KENYA

The Race to Electrification
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I-DEV INTERNATIONAL
Unlocking Business Potential in Emerging Markets

APRIL 2018
#KenyaOffgrid

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I-DEV INTERNATIONAL
Unlocking Business Potential in Emerging Markets

I-DEV *is a management strategy and investment advisory firm that specializes in helping to grow and scale businesses in emerging markets. Over the past decade, I-DEV has worked with 350+ small and medium businesses (SMEs) and helped raise over $80M in financing for growth-stage companies across Sub-Saharan Africa, Latin America, and Asia.*

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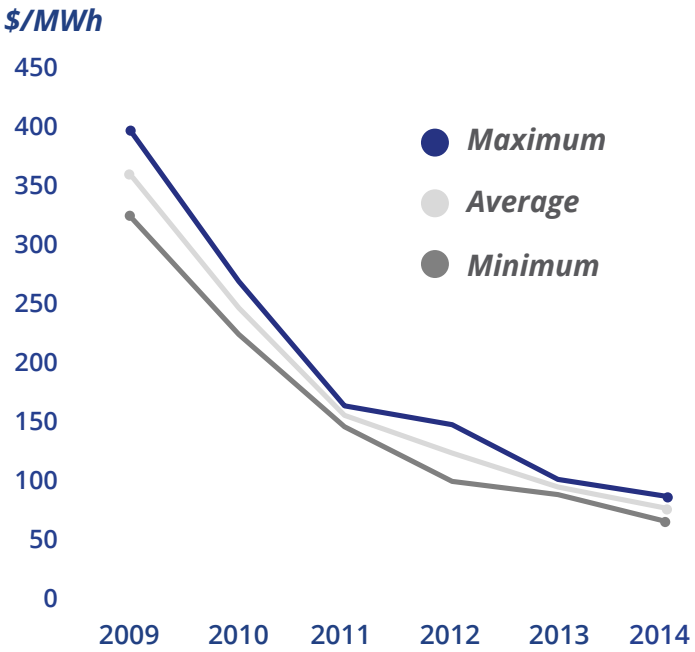
1 Kenya
Solar lights up new horizons

Levelized Cost of Electricity (LCOE)

Solar PV



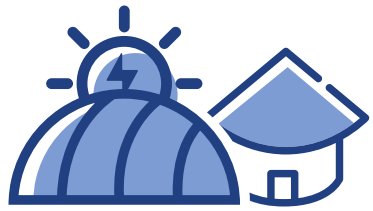
Source: Lazard's Levelized Cost of Energy Analysis, Nov 2017

In Africa, it's estimated that more than 600 million people live without regular access to electricity, most of them in rural and hard to reach areas. For these communities, gaining access to electricity by connecting to central power grids would take many years and millions of dollars in investment. However, in rural Kenya the quest of business owners and households to broaden access to power has found a promising solution in decentralization and the installation of mini grids to meet their energy access demands. Local businesses can thrive connected to the community's micro-grid, and payments can be taken care of via the robust mobile money system already operating in the country for years.

In the last few years, technological advancements and dropping production costs have made solar technology inexpensive. This phenomenon coupled with a growing availability of efficient appliances – such as LED bulbs and highly efficient fans, TVs, refrigerators, and other equipment – is enabling the expansion of solar energy sources in rural areas.

In Kenya, the steep decline in the price of solar panels and current political support will enable rural areas to bypass the need to join the national grid and embrace solar as their main power source instead.

In the last few years, solar technology has become inexpensive and more readily available, enabling expansion across rural areas.



2 Solar
Electrifying the nation

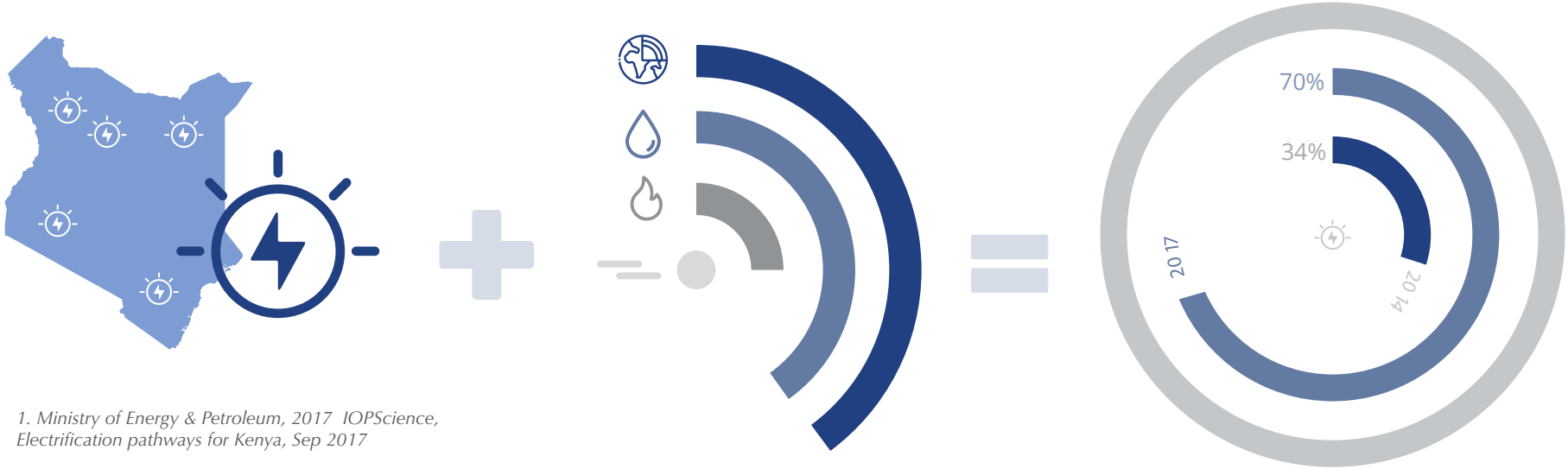
If the cost of producing electricity using solar PV drops to the point where providing electricity can be as cheap or cheaper than through the national grid, then the technology can claim to have reached grid parity, i.e. it can generate power at a Levelized Cost of Electricity (LCOE) that is less than or equal to the price of purchasing power from the grid.

Although Kenya has not reached grid parity from solar generation yet, in many regions electrification is making its way through solar energy solutions. This is in large part due to the fact that off-grid systems provide tiered payment and pay-as-you-go models, which are better suited to the needs of rural customers and easy to implement thanks to Kenya's high penetration of mobile money.

Kenya's Vision 2030 plan calls for 100% of the population to have access to electricity, and so far it is living up to the plan. While in 2014 only 36% of the population had access to electricity, this figure has doubled currently reaching almost 70% of households today, according to government estimates.[1]

The 100% target cannot be accomplished by 2030 via the expansion of the power grid. The costs would be astronomical, and the infrastructure required would take a significant amount of time to be developed.

By 2030
100%
Electrification



1. Ministry of Energy & Petroleum, 2017 IOPScience, Electrification pathways for Kenya, Sep 2017

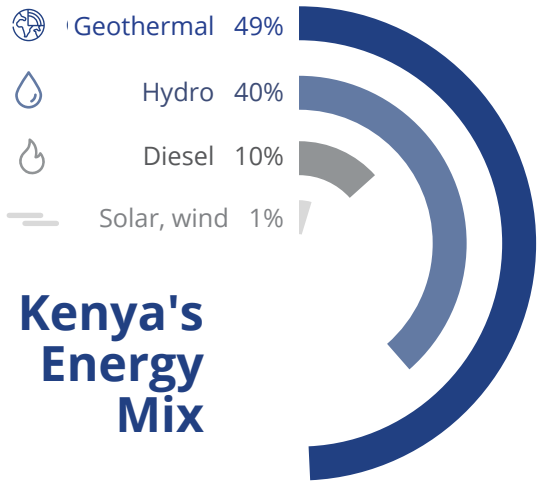
As a result, the Kenyan Ministry of Energy and Petroleum with the World Bank's support has set up a $150 million project to install solar in the most remote areas of the country. The five year Kenya Off-grid Solar Access Project (KOSAP) will allow for 5.2 million new connections within the first three years of the project. Out of these new connections, it is expected that 690k will be solar home systems (SHS), while the rest will be connected to green mini grids (GMG).

This constitutes an authentic solar revolution in the country's rural areas, especially considering that when the Kenya Vision 2030 plan was designed, the number of solar home systems installed per annum was growing at an average of 20,000 units per year.[1] This revolution will contribute to the electrification not only of households, but also businesses, schools, community centers, and market centers across 14 counties.

Kenya's current generation mix is dominated by hydro, thermal, and geothermal, with solar and wind energy comprising barely one percent of the energy sources. However, the government's Least Cost Power Development Plan for 2030 puts renewable energies on the spotlight. Kenya is a country astride the equator, with an estimated average insolation of 6 kWh per square meter per day across more than 28,000 km^2 of land.[2] This results in a consistent and relatively stable potential for electricity generation from solar. Moreover, the country counts on an increasing workforce trained in solar equipment installation and increasingly progressive policies that support the development of the industry.

The government's plan to provide electricity in rural areas will be implemented by installing both solar home systems to provide electricity individually to each household, as well as establishing green mini grids that can power up entire villages.

But, what are the differences between these two options, and what is the rationale behind the installation of one or the other?



Source: Kenya LCPDP, 2015

POTENTIAL FOR GROWTH IN SOLAR

INSOLATION
6kWh/m²
PER DAY

Proximity to Equator & High Insolation

Cheaper than Power Grid

Policies & International Investment

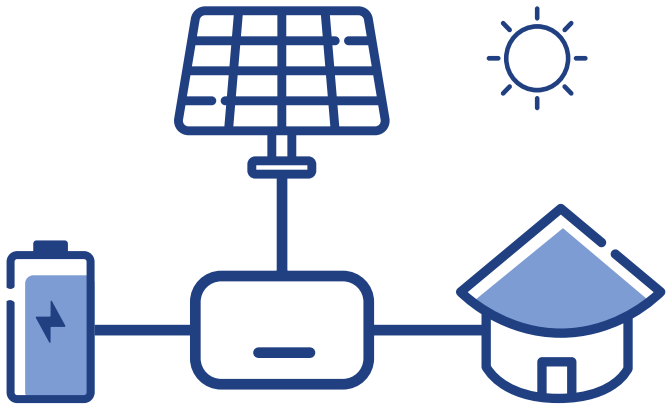
1. Republic of Kenya, Least Cost Power Development Plan, 2011-2030

2. Energy Regulatory Commission, Renewable Energy Portal

3 Solar Home Systems (SHS) vs. Green Mini Grids (GMG)

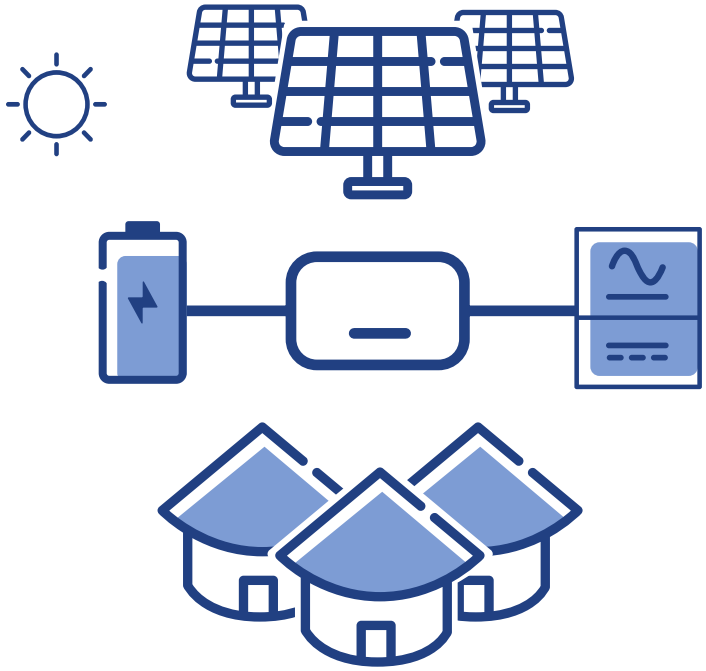
Solar Home Systems

SHS are standalone systems only connected to the household they provide energy to. The simplest forms SHS systems consist of: (i) a solar panel, that collects the energy from the sun; (ii) a charge controller, that regulates the voltage and current coming from the panels; (iii) a battery, that gets charged when the solar panel is producing more electricity than what the household is consuming, and that the household can access later at night.



Green Mini Grids

GMG are small-scale electricity networks that supply energy directly or via batteries to a group of households that live relatively close to one other and are connected to the system. These GMG units are generating facilities that operate disconnected from the main energy grid, and produce energy via renewable energy sources – mainly solar, and often supplemented with diesel generators.



SHS vs. GMG

When to use which?

Reliability & Cost per Household

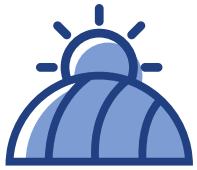
GMG units count on multiple panels and backup generators, and are thus a more reliable power source that can provide electricity for more energy intensive uses– i.e. refrigerators, TVs, and even small machinery. This can be a great economic boost for small businesses in rural areas. SHS systems are harder to scale and have smaller generation capacity. With higher upfront installation costs, SHS are also often not affordable for low-income households without financing. Many of the new programs allow households to make small payments over time via their monthly electricity bill. SHS has a faster payback period (approx. 2 years), while for GMG the payback period can range from 5 to 10 years.

Cost of Maintenance

Because SHS are individual systems, the maintenance costs per household are higher compared to a home connected to the GMG (although, it is possible for several households to share the electricity produced by an SHS). The maintenance costs associated with GMG are focused on one sole but large installation, while SHS require maintenance of each unit. In remote areas, getting the right technician to make a repair can be very costly. Lastly, both types of systems incur battery costs (either lithium or gel) that require periodic replacement, and add to the overall cost.

AC/DC Current

Solar panels produce DC (direct current) that can easily reach household appliances. Power grids, on the other hand, use AC (alternate current) in order to transport electricity longer distances. As a result, most household appliances are built to take in AC, which they later transform into DC to operate. This means that SHS households must add a DC-AC converter to the system to use conventional appliances. This reduces energy loss and is more efficient than conventional models, but activity is more limited and cannot accommodate high energy intensive appliances. For businesses or locations that require use of heavy machinery, only GMG is suitable.



Location & Population

SHS systems can be installed in any household no matter how remote the location, enabling access to electricity even for those who live far away from villages and roads. This makes SHS the proper choice for households far away from communities and the grid. However, for population groups that live in remote areas but are relatively close to one other, GMG systems are a good solution that allow electricity to be provided most efficiently far from the grid.

Regulation

Costs Savings

Agriculture

Reliability

International & Government Support

4 Key Drivers

What's pushing the market?

Regulation

Public policies have supported solar via tax exemption. Since 2014, the Kenyan government lifted the 16% VAT charges on solar equipment imports. The public administration has also set up its own micro-grid projects in various agencies: (i) Kenya Power and Lighting Company (KPLC) with 13 operational micro grids, (ii) Rural Electrification Authority (REA), which owns the generating equipment of 11 of these; and (iii) Kenya Electricity Generating (KenGen), which owns the remaining two. The KPLC is in charge of distribution and market sales of all electricity generated via these micro grids.

Cost Savings

The main potential for mini grid expansion is in rural areas where the cost of extending the grid is too burdensome for the number of citizens that it would eventually serve. However, mini grids also have potential in places where the national grid is present. Solar could be a cheaper solution to supply energy to meet the country's growing demand and provide a safe energy buffer when load shedding occurs.

Agriculture

Beyond households, there is huge potential for green mini grids to provide energy for agricultural purposes, such as to power pumps and provide water for fields and homes. Solar powered water pumps lower operational and maintenance costs and have great potential across many industries in the near future. There is also potential to target current diesel powered pumping systems and retrofit them with hybrid solar systems. This greatly expands investment opportunities, as diesel generators are currently the most common source of energy in rural Kenya.

In 2014, the Kenyan government lifted the 16% VAT charges on all solar equipment imports. This has been the leading factor driving solar energy growth.

1. World Bank, Enterprise Survey 2013

Reliability

Even in the limited areas of coverage in Kenya, the national grid remains highly unreliable. Frequent voltage fluctuations and power outages – occurring more than 6 times a month and lasting up to 5 hours on average[1] – can harm business productivity as well people's livelihoods. According to the World Bank's Enterprise Survey in 2013, power outages cost firms more than 5% of annual sales in total losses. Solar alternatives could provide a more consistent energy source, especially as energy storage options become more efficient and reliable.

International & Government Support

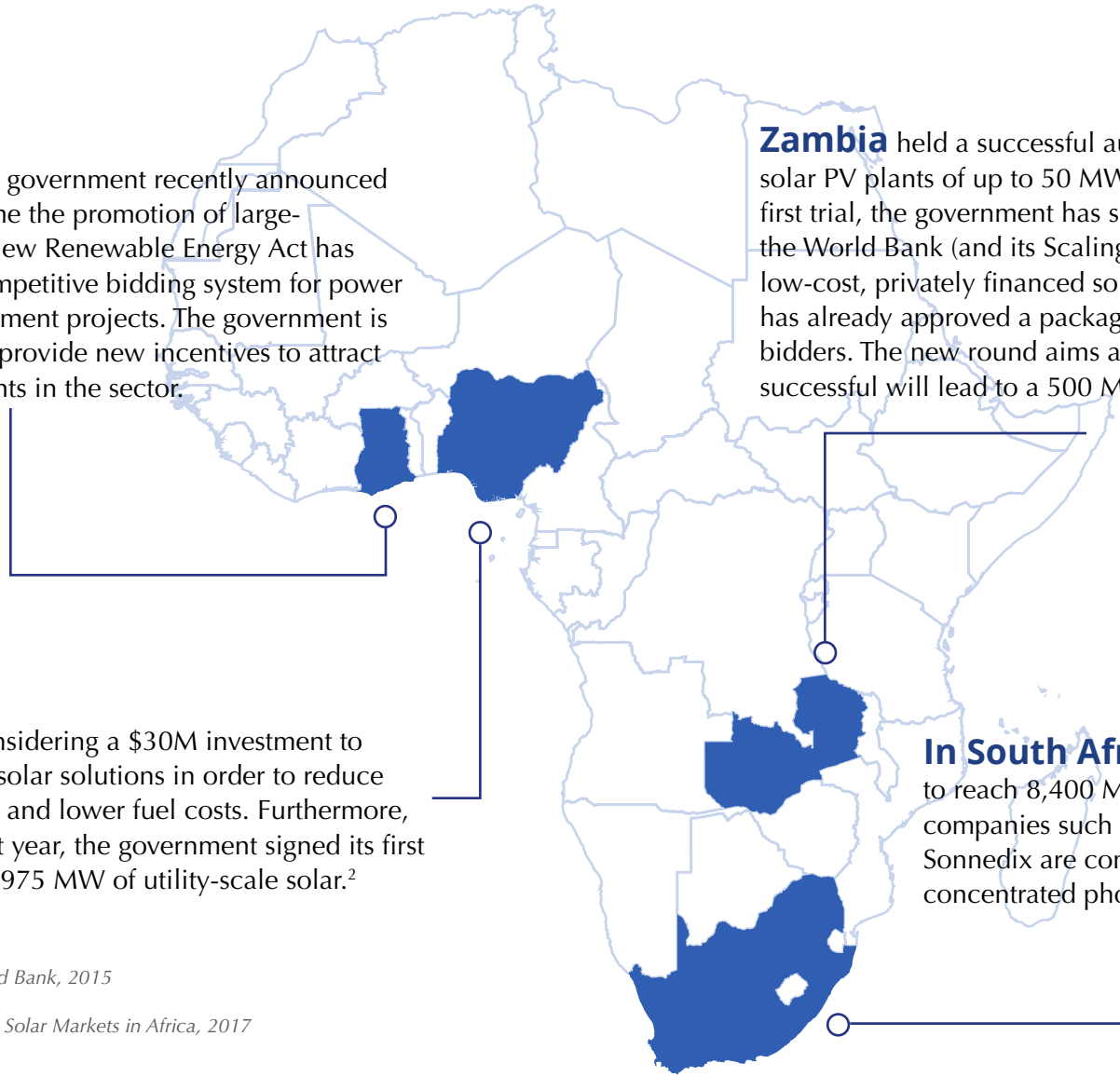
The international community is investing heavily in the potential for solar mini grids to bring electricity to rural areas in Kenya. The UK Department for International Development (DFID) and the French Development Agency (Agence Française de Développement, AFD) have implemented the Green Mini Grid Facility Kenya, a fund aiming to "enhance access to energy in Kenya by encouraging private investment in renewable energy based mini grids." The Kenyan government has supported progress stating that, "the lower the total demand and the larger the distance from the grid, the more likely PV is an economic solution." Furthermore, it has included four of its agencies as part of the program committee: (i) MoEP, (ii) ERC, (iii) REA, and (iv) KPLC. The Kenyan Government is also backing a program to bring solar electricity to rural off-grid areas via investment into mini grid solar plants, funded by the World Bank ($150M).

Beyond Kenyan Borders

How the market's developing in neighboring countries?

Ghana's new government recently announced its plans to resume the promotion of large-scale solar. The new Renewable Energy Act has established a competitive bidding system for power capacity procurement projects. The government is also planning to provide new incentives to attract private investments in the sector.

Zambia held a successful auction back in 2016 for two solar PV plants of up to 50 MW each. After this successful first trial, the government has signed a second agreement with the World Bank (and its Scaling Solar program) to provide low-cost, privately financed solar energy. The World Bank has already approved a package of financing products for the bidders. The new round aims at developing 200 MW, which if successful will lead to a 500 MW developed installation.[1]



Nigeria is considering a $30M investment to develop off-grid solar solutions in order to reduce diesel generators and lower fuel costs. Furthermore, by the end of last year, the government signed its first PPA to purchase 975 MW of utility-scale solar.[2]

In South Africa solar energy is expected to reach 8,400 MW by 2030,[3] where big companies such as Acciona, Iberdrola, and Sonnedix are completing solar photovoltaic and concentrated photovoltaic projects.

1. Scaling Solar & World Bank, 2015
2. PV Tech, July 2016
3. LSE, The Five Biggest Solar Markets in Africa, 2017

5 Considerations
What will it take to reach scale?

Despite the strong market drivers, certain factors must be taken into consideration when evaluating the potential for full-scale SHS and GMG implementation in Kenya.

Financing:
It's true that solar projects are getting a lot of attention and funding from the international community, and the Kenyan government is supporting these efforts. However, when it comes to commercial financing for smaller ventures, businesses might still struggle to get financing from national or regional banks.

Lack of Precedent:
Kenya is bound to experience a solar revolution that will allow the majority of its population to access electricity nationwide. Yet, even though the market projections are optimistic and pilots have been successful, large-scale implementation in the country is unprecedented and thus a certain level of uncertainty remains, e.g. How fast will the infrastructure develop? How will the market respond? Will customers respond to the these new energy sources positively? etc.

Other Energy Sources:
Kenya's energy mix is highly dominated by geothermal, thermal, and hydro, with solar making up a very small percentage of total energy supply. The government continues betting on hydro and geothermal to grow and has heavily invested in long-term projects in these sectors. Oil prices also remain low, and even though Kenya is still a net oil importer, the discovery and exploitation of oil reserves has increased in recent years. Kenya's plans to start exporting crude oil to Mombasa via the newly constructed pipeline were supposed to kick off in mid-2017 but the government has temporarily frozen this multi-million dollar plan. While it's currently uncertain, if oil and gas exploitation were to grow in the country and prices go down, efforts to expand solar energy sources might get delayed.

This report was complied by I-DEV, part of the Managing Entity of the GMG Facility Kenya, to summarize key insights from our work in the sector.

The Green Mini Grid Facility Kenya, led by the Agence Française de Développement (AFD), is designed to enhance energy access in-country and across the region by strengthening private investment in renewable energy-based mini grids and operators, as well as general sector strengthening.

The GMG Facility is funded through a £9.5M venture grant facility funded by the UK Department for International Development (DFID) and an additional €5.65M from the European Union Africa Infrastructure Trust Fund (EU-AITF). The project is managed by Innovation Energie Developpement (IED), in partnership with I-DEV and Practical Action Consulting (PAC) – the Managing Entity.

Since its launch in 2017, the GMG Facility has supported 4 Kenyan mini-grid developers with investment grants and technical assistance in demand assessment, productive use of energy, business modeling and capital structuring. Initiatives have also included a mapping of barriers to market development and opportunities for impact in BoP markets; recommendations on strengthening mini-grid regulations and tariff models; and approximately €5M in output-based grants to 3 private mini-grid developers. The GMG Managing Entity is also implementing a sector-level initiative to assist mini-grid practitioners to develop and deploy high-priority productive use of energy applications; and is co-developing a suite of financial products and services with financial partners to improve access to finance in Kenya.

Ultimately, the Facility's objective is to promote strong economic development and social impact in rural areas; reduce inequalities between rural and urban/per-urban areas; improve standard of living for these communities; and reduce greenhouse gas emissions. Successes and lessons learned in Kenya will inform the region and operators on key opportunities for regional scale and replication.

GMG Facility Kenya

Targets:

2 *MW of sustainable energy*

8-10 *Mini-grid developers benefiting from grants and TA*

25k *Number of connections established*

100k *Number of Kenyans whose lives are improved*

EUR 15M
Total Funds

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