

SOLAR ENERGY

An opportunity for affordable and clean energy for all

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SYNOPSIS

The majority of communities and households in African countries do not have access to clean and affordable power—often due to high cost, especially in rural areas—undermining their quality of life in education and health. Yet Africa has abundant and underexploited renewable energy sources, including solar energy.

This case study presents a success story from Tanzania on the use of solar power to improve lives in rural and semi-urban communities. It shows the efforts of Off-Grid Electric in combining information and communication technologies with solar energy to provide affordable and smart energy services in African communities.

Key findings: Solar energy has increased access to clean energy to more people and to the neediest, contributing to the well-being and safety of households and individuals, and largely fulfilling the objectives of Sustainable Development Goals. By end-March 2015, Off-Grid Electric systems were in use in over 10,000 households in rural Arusha, bringing benefits such as access to high-quality light for study and relaxation, increased safety and security, and direct and indirect (often part-time) jobs for more than 45,000 people. The company also created direct and indirect employment for more than 15,000 young people in rural areas. Solar light has provided safer and brighter homes, enabling children to study and perform better at school. Likewise savings made by households formerly using kerosene can be put to other uses. Many families consider solar lights to have improved their quality of life.

Main lessons: Well-designed programs for access to energy can improve livelihoods of communities especially the rural ones, boost job creation and enable poor rural people to contribute to economic development. The case study demonstrates that shifting from a government monopoly of energy sector to a more open market approach can increase access to clean energy and improve the living conditions of the population. Therefore, public-private partnerships are essential to design and develop affordable and sustainable services in key sectors like energy.

Key recommendations: African states should foster coherence in addressing access to energy for all and should therefore collaboratively invest in solar energy plants and local manufacturing of spare parts, and promote social enterprises in solar energy. At national and regional levels, African leaders and policy makers should also establish an enabling environment and develop efficient strategies and programs that facilitate investments from private sector into the energy sector. African capacity building organizations can provide the necessary knowledge and support to governments in designing, financing and implementing the appropriate programs and strategies.

Introduction

Energy in Africa is a scarce commodity. About two-thirds (621 million) of the people in Africa live without electricity (Watkins 2015). The number rises daily due to the increasing costs of electricity and growing poverty in most African countries. Most of the region's homes still use charcoal and firewood for cooking and heating. This trend means that the global target of energy for all by 2030 cannot be reached (Watkins 2015).

The energy availability deficits in Africa vary widely. In Sub-Saharan Africa, only 290 million of 915 million people (31.7 percent) have access to electricity, and the total number without access has been rising (IEA 2014). The situation is worse in rural and semi-urban communities where, according to Van der Hoeven (2013), 9 of 10 people have no access to energy. The major reasons are an aging power infrastructure that is incapable of meeting current power demand, inadequate infrastructure financing, and poor planning.

Inadequate and unreliable electricity supply in Africa undermine investment. Power shortages reduce economic growth by about 2–4 percent annually (Watkins 2015). Health clinics are unable to refrigerate life-saving vaccines. And few children have access to the source of light they need to study in the evening. Firewood and dung are the most accessible sources of energy. For lighting, the only choices for many communities are toxic kerosene, paraffin or candles. The toxic fumes released by these sources kill about 600,000 people a year, half of them children (Watkins 2015).

In the same time, Africa is home to a vast quantity of solar power with the potential to meet its electricity demand (Trieb 2009). Solar power is a hugely promising source of energy that can increase access to domestic electricity to the hundreds of millions now lacking it. With the price of solar panels declining (Trieb 2009), there are opportunities for

both the private and public sectors to connect millions of poor households to affordable small-scale, off-grid systems. The Africa Progress Panel report (2014) estimates that 138 million households living on less than USD 2.50 a day spend USD 10 billion annually on energy-related products, including charcoal, candles, and kerosene—per unit cost, 60–80 times more than people living in London or Manhattan. Off-grid solar power can greatly reduce these costs; promote productive investment, health, and education; raise life expectancy; and reduce poverty.

Objectives of the case study

This case study focuses on Tanzania's success in using solar power. The objective is to demonstrate how solar energy could be used as an affordable source of domestic electricity in Africa. It also aims to showcase the use of information and communication technology in empowering and improving the lives of rural communities. The study uses qualitative and quantitative data from the Solar Energy Foundation and Off-Grid Electric in Tanzania to substantiate why African countries, in their bid to provide cheap electricity, should consider investing in solar energy. Additionally, it aims to showcase the economic, social, and health benefits of using solar power.

For the case study, a review of available secondary literature was the main source of information. Thus journal articles, technical reports, and other documents were consulted. Hard copies and Internet sources were also used.

Case study: Electrification project of Off-Grid Electric¹ in Tanzania

Tanzania is the largest country of East Africa.² It has a population of more than 53 million with an annual growth rate of 2.7 percent in the last 10 years³. Its main development challenge is widespread and persistent poverty, with 48 percent of the population living below the basic needs poverty line. The

¹ Name of the company showcased in this case study

² www.tanzania.go.tz/home/pages/219 (accessed March 10, 2016).

³ <http://data.worldbank.org/country/tanzania> (accessed on February 13, 2017)

economy is heavily dependent on agriculture, which accounts for 50 percent of gross domestic product and provides about 85 percent of exports and employs 90 percent of the work force (URT 2013). Like any other Sub-Saharan African country, Tanzania faces socioeconomic and political challenges, such as poverty, gender inequality, promotion of democracy, and human rights observance. Tanzania is one of the 50 least developed countries (LDCs) having an annual per capita income of some USD 250 (URT 2013).

Key data on energy in Tanzania

The energy resource base includes oil and gas, coal, hydro, wind, geothermal, biomass, and uranium (Ministry of Energy and Minerals 2015). The country has natural gas reserves of about 53.3 trillion cubic feet, equivalent to 9.2 billion barrels of oil. This resource has not been fully developed because major discoveries have been made only in recent years. Moreover, Tanzania has a sizable coal reserve of about 1.9 billion tons, of which 25 percent is proven. Geological data indicate that the potential could be up to 5 billion tons. The small amount exploited is used for other industrial applications and not for electricity generation.

Only 24 percent of the population is connected to the power grid, with only about 11 percent of the rural population connected to electricity services. The government plans to increase the connectivity level to 50 percent by 2025 and to at least 75 percent by 2033 (Ministry of Energy and Minerals 2015; TANESCO 2014). Tanzania's installed capacity stood at 1,500 megawatts (MW), against a peak power demand of 900 MW (TANESCO 2014). The full installed capacity is, however, rarely available due to power plant outages and drought. TANESCO's 2014 report also indicates that demand for electricity has been growing at 10–15 percent a year. Tanzania has made big natural gas discoveries off its southern coast and hopes to use its deposits to end chronic energy shortages.

The institutional setup and actors in the energy sector comprise:

- The Ministry of Energy and Minerals, through which the government formulates energy policy. The Electricity Act focuses on restructuring the electricity supply industry, attracting private and other participants, and bringing an end to the monopoly of the Tanzania Electric Supply Company (TANESCO). The electricity sector's act provides separate licenses for generation, transmission, and distribution.
- The Energy and Water Utility Regulatory Authority is responsible for technical and economic regulation of electricity, petroleum, natural gas, and water.
- The Rural Energy Agency has responsibility for boosting modern energy services in rural areas.

Opportunities

With a population of 53 million and a gross domestic product estimated at \$27.3 billion in 2016, Tanzania is the second-largest economy in East Africa.⁴ Like all Sub-Saharan African countries, it faces tremendous challenges in ensuring access to energy: 85 percent of the population was still off-grid in 2011 (Ashden Award 2014). This included most households in rural areas and those on the outskirts of cities such as Arusha where, although the grid is available, the connection cost of around USD 700 is prohibitive for most people. Some solar home systems can provide power to run lights, mobile phones, and other small appliances, but the initial connection cost and after sales service prevent widespread adoption of these systems.

As in other African countries, mobile phone use has rocketed in Tanzania in the past decade. The number of mobile phone subscribers in Tanzania rose by 16 percent in 2014 to 31.86 million for mobile phone

⁴ <http://countrymeters.info/en/Tanzania/economy>.

penetration of 67 percent.⁵ Yet this spread has far outstripped that of grid electricity.

As most citizens are without access to electricity, they rely on kerosene to light up their houses. Yet if the country is to realize its development objectives, access to clean and affordable energy should be increased by involving the private sector in the energy sector and by developing innovative mechanisms.

This situation points to opportunities to generate and increase the availability of conventional and solar power. In 2011, Xavier Helgesen, Erica Mackey and Joshua Pierce seized that opportunity by setting up an off-grid power company, Off-Grid Electric, in Tanzania. These founders shared a vision of making solar energy accessible and affordable in a mass market rather than as a niche product. Pooling their knowledge, they developed a business idea to make use of the growing penetration of mobile phones and mobile money services in East Africa to sell solar-powered electricity as a daily service.⁶

Financing the initiative

The Off-Grid Electric Company was financed mainly by equity investment. It consisted of a Tanzanian-registered business that managed sales of solar services from its headquarters in Arusha and a Seychelles-registered business that managed investment, hardware, and software development. By March 2014, the company had some 90 staff and several hundred local agents. Off-Grid Electric designs small solar home systems in partnership with Fosera, a German solar company. The systems, branded as “M-Power,” are manufactured in Thailand.

Overall approach and outcomes

The company provides an agreed level of service from a solar home system installed in a customer’s home. The customer pays for the service using mobile money, with a minimum payment of one day’s use. A network of local agents is used to find

customers, install systems, and provide customer support. They use a tailored smartphone application linked to a database to integrate information on customers, systems operations, and payments. Cloud-based servers keep data secure. The entry-level service is two bright lights and a phone charger for eight hours a day. Customers can add more appliances at additional cost. The second level has up to six lights, two phone chargers, and a radio. A third level, which powers a television set, is being field-tested. In 2014, each customer paid a deposit of TZS 10,000–15,000 (USD 6–9) and a daily fee of between TZS 300 and TZS 1,000 (\$0.18 and \$0.63), depending on the level of service.

The technology is promoted through publicity campaigns and installation of demonstration systems. Interested local people then pay a non-refundable fee for training. These people then become responsible for recruiting customers and installing systems in their neighborhoods. After a system is installed, payment control is set up by the agent, who shows the customer how to operate the system and make their first payment. Off-Grid Electric retains ownership of the system and, if needed, will replace or repair it at no cost, provided that the customer is paying for the service.

In 2014, payments were made largely through mobile telephony, either via customers’ own mobile phones or through a local mobile money kiosk, though cash was also acceptable. After payment is made, the customer receives a code to activate their system through Short Messaging Service (SMS). The minimum acceptable payment is for one day, but if a higher amount is paid, it is automatically pro-rated to the appropriate time period (to the nearest minute). The system is automatically disabled when the money runs out, until it is topped up. Off-Grid Electric emphasizes customer service, and its headquarters has a large customer care department with an 18-hour a day call center.

⁵ <http://www.reuters.com/article/tanzania-telecommunications-idUSL5NOXD37P20150416> (accessed April 6, 2016).

⁶ <http://offgrid-electric.com>.

Off-Grid Electric was so successful that, by end-March 2015, its systems were in use in over 10,000 households in rural Arusha, bringing benefits such as access to high-quality light for study and relaxation, increased safety and security, and direct and indirect (often part-time) jobs for more than 45,000 people. The company also created direct and indirect employment for more than 15,000 young people in rural areas.

According to the company's 2016 "success stories," the company delivers solar power at a price customers can afford without sacrificing quality. For the same amount of money their customers already spend on kerosene or candles, Off-Grid Electric provides clean energy with 25 times more light and additional energy for appliances such as televisions and radios. The company also offers financing for appliances such as radios and television sets so that customers can enjoy the additional benefits of modern energy at a low cost. Customers can make these payments, too, through mobile money.

Key messages

The first key message is that achieving the United Nations Sustainable Development Goals, the African Union Agenda 2063, and the AfDB agenda related to energy is feasible as far as efforts to light up Africa and provide clean energy are concerned.

Second, solar power offers enormous opportunities to empower local communities, and it can be used locally on a small scale to contribute to rural development and electrification. Local projects also offer economic opportunities—to the locals—but require a clear energy policy; an enabling framework of laws, regulations, and institutional setup; and viable business plans to ensure accelerated solar power deployment.

A third point is that many African policy makers and regional economic institutions appreciate the opportunity that solar energy presents to African nations. As power sectors and institutional frameworks mature, regulatory policies such as auctions and net metering are likely to be introduced. Policies are needed to attract private

capital, and include public–private partnerships to share costs and risks, to build capacity in local financial institutions, and to increase access to loans and other forms of financing. Regional collaboration is vital for realizing efficiencies and economies of scale by deploying renewable energy technologies. Such an approach is particularly effective in large-scale deployment of shared renewable resources for power generation.

More widely, adopting an integrated approach to transboundary issues such as trade, regulatory frameworks and policies, regional infrastructure, and other cross-border issues will allow African countries to access regional renewable resources at more affordable prices (IRENA 2016).

Finally, an enabling environment for renewables in Africa requires the right mix of policies, incentives, and multi-stakeholder collaboration at country and regional levels. The rewards accruing to countries that meet the challenge will be immense. Correct use of modern renewables can make power shortages a thing of the past, bring electricity and development opportunities to rural villages, spur industrial growth, create entrepreneurs, and support ongoing lifestyle changes across the continent. At the same time, leveraging renewables will facilitate a cost-effective transformation to a more secure and sustainable power sector.

Conclusion, lessons, and policy recommendations

The case study demonstrates the value of solar light in improving the lives of people in Tanzania through tapping into abundant solar energy, and using mobile phones and mobile money services.

Although solar power is the most affordable clean energy in the continent, such affordability varies by market segment. Solar projects must recognize that most rural communities are behind socially and economically. African states must subsidize some of the costs related to the delivery of solar power so that all citizens have equal access to clean energy by 2030.

Quality is an essential element of solar lighting and cannot be compromised. Systems quality and the ability to access spare parts and repair services must be an integral part of any solar power program. Performance standards should be in place and monitored for all solar power companies. A strong inspectorate should be built to ensure that high-quality products and services are delivered. With the mushrooming of counterfeit products in African markets, this aspect requires close scrutiny.

Partnerships and close involvement of the private sector in addressing challenges of access to clean energy are necessary. African countries need to ensure that long-term, sustainable solutions to its power supply problems are implemented.

Well-designed programs can enhance rural communities' contributions to national economies, improve business opportunities and job creation, and enhance the revenue and livelihoods of low-income populations—all contributing more generally to raising the quality of people's lives as more people access clean energy.

The following policy recommendations are put forward:

- 1) Governments in the region should recognize and support social enterprises delivering clean energy to the poorest households.
- 2) African leaders should show greater leadership in mobilizing domestic resources to finance access to clean energy and focus on providing light to rural communities. They should also develop short- and long-term strategies to implement the globally agreed targets on universal access to energy by 2030. National programs for agricultural, climate change, and energy transformation should be aligned for coherence. African capacity building organizations can provide the necessary knowledge and support to governments in designing, financing and

implementing the appropriate programs and strategies.

- 3) Governments in Sub-Saharan Africa should encourage the uptake of solar lights and their components by removing taxes and duties on imported technologies and by reducing the number of licenses required by solar light manufacturers and distributors. A special agency should be set up to plan and promote solar light, coordinate technology standards and testing, and manage national and subnational data on the supply and demand of solar light and energy.

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