyramid. Every company envisions their customers growing with the product: from a small lantern to a powerful back-up system. We, as a whole sector have to come up with ways to do this together.

#### How do you see the future off-grid solar?

Smart 🙂



# Conclusions

Rural electrification currently presents challenges to many different stakeholders, from nonprofit organizations to governments and start-ups. Start-ups are the most recently arrived to the sector. Newcomers to the off-grid solar sector have to deal with rapid, profound changes while trying to find the key to unlock access to new capital and, at the same time, addressing the global challenge of providing sustainable and affordable energy to millions of people.

The results of this research show that **German and British businesses have been the first** to enter new markets in Africa that today host start-ups from up to **seven different European countries**. Start-ups from France and the Netherlands are strongly involved in last-mile distribution allowing reaching out countries off the most beaten tracks. Firms have **first expanded in the Eastern Africa region** that, at present, remains the most densely populated by electrification projects. Only more recently, companies have reached also the French-speaking countries located in the Western part of the continent. Overall, less than 40% of Sub Saharan African countries have welcomed any of the companies in this report.

A trans-disciplinary participation has been key to the development of the start-ups currently active in the African off-grid solar market. This type of collaborations can either take place within the same company or among different start-ups in the form of a service worth value. While the first approach prevailed during the early stages of the ecosystem, a different trend might be currently gaining traction. In fact, the sector growth is accompanied by a diversification of companies' focuses, with an increasing number of B2B services. In this context, a strategic headquarter location might be required: start-ups involved in last-mile distribution will possibly move their offices to the country in which they operate, thus increasing the chances of employing local workforce and being closer to customers' needs.

What lies ahead for the off-grid solar sector cannot be easily foreseen by looking at the European start-ups only - a large number of stakeholders with different interests and strategies is involved, including American and Asian companies, as well as public development programs and non-governmental organizations, making the whole ecosystem much more complex than what this report covers.

YES-Europe envisions a stronger interconnection among professionals in the energy sector. In line with this idea, the findings of this report confirm the importance of connecting members from different disciplines to go beyond traditional businesses and foster entrepreneurship and innovation to tackle global challenges, such as rural electrification.

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## About YES-Europe

In early 2016, a group of enthusiastic students at EPFL (Switzerland) reached out to their fellow peers across Europe and proposed that they meet to find how to make a greater impact on the World energy challenges. To their surprise, they accepted the invitation, and dozens came from more than 9 countries to attend the conference. YES-Europe was born. We envision a sustainable tomorrow and strive to achieve it by connecting future energy leaders and enabling them to make an impact now and in the future.

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