



# Mini-Grid Policy Toolkit- Case Study

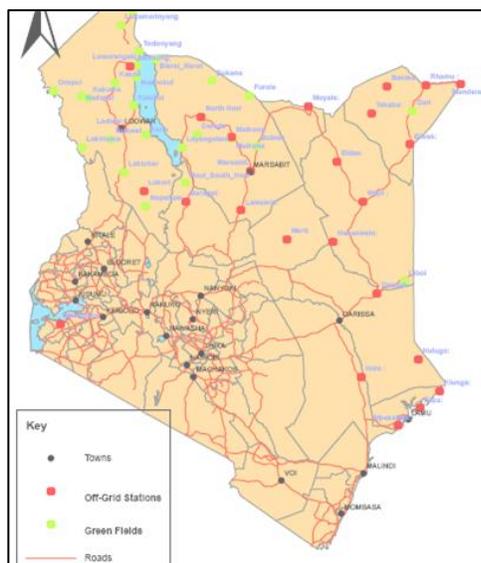


Country: KENYA

Project: Rural electrification with government-run mini-grids

Utility Operator Model

## Project Summary



Site map of Kenyan mini-grid locations (red dots)

In off-grid areas of commercial or strategic importance, Kenya has traditionally set up diesel-powered mini-grids that are managed by the national utility. Political pressure to continue expanding electricity access to the entire population has led to a revised policy framework under which the national Rural Electrification Authority (REA) now handles development of mini-grid sites throughout the country. Meanwhile, the high cost of diesel has led to the adoption of hybrid renewable-diesel mini-grids in a number of remote areas. This is a public sector model, with work managed by REA and carried out by the company Kenya Power(KPLC), a for-profit corporation majority-owned by the Government. Revenue is used for site-specific operation and maintenance, and the Government compensates KPLC for the extra costs it must incur to manage and fuel remote sites through a rural energy levy on all electricity bills.

## Background

Kenya has piloted a Government-owned and operated model of off-grid power generation, using mini-grids powered mostly by diesel generators. A small percentage of the energy in 7 of these 14 mini-grids is now being produced by solar and wind energy, which operate in conjunction with the existing diesel setup (hybrid mini-grids). The new Scaling-up Renewable Energy Programme (SREP) will fund dozens more of these renewable and hybrid mini-grids going forward. Some of the benefits and challenges of this Government-run model are outlined below.



## Basic Information

Location	Various, rural Kenya
Project implementer	Kenya Power (KPLC)
Project date	Kenya has been managing diesel mini-grids since before the country's independence. Solar and wind hybrid systems were first introduced in 2011.
Beneficiaries	Residential, schools, cottage industries, community centres
Project cost	kWh costs per site are significantly higher than Kenya Power electricity costs because of the transport of fuel to site and losses incurred. Government investment costs in equipment (generators and renewable equipment) are also relatively high compared to normal investment costs.
Organisations involved	KPLC, Rural Electrification Authority, Ministry of Energy and Petroleum

## Policy & Regulatory Framework

Kenya is committed to universal access to modern forms of energy by 2030, as outlined in Vision 2030, the national development blueprint. Energy has been identified as one of the important pillars to achieve this vision: the Government plans to increase access from the current 30% to 65% by 2020 and to 100% by 2030. In order to achieve this, the Government is reviewing national energy policy (Sessional Paper No. 4) and the Energy Act of 2006. Section 66 of the Energy Act of 2006 established the Rural Electrification Authority (REA) with the principal mandate of extending the electricity supply to rural areas, managing a rural electrification fund, mobilizing resources for rural electrification, and promoting the development and use of renewable energy.

The REA has put in place a Rural Electrification Master Plan (REMP) with a view to addressing off-grid energy needs. A 2009 study conducted as part of the REMP identified 33 sites for the establishment of off-grid power stations, of which 10 are currently under development, along with 8 additional sites not recommended in the study. It is not clear whether these sites overlap with planned grid extension; although REA is responsible for both grid extension and off-grid mini-grid site mapping, grid extension is a highly politicized process and anticipating the pace and specific targeting of grid connections has been difficult.

Rural electrification projects in Kenya are funded by the Ministry of Energy and are carried out primarily by REA, with some implementation by KPLC, the national utility. KPLC is the single buyer in the power market in Kenya, purchasing in bulk from all power generators on the basis of the negotiated Power Purchase Agreement (PPA) for onward transmission, distribution, and retail to customers. The Government has a majority share in KPLC; the rest is privately owned. In practice, KPLC manages and operates remote mini-grids around the country.



## Technology

### Overview

The Kenyan mini-grids generally utilise diesel-fuelled generator technology.

The total installed mini-grid capacity across Kenya is 19.16 MW, consisting of 18.1 MW thermal, 0.55 MW wind, and 0.5 MW solar PV power. The relatively small solar and wind contributions, outlined in the table below, represent only 5% of total installed capacity (and even less of the power produced) as they are being piloted in just 7 of the mini-grids, with a view to scaling up this hybrid approach once funding is secured. The solar energy component helps to service the base load during the day. As there is no energy storage, the remaining load is met by the diesel generators.

The existing medium voltage transmission network is either 33kV and/or 11kV, both of which are stepped down to 0.433kV and 0.24 kV for distribution to consumers. All the consumers connected to the mini-grids have post-paid meters utilizing the same domestic consumer tariffs as grid-connected customers. The domestic tariff is divided into three sections (0–50kWh, 51–1500kWh and >1500 kWh).

No.	Station	County	Installed Diesel Capacity (kW)	Installed Wind Capacity (kW)	Installed Solar PV Capacity (kW)
1	Wajir	Wajir	1746	0	0
2	Mandera	Mandera	1600	0	300
3	Marsabit	Marsabit	560	500	0
4	Lodwar	Turkana	1440	0	60
5	Hola	Tana River	800	0	60
6	Merti	Isiolo	128	0	10
7	Habaswein	Wajir	360	50	30
8	Elwak	Mandera	360	0	50
9	Baragoi	Samburu	128	0	0
10	Mfangano	Homabay	584	0	0
Total			7706	550	510

Installed capacity at 10 Kenyan off-grid mini-grids (Source: SREP Kenya)

### Technology Approach

Expansion of the network to other customers is a continuous process, but is done only upon request by the new customer and after payment of the required connection fee. The connection fee depends on several variables, including the type of voltage required by the consumer and their distance from the grid. The power supply schedule is 24 hours per day, 7 days per week, targeted mainly to small businesses, social institutions such as schools and health centres, and residents.



## Operator Model

### Ownership and Operations

The Kenyan Government mini-grids use a Government-managed operator model. Generation assets belong to the Ministry of Energy and Petroleum. KPLC operates and maintains the mini-grids. The Rural Electrification Authority plans and implements new mini-grids using income generated from the Rural Electrification Levy (which is part of all consumer bills).

The national power supply consists of an interconnected grid system and 14 diesel mini-grids serving areas located far from the national grid. Of these 14 off-grid mini-grid diesel power stations, 12 are owned by the Government and are operated and maintained by KPLC. The other two (in Lamu and Garissa) are comparatively large and are owned and operated by Kenya Electricity Generation (KenGen) company. This case study focuses on the KPLC-run smaller sites.

Diesel mini-grids face significant cost challenges with continued increases in fuel costs. In fact, government-owned diesel off-grid power plants operate at a loss. To address this constraint, the Government has embarked on a pilot programme to install renewable energy (RE) into the existing diesel power stations. The programme has had slow progress due to funding constraints, and as of 2013 only 7 plants had any RE capacity installed. The RE mini-grids being constructed by REA will remain assets of REA. REA and KPLC have signed a Service Level Agreement (SLA) that provides for all its off-grid power stations to be operated and maintained by KPLC. Furthermore, as mentioned above, the reconciling of off-grid electrification planning with grid extension plans has not always been easy.

As of 2013, the Privatisation Commission of Kenya was developing a Public Private Partnership (PPP) framework for hybridization (with RE) of both existing and planned off-grid stations. The scope for private off-grid power ownership, operation, and maintenance, however, remains a work in progress, as the "threat" (although it is widely agreed to be a good thing) of grid extension means either decommissioning or trying to feed power into the main grid at standard feed-in tariffs for private investors (which are not currently viable for them). The RE mini-grids being developed will operate within this framework. REA has at least 2 small-scale PPPs in place for "demo" mini-grids, one of which was established by Southampton University in Kajiado (southern Kenya).

### Pricing and Tariffs

The agreement between KPLC and the Government is such that all revenues generated at a specific site are retained for the operation and maintenance of that mini-grid. In the event that revenues are insufficient to cover costs (which is always the case with high-cost diesel fuel powered generators), the Government covers the losses, resulting in increased viability and reduced risk for KPLC, but at the same time reducing the incentives to implement measures to increase efficiency. As the electricity tariff is uniform nationwide for both on and off-grid power, this Government reimbursement means on-grid consumers effectively subsidise higher-cost off-grid electricity



production through a rural energy levy on all electricity bills.

## Lessons Learned

- ✓ The unified tariff (all Kenyan electricity rate payers pay the same per kWh both on and off-grid) means that more expensive electricity from mini-grids must be subsidised. The rate-payers and the Government must thus cover the cost of all electrification roll-outs. REA and KPLC do not have the resources to cover the entire off-grid regions with subsidised electricity.
- ✓ A detailed, updated and predictable rural electrification master plan is needed to reduce the possibilities of off-grid power sites being overrun by the national grid. This is important for any off-grid site development, but essential if the Government is to open up off-grid power generation to the private sector.
- ✓ Renewable energy technology has higher up-front costs than diesel generators. In order to be attractive to the private sector, they must be assured of an 'anchor load' (main guaranteed electricity consumer), and even so, the numbers can be difficult. The public sector is in the position to encourage RE uptake through funding of up-front costs; in the current donor climate, governments are relatively disinclined to pay for this themselves, if there is a prospect of donor participation (such as with SREP).
- ✓ The tariff structure in Kenya is such that the fuel cost of power generation is passed through to the consumer, meaning prices are high. Various mechanisms to bring down costs must be considered.