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## SMART COMMUNITIES COALITION – MAKE CHANGE PILOT

### Assessing the Potential for Off-Grid Power Interventions in Turkana County with a Focus on the Communities around Kakuma and Kalobeyei

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## Executive Summary

Mini-grids and solar home systems (SHS) in Kenya for Energy Access (MAKE Change for Refugees) is a Smart Communities Coalition pilot that aims to increase off-grid energy access in the Kakuma and Kalobeyei refugee camp complex in Turkana County, northern Kenya, in a way that aligns with plans for the wider county. This report summarises the findings from a pre-feasibility mapping of the current energy initiatives in the county and camps. The Smart Communities Coalition (SCC) seeks to improve the delivery of essential services to refugees and host-community members through enhanced coordination between public and private entities as well as strategic implementation of technology. The SCC's efforts focus on three foundational pillars – connectivity, digital tools and energy access – with pilots in Uganda and Kenya in 2018 and 2019.

Kakuma camp hosts nearly 150,000 refugees and Kalobeyei is a settlement, about 15km away, hosting a further 38,000 refugees.<sup>1</sup> The Office of the United Nations High Commissioner for Refugees (UNHCR) manages both sites in cooperation with the Refugee Affairs Secretariat (RAS) and a range of donor agencies. Although the town of Kakuma uses a Kenya Power diesel mini-grid, **many inside the settlements have no access to power, while those who do get it from expensive and unreliable sources such as informal diesel mini-grids or rooftop solar systems that often fail.** Kenya Power may be willing to connect customers inside the camp, but this does not fall clearly under its remit.

Challenges to commercial off-grid energy provision within the camps include **short-term procurement cycles and political prospects**, as well as **a lack of economic incentives for agency and household consumers to pay** for cleaner power – in addition to the logistical difficulties inherent to all off-grid power delivery. Private companies may be encouraged to offer cleaner, more affordable and reliable off-grid power in these settings if certain risks are mitigated. **Examples of private-sector-operated mini-grids and commercial SHS sales in other humanitarian settings are limited** – and would merit further assessment.

Feasibility work has been done on potential mini-grid sites in Turkana County through several programmes such as the Kenya Electricity Modernisation Project (KEMP) and the Kenya Off-grid Solar Project (KOSAP). Additional studies by the International Finance Corporation (IFC) and the Moving Energy Initiative have looked at opportunities for energy interventions within Kakuma and Kalobeyei. A number of projects have been implemented or are planned, including by Energias de Portugal (EDP) (solar street lights), the IKEA Foundation (solar streetlights and solar lanterns), SNV Netherlands Development Organisation and the Moving Energy Initiative (SHS supply-chain support), the International Rescue Committee (institutional solar at clinics), and the German development agency GIZ (mini-grids). **Historically, projects have been limited in scope, sustainability and impact.**

Upcoming **opportunities to finance off-grid energy activities** in the region include the IFC Challenge Fund and KOSAP. Equity Bank and Africa Action Help International offer **consumer and asset financing products that could expand access**, and existing pay-as-you-go SHS distributors operating in Kenya are seeing modest success with their mobile-money-enabled credit platforms.

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<sup>1</sup> UNHCR figures as of 30 June 2018, <http://data2.unhcr.org/en/situations/southsudan/location/1867>

This mapping exercise identified **several opportunities for private-sector off-grid companies to deliver clean, reliable power at un-electrified and diesel-powered sites**, working with existing donor agencies, NGOs and informal energy providers. There are also potentially significant opportunities for SHS companies to develop local markets, but they will require limited subsidy and other forms of risk mitigation to do so.

**The main opportunities for increasing electrification lie within and around the Kakuma camp and the Kalobeyei settlement** because KOSAP and KEMP cover much of the wider county. Having said that, **there are opportunities to partner with KOSAP and also the county government** in the realisation of their recently drafted energy plan.

In relation to Kakuma and Kalobeyei, the following opportunities exist for the SCC to support improved energy access.

- **Work with local diesel mini-grid operators** to formalise their businesses, hybridise power generation and expand distribution.
- **Hybridise the town of Kakuma's existing Kenya Power mini-grid with solar**, and support its extension to agencies and potentially other customers within the camp.
- **Build upon ongoing electrification projects**, such as the GIZ-funded Kalobeyei mini-grids and recently installed solar installations with excess capacity.
- **Conduct detailed feasibility and develop opportunities for new micro-grids and mini-grids** using existing diesel-powered institutions such as field offices or health clinics as anchor loads (for privately run hybrid A-B-C models<sup>2</sup>) or greenfield sites.
- **Expand support to SHS companies to increase their market** within Kakuma, using it as a base to expand further into Turkana County.
- Ensure that these interventions incorporate **models for improved operations and maintenance, financing, procurement and management**, learning lessons from GIZ and KOSAP implementers as well.

These opportunities will be discussed further with the SCC's MAKE Change pilot working group to develop a detailed work plan for any future intervention.

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<sup>2</sup> The "ABC" model splits the customers of the mini grid into three categories – anchor, business and community. The anchor customer typically has larger loads and is a reliable credit worthy customer. The business customers are local income generating businesses using power for productive use or commercial loads. Finally, the community customers are local households or community building that typically have smaller demands for lighting and powering small appliances.

## Acronyms

ERC	Energy Regulatory Commission
GIZ	German Corporation for International Cooperation
IFC	International Finance Corporation
IRC	International Rescue Committee
KEMP	Kenya Electricity Modernisation Project
KOSAP	Kenya Off-grid Solar Access Project
LWF	Lutheran World Foundation
MAKE	Mini-grids and SHS in Kenya for Energy Access
MEI	Moving Energy Initiative
NES	National Electrification Strategy
PPA	power purchase agreement
PPP	private-public partnership
PV	photovoltaic
RAS	Refugee Affairs Secretariat
RBF	results-based finance
REA	Rural Electrification Authority
SHS	solar home system
SWH	solar water heating



# Introduction

## 1.1 The MAKE Change Pilot

Mini-grids and solar home systems (SHS) in Kenya for Energy Access (MAKE Change for Refugees) is a pilot under the Smart Communities Coalition (SCC),<sup>3</sup> conceived during a design workshop in Nairobi in March 2018. The SCC seeks to improve the delivery of essential services to refugees and host-community members through enhanced coordination between public and private entities and strategic implementation of technology. The SCC's efforts focus on three foundational pillars – connectivity, digital tools and energy access – with pilots in Uganda and Kenya in 2018 and 2019. The SCC recognises that there are a number of actors looking at providing electricity access in the Kakuma and Kalobeyei refugee camp complex, and the government of Turkana County has a newly drafted energy plan that, alongside the National Electrification Strategy, presents opportunities to electrify the county more broadly. Within this space there is a risk of duplication, missed collaboration opportunities and missed lessons.

The SCC MAKE Change pilot aims to investigate and implement a strategy for increasing energy access through mini-grids and SHS, using a holistic and well-coordinated approach that builds on current activities and considers Kakuma in the wider context of the county. It will also seek to link energy access with connectivity and digital tools in the two settlement areas.

The MAKE Change pilot consists of four activities, which will result in a roadmap and facilitation of new off-grid opportunities for private-sector-led electricity-access solutions considering Kakuma, Kalobeyei and the wider Turkana County.

- Activity 1: Mapping current and planned activities, relevant policies and regulations, private-sector barriers to entry and opportunities with the purpose to identify gaps, challenges and opportunities.
- Activity 2: Conduct a detailed feasibility study to identify specific electricity needs to be met.
- Activity 3: Define best-fit electricity solutions, including innovative business models and implementation approaches linking electricity solutions to connectivity and digital opportunities.
- Activity 4: Facilitate implementation of pilot activities through mini-grids, household solar solutions, connectivity solutions and digital tools.

This report supports Activity 1 with findings from electricity-supply mapping work completed by Energy 4 Impact. The mapping included a review of documents and feasibility studies, stakeholder interviews and on-the-ground assessments. It also draws heavily on data collected through the Moving Energy Initiative (MEI).<sup>4</sup> Information for this report was collected in June and July 2018 and as such is valid as of that period.

As an energy-sector mapping exercise, this report does not specifically discuss issues of connectivity and new digital tools in the camps, in terms of the current situation and of potential interventions. However, the MAKE Change pilot will seek to advance digital solutions and improved connectivity alongside improved access to electricity.

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<sup>3</sup> For further detail see - <https://www.tent.org/members/smart-coalition/>

<sup>4</sup> MEI is a collaboration between Energy 4 Impact, Chatham House, Practical Action, the Norwegian Refugee Council and UNHCR, with funding from DFID.

## 1.2 Turkana County

Turkana County is the second-largest by land area in Kenya (at 13%). It borders four other Kenyan counties as well as South Sudan, Uganda and Ethiopia. Turkana has a harsh, semi-arid climate, with temperatures reaching above 40°C and unreliable rainfall ranging between 150mm and 400mm per annum. There is little suitable agricultural land, and wooded areas and biomass are scarce. Turkana is also the poorest county in Kenya with 88% of the population living below the poverty line, compared with 45% nationally.<sup>5</sup>

The predominant economic activities in the county are nomadic pastoralism and fishing. Most fresh food is brought by road from Kitale, a town in the Rift Valley. Lodwar, the county capital, is the biggest town in northwestern Kenya and is an important commercial centre for the wider region. The discovery of commercially viable oil in Turkana in 2012 is hoped to attract additional investment and development.

## 1.3 The Kakuma Camp and the Kalobeyei Settlement

### 1.3.1 Overview

The Kakuma refugee camp is more than 700km from Nairobi and 130km from the border with South Sudan. In 1992 the United Nations High Commission on Refugees (UNHCR) and the Kenyan government created it to accommodate 12,000 refugees fleeing war in Sudan. It now hosts approximately 147,000 refugees from across the region,<sup>6</sup> including from South Sudan, Ethiopia, Somalia, the Democratic Republic of the Congo and Burundi. Nearly 60% of its population is under the age of 18, and there is a greater proportion of men (54%) than women (46%).

The camp is split into four sub-camps, each with residential and market areas. People live in densely situated mud-brick structures with corrugated iron roofs. UNHCR, working closely with the Refugee Affairs Secretariat (RAS), has overall management responsibility for the camp. It is supported by implementing partners responsible for various activities; for example, the Norwegian Refugee Council is responsible for water, sanitation and hygiene, and the International Rescue Committee (IRC) is responsible for healthcare. These agencies receive a budget from UNHCR to implement activities as well as receiving funds directly from other donors.

The town of Kakuma lies adjacent to the refugee camp and is home to approximately 60,000 inhabitants. After 16 years, the camp is now an established settlement, and it plays an important role in the economic landscape of the area due to the high presence of aid agencies, donor-funded programmes and their staff, which source goods and services through the town. There is competition between the local Turkana community and those living inside the camp, especially for resources such as water and land for grazing livestock. With the aim of prioritising land for local communities, refugees have been prohibited from owning livestock and have no right to work or live outside the camp.<sup>7</sup> The majority remain dependent on aid agencies for subsistence; it is estimated that just 8% of the camp population engages in livelihood activities and/or has a means of income beyond the humanitarian assistance provided.<sup>8</sup> However, there is entrepreneurial activity as well as an informal economy in the market centres, which offer a range of goods and services such as haircutting, eateries, hardware stores and food items. A 2018 study by the International Finance Corporation (IFC)

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<sup>5</sup> See <https://www.reuters.com/article/us-kenya-turkana/kenyas-poverty-stricken-turkana-district-dreams-of-oil-wealth-idUSKBN1FU0JH>.

<sup>6</sup> UNHCR figures as of 30 June 2018, <http://data2.unhcr.org/en/situations/southsudan/location/1867>

<sup>7</sup> Refugees, however, can receive a stipend up to a maximum of KES 6,000 (\$60) per month as incentive workers.

<sup>8</sup> Corbyn, D. and Vianello, M. (2018), *Prices, Products and Priorities: Meeting Refugees' Energy Needs in Burkina Faso and Kenya*, The Moving Energy Initiative.



highlights the potential to attract new private-sector players to the area in several key sectors to boost services and job opportunities.<sup>9</sup>

Estimates suggest nearly 85% of households in Kakuma own a mobile phone, and many use mobile money as a method of savings – indicating high potential for mobile-based energy-access tools.<sup>10</sup> Mobile money is more widely used in the town than in the camp (86% of respondents in the town use their phone/SIM card for mobile banking or money transfers compared to 31% in the camp).<sup>6</sup>

Kalobeyei is a refugee settlement that lies 15km from Kakuma camp. Developed by UNHCR and the Turkana County government, it aims to integrate refugees and the local host community, while promoting self-reliance through better livelihood opportunities and enhanced service delivery. Kalobeyei currently provides for over 38,000 refugees<sup>11</sup> and it has the potential to be developed to a population of approximately 45,000. As a relatively new settlement, it is billed as an opportunity to test out new approaches for refugee integration, private-sector engagement and sustainability. It is managed by UNHCR out of its Kakuma sub-office, with support from implementing partners.<sup>12</sup>

### 1.3.2 Electricity Supply and Demand within the Settlements

UNHCR and its partner agencies use diesel generators to supply electricity at most large facilities in the Kakuma camp, including the main agency compounds, managing the infrastructure in-house. There have been efforts to supplement diesel with solar photovoltaic (PV) generation and battery storage at some sites, and also to provide dedicated clean energy at others. These efforts have had mixed results, mainly due to the harsh operating environment, lack of proper operation and maintenance (O&M) of the systems, and a lack of budgetary allocation, often on the part of the agencies, which has led to several cases of premature battery failures.<sup>13</sup>

An estimated 30 *jua kali* (informal) diesel mini-grid operators serve households and businesses within the Kakuma camp. The owner-operators sell power typically for just a few hours a day, charging high tariffs, and often with sub-standard wiring. The informal mini-grid market consists of different suppliers in different quarter of the camp operating as monopolies. The quarters are largely organised by ethnicity.

In Kakuma I, one of the largest informal diesel mini-grid owners (85kW) supplies power to approximately 100 businesses and 20 households through a series of overhead lines that are run to buildings in an ad hoc fashion. There is intermittent supply from 7am to noon and from 3pm to 7pm. In between the generator is switched off for maintenance and to avoid overheating in the high temperatures. There are no meters, so customers pay a fixed monthly charge based on appliances: KES 3,000 for a television, KES 3-4,000 per month for a printer, KES 5,000 for a refrigerator. There is also a fixed connection fee of KES 500. These prices are extremely high, especially compared to the (subsidised) Kenya Power tariffs in the town of Kakuma. This demonstrates there is willingness and ability to pay for electricity.

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<sup>9</sup> IFC (2018), *Kakuma as a Marketplace*, [https://www.ifc.org/wps/wcm/connect/8fb8fab4-af24-4b09-bdff-2109d2c45974/20180427\\_Kakuma-as-a-Marketplace\\_v1.pdf?MOD=AJPERES](https://www.ifc.org/wps/wcm/connect/8fb8fab4-af24-4b09-bdff-2109d2c45974/20180427_Kakuma-as-a-Marketplace_v1.pdf?MOD=AJPERES)

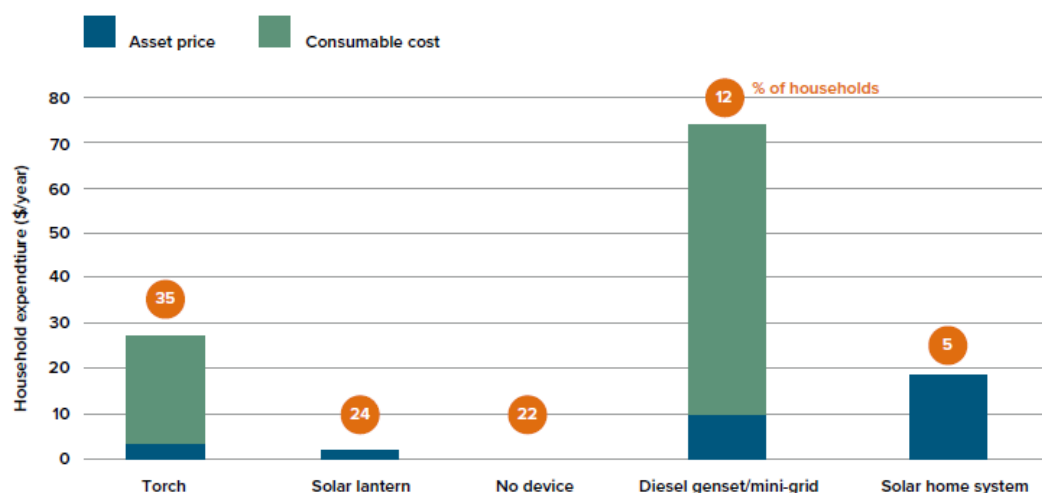
<sup>10</sup> Mwaniki, D. (November 2016), *Socioeconomic Baseline Survey Draft Report (Kalobeyei)*.

<sup>11</sup> UNHCR figures as of 30 June 2018.

<sup>12</sup> Patel, L. (forthcoming), *Infrastructure Management Contracts – Improving Energy Asset Management in Displacement Settings*, MEI, London: Royal Institute of International Affairs.

<sup>13</sup> Ibid.

Surveys conducted by MEI in Kakuma 1 in 2016<sup>14</sup> show that 78% of households have some form of electric light, either from a mini-grid connection, SHS, solar lanterns and other options (battery torches, etc.). Figure 1 shows a breakdown of household expenditure in Kakuma I for the different energy sources.



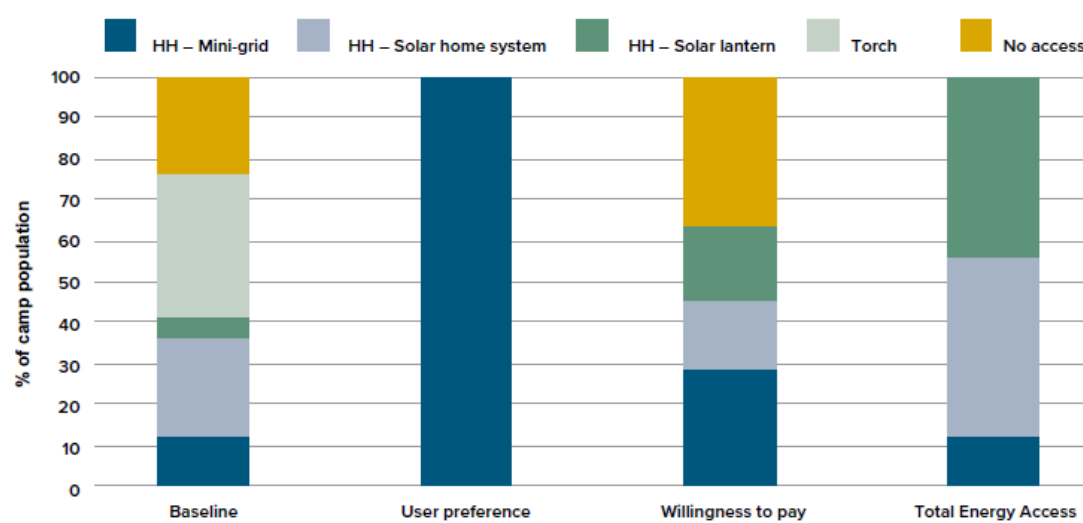
Note: The cost for a diesel generator set/mini-grid is the amount paid by the customer, not by the operator that purchases the generator. Kerosene and candles are used by less than 2 per cent of people. The asset price is levelized according to estimated cost over a five-year product lifetime.

Figure 1: Prevalence of Different Household Lighting Technologies and Annual Expenditures in Kakuma I (MEI, 2018)

Figure 2 shows the mix of lighting technologies present in several different scenarios considered during the surveys, including the recorded baseline, user preference and willingness to pay. It shows that all refugee respondents reported a preference for grid electricity, but fewer than 30% were willing to pay for it. Indeed, more than 35% of respondents were unwilling to pay for any light access. While there are certainly additional factors (including, significantly, ability to pay) influencing the potential market for off-grid energy, these findings point to potential for market-based delivery of power (with subsidies and tailored payment schemes opening up more opportunities).<sup>15</sup>

<sup>14</sup> Corbyn, D. and Vianello, M. (2018), *Prices, Products and Priorities*.

<sup>15</sup> The results of the MEI's surveys can be found on its website here - <https://www.chathamhouse.org/sites/default/files/publications/research/2018-01-30-meeting-refugees-energy-needs-burkina-faso-kenya-mei-corbyn-vianello-final.pdf>



Note: The levels of access for enterprises and community facilities are not indicated on this chart.

Figure 2: Lighting and power scenarios for Kakuma I – refugee households' access to different supply technologies (MEI, 2018)

# Off-grid Energy Policy Framework

## 1.4 National Electrification Policy and Regulation

Kenya's long-term development strategy, Vision 2030, aims to transform the country into a 'middle-income country providing a high-quality life to all its citizens by the year 2030.' Under it, medium-term plans<sup>16</sup> are prepared to implement the successive phases of the strategy. They include expanding access to electricity. The Least Cost Power Development Plan 2011–2030 is the Ministry of Energy's plan for delivering the power sector's targets outlined in Vision 2030.

A new National Energy and Petroleum Policy was drafted in 2015, but it awaits adoption by parliament. Under it, the draft Energy Bill 2015 recognises renewable energy and off-grid technologies as part of a suite of solutions to achieve universal access.<sup>17</sup>

The Energy Act 2006 set up an independent regulator, the Energy Regulatory Commission (ERC), whose role includes the approval of power purchase agreements (PPA) and the preparation of national energy plans.<sup>18</sup> The act also created the Rural Electrification Authority.

Following this, policies were introduced to support the development of independent suppliers of energy such as the Electricity Licensing Regulations 2010 and the Feed-in Tariff Policy 2012.<sup>19</sup>

According to the ERC, it costs approximately KES 35,000 (\$347) to connect a new customer to the national (Kenya Power) grid and about \$0.15 equivalent per kWh of electricity service.<sup>20</sup> This connection fee is being further subsidised under the last-mile connectivity programme,<sup>21</sup> which aims to make it more affordable for Kenyans to connect to the national grid. The true cost of connection is relatively high due to the investments being made in new generation, transmission and distribution facilities by the government.

A number of regulations govern the installation of institutional solar systems, power generation and distribution, and renewable energy use. For a private-sector company to engage in providing energy services, it needs to obtain a license or permit for power generation, distribution and supply.<sup>22</sup> However, elements of mini-grid regulation are unclear or cumbersome; for example, policy on the arrival of the grid.

The World Bank is currently funding the Kenya Electricity Modernisation Project (KEMP), which includes grant financing for the connection of new households, thus introducing a more cost-effective and suitable source of funding for electrification investments.<sup>23</sup> Under this programme the National Rural Electric Cooperative Association produced the National Electrification Strategy (NES), which articulates a road map for least-cost electrification using grid, mini-grid and SHS options. The NES was launched in December 2018 and gives the least-cost options for bringing electricity to households and businesses throughout the country.

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<sup>16</sup> The third medium-term plan will cover the period 2018–2022.

<sup>17</sup> For further details, see <https://www.globallegalinsights.com/practice-areas/energy-laws-and-regulations/kenya#chaptercontent3> - accessed 11/07/18

<sup>18</sup> Boampong, R. and Phillips M.A. (2016), *Renewable energy incentives in Kenya: Feed-in-tariffs and Rural Expansion*, [https://bear.warrington.ufl.edu/centers/purc/docs/papers/1610\\_Boampong\\_Renewable%20energy%20incentives%20in%20Kenya.pdf](https://bear.warrington.ufl.edu/centers/purc/docs/papers/1610_Boampong_Renewable%20energy%20incentives%20in%20Kenya.pdf)

<sup>19</sup> A full list of policy and regulatory documents can be found on the ERC website, <https://www.renewableenergy.go.ke/index.php/content/19>

<sup>20</sup> For further details, see <https://www.renewableenergy.go.ke/index.php/content/46> - accessed 11/07/18

<sup>21</sup> For further details, see <http://www.kplc.co.ke/content/item/1694/last-mile-connectivity-program-q---a>

<sup>22</sup> For further details, see <https://www.giz.de/en/downloads/GIZ2015-ProSolar-Licensing-Guidebook.pdf>

<sup>23</sup> <http://documents.worldbank.org/curated/en/517661468253781559/Kenya-Electricity-Modernization-Project>

## 1.5 Turkana County Energy Plan

Turkana County has engaged the German development agency GIZ to develop its energy plan, which does not cover the refugee settlements, targeting the following goals by 2022:

- 2 laws or pieces of legislation to establish an Energy Resource Development Committee (EnEC) and Turkana Energy Service Corporation (TURESCO),
- 3 public-private mini-grids,
- 4,500 additional household customers accessing modern energy through mini-grids,
- 10 new Information Communication and Energy centres with 1,000 users at each,
- 100 schools with solar PV systems receiving extra lighting capacity through off-grid power systems, and
- 50 health centres receiving extra lighting and refrigeration capacity through off-grid power systems.

The timelines and resource availability for implementation are not clear, and may present an opportunity for support from the SCC. Implementation challenges may include inconsistent baseline data, inadequate transport infrastructure,<sup>24</sup> and low government capacity (particularly after staff were moved following the 2017 elections).

## 1.6 Relevant Non-energy Policies

In addition to national energy policy there are rules governing refugee rights, land use and allocation, and employment that will impact on energy projects implemented in the refugee camps. In the case of Kakuma, land in the camp is managed and allocated by the Refugee Affairs Secretariat (RAS) working with UNHCR. Applications for allocation of land are made through UNHCR, which then works with the RAS to process the request.<sup>25</sup> Refugees do not formally have the right to work but they may be engaged as incentive workers for organisations or partake in running small businesses in the camp (by obtaining the relevant business permit from the county government). Any projects should first engage with UNHCR and the RAS before implementation to fully understand all applicable policies for the camp.

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<sup>25</sup> Patel, L. *et al* (forthcoming), *Infrastructure Management Contracts*.

## Mapping: Off-grid Electrification Efforts in Turkana, Kakuma and Kalobeyei

This section offers a snapshot and non-exhaustive list of past, current and planned off-grid energy projects and programmes in Turkana County as well as the Kakuma and Kalobeyei areas. It reflects the best available information in June/July 2018. These activities are donor- or government-funded and/or subsidised, with the private sector primarily in the role of procured supplier.

### 1.7 Turkana County Projects

Here we consider the general context of off-grid electrification efforts in Turkana County.

#### 1.7.1 Electrification Feasibility Studies

Feasibility studies have been conducted to understand potential electrification opportunities in Turkana. These have primarily been done under donor or government programmes that use the information to tender specific sites for private-sector solutions.

- The IFC commissioned a 2015 assessment for the ERC to understand the potential market size for privately operated mini-grids in Kenya.<sup>26</sup> Consultants assessed 21 mini-grid sites, including two in Turkana.
- KEMP in 2016 assessed 30 sites,<sup>27</sup> four of which were in Turkana County.<sup>28</sup>
- GIZ has a \$1.5m results-based finance (RBF) fund for mini-grid development in rural areas. It engaged with the Turkana government to obtain a list of areas that the county wants to electrify, and then conducted demand assessments for 12 of these sites (see more detail below).
- After implementing a pilot mini-grid in Wajir South constituency, which serves 200 homes, the Rural Electrification Authority (REA) sought to identify 25 sites that would benefit from a similar system and are not targeted for grid extension. They identified six trading centres in Turkana, but the status of these projects is unclear.
- The Kenya Off-grid Solar Project (KOSAP) identified 20 mini-grid sites, 82 health clinics, 5 schools and 1 administrative office in Turkana that will fall under Lot 1 (which will also include West Poket). These will be tendered out for mini-grid, SHS or solar water-heating solutions in 2019. KOSAP completed geospatial mapping of these sites, information that was due to be released alongside the NES in December 2018, but it was still unclear at the time of writing if that document has been produced.<sup>29</sup>

There is some overlap of sites under KEMP and KOSAP. KOSAP appears to have identified smaller mini-grids as it is considering separate solutions for public buildings and water pumps, though this was the subject of stakeholder feedback and may evolve. KEMP and KOSAP will align with the NES; it is likely that KEMP will cover the larger sites and KOSAP the smaller. (See further below for more on the GIZ, REA and KOSAP implementation of the above feasibility work.)

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<sup>26</sup> The report can be found at [https://renewableenergy.go.ke/asset\\_uplds/files/ERC%20IFC%20mini-grids%20-%20final%20report%20-%20Final.pdf](https://renewableenergy.go.ke/asset_uplds/files/ERC%20IFC%20mini-grids%20-%20final%20report%20-%20Final.pdf)

<sup>27</sup> See <http://projects.worldbank.org/procurement/noticeoverview?id=OP00029870&lang=en>

<sup>28</sup> For further details, see [https://www.gmgfacilitykenya.org/images/Kenya%20mini-grids%20PFS\\_draft%20final%20report%20vol1.pdf](https://www.gmgfacilitykenya.org/images/Kenya%20mini-grids%20PFS_draft%20final%20report%20vol1.pdf)

<sup>29</sup> For further details, see <https://www.worldbank.org/en/news/press-release/2018/12/06/kenya-launches-ambitious-plan-to-provide-electricity-to-all-citizens-by-2022>



### 1.7.2 GIZ RBF-funded Mini-grids

GIZ and Barclays Bank of Kenya are co-implementing a €1.5m RBF programme (funded by the United Kingdom's Department for International Development (DFID) and hosted by EnDev). They issued in 2016 a call for proposals from companies interested in developing solar PV hybrid mini-grids in rural Kenya, including in Turkana. The programme offers up to 50% capital expenditure (CAPEX) funding and an additional RBF subsidy for household connections made. It will operate through 2019.

All sites were selected from a list of key development areas provided by Turkana County government, after which GIZ (as noted above) conducted further feasibility work. Seven sites have been awarded, through two calls for proposals, with all sites now awaiting ERC licenses. Initially 10 sites had been tendered, but GIZ was informed that three will now fall under KOSAP and as such were removed from the programme.

The final two sites, both in the Kalobeyei settlement (labelled '**Village 1**' and '**Host Community**'), were tendered in July 2018 for commissioning by April 2019, with the idea that one developer will construct both mini-grids. The awarded developer will design, build, own and operate these. It is predicted that the majority of the demand will come from local businesses. Households will also be connected as well as some institutions, but no single anchor client has been identified. GIZ originally proposed a 170kWp system with battery storage and generator backup for Village 1 with 60kWp of capacity being implemented in the first phase. For the Host Community mini-grid, the system size is estimated to be 20kWp. GIZ may consider subsidising the end-user tariff further for these sites and expanding the grid capacity if additional funds can be secured. UNHCR will work closely with GIZ and the awardee on this.<sup>30</sup> Further details can be found in Appendix 1.

### 1.7.3 Rural Electrification Authority

The REA plans to make grid connections to households and businesses in the Turkwei-to-Lokichar corridor alongside a new power line that will service oil extraction efforts in Lokichar. They also develop mini-grids, including as an implementer of KEMP and KOSAP. As noted above, the REA has also identified six sites in Turkana for 60kWp solar-diesel hybrid mini-grid development and tendered them in August 2016. The status of this tender is unclear, as is how these sites link to the National Electrification Strategy and KEMP.

### 1.7.4 Kenya Off-grid Solar Access Project

The Kenya Off-Grid Solar Access Project (KOSAP) (2018–2023) aims to support **solar technology for the electrification of households, enterprises, community facilities and water pumps**. The programme, however, has no plans to conduct electrification projects within the refugee camps and settlements.<sup>31</sup> Turkana is one of 14 'under-served' counties included in the World Bank-funded project, which will provide \$150m as follows.

- Component 1: Mini-grids for community facilities, enterprises, and households (\$40m) through 7-10 year PPA agreements and O&M contracts.
- Component 2: Stand-alone solar systems and clean cooking solutions for households (\$48m) supported through a RBF and debt facility for eligible service providers.
- Component 3: Stand-alone solar systems and solar water pumps for community facilities (\$40m), including health facilities (level 2 & 3), educational facilities and administration offices. Supported through installation and O&M contracts.

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<sup>30</sup> Patel, L. *et al* (forthcoming), *Infrastructure Management Contracts*.

<sup>31</sup> The clean-cooking component of KOSAP may consider interventions in the refugee camps/settlements.

- Component 4: Implementation support and capacity building (\$22m) of sector and counties.

For a full summary, see Appendix 2.

### 1.7.5 OVO Foundation: Project Jua

Energy 4 Impact is working with the OVO Foundation to electrify schools and clinics in the least developed counties of Kenya, an effort branded as Project Jua. The pilot phase started in August 2017 and included the installation of 10 800W solar systems in schools and clinics in Turkana, as follows: Kalokor (3), Naanam (1) **and the Kakuma camp (6). Sollatek installed the systems at a cost of \$2,500 each, and will maintain them for a three-year period.**

Project Jua is complementing KOSAP by focusing on institutions left out, namely certain private facilities and level 1 clinics. After the success of the pilot, the OVO Foundation agreed to scale up the programme with Energy 4 Impact in 2019. This second phase may cover up to five counties, targeting more clinics and schools in efforts to enhance their service delivery. It is possible that more sites from Kakuma and Kalobeyei will be included, but this will depend on a needs assessment conducted in the coming months.

### 1.7.6 Green Mini-grid Support Facility

The Green Mini-grid Support Facility (which covers all of Kenya) is open to mini-grid developers proposing to operate on a commercial basis. They offer up to 30–40% CAPEX subsidy and technical assistance to participating companies, as well as general sector support.<sup>32</sup> The first round of funding is currently closing, with the second round launched in August 2018. To apply, developers must be compliant with Kenyan regulations and have completed feasibility work already. None of the first-round awardees are confirmed as planning a site in Turkana, although one is looking to develop multiple sites with one possibly in Turkana.

## 1.8 Kakuma Camp and Kalobeyei Settlement Projects

As noted above, just **two of the broader Turkana initiatives have included Kakuma or Kalobeyei sites**: the GIZ one (two mini-grids in Kalobeyei, planned for 2019) and Project Jua (six 800W solar installations at schools and clinics in Kakuma, completed in 2017). KEMP, KOSAP and the REA have not identified electrification project activities within the two camps.<sup>33</sup>

Compared with the rest of Turkana County, there has historically been a higher level of energy-sector activity in and around Kakuma, due to the presence of NGOs and humanitarian organisations. Past energy-access initiatives seem to have focused on pilot-level projects or free giveaways, both of which lack long-term sustainability. The most notable projects are outlined below.

### 1.8.1 Kakuma Town Mini-grid (ongoing)

In February 2018, the town of Kakuma received power from a REA-constructed, Kenya Power-operated diesel mini-grid, which is reducing local energy bills by up to 60%.<sup>34</sup> The mini-grid runs on two 500kVA generators, providing 600kWp using an average of 36,000 litres of

<sup>32</sup> For further details, see <https://www.gmgfacilitykenya.org/index.php/en/about-us/about-us-2>

<sup>33</sup> The clean-cooking component of KOSAP may consider interventions in the refugee camps/settlements.

<sup>34</sup> Local restaurant owners said that previously fuel spend was KES 1,500 per month to power their own diesel generators for intermittent access, and that they now pays KES 600 per month for 24/7 access.

diesel per month. The average peak load is just 140kWp so there is room (and likely a business case) for adding connections and building demand.<sup>35</sup> Kenya Power intends to extend distribution to other nearby villages, including Kalobeyei, which would require upgrading the transformer. It may consider supplying larger buildings and businesses in the Kakuma camp (and observations on the ground suggest this is being piloted) but, **as the camp is not under government mandate, supplying it more broadly with government power may be politically sensitive**<sup>36</sup>.

### 1.8.2 EDP Kakuma Street Lighting Project (2010–2013)

The street lighting project, led by the Portuguese company EDP, launched in 2010, distributed 4,500 rechargeable solar lanterns (for free) and installed 31 streetlights (including 10 in the host community) and institutional solar systems of 1–3kW.<sup>37</sup> The institutional systems, installed by Don Bosco Kakuma,<sup>38</sup> with training from a Portuguese technician, were maintained for three years but then **O&M funding ran out – a challenge of off-grid systems well beyond Kakuma that are not developed and maintained by a private-sector operator or institutional solar-system developer with such O&M terms defined before construction begins**. Now only three of the ten institutional systems are still working and most of the institutions have gone back to diesel or have no power anymore.<sup>39</sup>

### 1.8.3 IKEA Foundation – Brighter Lives for Refugees Campaign (2016–2018)

In 2016, the IKEA Foundation launched a project to:

- Distribute free solar lanterns to 36,000 households in Kakuma (out of approximately 54,900 total households),
- Install approximately 350 solar street lights in the Kalobeyei settlement around public facilities and the trading centre, and
- Install 900 solar streetlights in the Kakuma camp including around the airstrip.

**Historically solar streetlights in Kakuma have been vandalised.** UNHCR and the host-community leadership are undertaking joint installation in a bid to promote ‘ownership’ by the community. Sixty refugees will be trained in maintenance of the solar equipment. The project was expected to close at the end of 2018.

### 1.8.4 SNV – Market-based Energy Access<sup>40</sup> (through 2018)

SNV Netherlands Development Organisation, with support from Endev, is implementing a market-based energy-access intervention for refugees and the host community in the Kakuma camp and the Kalobeyei settlement. The initiative aims to promote sustainable market-based energy access for cooking and lighting through support to energy entrepreneurs. As part of this SNV is facilitating sales of SHS from four solar companies that received a grant to encourage them into the region: Azuri, Greenlight Planet, Pawame and Sollatek. As of June 2018 the companies had sold over 950 assorted lights between them in the last nine months. SNV runs weekly awareness events and training sessions with community influencers. The first phase of the programme ran until the end of November 2018; and SNV is currently planning to scale it up.

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<sup>35</sup> Data obtained during a meeting with KenGen technicians at the Kakuma town site in June 2018.

<sup>36</sup> Patel, L. *et al* (forthcoming), *Infrastructure Management Contracts*.

<sup>37</sup> For further details see <https://www.edpr.com/en/stories/edp-project-kakuma>. These systems covered 4 schools, 3 hospitals, 1 system at Don Bosco training facility, 1 solar/wind hybrid system at UNHCR's compound and 1 water pumping system.

<sup>38</sup> Don Bosco Kakuma is a charitable organisation that runs local technical institutions among other activities.

<sup>39</sup> Based on MEI surveys from 2016, current status not confirmed.

<sup>40</sup> For further details, see <http://www.snv.org/project/market-based-energy-access-mbea-project-kakuma-turkana-county>

SNV notes that displacement settings present a **customer base accustomed to free giveaways**,<sup>41</sup> which makes it difficult to introduce a commercial product or service, particularly when the product is the same (solar lantern) to what was provided free, and when second-hand or low-cost goods, as well as low-cost power connections are available in the market.

#### 1.8.5 The Moving Energy Initiative (until November 2018)

The Moving Energy Initiative (MEI) aims to identify how innovation within the humanitarian sector can improve access to sustainable energy among displaced populations and camp operators and has implemented demonstration projects in Kenya, Burkina Faso and Jordan. It aims to incentivise private-sector engagement in the provision of sustainable energy solutions, including through strategic partnerships with humanitarian actors, and to promote local market development and commercial business models. The following initiatives have been supported under MEI.

##### *SHS Supply Chain Support – BBOXX*

MEI has supported BBOXX to establish a local distribution outlet at Kakuma. BBOXX recruited staff, and set up a shop in February 2018 within the town of Kakuma, offering retail sales, marketing, technical and aftersales support. Products are sold on a pay-as-you-go basis, following an initial down payment, with payments made through mobile money.

Seventy-five SHS were sold in the first four months, 66 of which were in the camp. BBOXX initially could not meet demand due to stock shortages; an issue that has now been resolved. As of June 2018, it had not had any payment defaults, and it reported that customers are requesting options that include televisions and one-off payment plans (as opposed to pay-as-you-go).

**Challenges include high costs of transport and logistics, and climate conditions** that wear out the solar installations quickly (BBOXX has placed strong emphasis on proper installation and aftersales service).

##### *Solar Electrification – IRC Clinics 5 and 6*

In early 2018, Kube Energy, working with PowerGen, installed solar at IRC-run Clinics 5 (3kW) and 6 (36kW) within the Kakuma camp. The IRC will manage the systems and will sign an initial one-year O&M contract with PowerGen. At both clinics this has resulted in significant savings for UNHCR, which provided operational fuel.

As of August 2018, the Clinic 6 system had excess capacity – perhaps as a result of unrealistic load projections, shortfalls in the IRC budget resulting in fewer energy-dependent appliances, or a non-commercial incentive to ‘build big’. Utilisation of the system is expected to increase as the IRC add more energy dependent appliances. Initial feasibility studies included connection of nearby businesses to the system, but it is unclear who would manage these connections as it falls outside of the IRC’s core mandate and would be too few for a commercially viable mini-grid.

In this case PowerGen will provide O&M services to the system and the IRC advised **that finding suitably qualified technicians** within the local areas can be challenging.

In addition to the above, UNHCR solarised the main hospital in the Kalobeyei settlement in July 2018 with a 55kW solar hybrid system that was designed and built by the private sector

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<sup>41</sup> There have been several hand-outs of free solar lanterns in the camp. In addition to the IKEA Foundation and EDP, Windle Trust also distributed 5,000 solar lanterns in 2014.

and will be operated by trained staff of the Red Cross. This system similarly had excess capacity following installation that could be further utilised.

#### *Other MEI Activities*

- A solar-powered ICT and learning hub launched in June 2018, run by Swisscontact and SAVIC, provides skills training, commercial services (such as photocopying and phone charging) and opportunities for local schools.
- Training and mentoring for local micro entrepreneurs who are retailing solar products and using solar for business purposes.
- Mapping of the credit landscape with Africa Action Help International and feasibility study of a revolving fund focused on solar-product loans.
- Support to Mwangaza Light and the National Council of Churches in Kenya to conduct market assessments in Kakuma. Following this the two organisation are planning to launch an initiative to promote the use of solar-powered products through religious networks within the camp as well as launching a solar loan product with SMEP micro finance that could potentially be available in the area.
- Feasibility study of options for infrastructure management contracts in the Kalobeyei settlement.

#### **1.8.6 Equity Bank – EcoMoto Access to Finance (ongoing)**

Equity Bank is the only bank to have a branch in the town of Kakuma. It has an agreement with the Central Bank of Kenya and UNHCR to give bank access to refugees, and it has approximately 20,000 camp customers and 40,000 host-community customers representing a modest penetration of the market.<sup>42</sup>

There is a demand for banking services in the camp, but unsurprisingly **most refugees have trouble meeting credit criteria due to lack of credit history or lack of collateral**. Credit guarantees to de-risk lending to local customers would be one area for donor and public intervention.

Equity Bank has a clean-energy loan product called EcoMoto. Users of Equitel mobile money are automatically enabled for EcoMoto after six months of SIM card use. It appears as part of the normal Equitel service menu and allows users to purchase financed energy products. Equity has not marketed the product, however, and initial momentum was lost during the 2017 elections.

#### **1.8.7 Spark Access to Finance Project**

In October 2017 the Spark consortium led by Africa Action Help International organised a KES 4m revolving fund, where loans are provided to individuals and the repayments are made to a local community cooperative or village savings and loan association, in this instance Turkana West and Integrated Savings Cooperative (TWICS).

Small businesses can borrow up to KES 200,000. Approximately 70% of all loans relate to energy access. KES 1-2m had been repaid as of June 2018 with a repayment rate of 88%. It was expected the full KES 4m fund would be paid off by November 2018, by which point AAH-I hoped to have built enough capacity within TWICS for it to take over the fund.

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<sup>42</sup> Interview with Equity Bank staff in Kakuma in June 2018. This would represent approximately 27% of the adult population in the camp. Surveys completed under the IFC's 'Kakuma as a Marketplace' study found 54% of respondents in the town and 10% in the camp had a bank account.

### 1.8.8 Kakuma Kalobeyei Challenge Fund (planned)

The IFC is setting up the Kakuma Kalobeyei Challenge Fund with the aim of overcoming the information gap, improving the regulatory environment for refugees and host communities in Turkana County, and increasing access to finance and services. The fund will accept applications on a rolling basis from commercial companies, social enterprises, and local and refugee entrepreneurs wishing to implement viable and sustainable business projects in the Kakuma/Kalobeyei area. In addition to funding, technical assistance and advisory services will be offered with the aim of facilitating long-term sustainable business service provision for the area. Energy access will be a focus of the fund, alongside other key areas such as water, sanitation and hygiene, and livestock value chains.<sup>43</sup>

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<sup>43</sup> Cohen, Y. and Patel, N. (February 2018) *Innovative Financing for Humanitarian Energy Interventions*, Research Paper for the MEI, London: Royal Institute of International Affairs.



## Delivering Off-grid Energy in Humanitarian Settings: Business Models and Financing

The use of green or hybrid mini-grids in humanitarian settings is still relatively new. Most uses of cleaner (non-diesel) technologies are stand-alone solutions, mainly donor-funded, such as with past projects in the Kakuma camp.

The context in camp and non-camp settings can vary. For example, in Jordan many refugees live in urban settings outside of refugee settlements, where electricity is available from the national grid. Large influxes of refugees place pressure on grid infrastructure and energy-efficiency/demand-side measures may be required. However, in this report we have focused mainly on the camp-specific context as it is most relevant to SCC pilot locations. The case study below highlights a large-scale initiative that has been implemented in Jordan, illustrating some characteristics of developing off-grid solutions in displacement settings.

There is a wide range of business and financing models for green and hybrid mini-grids, stand-alone institutional solar systems and SHS. These include everything from energy-as-a-service to energy-product models, and from incremental to up-front payment schemes, many of which are being piloted in Kenya. While it is not possible to summarise all the models here, we make some general observations in this section about the operational conditions particular to humanitarian settings, and how these might drive different business approaches in Kakuma and Kalobeyei.

### **Box 1: Jordan Solar Farms**

Two refugee settlements in Jordan have mid- to large-scale solar power installations. UNHCR, with IKEA Foundation funding, built a 2MW solar PV plant in Azraq Camp.<sup>44</sup> The largest refugee-camp solar installation in the world, funded by the German development bank KfW, is the 12.9MW plant at Za'atari Camp.<sup>45</sup>

Initially both camps had national grid power at the 'base camp' centre where most humanitarian organisations had offices. Local diesel mini-grids and stand-alone solar supplied power for street lighting, markets, a hospital and other facilities; **existing distribution networks were informal and required upgrading during the new installations.** Some NGOs and agencies operating outside of the grid area are still reliant on generators or hybrid solar/generator setups.

The Azraq farm is being developed in three stages: Phases 1 (2MW) and 2 (1.5MW) inside the camp, and Phase 3 (1.5MW) outside the camp, which will connect to the national grid. Azraq and Zaatari solar farms are to be **connected to the national grid using a net metering scheme to minimise alternative storage costs.**

In both camps, the private sector has been involved in the design, construction and O&M of the systems, which were awarded through competitive international tenders. In Azraq, UNHCR manages a two-year O&M contract. In Zaatari there is a three-year O&M contract supervised by the government and UNHCR. The engineering, procurement and construction contractor at Zaatari hired refugees during construction and O&M.

**Both solar installations were unusual in that they:**

<sup>44</sup> Opened in 2014, with a population of 43,000 as of May 2018.

<sup>45</sup> Opened in 2012, with a population of 83,000 as of May 2018.

- Developed new types of partnerships, with the IKEA Foundation funding the Azraq solar farm partly via profits from sales of LED lightbulbs in IKEA stores, and
- **Used humanitarian aid funds for large ‘legacy assets’ built to outlast the refugee-hosting period.**<sup>46</sup>

## 1.9 Considerations for Energy Supply in Humanitarian Settings

Compared to many potential mini-grid project locations, **refugee camps have three advantages.**

- **High population density:** The target customers live close together, offering the prospect of lower distribution costs and aggregated demand.
- **Good anchor loads:** Onsite institutional demand by the humanitarian agencies’ facilities, schools and clinics is predictable, long term and purchased by creditworthy institutions.
- **Potential for financial underpinning:** The interest of various public agencies in ensuring ongoing service (and, potentially, in de-risking the market for private investments) means that there may be increased levels of subsidy, concessional finance and risk mitigation on offer.

Nevertheless, mini-grid developers considering a refugee camp will face the same challenges as in other off-grid settings, as well as additional considerations, including the following.

- **Regulatory limitations beyond just the energy-sector framework.** There are likely to be regulations specifically governing operations in refugee camps, i.e. around land rights, asset ownership and conduct of business. For example, in the Kakuma camp land is managed and allocated by the Refugee Affairs Secretariat working with UNHCR. There are also laws against employment of refugees. This can impact a range of operational and business model issues.
- **A shorter time horizon that presents a mismatch to energy-sector business models** with longer payback periods. There are two implications of this.
  - For humanitarian agencies operating on budgets assigned each year, it is **difficult if not impossible to commit to service agreements more than 1–2 years.**<sup>47</sup> This has been a major barrier to project developers trying to implement mini-grids in displacement settings under public-private partnership (PPP) type models. There are business models companies are trying that can partially address these constraints – such as kWh-based rather than duration-based PPA. A partial risk loan guarantee could be a potential mitigating instrument and be utilised where a humanitarian agency is no longer able to pay the power provider; allowing a larger number of projects to be guaranteed than could be funded directly.<sup>48</sup>
  - There are business risks and costs to an inability to predict medium- to long-term plans of authorities, influx or out-flux of populations, volatility, etc. The extreme case of this is the **risk of early closure of the camp.** It is possible that some energy assets could be moved (privately) or re-deployed (by donors/institutions), but this risk needs to be mitigated to reassure providers of private-sector solutions.

<sup>46</sup> Grafham, O. and Lahn, G. (2018), *The Cost of Fuelling Humanitarian Aid*, The Royal Institute of International Affairs, <https://www.chathamhouse.org/sites/default/files/publications/research/2018-12-10-Costs-Humanitarian-Aid2.pdf>

<sup>47</sup> Further research into how service agreements are structured in other sectors and in other areas of humanitarian aid should be considered.

<sup>48</sup> Patel, L. *et al* (forthcoming), *Infrastructure Management Contracts*.

- **Particularly low access to consumer finance or energy-dependent devices**, which means mini-grid and SHS providers gravitate to larger institutional clients to anchor (or completely focus) their business model. If, alternatively, the revenue model for the demand is wholly dependent on the refugees themselves, then there will be very limited evidence or prior experience on which to base demand projections. These households and small and medium-sized enterprises are often the poorest consumers that may not even afford a pay-as-you-go plan, or have energy needs beyond basic lighting and phone charging – both of which may make them especially high-risk for pay-as-you-go providers as well. The cost-reflective, partially subsidised tariffs or pay-as-you-go plans (especially those with multi-year payback), offered by mini-grid and SHS companies may not be viable in this setting.

Furthermore, unless the humanitarian agencies operating in the camp have a mandate to provide electricity access (which none of them have in the case of households or businesses), a subsidy in this regard may not fall within their budget or remit. Having said that, in protracted settings, such as Kakuma, there are often vibrant informal economies, as noted by the IFC's *Kakuma as a Marketplace* report, where some of these challenges are not as prevalent. The balance along a spectrum from free giveaway to subsidizing energy opportunities, to enabling cost recovery and commercial profit is a difficult one – and this must be aligned to the mandates these agencies have to 'do no harm'.

- If there is **desire to supply neighbouring host communities**, then the political and economic viability of extending the distribution system will have to be considered. There may also be **tensions if the settlement community is seen to be given preference** over the host community. Connection to a larger government-run grid can help minimise battery storage and diesel-backup costs, but some governments may stop short at power supply in refugee settlements. On the other hand, adding demand to a heavily subsidised government grid could be beneficial. Depending on national power supply and stability, a feed-in tariff or net metering scheme with large installations in settlement camps may be viewed either as helpful or an unwanted cost.
- **Particularly challenging logistics, politics, human-resource constraints and security risks**, which add time and cost to all operations. Among these may be entrenched interests, some corrupt, in maintaining the status quo or control over energy access in and near the camp. There may be diesel or electricity-supply 'cartels' that present a greater challenge than 'merely' offering solar hybridization opportunities to local micro-grid or diesel generator operators.
- **Risk of low or conflicting incentives between agencies to shift from diesel.** Because of the different ways energy costs are structured in camps, the funder is not always the end-user. For example, in the Kakuma camp, the IRC is provided with diesel in kind rather than allocated a budget from UNHCR to purchase it. As such, the MEI project having solarised two of the IRC's health clinics does not actually save money on the IRC's budget; instead it is left with excess diesel, likely resulting in its allocation being lowered. The cost of saving diesel is not realised by the IRC, which is using and managing the solar system, but by UNHCR, which supplies them with the diesel.

With any proposed shift – such as to a solar solution, or connecting to a mini-grid, all parties should realise an economic benefit. This means that whoever funds the capital cost of the installation will need to realise a revenue stream or operating expenditure (OPEX) saving that justifies this investment. Or, putting it another way, whoever realises the gain from reduced diesel consumption should be the party who, either directly or indirectly (via offtake payments or monthly fees), funds the investment cost. Clearly, this will require UNHCR to play a leading role in implementing any mini-grid

connecting institutional buildings in refugee camps, and in coordinating the allocation of associated payment and supply responsibilities.<sup>49</sup>

## 1.10 Implications for Off-grid Business Approaches

With the above in mind, we can make some preliminary comments on four features of off-grid business models.

- **Ownership** of the energy-producing asset(s). The implications of ownership vary widely between a SHS (for which ownership is clearly transferred to the buyer, either immediately or over a payment period) and larger systems and mini-grids, for which significant capital outlay may be required, and with that higher risk. Mini-grid ownership models typically include government/utility, community/NGO, private and PPP.
- **Business financing**, here the sources of finance that fund a particular asset or service. All sizes of energy asset may, at times or for certain business models, require some subsidy. As systems get larger the role of public sector or donors in buying down some CAPEX cost or OPEX risk typically increases.
- **Energy sales model**. Off-grid energy, unlike grid power, may be consumed by the end-user along a range of sales models. These include sale of energy services, sale of power and sale of an asset and others, and is related to ownership.
- **Customer financing** is particularly relevant in markets with very poor customers. The availability (or lack thereof) of consumer credit is a distinguishing feature of a company's approach. It impacts the sales approach and the potential vulnerabilities (for example, if the company requires payments over several years before recouping their investment).

The table below presents some considerations for private-sector involvement in displacement settings as they relate to these different features.

Considerations of Business and Financing Models	Off-grid Solution		
	Mini-grid	Institutional solar	SHS
<b>Ownership</b>	<p>High-risk CAPEX points to PPP as an option, with a humanitarian agency playing the role of a public agency.</p> <p>High risks and limited data may prohibit straight commercial mini-grid operation without public subsidy (no profitable models in any off-grid setting).</p> <p>Community models Less applicable if medium- or long-term</p>	<p>If agencies procure and own the assets, they must take responsibility for the ongoing O&amp;M.</p> <p>If private solar suppliers retain ownership and O&amp;M of a large system, they assume risks of continued operation.</p> <p>May consider solutions that can be redeployed although this would incur additional costs.</p>	<p>NGOs may procure and distribute (for free or subsidised) to their beneficiaries (at the risk of market distortion).</p> <p>Commercial sales may be done on various sales models – see below.</p>

<sup>49</sup> Patel, L. *et al* (forthcoming), *Infrastructure Management Contracts*.

Considerations of Business and Financing Models	Off-grid Solution		
	Mini-grid	Institutional solar	SHS
	<p>plans for the camp are uncertain.</p> <p>Local <i>jua kali</i> diesel micro-grid owners may be engaged to hybridise with solar, extend distribution with extra funding, etc.</p>		
<b>Business financing</b>	<p>Mini-grid developers may need CAPEX support (especially for high up-front costs) and likely end-user tariff subsidy.</p>	<p>Grants may be available, but agencies have energy budgets. Potential for straight commercial sale if agencies are able to commit to off take agreements.</p>	<p>SHS companies may need subsidy/grant to de-risk their initial investment in displacement settings.</p> <p>Mechanisms could guarantee default risk of consumer financing.</p>
<b>Energy sales model</b>	<p>Various fee-for-service, fee-for-power models could work. A-B-C model offers real benefits in diversifying off-take risk, but sites with A customers (large agency offices, hospitals) must be near to B and C.</p>	<p>Fee-for-service models may be preferable for humanitarian agencies reluctant to invest in energy assets – but short-term procurement cycles mean non-time-based models may be preferable (minimum use, per kWh, etc.)</p>	<p>Range of models from cash retail sales to pay-as-you-go. Wealthier customers may prefer the former, but the majority of consumers will not be able to afford a one-time payment. Risks and vulnerabilities in the pay-as-you-go model for SHS companies may be magnified in this setting (payment default, compromised data, etc.) but there is no data to support these concerns.</p>
<b>Customer financing</b>	<p>Large agency A clients may subsidise other nearby B and C customers.</p>	<p>Agencies have energy budgets, but the economic case must be made if shifting from diesel to solar.</p>	<p>See above re pay-as-you-go.</p> <p>Credit from Equity Bank/EcoMoto could work for customers able to meet credit requirements.</p>

## Potential Off-grid Energy Supply Interventions in Kakuma and Kalobeyei

Based on our review of projects and assessments (past and ongoing) on the ground, we present the following preliminary ideas for SCC intervention in support of mini-grids, institutional solar, and/or SHS.

### 1.11 Support Government Initiatives in Turkana

The REA and Kenya Power have begun the process of electrifying the town of Kakuma and Turkana County in line with KEMP, so there is limited value in the SCC implementing similar solutions in KEMP/KOSAP locations. There could be potential to create added value by coordinating with the REA/Kenya Power or the county government on the following.

- **Hybridise the town of Kakuma's diesel mini-grid with solar.** Install solar capacity at the site to offset diesel usage and support the extension of the grid to connect some of the agency compounds near the town.
- **Complement KEMP/KOSAP activities.** Market awareness, productive use and training activities have been shown to have a positive impact on the uptake and sustainability of projects. Taking forward the lessons learned and experience gained via projects (for example, MEI, SNV and wider Energy 4 Impact on-the-ground expertise), these supporting activities could add value to the plans of KEMP or KOSAP.
- **Technical assistance to the county government.** With such a range of overlapping projects and stakeholders, it might benefit from external support.

It should be noted that working with government entities could be a lengthy process.

### 1.12 Engage Local Diesel Mini-grid Operators

Within the Kakuma camp there are an estimated 30 informal diesel mini-grids.<sup>50</sup> **There may be opportunities to hybridise and formalise these grids with solar, and at the same time improving distribution safety, reliability and cost.** It could be beneficial to pair solar suppliers with existing mini-grid operators that know the setting well, already have customer relationships and might otherwise be out of business if forced into competition with newly installed solar grids. Different models could be explored such as working with a more established mini-grid developer to build and commission the equipment that could be leased to the operator, who would then distribute the power within the camp and pay back the cost within 7–10 years. Obstacles would need to be overcome, such as formalising the business, getting a distribution license and financing the hybridisation. Options for new metering and payment platforms could be explored. This has not been tested in Kenya, though there are companies providing similar solutions in India.<sup>51</sup>

### 1.13 Solarise Agency Compounds

There are various agency compounds in Kakuma belonging to UNHCR, the World Food Program, the Norwegian Refugee Council, the Lutheran World Foundation (LWF) and the National Council of Churches in Kenya. They all operate their own diesel generators.

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<sup>50</sup> Meeting with unregulated mini-grid operator within Somali Market, Kakuma I.

<sup>51</sup> For further details, see [//cdkn.org/wp-content/uploads/2014/07/AAGL-CDBN\\_TARA-cKinetics-Presentation\\_Final\\_07-08-14.pdf](https://cdkn.org/wp-content/uploads/2014/07/AAGL-CDBN_TARA-cKinetics-Presentation_Final_07-08-14.pdf)



Based on discussions with UNHCR technicians, it was estimated that diesel generators at the UNHCR compound consume approximately 1,000 litres of diesel per day, representing an annual cost of approximately \$365,000.<sup>52</sup> The LWF compound (hosting 19 agencies) operates 24-hour diesel power at a cost of nearly \$20,000 per month (about 45% of the compound's budget). The LWF has discussed connecting to the town of Kakuma's Kenya Power mini-grid, in the hope of reducing costs by up to 80%.<sup>53</sup> UNHCR also indicate that it will connect to the Kenya Power mini-grid. However it is not clear if or when Kenya Power will be able to connect it; and shifting to another form of diesel power is not as 'green' an option as some agencies might like.

As large anchor loads, there is an opportunity to solarise/hybridise these compound sites directly to become self-reliant – or, if the compound sites could be combined, this could be a good location for a larger solar generation site (as mentioned above) where the excess could be sold to and used by others. Utilising compound land would also mitigate the challenge of land acquisition, which is a key factor that delayed Kenya Power from becoming operational with the grid in the town of Kakuma. There is a clear commercial opportunity for such hybridisation since agencies spend so much money on diesel. The private sector could be engaged to provide energy as a service – potentially financing the equipment if the agencies will sign up for long-term agreements (but this has been a challenge for such procurements). However, it is likely that the agencies will connect to the Kenya Power mini-grid to support the efforts of the government. In addition, a private mini-grid operator could not match the tariff being offered by the Kenya Power mini-grid without ongoing public subsidy, so agencies would have to be prepared to pay more for it. As such, hybridisation of the Kenya Power mini-grid as discussed above, may be the best options for these compounds to access cleaner energy.<sup>54</sup>

## 1.14 Expand Existing Energy Projects

### *IRC Clinics*

As noted above, the IRC's Clinic 6 initially had excess power as of August 2018. If the IRC does not foresee needing the surplus, there might be opportunity to expand distribution to nearby households and businesses in a mini-grid.

MEI has funded the Clinic 6 CAPEX costs, so the new cost would focus on feasibility and expansion of distribution (and generation if needed) and connection to new users. In turn, this would also be an optimum environment to test out new operating models (for a clinic-anchored mini-grid) such as metering systems, and productive use models, to test the willingness to pay of households and businesses and to understand how management of the system and alignment of incentives could work.

Clinic 6 is potentially within connection distance to the market in Kakuma III. If a suitable unregulated mini-grid operator can be identified, then this could also be used to test a hybridisation model, with reduced CAPEX risk.

Similarly, the solar system at the main hospital in the Kalobeyei settlement could be considered for such a model.

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<sup>52</sup> Patel, L. *et al* (forthcoming), *Infrastructure Management Contracts*.

<sup>53</sup> *Ibid.*

<sup>54</sup> *Ibid.*

### *Kalobeyei Extension*

As GIZ has already begun developing two mini-grids in Kalobeyei, there is an opportunity to engage with it about possible opportunities for support and expansion. These might be to extend the capacity in a future phase, to facilitate supporting activities (e.g. demand side management or productive-use stimulation), or to begin working on Villages 2 and 3 to electrify the full area.

### *Project Jua – Ovo Foundation*

Based on the initial success of Project Jua, the Ovo Foundation is considering a second phase of electrification. It will continue to look at schools and clinics, so it might consider, for example, the 24 LWF school facilities or three remaining IRC clinics within the camp (see below for more on these un-electrified sites).

## 1.15 Facilitate Solutions for Un-electrified Sites

### *Lutheran World Federation*

The LWF operates in the Kakuma camp, the Kalobeyei settlement, West Turkana and near the border with South Sudan. It is interested in providing 24 schools in Kakuma and 5 sites in Kalobeyei with internal and street lighting (to improve security). Power demand at the school sites would not qualify them as mini-grid anchor loads; rather, they could be powered by decentralised stand-alone solar or it may be possible to identify other users to justify a micro-grid. These school sites could also present a collaboration opportunity with Project Jua, as mentioned above.

### *IRC Clinics*

The IRC run six clinics, of which Clinics 5 and 6 are newly electrified through the Kube Energy project (see above) and Clinic 7 (the general hospital) received solar power with DFID funding. The secure energy supply at these sites has been positive for the IRC not only in meeting on-the-ground objectives but also in assuring donors of its capacity to deliver without power constraints.

Clinics 1 (main hospital), 2 and 4 still run off diesel generators and would benefit from cleaner power. The main hospital is the largest hospital in the Kakuma camp; as such, it is a significant facility to power and one that could serve as a mini-grid anchor load.

## 1.16 Increase SHS Distribution

Kenya has a mature and innovative SHS market. Suppliers we interviewed see the Kakuma camp as a high-potential market (especially with support from MEI and SNV) but also as extremely difficult and expensive to reach. There is an opportunity to scale up and build upon the support offered by previous programmes (MEI, SNV) to help overcome some of the key challenges faced by SHS suppliers – e.g. logistics, user awareness, customer service and sales support – to help increase the distribution of SHS and access to energy across the wider county. KOSAP will offer a RBF and debt facility to SHS companies looking at Turkana markets, which could support expansion. In addition, the SCC could look to support local entrepreneurs that are using solar for business purposes, making credit facilities available to them for business expansion and supporting them with business development skills. End-user financing options can be further explored through Equity Bank's EcoMoto loan and through local savings groups.

## Key Findings and Recommendations

This section summarises the main findings from this mapping report and offers preliminary recommendations for next steps.

### 1.17 Current Energy Context

- **Kenya's national energy policies** support the use of renewable energy and off-grid power supply through private operators, but some elements of mini-grid regulation are unclear or cumbersome. **Turkana County has drafted an energy plan**, though its implementation had not yet begun as of June 2018. There are regulations **specific to refugee camps that impact private-sector energy delivery** there – for example, regulations on land use or labour – that should be investigated further for specific projects.
- There is a **Kenya Power-run diesel mini-grid powering the town of Kakuma**, and around 30 **informally operated diesel micro-/mini-grids within the camp**. Large agencies primarily use diesel generators, and to some extent institutional solar, for their own compounds and for public sites for which they are responsible. **Kenya Power may be willing to expand its grid into the camp**, as it would benefit from additional connections and demand, but the **camp does not fall under the government's remit**. Some of the **main agency compounds close to the town are considering connecting to the Kenya Power grid**.

### 1.18 Off-grid Feasibility Work and Potential Sites

- Surveys conducted under MEI in 2016 show that the majority of people within the Kakuma camp want the equivalent of a grid connection, but also that less than 30% are willing to pay for it. More than 35% of surveyed households said they are not willing to pay for any form of access. **There is likely to remain a portion of the population that cannot afford to pay for any type of energy access.**
- Some **feasibility** studies have been done on potential sites for mini-grids within Turkana County. It is **not always clear how these individual studies link to each other or whether there is overlap in sites**. It is likely that most economically feasible sites in the county have already been identified and will be developed under KOSAP and KEMP. It is clear, however, that these programmes will not fund any electrification projects inside the Kakuma camp or the Kalobeyei settlement, and these are not included in the feasibility studies. Only two places within the refugee settlements – both in Kalobeyei – have been included in these studies (by GIZ, which has awarded them for development).
- **There has not been a comprehensive electricity mapping of Kakuma and Kalobeyei** although studies conducted by MEI collected significant data from Kakuma 1 on energy use and preferences. Potential mini-grid and institutional solar sites that were identified during this mapping exercise include:
  - Kalobeyei Villages 2 and 3 – currently no electricity,
  - Kakuma Clinics 1, 2 and 4 (including the main hospital) – currently running on diesel,
  - 24 clinics and schools identified by the LWF – currently no electricity, and

- Various diesel-powered agency compounds, institutions and micro-/mini-grids with potential for solar hybridisation and expanded distribution to neighbouring businesses and households.
- **The extent of SHS penetration in the camps remains low** although efforts by SNV and MEI have showed commercial sales are possible. It is likely there is reasonably high use of smaller solar lanterns, whether by NGO/agency giveaway or individual purchase (accessible because of lower prices). Quality, durability and market spoilage (pricing resistance) will all be challenges for SHS operators but these are not insurmountable.

### 1.19 Off-grid Electrification Projects in Kakuma and Kalobeyei

- **A number of off-grid energy projects have been conducted in the Kakuma camp** over the years (e.g. EDP, IKEA Foundation), focusing on solar lantern giveaways, street lighting and institutional solar systems for public buildings. These projects, however, have been **limited in their impact and sustainability**, due to lack of beneficiary valuing of free products, lack of clear ownership of the equipment and lack of long-term funding for O&M that has left some systems non-functional.
- More recently projects such as the MEI and SNV's Market-Based Energy Access project in Kakuma have focused on **engagement of the private sector** in energy solutions. The **IFC is planning a challenge fund for the Kakuma and Kalobeyei areas**, which will provide investment into the sector.
- Several companies have had success in selling **SHS in Kakuma through pay-as-you-go models**, indicating that a market for the products exists. There is scope to support these companies further, including under MEI or in cooperation with the **KOSAP debt and RBF facility**.
- **A number of projects are currently planning to electrify sites across Turkana County** through off-grid energy solutions, most notably the World Bank's KOSAP, GIZ's RBF and the REA (using the soon-to-be-finalised National Electrification Strategy). With the exception of GIZ's two Kalobeyei mini-grids, the impact on Kakuma and Kalobeyei will not be direct, but there may be scope to link activities.
- Two groups are making headway in **enabling refugees to gain access to finance**: Equity Bank and the Spark initiative working through Africa Action Help International.

### 1.20 Business and Financing Models

- **Examples of renewables-powered mini-grids in other humanitarian settings are limited** – Azraq and Zaatari camps in Jordan are the first examples of a solar farm to power refugee camps. A major **limitation is the procurement processes of agencies restricting them from entering into long-term contracts beyond standard annual budget cycles**.
- There are certain **considerations for private companies looking at delivering off-grid energy in displacement settings**. In addition to issues facing all off-grid providers, these include:
  - Mismatch between **short-term procurement cycles and political prospects** for the camp, and longer-term payback periods for private mini-grid providers,

- High **availability of donor funding** may incentivise short-term procurements rather than longer-term agreements that may prove more cost effective and efficient in the mid to long term,
- History of (or ongoing competition with) **energy supply give-aways**, second-hand markets or (intentionally) ‘market distorting’ subsidies, and
- Cooperative and/or competitive **relations between camp and host community**.
- Engaging the private sector in off-grid energy solutions for Kakuma and Kalobeyei will likely require **significant public support** in the form of subsidy, risk mitigation, public-private partnership and more.

## 1.21 Recommendations

**The main opportunities for increasing electrification exist within and around the Kakuma camp and the Kalobeyei settlement** since KOSAP and KEMP will develop the most economical mini-grid sites in the wider Turkana County. The SCC could consider partnering with KOSAP on activities, but since the programme is already well resourced and defined it may not add real value.

**There is potential for the SCC to partner with the county government** in the realisation of its recently drafted energy plan focusing on decentralised solarisation of health clinics and schools. However, since KOSAP and Project Jua is also targeting these areas, it is likely that the sites with the highest potential will be covered and the SCC’s added value may be limited.

Based on the information collected through this mapping exercise, we recommend the following for consideration by the SCC for interventions based in or around Kakuma and Kalobeyei.

1. **Work with local diesel mini-grid operators to formalise their businesses, hybridise power generation and expand distribution.** This would avoid displacing current businesses and harness the existing community relationships and market understanding on the ground. Local mini-grids could also serve as community ‘energy hubs’ selling or renting SHS, solar lanterns, phone-charging stations and other services.
2. **Hybridise the town of Kakuma’s existing Kenya Power mini-grid with solar, and support its extension to agencies and potentially other customers within the camp** (pending confirmation if Kenya Power would take up a mandate to connect customers inside the camp).
3. **Build upon ongoing electrification projects**, such as GIZ-funded Kalobeyei mini-grids and the solar system funded by MEI at the IRC’s Clinic 6. These projects could be used to test out new management and community engagement models that would promote the economic feasibility of any mini-grid.
4. **Conduct feasibility studies and develop opportunities for new micro-/mini-grids** using existing diesel-powered institutions as anchor loads (for privately run hybrid A-B-C models) or green-field sites. Potential sites include three health clinics and main agency compounds (although it is likely they will instead connect to the Kenya Power mini-grid). Consider aggregating sites, where possible, for economies of scale and enable piloting of productive use and/or community development activities. This intervention should build off

any emerging lessons from the GIZ-supported mini-grid in Kalobeyei, which has already been released for tender.

5. **Expand support to SHS companies to increase their market within Kakuma and use it as a base to expand further into the county.** Additional funding could be made available to these companies through the debt and RBF facilities that KOSAP will set up. However the SCC could support these companies by increasing consumer awareness, identifying new outlets and training sales agents and retailers. In addition, the SCC could look to support local entrepreneurs that are using solar for business purposes, making credit facilities available to them for business expansion and supporting them with business-development skills. End-user financing options can be further explored through Equity Bank's EcoMoto loan and through local savings groups.
6. **Pilot models for improved O&M, financing, procurement and management,** learning lessons from GIZ and KOSAP implementers as well. In parallel to any intervention, new models for improved electricity delivery should be explored, such as having camp-wide O&M contracts, mechanisms to address short-term procurement versus long-term payback mismatch, tailored PPA templates for humanitarian settings or development of local technician networks.

These options will be discussed further with Power Africa and the MAKE Change working group to decide which interventions to take forward. Following this, more detailed feasibility work should be completed to come up with a work plan for the intervention. In addition, further feasibility may be required to understand the following:

- Kenya Power's plans to extend the diesel mini-grid in the town of Kakuma to new customers within and/or at the border of the camp, and
- Alignment and/or overlap to the NES/KEMP and KOSAP activities; for example, as regards potential mini-grid or institutional solar site aggregation, supply-chain support, subsidy design, consumer payment innovation and learning, and more.



## **Appendix 1. Additional Information on GIZ's Planned Mini-grid for Kalobeyei**

### Kalobeyei Settlement, Village 1

For the Kalobeyei settlement's Village 1, GIZ originally proposed a 170kWp system with battery storage and generator back up based on the following assumptions.

- All institutions and businesses to be connected to the mini-grid.
- 500 households to be connected out of a total of 3,000 households in Village 1.
- All connected customers will not be limited on the amount of electricity they can use per day; they will pay based on number of units consumed.
- An allowance of 8% per annum demand growth is included for the first five years of operation.
- System expansion to cover all households in Village 1 and the other Villages (2 and 3) has been considered; thus, a modular mini-grid system will be implemented in this first phase.
- Subject to availability of funds from the private sector, development partners and/or government, the mini-grid project will be scaled up to cover all villages.

In the first phase 60kWp of generation system capacity will be implemented, while the additional capacity will be added on later depending on availability of funds. GIZ has committed to giving at least 50% of project cost as incentives to the selected private developer. Once the developer is selected, GIZ advises that additional funding will be sought to further subsidise the end-user tariff to national utility rates ensuring that the project operates sustainably over the permit period of 20–25 years.

### Kalobeyei Host Community Town

For the Kalobeyei host community mini-grid, the system size was estimated to be 20kWp. GIZ will give up a minimum of 50% project cost subsidy and seek additional subsidies from other partners to de-risk the private investor and to lower end-user tariffs to national utility tariff rates. For tariff equality in the two mini-grids, one developer will be selected to develop the two projects.

### Next Steps

- GIZ tendered out these two projects to mini-grid companies active in Kenya in July 2018 with the target of project completion by April 2019. They will be eligible for the RBF funding under the GIZ RBF project.
- Interested development partners shall enter into a memorandum of understanding with the selected private developer on the additional funding. GIZ will provide technical assistance for developing the memorandum of understanding.

GIZ and UNHCR will work jointly to oversee the project development by the private developer.

## Appendix 2. Kenya Off-grid Solar Access Project (KOSAP) Summary

Providing equal opportunities to the entire country is key to achieving vision 2030 and especially the national target of achieving universal access to electricity by 2020. To do so, the government of Kenya is looking to provide electricity to remote, low-density and traditionally underserved areas of the country.

The Kenya Off-grid Solar Access Project (KOSAP) looks directly to promote this by supporting solar technology to drive electrification of households (including in host communities around refugee camps), enterprises, community facilities and water pumps.

As part of the project, \$150m is being made available from June 2017 till 2023.

Turkana is one of the 14 identified counties under this project, which will look to benefit from the four project components.

### Component 1: Mini-grids for Community Facilities, Enterprises and Households (\$40m)

Mini-grids will be developed under a PPP, whereby private and public funds co-finance the construction of the generation facility and public funding is used for the distribution network. A private service provider will be responsible for the construction and sign two contracts with Kenya Power for a 7–10 years PPA for the O&M of the generation asset and the distribution asset.

The REA and Kenya Power will jointly implement the component, with the procurement of lots divided among them.

It is recommended that both are continued to be engaged to understand the split and status of all sites under this component.

### Component 2: Stand-alone Solar Systems and Clean Cooking Solutions for Households (\$48m)

The solar-system component will be accomplished via two financing instruments to which eligible solar service providers will have access:

- RBF Facility: competitively awarded incentives to cover expansion costs, and
- Debt Facility: debt financing to solar service providers to support upfront costs and medium-term consumer financing

The implementation of this component will be under oversight of the Ministry of Energy. The facility manager will be competitively selected and will be a consortium with demonstrated experience with managing similar instruments in Kenya and similar geographies. The facilities are likely to be available to companies from 2019.

### Component 3: Stand-alone Solar Systems and Solar Water Pumps for Community Facilities (\$40m)

The community facilities considered in this component are the existing and upcoming: health facilities (levels 2 and 3), educational facilities (secondary schools and technical training institutes) and administrative offices (for example, assistant county commissioner offices).

A private-sector contractor will be competitively selected for each service territory to supply, install, and maintain stand-alone solar systems in community facilities. Kenya Power will sign two contracts in each territory, one for the installation and the second for the O&M.

For solar water pumps, the REA will sign two contracts in each territory, similar to Kenya Power's for the stand-alone solar system mentioned above.

#### Component 4: Implementation Support and Capacity Building (\$22m)

This component will look to support consumer education and engagement as well as to support all technical studies, implementation support and capacity building of sectors and counties.

#### Key lessons learned

The following key lessons learned have been gained from work completed to date on KOSAP.

#### Solar Home Systems

- Quality control matters. Standards need to be implemented up front. The Lighting Africa programme helped establish this with certified products and as a result kick-started the market in East Africa.
- Sustainability of the programme must be thought through up front, i.e. what happens to the users and system after the project.
- Cost sharing with consumers is the key to an enduring service delivery model. The success of pay-as-you-go companies in Kenya has shown that people are able to pay for larger systems if the up-front payment can be spread over time.

#### Mini-Grids

- Mini-grid selection and design: Mini-grids are mostly suited for rural towns and larger villages that are relatively removed, densely populated and have significant loads to justify the investment over SHS. Also, in the eventuality that the grid will arrive, mini-grids should apply technical standards that would allow future adoption/interconnection with the main grid.
- Private sector participation: To attract the private sector, mini-grids need to be financially viable and minimise regulatory risks. For example, the private sector needs to have clarity on allowable tariffs subsidies available, a transparent licensing regime and operating time frame and concessions in the event the national grid arrives.
- Sustainability. Historically sustainability is a key challenge, especially in community-based mini-grids, which often resulted in tariffs that were insufficient to cover the costs of O&M and eventual mini-grid expansion. The private sector-driven mini-grids on the other hand tended to result in high user tariffs, which limited usage, access and impact and often led to community and political discontent. Most governments/donors are therefore exploring PPPs that rely on public resources to reduce user tariffs.

Mini-grid financial sustainability can further be increased by promoting increased use of energy, productive use, energy efficient appliances and supporting gender sensitive designs.

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Power Africa is a U.S. Government-led partnership coordinated by the U.S. Agency for International Development (USAID). Launched in 2013, Power Africa's goals are to increase electricity access in sub-Saharan Africa by adding more than 30,000 megawatts of electricity generation capacity and 60 million new home and business connections. Power Africa works with African governments and coordinates the efforts of 12 U.S. government agencies, 18 bilateral and multilateral partners, and 145 private companies, 72 of which are U.S. companies, to remove barriers that impede energy development in sub-Saharan Africa and to unlock the substantial natural gas, wind, solar, hydropower, biomass, and geothermal resources on the continent. To date, Power Africa has leveraged over \$50 billion in commitments from the public and private sectors.

For additional information, please visit the Power Africa website ([www.usaid.gov/powerafrica](http://www.usaid.gov/powerafrica)).