REPUBLIC OF KENYA

MINISTRY OF ENERGY AND PETROLEUM

CURRENT ACTIVITIES AND CHALLENGES TO SCALING UP MINI-GRIDS IN KENYA

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CONTENTS

LIST OF FIGURES & TABLES

1 | BACKGROUND

Access to electricity service in Kenya has increased rapidly from 23 percent in July 2009 to 41 percent by the end of 2014 and to roughly 50 percent by August 2015, exceeding the average rate of access to electricity in Sub-Saharan Africa of 35 percent.[1] Despite significant achievements in the last five years, the interconnected electricity system covers only the coastal, central, parts of eastern and western part of the country (Figure 1). As such, most of the remote parts of the country have no grid coverage and electricity access in these regions is less than 5%. The counties located in these areas have also lagged behind in economic development. In fact, 8 of Kenya's 20 poorest constituencies — where 74 to 97 percent of people live below the poverty line — are in northern Kenya.[2]

The 1997 Rural Electrification Master Plan (REMP) was developed in an effort to accelerate rural connections and address this disparity. This plan, however, focused on central grid extension without addressing the need for decentralized solutions. In 2009, the REMP was revised and adjusted to incorporate off-grid electrification approaches. Now the source of electricity supply in some of these underserved and remote counties is from a few existing, predominantly diesel-powered mini-grid systems developed by the government, and other off-grid options, such as standalone home systems from private developers.

The country has an ambitious target of achieving universal access to electricity by 2020, with due consideration to enhancing shared prosperity, and not leaving behind traditionally underserved rural populations, as well as rural institutions such as schools, health centers, and administrative buildings. Mini-grids will likely play a significant role in achieving this target – up to 23 percent of the population could be served by mini-grids.[3]

[1] Sustainable Energy for All Global Tracking Framework 2015 "Progress Toward Sustainable Energy" http://trackingenergy4all.worldbank.org

[2] Republic of Kenya "Vision 2030 Development Strategy for Northern Kenya and Other Arid Lands" July 2011

[3] A report commissioned by DFID to consulting firm IED estimates that about 23% of the population is best served by mini-grids demonstrating a high potential for mini-grids in Kenya.

2 | CURRENT STATUS OF MINI-GRIDS IN KENYA

Approximately two thirds of the Kenyan population live in the Southern belt, extending from east to west, and are within reach of the national grid. The northern portions from the east to the west are sparsely populated, however, and they will be expensive to interconnect to the national grid (Figure 1). Kenya has established mini-grids, initially diesel-based mini-grids and more recently has integrated wind and solar generation into these mini-grids. The Kenya off-grid program to electrify remote centers has been running since the early 1980's. Currently, there are twenty-one mini-grid stations,[4] 19 of which are owned by the Rural Electrification Authority (REA) and managed by Kenya Power (KPLC) while the other two stations are owned and managed by Kenya Electricity Generating Company (KenGen). The total installed capacity for these mini-grids is 24.8 comprising of 23.7MW thermal, 0.55MW wind and 0.569MW solar.[5] The stations operated by KenGen (Garissa and Lamu) are comparatively large; therefore Lamu was recently connected to the national grid, and construction is being undertaken to connect Garissa to the grid as well[6]. Next to those large and medium-sized mini-grids, pico-grids exist, many of which are community owned and operated.

According to a recent study,[7] there are 11 mini-grid sites currently under construction by REA. The REMP of 2009 and the SREP project document for mini-grids of 2013 also identified another 42 potential sites for mini-grid development.

Various development partners are supporting the integration of more renewable energy generation into existing mini-grids and also constructing new renewable energy and diesel mini-grids. Many donor activities aim to leverage private sector participation. A summary is provided below in Table 1.

TYPES OF MINI-GRIDS IN KENYA[7]

Type 1 (> 1000 kW)

Type 1 mini-grids are essentially Independent Power Producers (IPP) that are usually grid-connected and sell most of their power to an anchor off-taker (typically Kenya Power) based on a Power Purchase Agreement (PPA). The licences issued by the Energy Regulatory Commission are for captive supply, indicating that distribution and supply of electricity occurs within the boundaries of the estates. While technically a mini-grid, including their own power source, distribution networks and a number of consumers (processes, offices, staff housing, etc.), these firms are not currently selling electricity under retail agreements. However, they may step-down power to local retail consumers mostly for social reasons (for example, some companies supply power to workers' families within their land) or because of obligatory commitments. The most common profile of a Type 1 project is a large industrial operator, e.g. a tea factory or flower farm that first develops energy solutions for internal use, then sell the excess to KPLC under a PPA. Examples of such firms include Oserian Development Company, Virunga Power, and the Kenya Tea Development Agency Power Limited. These projects usually have the ability to attract project and corporate financing, depending on the track record of the developers and the characteristics of the PPA. Capital grants to bring down the cost of the distribution network is one of the greatest needs

[4] Most are diesel-based while some are hybrids with solar and wind

[5] KPLC Annual Report and Financial Statements, Year End 30 June 2015

[6] Lamu is now connected to the grid through a 220kV line from Rabai (Mombasa), while the 132kV line Kindaruma-Mwingi-Garissa line is under construction.

[7] Until new legislation is passed, installed mini-grid capacity of less than 3,000kW require a permit. Anything greater than 3,000kW requires a license.

among this group. Besides the relatively higher installed capacity, the unique feature of Type 1 mini-grids is that their business is anchored on purchases from the utility with a confidence in demand for electricity and expectation of reliable and timely payment for service.

Type 2 (100kW – 1000 kW)

Type 2 mini-grids in Kenya, just as the twenty-one mini-grids described at the start of this section, have so far been delivered exclusively through a public model in which REA is in charge of implementation of projects (construction of the generation and distribution infrastructure) and KPLC is in charge of operation and maintenance. The tariff schedule approved by ERC is uniform for all customers of KPLC, retailing at an average[8] of $0.20/kWh. With the exception of the mini-grids in Lamu and Garissa, all type 2 mini-grids are run by the public utility, KPLC.

Among other possible models, there are two business models commonly envisaged for type 2 mini-grids with private-sector involvement:

- **Mini-grid IPP Model** (Separate Genco-Disco). Mini-grids developed using a Public-Private Partnership (PPP) model where the GoK, through e.g. REA, invests in land, electricity distribution network and basic support infrastructure, and the private sector invests in and operates the hybrid system, and sells power to KPLC under a PPA. KPLC or REA would be responsible for retail distribution of electricity.
- **Mini-grid Concessions** (Combined Genco-Disco) Mini-grids where the private sector invests in both generation and distribution, operates the mini-grid and sells electricity to retail customers at a tariff approved by ERC. ERC would grant a concession to the company. Subsidies may be required depending on the tariff model.

Many mini-grids have now integrated renewable energy (solar and/or wind) to offset diesel consumption. Wind for Prosperity, which is a program being developed by Vestas, DI Frontier Capital and Maara Energy Limited is one example of a type 2 approach.

Type 3 (< 100kW)

NGOs, communities, and academia have developed small type 3 mini grids, and several private firms in Kenya are developing these mini-grids in small but densely populated areas, sometimes just next to the main grid. These sites differ greatly from the utility scale approach of KPLC in that these mini-grids are based on renewable energy (mostly solar), are relatively mobile, and cover smaller radiuses with low voltage distribution. Some of them do not provide grid-quality electricity (often providing a lower tier of electricity access – tier 2 to 3) and the tariffs are unregulated and cost-reflective. Until recently, these kinds of firms were unlicensed yet "tolerated" to operate. The ERC however recently issued Powerhive a provisional license to expand to 100 sites in the counties of Kisii and Nyamira. To-date this licence covers the tariff schedule as well as technical issues, including issues of land, environmental impact assessments and other clearances. While most type 3 mini grid projects have relied on grant funding, many are now pursuing a commercial approach. Powerhive, Powergen, and Practical Action are a few examples of firms that are developing type 3 projects in Kenya. GIZ has also developed a mini-grid project in Talek, Narok County, as a demonstration project. The 50kW solar-hybrid system (PV, batteries, back-up generator)

[8] This value is not fixed, but changes every month depending on the pass-through costs (monthly fuel and forex fluctuations, and semi-annual changes due to inflation).

operates under a Special Purpose Vehicle (SPV), the Talek Power Company, and is owned by the County Government of Narok. Un-interrupted grid quality electricity is be provided at a tariff agreed with the community. The project has received a permit from the ERC to generate, distribute and retail electrical power.

There is no established model to deliver Type 3 mini-grids, with most developers currently in their pilot stage. Projects are private, developed by either companies on a commercial basis, NGOs or other, but revenue and ownership models differ in each case. Nevertheless, commonalities of the emerging private/commercial models are:

- Choice of small but densely populated sites with ability and willingness to pay for services. Most of these sites are near the grid (but have not yet been connected) rather than in remote vulnerable locations, such as Northern Kenya, where most type 2 mini-grids are planned by the government.
- Customers are charged cost-reflective tariffs (>0.8 $/kWh). These are however below the equivalent cost of traditional energy sources, such as kerosene, dry cell batteries, cell phone charging services, etc. Unlike the billing structure of KPLC, these companies have very low connection fees or fixed monthly charges, including all of these in the variable per kWh cost. This is better suited to base-of-the-pyramid market and their expenditure patterns.
- Tariffs are high enough to guarantee fast payback periods (usually below 10 years). Considering many of the type 3 projects are not protected by licences, investments need to be recovered quickly.
- There are different views regarding the ownership of assets and exit strategies. Some companies are thinking of models where assets are transferred to the communities after a certain period. Considering the proximity of many sites to the national grid, selling to the national or regional utility may also be an alternative.

3 | CHALLENGES TO PRIVATE SECTOR DEVELOPMENT OF MINI-GRIDS IN KENYA

Private sector-led development of mini-grids is recognized by the GOK as a sustainable approach to achieving energy access targets. While Kenya's energy policy and law are currently being reviewed to reflect the adoption of the Kenya Vision 2030 and the promulgation of the Constitution of Kenya 2010, the policy is clear with respect to accelerating universal access to electricity, both through grid extensions and through isolated mini-grids. The policy text is also clear in that the government will seek to collaborate with the private sector in the field of rural electrification.[9]

However, the specifics of operationalizing these provisions remains unclear and there is no articulated strategy for the development of mini-grids. A framework for collaboration with county governments is needed, and specific regulations on tariffs, licensing, and grid expansion, among others, are required for private players to increase their involvement in the mini-grid space.

ISSUE 1: LICENSING AND PERMITTING

Both the current law – the Energy Act (2006) – and the proposed Energy Bill (2015) make clear provisions for entities to apply and obtain generation and distribution licenses through the regulator. More specifically, distributors other than KPLC can be provided with regional licenses to operate distribution networks in the different counties, including mini-grids; however the policy is to have only one distributor in any given geographic area at any given time. Although several private sector companies have been licensed to generate electricity, only two entities (Powerhive, Talek Power Company) have received provisional distribution licenses/permits besides KPLC. While distribution licensing is anchored in law, the process of obtaining a distribution license is still cumbersome, especially for small-scale type 3 mini-grids due to high transaction costs.[10]

Additionally, licensing for activities of power generation, distribution and retail, as well as the power purchase agreements, are not suitable for mini-grids as they are designed for large projects and large utilities (e.g. multi-MW IPPs) and are too long and costly for mini-grid projects. The agencies involved in providing licenses and permits are MOEP, the ERC and the County Governments, and clearances are also required from National Environment Management Authority, Ministry of Lands for way-leaves, Water Resource Management Authority in the case of hydro projects, and Kenya Civil Aviation Authority in the case of wind projects. The licensing and permitting process is lengthy, lasting up to 3 years,[11] and includes high transaction costs. Similarly, there is no programmatic approach for firms interested in developing multiple sites.

Lastly, the negotiation of tariffs is also part of the licensing process. The negotiation of end-use tariffs is to be done with the ERC; however, there is little precedent of this, with KPLC and, as of May 2016, Powerhive being the only entities with approved tariff schedules.

[9] "Kenya: Preparation of a programme for the promotion of investments in Green Mini-Grids" executed by AFD with support from Economic Consulting Associates and EED Advisory as part of DFID's Green Mini-Grids Kenya program. April 2015

[10] The overall licensing costs can often exceed 10% of a project's Capex costs.

[11] Reacting to this lengthy process for such a small system (type 3), GIZ has published a guide for mini-grid licensing to assist mini-grid developers.

ISSUE 2: POWER PURCHASE AGREEMENTS

The power purchase agreement (PPA) used currently for sale of renewable electricity to KPLC, while it may be appropriate for mini-grids when the renewable electricity supplier is operating in a fuel-saver mode and commits only to supply energy (kWh) and not meet capacity, is inadequate for cases when supplier has to meet both capacity and energy requirements. It furthermore only applies for projects above a certain threshold (pursuant to the Feed-in-Tariff Policy).

ISSUE 3: RETAIL ELECTRICITY TARIFFS

The policy is clear in that tariffs ought to be affordable. However, it remains unclear whether uniform tariffs must prevail, or whether cost-reflective tariffs will be allowed. In the case of the latter, it is also unclear how private sector distributors will be allowed to charge and enforce cost-reflective tariffs.

Currently, type 1 mini-grids do not participate in retail activities, and the tariffs of type 3 mini-grids have not been regulated and are thus cost-reflective. Until recently, the only utility with an approved tariff schedule is KPLC, and this tariff schedule is uniform for customers across the country supplied at a particular voltage (whether grid connected or off-grid – this applies to existing type 2 mini-grids). There is a high risk of "tariff jealousy" in the event that neighboring villages are served by private distributors charging cost-reflective prices which are almost always higher than those offered by KPLC. Therefore private businesses are under pressure to match this KPLC uniform tariff, which would make mini-grid projects unviable without subsidies. This could also have socio-economic implications in the areas under private sector coverage with businesses and households preferring areas served by the national utility.

The retail price of electricity ranges between US¢ 15 and US¢ 20/kWh and the government has declared its intention to lower this by up to 50% by 2017. Significant investments in geothermal and plans for coal production have been increased and an agreement to import cheaper electricity from Ethiopia has been signed. If this is achieved, cost reflective tariffs charged by private sector mini-grids will increasingly be challenged.

It should be noted that the current subsidy scheme for Kenya's existing public mini-grids (operated by KPLC and KenGen) includes (a) subsidies for the construction of mini-grids via the Rural Electrification Fund; (b) subsidies for electricity connections, such that connections by REA are fully subsidized and those undertaken by KPLC are partially subsidized; and (c) subsidies for operating costs, including cross subsidization via the Fuel Cost Adjustment (FCA) in the electricity bill of KPLC customers. If KPLC's uniform tariff is to prevail, or if cost reflective tariffs are above the ability or willingness of customers to pay, or if there is some other regulatory imposition (such as compliance with technical standards), private sector subsidy mechanisms will be needed.

ISSUE 4: GRID EXTENSION & MINI-GRID TRANSFER

It is estimated that more than 2 out of every 3 households in Kenya is within a sub-location that is covered by the central grid. More than 90% of the 25,873 trading centers across the 47 counties have been electrified either through KPLC or REA initiatives. The spread of the central grid will be further enhanced by the Last Mile Programme which seeks to promote grid densification around locations that are already served by the distribution infrastructure.

There is a lack of information on grid expansion plans and the areas designated to KPLC, as well as a lack of guidelines on how private investment could be protected if the grid arrives. This causes tremendous delays in projects, and hinders private developers from entering communities out of fear that their investments will be unexpectedly overrun by the central grid and rendered obsolete, even in the case of concessions. For example, politicians could incite or lobby the government to extend the national grid to these areas, in spite of the distribution concessions.

ISSUE 5: CONCESSIONS – ELECTRIFICATION REQUIREMENTS, TECHNICAL STANDARDS, AND FUTURE GRID CONNECTION

As described above, the new framework presents opportunities for competition for concession areas (the policy is to have only one distributor in any given geographic area at any given time), including both grid and off-grid concessions. However, guidelines for concessionaires have yet to be developed. For example, it is not clear to developers whether the area in which a concession may be attained must have 100% access or another level, and the required level of service provision for customers (duration of service per day, the level of reliability, the quality of supply, and the access tier) has yet to be specified. More explicitly addressing service quality may in fact provide an opportunity for expanded service provision. For instance, a "fee-for- service" or a "flat fee," such as a fixed monthly charge for five lights and a single load-limited socket, may allow cost recovery without the unacceptability of a visibly high retail tariff that is expressed in KES/kWh and can be easily compared to KPLC's uniform national tariff.

Similarly, the national electrical grid has technical standards by which contractors building on behalf of KPLC must comply. However, mini-grid developers do not currently have any guidelines, standards, or best practices for development of mini grids which may prevent future interconnections to the main grid[12] and result in sub-standard mini-grid infrastructure. While ERC in fact performs a due diligence (i.e., checks compliance with grid code and ensures installed capacity meets local demand) during the licensing process to check the technical viability of mini-grid projects, the lack of shared guidelines and technical standards imposes uncertainty on project costs, returns, and ultimately project viability. Again, this prevents developers and investors from building mini-grids in Kenya.

ISSUE 6: COUNTY GOVERNMENT COLLABORATION FRAMEWORK

Development partners call for stronger coordination between REA, KPLC and MOEP. The lack of a specified framework for engagement and communication among the three stakeholders has caused significant delays in ongoing projects. Additionally, the new Energy Bill states that the Government shall transform REA into the Rural Electrification and Renewable Energy Corporation (REREC). REREC functions include planning, implementation and promotion of electrification and renewable energy. Given the devolved system of government and the new constitution, some rural electrification activities are viewed as a component of county planning and development of electricity reticulation, which could be transferred to regional distributors (other than KPLC) for operation. Therefore, REREC is to establish a framework for

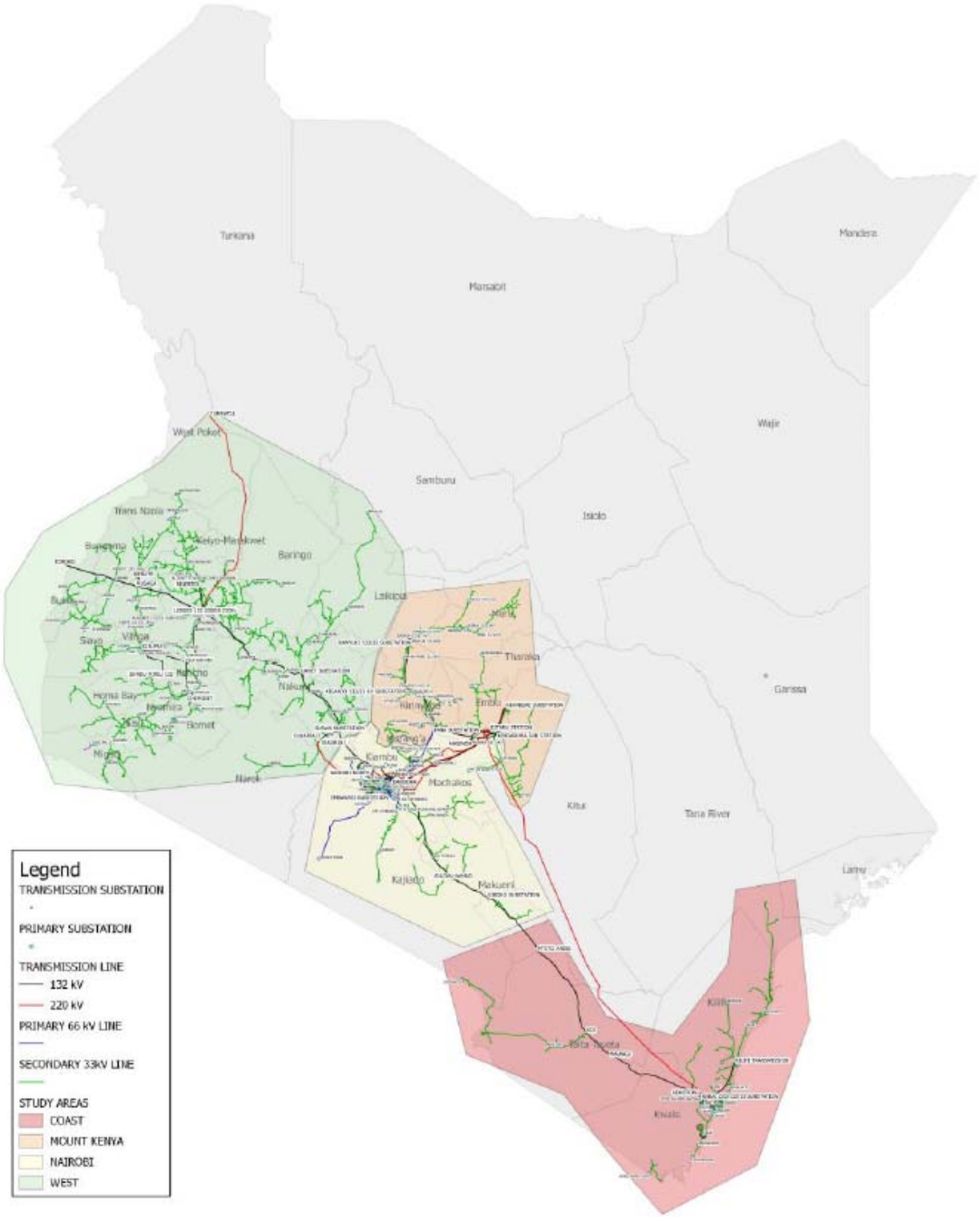
[12] The GOK demanded that the LV distribution for the 50kWp GIZ/Narok County mini-grid pilot (of Talek Power Company) is constructed as per the guidelines of the National Grid Code, which allows subsequently the integration into the national grid. Powerhive specified that their systems will also be designed and constructed according to this standard. It is important for the GOK to explicitly specify whether this will be the persisting standard for all mini-grids.

collaboration with County Governments in the discharge of its mandate, and moving forward mini-grid developers will need to engage with an additional stakeholder – the counties.

ISSUE 7: CAPACITY OF FINANCIAL INSTITUTIONS/ACCESS TO FINANCE

Very few financial institutions in Kenya have experience financing energy projects, but pre-investment and development financing is costly with limited availability. While a few banks have shown great interest in the mini-grid business, mini-grids developers have found it difficult to engage commercial financial institutions due to the unproven nature of their business models as well as the policy and legal gaps discussed above (especially in the case of the typically unlicensed type 3 mini-grids whose role has not been officially recognized by ERC).

Figure 1: Extent & Regional Split of KPLC's Distribution Network



Source: Distribution Master Plan Study, April 2013

Table 1: Summary of Ongoing Mini-Grid Activities in Kenya

ORGANIZATION	AMOUNT	# MINI-GRIDS	SOURCE OF FUEL	BUSINESS MODEL	LOCATION	DESCRIPTION
AFD	€33 million (loan)	23	Solar and wind	PPA	Previously existing mini-grid sites	Retrofitting of 23 KPLC mini-grid sites to add renewable energy
AFD	€60 million (loan) made available - but not exclusively earmarked for mini-grids			Mainly those associated with type 1 and 2 mini-grids	No limit on geographical location within Kenya.	AFD lines of credit established at local banks provide capital support to renewable energy in Kenya. This financing is not only limited to mini-grids, but green mini-grids will be explicitly made eligible, and partner banks will be specifically briefed. Will have close links with the £30 M DFID grant (refer below).
KfW (via German Development Cooperation)	€15 million	3		Mixed model ("PPA Model") where the private sector builds, owns & operates the generation component of each mini-grid. KPLC will distribute.	three sites in Turkana/Marsabit, namely Dukana, Kalokol, and Ngurunit	KfW will develop mini-grids in Turkana and Marsabit County. The selection of private sector will be done through reversed bidding process (RE auction model).
GIZ (via German Development Cooperation)	€7.5 million	Up to three	Solar-hybrid	Focus on ESCO (energy service company)/ concession model	Country wide, with a focus on Northern Kenya (Turkana, Marsabit)	The GIZ Promotion of Solar-Hybrid Mini-Grids project has set out to test the viability of mini-grids in Kenya through private sector leadership. GIZ is providing technical assistance on mini-grid policy, implementing mechanisms (e.g. tariff structures, licensing), capacity building with focus on solar technicians, and support to pilot projects.
GIZ (funded by DFID, hosted by Energising Development and implemented by GIZ)	€ 2.1 million	Up to 20 (<50kW)	Solar-hybrid	Two potential delivery models: IPP and concession (ESCO) models	Country wide, with a focus on Northern Kenya (Marsabit, Turkana)	The results-based financing (RBF) intervention aims to provide incentives to project developers to create a market for mini-grid electricity generation and trigger private sector investment. GIZ is cooperating with Barclays Bank of Kenya to provide incentives.
DFID	£30m	600,000 new connections by 2020	Solar and Wind	Open	No limit on geographical location within Kenya.	With support from the International Climate Fund (ICF), DFID will support project preparation and leverage private investment in Green Mini-Grids (GMGs). AFD is the local implementing partner.
World Bank	US$ 11 million			two private sector PPA models with KPLC as the off-taker		The World Bank is supporting green-field mini-grid development.
USAID/Power Africa in collaboration with Powerhive		100 villages			Kisii	Power Africa is supporting a private company (Powerhive) for mini-grid development in Kisii to enable them to upscale. USAID will provide TA and OPIC debt financing. A generation & distribution license was granted by ERC.
Embassy of Spain	US$ 16 million	5	Solar, Wind, Diesel hybrid		five sites in Turkana, Napeitom, Kerio, Lokamarinyang, Illaut and South Horr	The Embassy of Spain is providing US$ 16 million in support for mini-grid projects (solar-wind-diesel hybrids)