

OCTOBER 2019

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# Off-Grid Solar Market Assessment

## Kenya

Power Africa Off-grid Project

## ABOUT POWER AFRICA

The Power Africa Off-grid Project is a four-year program that launched in November 2018 to accelerate off-grid electrification across sub-Saharan Africa. RTI International implements the project in collaboration with Fraym, Norton Rose Fulbright, Practical Action Consulting, and Tetra Tech. Power Africa is comprised of 12 U.S. Government agencies, over 145 private companies, and 18 bilateral and multilateral development partners that work together, supporting sub-Saharan governments to increase the number of people with access to power.

*Power Africa aims to achieve 30,000 megawatts of new generated power, create 60 million new connections, and reach 300 million Africans by 2030.*

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## Abbreviations and Acronyms

AFD	French Development Agency (Agence Française de Développement)
AfDB	African Development Bank
AMDA	African Mini-Grid Developers Association
C&I	commercial and industrial
CRB	credit reference bureau
DFID	United Kingdom Department for International Development
EAC	East African Community
EnDev	Energizing Development Program
EPC	engineering, procurement and construction
EPRA	Energy and Petroleum Regulatory Authority
ERC	Energy Regulatory Commission
FEI	Facility for Energy Inclusion
GDP	gross domestic product
GIZ	German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GOGLA	Global Off-Grid Lighting Association
GoK	Government of Kenya
ha	Hectare
IEC	International Electrotechnical Commission
KEBS	Kenya Bureau of Standards
KEMP	Kenya Electrification Modernization Program
KenGen	Kenya Electricity Generating Company
KEPSA	Kenya Private Sector Association
KEREA	Kenya Renewable Energy Association
KETRACO	Kenya Electricity Transmission Company

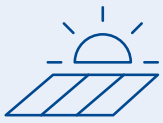
km	kilometer
kWh	kilowatt hour
kWh/m <sup>2</sup> /day	kilowatt hour per square meter per day
MFI	micro-finance institution
MGA	Micro-Grid Academy
MW	megawatt
NEMA	National Environment Management Authority
O&M	operation and maintenance
P'n'P	plug and play
PAYGO	pay-as-you-go
PROSOLAR	Program for the Promotion of Solar-Hybrid Mini-Grids
PPA	power purchase agreement
PV	photovoltaic
REA	Rural Electrification Authority



REREC	Rural Electrification and Renewable Energy Corporation
RUH	Raj Ushanga House
SDG	Sustainable Development Goal
SE4All	Sustainable Energy for All
SHS	solar home system
UNSD	United Nations Statistics Division
USAID	U.S. Agency for International Development
US\$	U.S. dollar
VAT	value-added tax
WB	World Bank
WHO	World Health Organization
WISEE	Women in Sustainable Energy and Entrepreneurship
Wp	watt peak

# INTRODUCTION

This report by Power Africa provides insights into the opportunities and risks associated with Kenya’s off-grid solar energy market and gives companies, investors, governments, and other stakeholders a deeper understanding of the market. While there are other market assessments conducted by other stakeholders (i.e. development partners), Power Africa recognizes a gap in the available market assessments. Bridging the gap, this report is characterized by the following:



A comprehensive and detailed review of solar home systems (SHSs), mini-grids, productive use, and other aspects of the off-grid solar value chain that Power Africa is engaged in is covered. Additionally, this report includes details on policy and regulatory issues, structure and historical context of the energy sector, and gender mainstreaming.



The most up-to-date sales and investment data from GOGLA in order to keep pace with the ever-changing dynamics of the off-grid solar sector.



Insights serve as an input to the Power Africa Off-grid Project’s (PAOP) planning and help to prioritize activities within the policy and regulatory; market intelligence; business performance; access to finance; and cross-sectoral integration work streams that PAOP advisors across sub-Saharan Africa are engaging in.

The report also serves as a baseline for Power Africa’s technical advisors to guide their continuing work and provides a snapshot that can be used to determine growth and changing dynamics of the market over time. Insights provided in this report include characteristics of Kenya’s electricity sector, electrification targets, government regulations, donor-funded activities, and details on subsectors of the off-grid solar energy market. Additionally, this report includes expert knowledge from Power Africa lead advisors, information gathered from stakeholder interviews, and data from the Global Off-Grid Lighting Association (GOGLA).

## About Power Africa and the Power Africa Off-grid Project (PAOP)

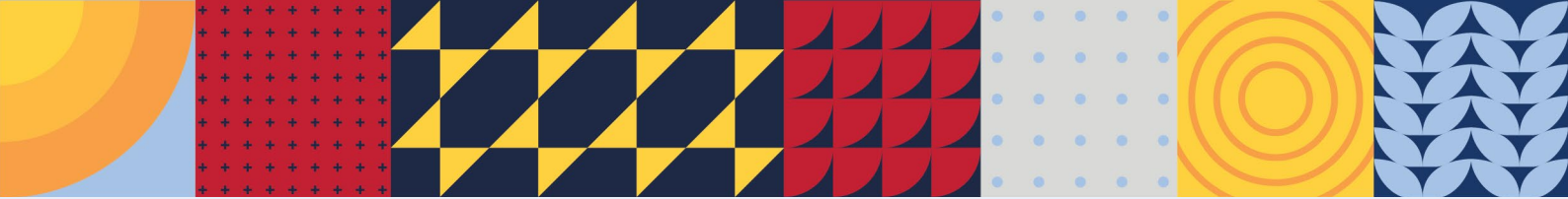
Power Africa aims to accelerate off-grid electrification across sub-Saharan Africa through targeted, context-specific interventions with private-sector companies, governments, investors, and donors. Power Africa’s goal is increase electricity access by adding 30MW of new generation capacity, and 60 million new connections through grid and off-grid solutions by 2030. The goal of the Power Africa Off-grid Project is to provide support to private off-grid companies and make the markets in sub-Saharan Africa more attractive for investment and operations. Power Africa defines “access” as the direct or actual number of new households and businesses connected to electricity via an on- or off-grid solution. The project focuses on accelerating off-grid energy access through household SHSs and mini-grids, with the goal of facilitating

6 million new connections by 2022. The project aims to accelerate off-grid electrification across 10 focus countries in Africa: Cameroon, the Democratic Republic of the Congo, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Niger, Rwanda, Senegal, and Tanzania. Figure ES-1 identifies the countries in Africa receiving Power Africa support, with the focus countries highlighted. The pins represent the locations of the project's in-country advisors.

FIGURE ES-1. THE PROJECT PROVIDES SUPPORT TO 20 COUNTRIES IN AFRICA



The Power Africa Off-grid Project (PAOP) is a Power Africa project funded by the U.S. Agency for International Development (USAID). Power Africa brings together technical experts with stakeholders from the public and private sectors to increase energy access rates in sub-Saharan Africa. The Power Africa Off-grid Project is implemented by RTI International, and headquartered in Pretoria, South Africa.



## I EXECUTIVE SUMMARY

Kenya is a country with an area of 569,000 square kilometers and has a population of close to 50 million people. The main languages are Swahili and English (both official).<sup>1</sup> Several ethnic languages are also spoken in the country. Two of the most widely spoken languages are Kikuyu and Luhya, but other languages include Luo, Kalenjin, Kamba, and Mijikenda. The total number of languages spoken is estimated at 68.<sup>2</sup>

Kenya has the largest and most dynamic economy in East Africa, with a gross domestic product (GDP) of \$85 billion (KSh8,904,983.9M, 2018) with a growth rate averaging 5.6 percent year-on-year over the past 5 years.<sup>3</sup> Major industries include agriculture, forestry, fishing, mining, manufacturing, energy, tourism, and financial services. In its development plans, the Government of Kenya (GoK) aspires to become a newly industrializing middle-income country by 2030.<sup>4</sup> Kenya is implementing Vision 2030 through five-year medium-term plans. The current plan for 2018–2022 focuses on four agenda items (referred to as the Big Four Agenda): universal healthcare, affordable housing, food security, and manufacturing. The success of the Big Four Agenda depends on adequate, affordable, and reliable electricity.

**Energy sector overview.** In Kenya, past reforms of the energy sector led to an unbundling of the sector, which separated the regulatory and commercial functions of the power sector. After GoK enacted the 2010 constitution of Kenya, it enacted the 2006 Energy Act and then replaced it with the 2019 Electricity Act, which outlines the obligations of the national and county governments for providing energy services. The 2019 Energy Act also outlines the establishment of powers and functions of energy-sector entities.<sup>5</sup> Organizations that are involved in the energy sector include the Ministry of Energy, the Energy and Petroleum Tribunal, the Energy and Petroleum Regulatory Authority, the Kenya Nuclear Electricity Board, and the Rural Electrification and Renewable Energy Corporation. Additional organizations that are involved in the energy sector include the Kenya Power and Lighting Company (KPLC), the Kenya Electricity Generating Company, the Kenya Electricity Transmission Company, the Geothermal Development Corporation, and independent power producers.

Kenya wants to achieve universal access by 2022. This target is espoused in the 2018 Kenya National Electrification Strategy (KNES) and will be achieved through grid and mini-grid intensification, densification, and expansion, in tandem with stand-alone solutions.<sup>6</sup>

Regarding grid electrification, the current generation capacity is 2,670 megawatts (MW), with peak demand of 1,841 MW. Generation mainly comes from renewable sources at 78 percent, of which 40 percent is from geothermal energy with the remainder being from hydropower, wind, and solar power. As of June 2018,

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<sup>1</sup> CIA, “Africa :: Kenya — The World Factbook - Central Intelligence Agency.”

<sup>2</sup> Eberhard, Simons, and Fennig, “Kenya.”

<sup>3</sup> Kenya National Bureau of Statistics, “Economic Survey 2019.”

<sup>4</sup> Kenya Vision 2030, “Kenya Vision 2030.”

<sup>5</sup> Munyaka, “Highlights of Kenya’s Energy Act 2019.”

<sup>6</sup> Kenya Ministry of Energy, “Kenya National Electrification Strategy: Key Highlights 2018.”

access to electricity was estimated to be 75 percent from both grid and off-grid electrification. Annual growth in the demand for electricity is estimated at 6.7 percent, driven mainly by population and GDP growth and by demand from Vision 2030 flagship projects. With these estimates and considerations in mind, demand for electricity is expected to reach 2,633 MW by 2022 and 3,348 MW by 2030, based on the Vision 2030 scenario.<sup>7</sup>

Regarding off-grid electrification in Kenya, December 2018 estimates indicate 700,000 off-grid connections. KNES sets out the target to electrify 1,105,000 households in the 14 underserved counties by 2022, with two million total new connections expected by 2022, located 15 kilometers from KPLC service.

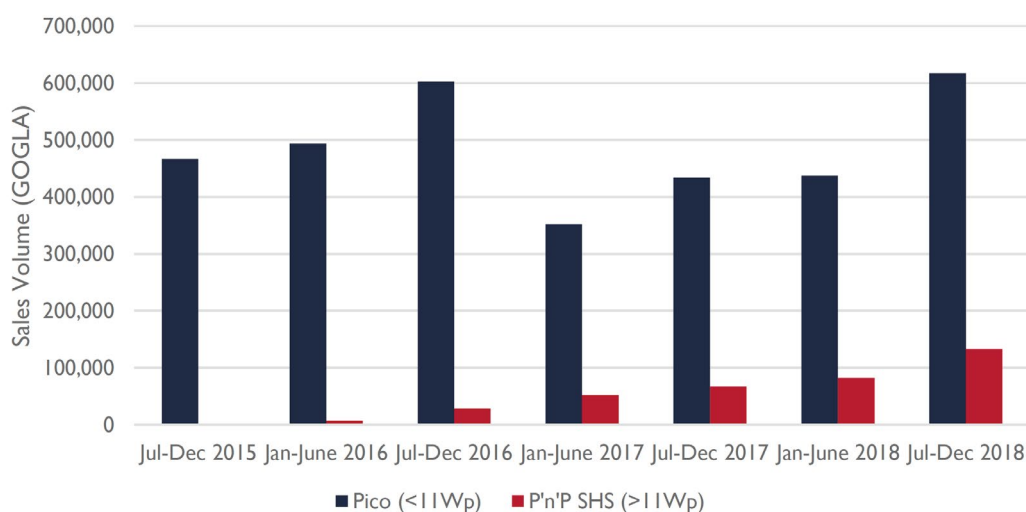
Regarding support programs, the energy sector in Kenya boasts many actively involved development partners. The main partners in the last-mile connectivity program are the World Bank, African Development Bank, the European Union, the European Investment Bank, and the French Development Agency (Agence Française de Développement [AFD]). The Kenya Off-Grid Solar Access Project (KOSAP) is currently the flagship project in the off-grid sector. Funded by the World Bank, KOSAP is designed to increase energy access in 14 of Kenya’s underserved counties via stand-alone solar systems for households and public facilities, mini-grids, solar water pumps, and efficient cooking solutions. While KOSAP is the largest such project, there are numerous other programs funded by bilateral and non-governmental organizations that support last-mile distribution of solar solutions in the off-grid areas and play a pivotal role in extending energy access.



**Solar home system sector overview.** Kenya is the market leader in solar home system (SHS) sales in Africa. This success is attributed to a largely favorable regulatory environment, government support, and the adoption of business models such as pay as you go (PAYGO).

The SHS sector in Kenya has attracted many diverse and active players, including Azuri, Barefoot Power, BBOX, Bidhaa Sasa, BioLite, Bright, d.light, Fosera, Givewatts, and Greenlight Planet. Additional companies include Mibawa, M-Kopa, Mobisol, Mwezi Energy, Orb Energy, Pawame, Solar Kiosk, Solar Panda, Solinc, Sollatek, and Spark Possibilities. Reported sales of off-grid solar products in Kenya since July 2014 have exceeded five million units. Recent sales volumes by GOGLA are summarized in Figure ES - 2.

FIGURE ES - 2. GOGLA SALES VOLUMES FOR KENYA



<sup>7</sup>Energy & Petroleum Regulatory Authority, “Least Cost Power Development Plan 2017 - 2022.”

In addition to SHS sales, the sector has experienced growth in the sales of appliances, with a record of 69,361 appliances reported during the second half of 2018. Most of the appliances sold were televisions .

Although the sales figures are impressive, Kenya’s solar home system market is not without challenges. These challenges include the high costs, challenging security situations, sparse population, poor infrastructure, low willingness or ability to pay, and sometimes pastoral geographies that remain underserved.

**Mini-grid sector overview.** Kenya has historically shown an understanding of the role of mini-grids in rural electrification, with public mini-grids supplying electricity in many remote locations throughout the country. Kenya was also an early adopter in the recent wave of privately developed mini-grids, with more than 23 developed in the early days of this new wave.

This rapid deployment was not supposed to continue indefinitely; however, the Kenyan mini-grid market experienced a period of reduced development as changes to the regulatory environment loomed. The uncertainty caused by the pending regulatory changes and procedural changes for the licensing of new mini-grids led to a period of reduced activity.<sup>8</sup>

Kenya has been redefining its mini-grid regulations and model and has undertaken initiatives to hybridize existing diesel mini-grids. Kenya has also developed numerous new public mini-grids and planned and started carrying out the Kenya Electrification Modernization Program (KEMP) and KOSAP that include tender-based opportunities for new mini-grid development. With successful implementation, these recent initiatives, projects, and changes will likely revive the Kenyan mini-grid marketing soon.

**Productive use sector overview.** The challenges that the agricultural sector is experiencing around irrigation, processing, and supply chain wastage have informed the development of most off-grid solar systems for productive use. These systems include solar water pumping and cold storage. The main manufacturers for off-grid solar productive-use products are summarized in Table ES-I.

**TABLE ES - I. PROVIDERS OF PRODUCTIVE-USE TECHNOLOGIES**

PRODUCTIVE-USE TECHNOLOGY	MANUFACTURERS	DISTRIBUTORS AND RETAILERS
Water pumps	Grundfos, Lorentz, Pedrello, and Shur-flow	Chloride Exide, Davis and Shirtliff, Futurepump, and SunCulture
Cold storage		InspiraFarm and Solar Freeze
Fishing lights	Omnivoltaic	WeTU

Productive use of energy is a much less mature sector of off-grid energy than either solar home systems or mini-grids, but the sector holds significant potential for clearly attributable economic impact among rural populations. It requires nurturing and support to flourish. Kenya has been a first-mover and leader in the development and implementation of other off-grid solutions, therefore there is great opportunity for the productive use of off-grid energy technology.

<sup>8</sup> Castalia and Ecoligo, “Mini Grids in Kenya.”



## 2 KENYAN ENERGY SECTOR OVERVIEW

### 2.1 KENYA INTRODUCTION

Kenya is the fifth largest economy in sub-Saharan Africa and the second largest in East Africa after Ethiopia.<sup>9</sup> The country's population is quickly approaching 50 million (Table I). It has experienced strong economic growth with an average gross domestic product (GDP) increase of 5.9 percent since 2010 and achievement of lower-middle-income status in 2014.<sup>10</sup> Kenya is widely regarded as the transportation, economic, and financial hub of East Africa.<sup>11 12</sup> Through its Vision 2030 program, it aims to be a “newly industrializing, middle-income country by 2030”.<sup>13</sup>

The Kenyan economy is dominated by agriculture. Tea and cut flowers are its top two exports, while coffee, legumes, and tropical fruits are also significant exports (see Table I).<sup>14</sup>

In the energy sector, Kenya has made significant strides in access. For example, 75 percent of the population had access in 2018, and Kenya is endowed with considerable solar resources (e.g., 4.5 kWh/m<sup>2</sup>/day)<sup>15</sup> as well as hydro and geothermal energy.

**TABLE I. KENYA'S DEMOGRAPHICS**

POPULATION SIZE	51.4 million <sup>16</sup>
POPULATION DENSITY	90 people per square kilometre (km <sup>2</sup> ) <sup>17</sup>
POPULATION GROWTH RATE	2.3% <sup>18</sup>
HOUSEHOLD SIZE	3.6 <sup>19</sup>
PERCENTAGE OF FEMALE-HEADED HOUSEHOLDS	36.1% <sup>20</sup>
URBAN/RURAL POPULATION	Urban: 27.0% Rural: 63.0% <sup>21</sup>
RATE OF URBANIZATION	4.23% (2015—2020) (CIA 2018) <sup>22</sup>
LANGUAGES	Official: Swahili and English, numerous indigenous languages <sup>23</sup>

<sup>9</sup> Robertson, “Africa’s Economies Ranked by GDP, Which Is Really the Largest? - CNBC Africa.”

<sup>10</sup> Copley, “Africa in the News: Kenya Becomes a Middle-Income Country; Mo Ibrahim Index Released; South Sudan Peace Talks Yield Promise.”

<sup>11</sup> Forbes, “Kenya: Best Countries for Business Profile.”

<sup>12</sup> Africa Business Pages, “Kenya Emerges as Business Hub of COMESA.”

<sup>13</sup> Kenya Vision 2030, “Kenya Vision 2030.”

<sup>14</sup> OEC, “Kenya (KEN) Exports, Imports, and Trade Partners.”

<sup>15</sup> Gichungi, “Solar Potential in Kenya.”

<sup>16</sup> The World Bank, “Kenya Population, Total | Data.”

<sup>17</sup> The World Bank, “Kenya Population Density (People per Sq. Km of Land Area) | Data.”

<sup>18</sup> The World Bank, “Kenya Population Growth (Annual %) | Data.”

<sup>19</sup> United Nations, “Kenya Household: Size and Composition 2018.”

<sup>20</sup> The World Bank, “Kenya Female Headed Households (% of Households with a Female Head) | Data.”

**TABLE 2. KENYA'S ECONOMY**

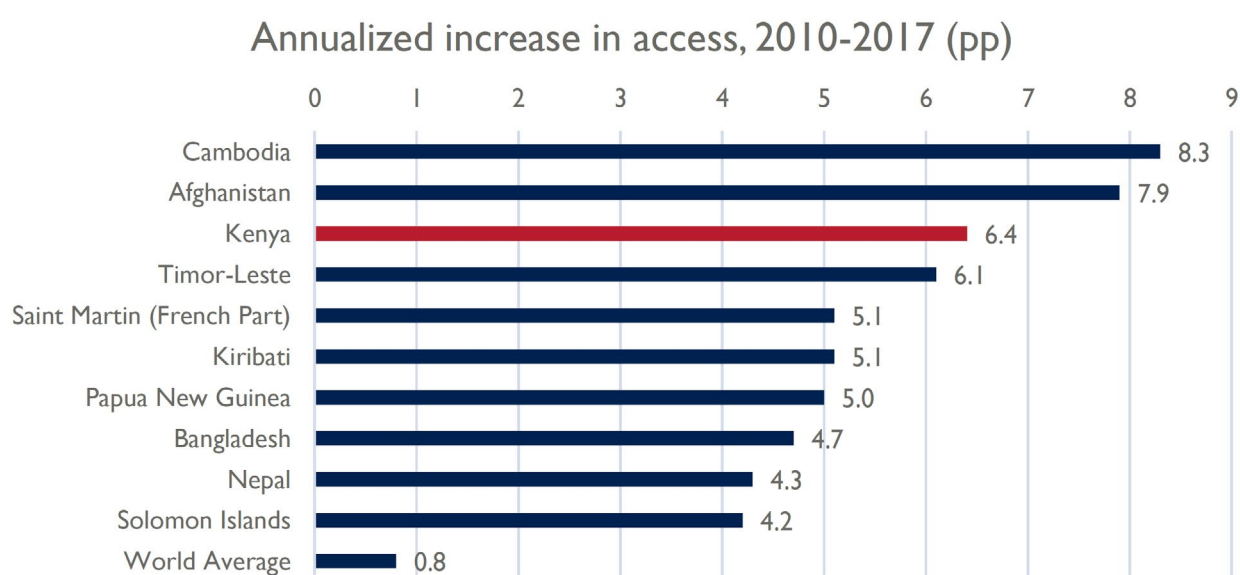
<b>GDP PER CAPITA</b>	US\$1,202 <sup>24</sup>
<b>MAIN AREAS OF EMPLOYMENT</b>	Agriculture: 61.1% Industry: 6.7% Services: 32.2% <sup>25</sup>
<b>LAND SIZE AND USAGE</b>	Agricultural land: 48.5% - Cropland: 11.1% - Permanent meadows and pastures: 37.4% Forestry: 7.8% Other: 43.7% <sup>26</sup>

## 2.2 GRID ELECTRIFICATION

With the enactment of the Electric Power Act in 1996 and the formation of the Electricity Board of Kenya in 1997, Kenya began the process of unbundling and privatizing Kenya’s electricity sector, with the first private-sector generation commencing in 1998. The sector would undergo further changes with the Electricity Board of Kenya becoming the Energy Regulatory Commission (ERC) in 2006 and Energy and Petroleum Regulatory Authority (EPRA) in 2019, following the enactment of the 2019 Electricity Act. In parallel with these regulatory structure changes, GoK sold 30 percent of its stake in the Kenya Electricity Generating Company (KenGen) to the public in 2006. The year 2008 saw the formation of the Kenya Electricity Transmission Company (KETRACO) to take over the role of transmission system operator from Kenya Power.

In 2019, World Bank listed Kenya as having the third fastest rate of electrification globally and the highest in Africa (Figure 1).

FIGURE 1. TEN FASTEST-ELECTRIFYING COUNTRIES

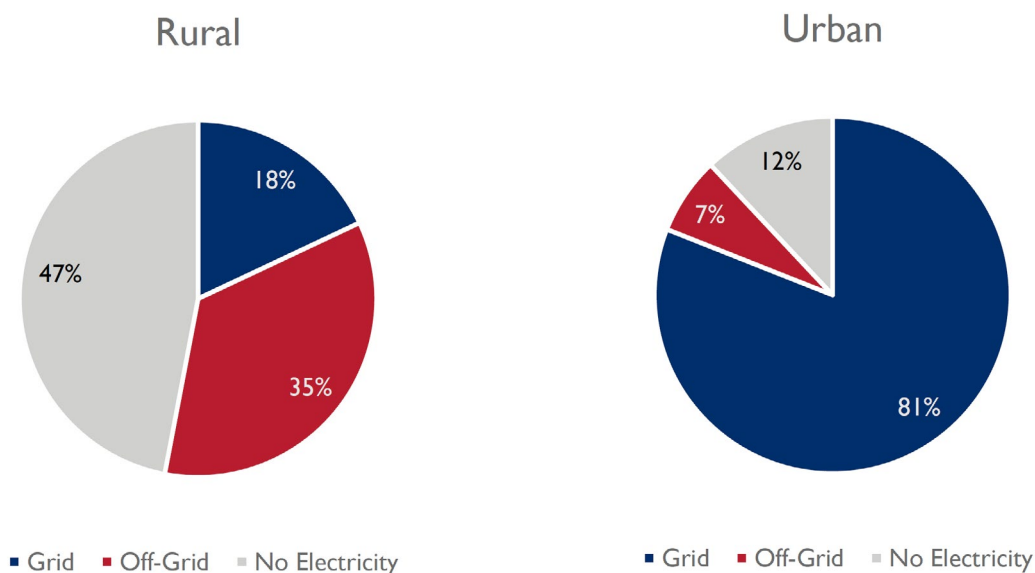


Source: <sup>27</sup>



However, Kenya’s strong grid electrification rates do not present a full picture of the country’s electrification (Table 3). Kenya also has the greatest deployed capacity of off-grid solar photovoltaic (PV) in sub-Saharan Africa with 36.84 megawatts (MW) of off-grid solar.<sup>28</sup>

FIGURE 2. URBAN AND RURAL ACCESS RATES, 2017



Source:<sup>29</sup>

### 2.2.1 QUALITY OF GRID SERVICE

While electricity access is an important enabler of economic development, so is quality of grid service, particularly as Kenya aims to become a newly industrializing middle-income country. Power quality and availability issues are particularly important to businesses and in cities. Outages, voltage sags, and other power quality issues incur significant direct and indirect costs.<sup>30</sup>

While public satisfaction with the GoK’s handling of electricity supply has steadily improved over the last nine years, as shown by the results of opinion polling in Figure 3, Kenya still has a long way to go if it wants to improve perceptions of providing reliable grid power for industry. Almost two thirds of businesses report owning a generator (Table 3). Grid reliability and end-user perception of the provision of electricity by state and semi-state actors are contributing factors to the demand for off-grid solutions by under-grid and bad-grid customers.

<sup>21</sup> The World Bank, “Kenya Urban Population (% of Total Population) | Data.”

<sup>22</sup> CIA, “Africa :: Kenya — The World Factbook - Central Intelligence Agency.”

<sup>23</sup> CIA.

<sup>24</sup> The World Bank, “Kenya GDP per Capita (Constant 2010 US\$) | Data.”

<sup>25</sup> CIA, “Africa :: Kenya — The World Factbook - Central Intelligence Agency.”

<sup>26</sup> CIA.

<sup>27</sup> The World Bank et al., “Tracking SDG7: The Energy Progress Report 2019.”

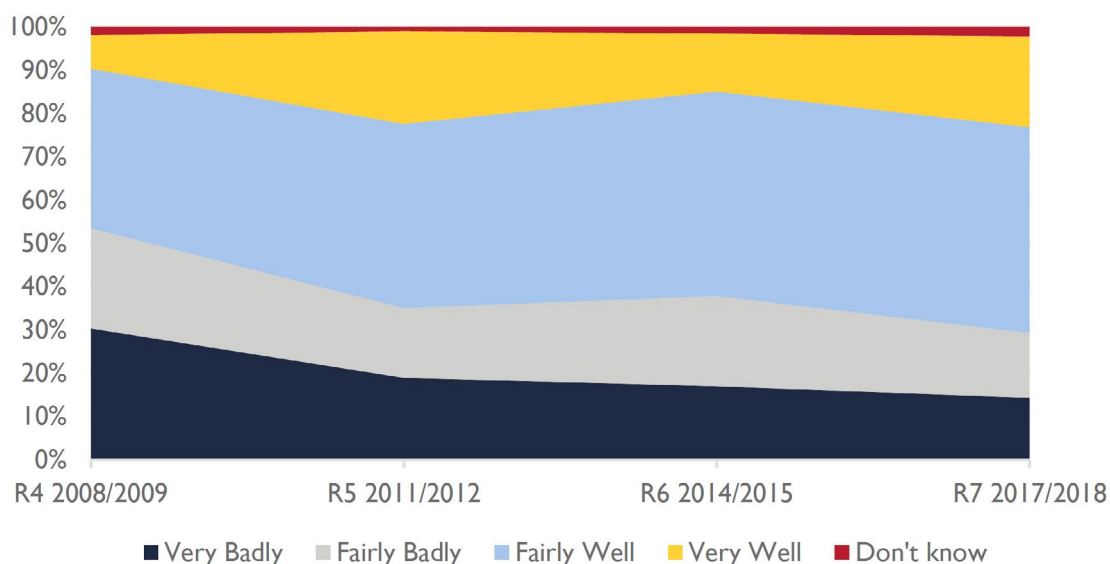
<sup>28</sup> IRENA, “Renewable Capacity Statistics 2019.”

<sup>29</sup> The World Bank et al., “Tracking SDG7: The Energy Progress Report 2019.”

<sup>30</sup> Gertler, Lee, and Mobarak, “Electricity Reliability and Economic Development in Cities: A Microeconomic Perspective.”

Grid reliability and end-user perception of the provision of electricity by state and semi-state actors are contributing factors to the demand for off-grid solutions by under-grid and bad-grid customers.

FIGURE 3. PUBLIC PERCEPTION OF GOK HANDLING OF ELECTRICITY SUPPLY



Source: <sup>31</sup>

**TABLE 3. GRID QUALITY OF SERVICE**

Average outages per month	3.8
Average duration of outages	5.8 hours
% of sales lost due to outages	5.4%
% of firms owning a generator	65.6%

Source: <sup>32</sup>

Kenya Power is undertaking a number of efforts to improve the quality of grid service to its customers. <sup>33</sup> While quality and reliability of electricity remain a key driver in deciding where to locate manufacturing facilities, ICT facilities, and more, these are areas where Kenya should consider differentiating itself within the region in order to attract greater industrial and commercial investment.

### 2.3 ANNUAL ELECTRICITY CONSUMPTION LEVELS

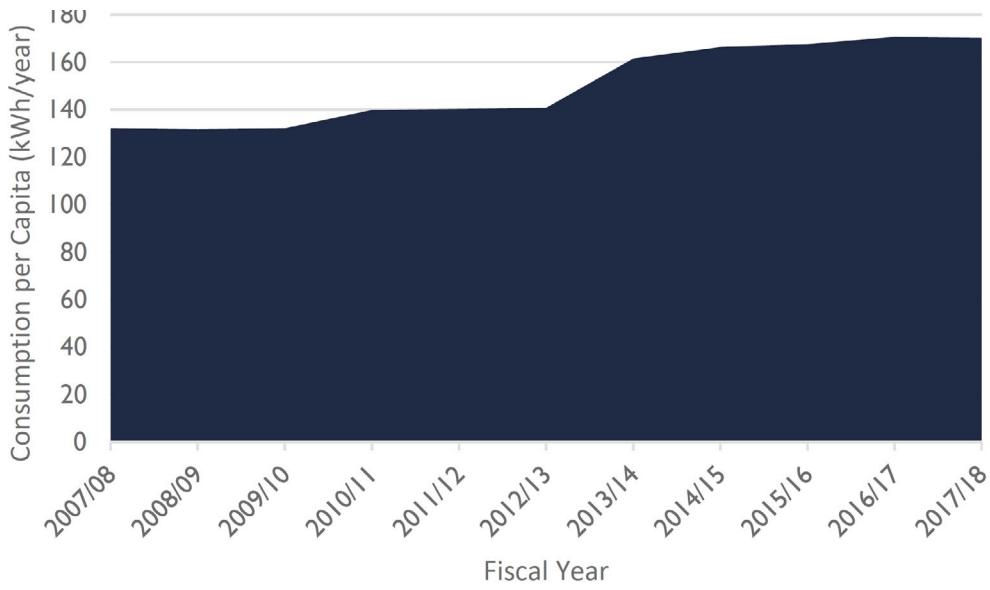
Over the last decade, consumption per capita in Kenya has increased steadily but has not experienced rapid growth. Annual consumption per capita increased an average of 2.87 percent per year from 132 kWh in 2007/2008 to over 170 kWh in 2017/2018.

<sup>31</sup> Afrobarometer, “Kenya | Afrobarometer.”

<sup>32</sup> The World Bank, “Enterprise Surveys.”

<sup>33</sup> Taneja, “Measuring Electricity Reliability in Kenya.”

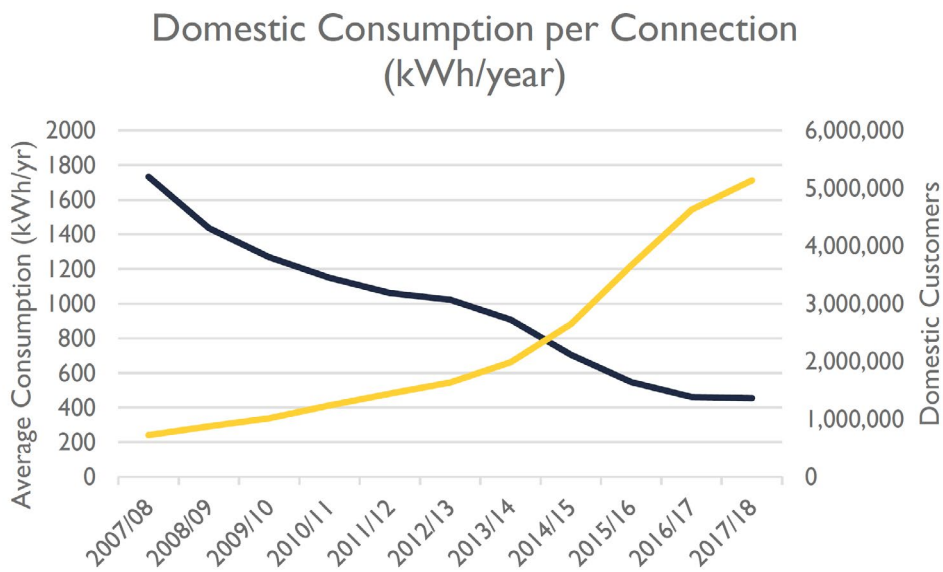
FIGURE 4. CONSUMPTION PER CAPITA (KWH/YEAR)



Sources: Author’s calculations based on Kenya Power Annual Report 2018, Kenya Power Annual Report 2013 and United Nations, Department of Economic and Social Affairs, Population Division (2017).

In the same ten-year period, the domestic consumption per grid-connected customer dropped significantly as more rural customers with low average consumption were connected for the first time (Figure 5).

FIGURE 5. DOMESTIC ELECTRICITY CONSUMPTION PER CONNECTION IN KENYA



Sources: Author’s calculations based on Kenya Power Annual Report 2018, Kenya Power Annual Report 2013 and United Nations, Department of Economic and Social Affairs, Population Division (2017).

It is important to note that other factors have also likely contributed to the reduction in domestic consumption, such as efforts by Kenya Power to reclassify small businesses from the domestic to small commercial category.

## 2.4 PROGRESS AND FUTURE TARGETS

Kenya has made significant progress toward universal access to electricity since 2013, to the point that it seems within reach. The country’s current goal is to reach universal access by 2022, as addressed in the Kenya National Electrification Strategy (KNES), a cornerstone for Kenya’s rural electrification strategy published in late 2018. Recent comments from the Energy Cabinet Secretary during an event in Tana River have suggested that Kenya is unlikely to achieve the 2022 target of 100-percent electrification, but it is on course to achieve 80 to 90 percent.<sup>34</sup> Regardless, Kenya has made significant progress in this area. Ninety-percent electrification by 2022 is a rate not yet achieved in developing countries. It represents a milestone and provides a model for other countries to follow.<sup>35</sup> (Figure 6).

FIGURE 6. KENYA PROJECTED ELECTRIFICATION RATE<sup>36</sup>

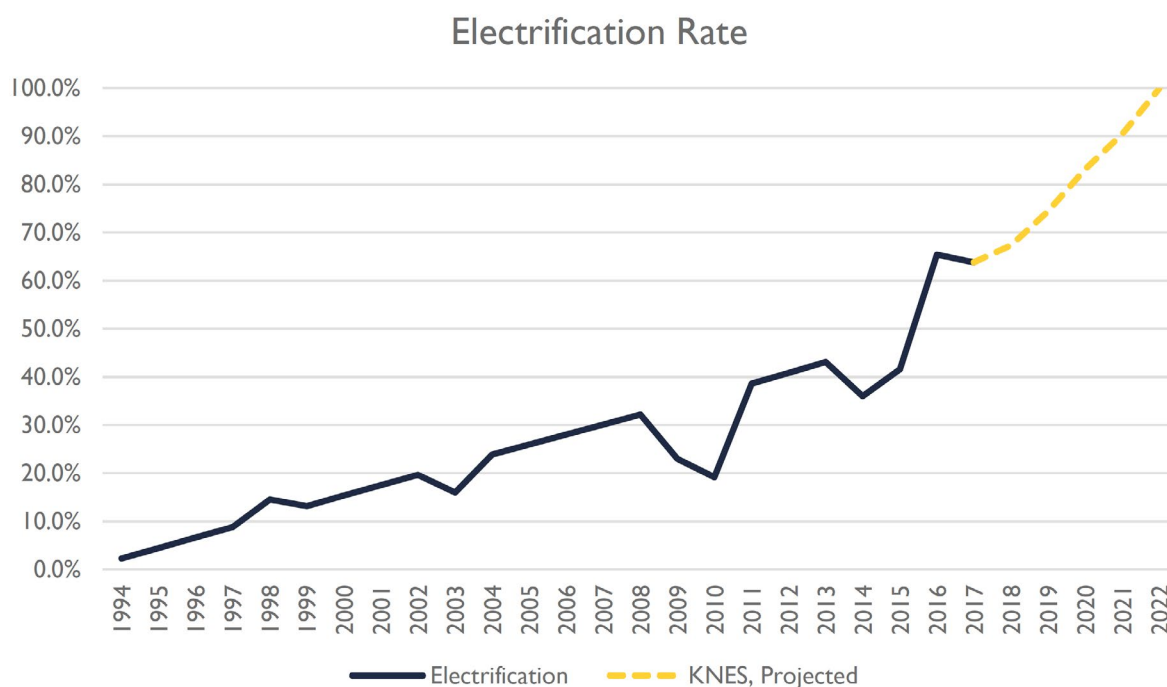


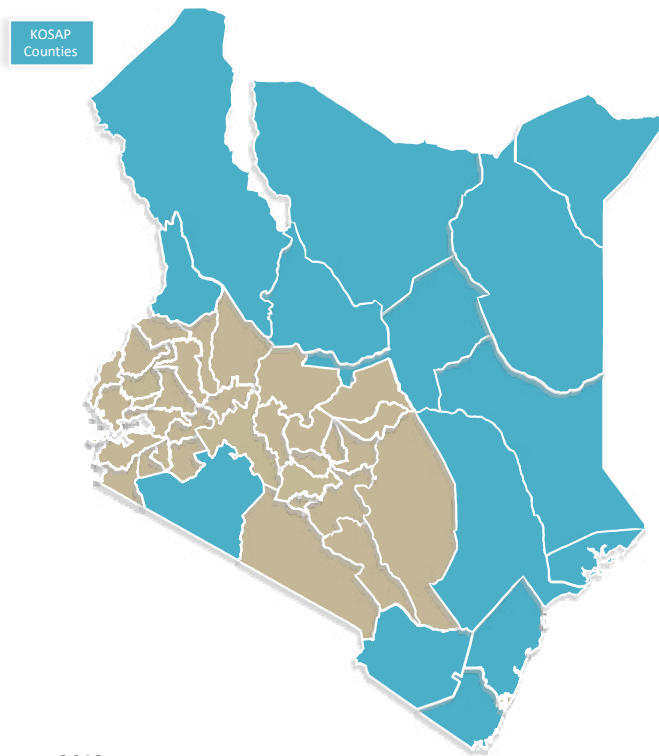
Figure 6 clearly indicates that Kenya has made significant progress toward universal electrification in the past several years. However, as Kenya strives to meet its ultimate goal, it must address certain structural issues. The main issue for off-grid electrification will be reaching those customers who reside in harder-to-reach areas and who are generally poorer. Figure 7 and Figure 8 highlight the underserved counties targeted by KOSAP and the distribution of wealth within Kenya via the gross county product per capita for the period 2013-2017.

<sup>34</sup> Kenya News Agency, “Government to Spend Sh.15 Billion on Electricity Connectivity in 14 Counties – Kenya News Agency.”

<sup>35</sup> Kuo, “Kenya Is Rolling out Its National Electricity Program in Half the Time It Took America — Quartz Africa.”

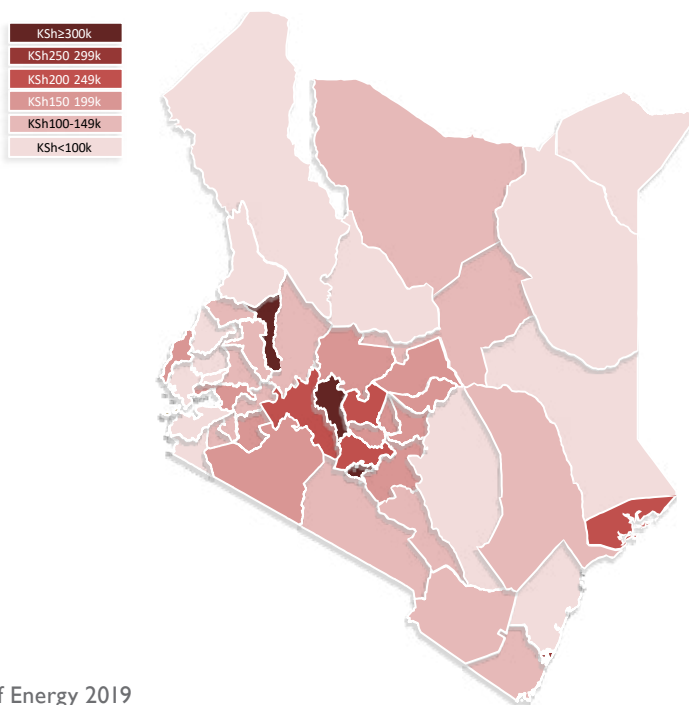
<sup>36</sup> Original analysis based on data from various sources, including Kenya Ministry of Energy 2019, the World Bank’s Global Electrification Database (GED), and the United Nations Population Division in the Department of Economic and Social Affairs (2017).

FIGURE 7. MAP OF KENYA'S UNDERSERVED COUNTIES



Source: Kenya Ministry of Energy 2019

FIGURE 8. PER CAPITA GROSS COUNTY PRODUCT, 2013-2017



Source: Kenya Ministry of Energy 2019

## 2.5 DEMAND FOR ENERGY

### 2.5.1 ADDRESSABLE MARKET AND HOUSEHOLDS' ABILITY/WILLINGNESS TO PAY

KNES expects to meet the energy demands of approximately two million households with off-grid solutions (solar home systems and mini-grid). Because serving this population will largely influence the future of the sector and the Kenya Off-Grid Solar Access Project (KOSAP) will play a significant role in serving them, one can look at economic characteristics of underserved counties targeted by KOSAP to better understand ability and willingness to pay. The analysis in this section looks at GDP per capita at a county level.<sup>37</sup> The maximum energy spending was assumed to be five percent of household income, which is used as a reasonable spending level for poor households in Africa.<sup>38</sup> Table 4 shows the results of this calculation for KOSAP counties.

**TABLE 4. GDP AND ESTIMATED MAXIMUM ENERGY SPEND PER MONTH IN EACH KENYAN COUNTY**

COUNTY	GDP/CAPITA (2019 US DOLLAR [USD])	ESTIMATED MAX ENERGY SPEND PER MONTH (\$)
Garissa	602.60	\$2.51
Isiolo	520.07	\$2.17
Kilifi	1,190.79	\$4.96
Kwale	1,841.86	\$7.67
Lamu	758.49	\$3.16
Mandera	349.77	\$1.46
Marsabit	524.00	\$2.18
Narok	472.91	\$1.97
Samburu	390.38	\$1.63
Taita Taveta	1,007.39	\$4.20
Tana River	972.02	\$4.05
Turkana	415.27	\$1.73
Wajir	482.08	\$2.01
West Pokot	402.17	\$1.68

<sup>37</sup> Bundervoet, Maiyo, and Sanghi, "Bright Lights, Big Cities: Measuring National & Sub-National Economic Growth from Outer Space in Africa, with an Application to Kenya and Rwanda."

<sup>38</sup> Kojima et al., Who Uses Electricity in Sub-Saharan Africa?

Values range from \$1.46–\$7.67 per month, which demonstrates a potential affordability issue for products that typically cost at least \$5 per month.<sup>39</sup> It should be noted that this is an average. KOSAP is designed to alleviate this problem by providing grant support to companies to reduce their costs in serving these communities. However, to reach universal access, SHS companies will need to develop new products and approaches to serve the poorest households that lack access, as there are no proven models to serve the true bottom of the pyramid.

## 2.5.2 LOW GRID CONSUMPTION



Information from the EPRA suggests that many households connected to the grid are only using grid energy for basic needs. EPRA reported in July 2018 that 3.6 million households (more than half of total connections) consumed KSh305 worth of electricity per month, which equates to less than 15 kWh per month.

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The data suggests that these customers are not using appliances like refrigerators or TVs and are likely only using power for basic needs like lighting, charging phones, and possibly radios. This trend is important to note in relation to the off-grid sector because it shows that even among household customers that were willing to pay the connection fee to the grid, electricity needs can be met by an SHS at a lower cost (for the household and the government). This observation potentially increases the market size for SHS beyond the two million connections identified in the KNES.

## 2.5.3 UNDER-GRID CUSTOMERS

In 2015, a study showed that even in communities within what could reasonably be considered the grid service area, only 5.5 percent of households had connected to the grid<sup>41</sup>, with respondents often citing high connection fees as the reason for not connecting. It should be noted that since 2015, the connection fee has been lowered from KSh35,000 to KSh15,000, but it demonstrates the point that households are either not able or not willing to pay a connection fee to the grid. Even with the lower connection cost, this amount is still well above the cost of a typical SHS. For instance, for the M-Kopa 5 SHS, the deposit is KSh2999, plus KSh50/day over a 12-month period.<sup>42</sup>

Overall electricity uptake rates (i.e., the percentage of potential customers within the grid service area who opt to connect) in Kenya have declined in recent years, as the grid expands to increasingly rural areas where ability to pay is less common. This can be seen in Figure 9, which shows grid uptake peaking in 2001–2005 before dropping to lower rates during the subsequent 2006–2010 and 2011–2015 periods.

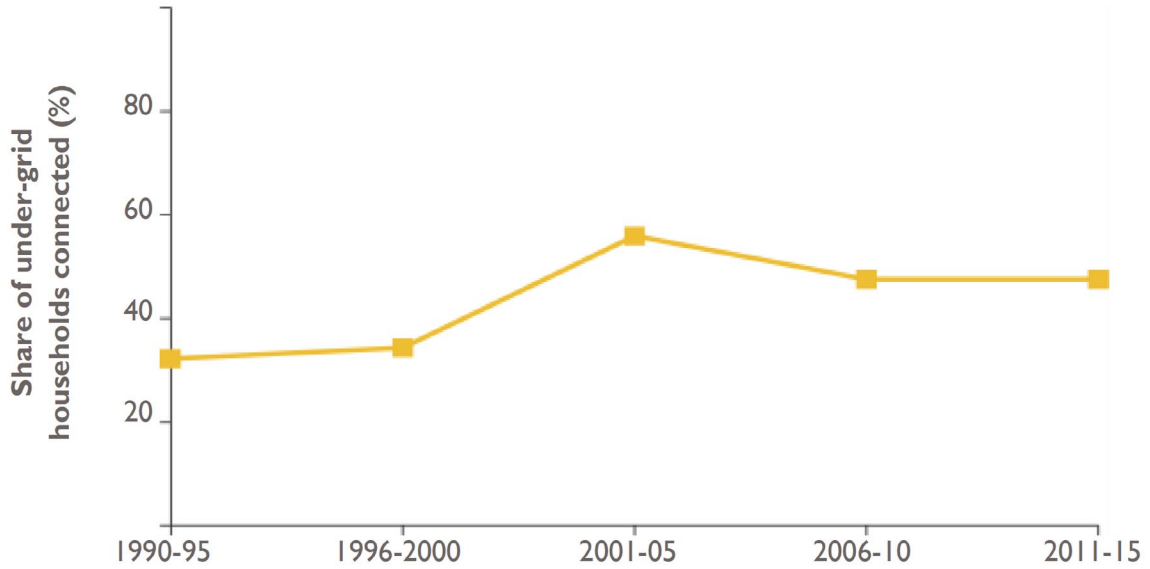
<sup>39</sup> Schutzzeichel, “Significant differences between prices for SHS in Kenya.”

<sup>40</sup> Otuki, “Electricity Demand Crosses 1,800MW Mark.”

<sup>41</sup> Lee et al., “Electrification for ‘Under Grid’ Households in Rural Kenya.”

<sup>42</sup> M-Kopa, “Products: M-KOPA 5 Solar Home System.”

FIGURE 9. KENYA GRID UPTAKE OVER TIME



Source: Blimpo and Cosgrove-Davies 2019

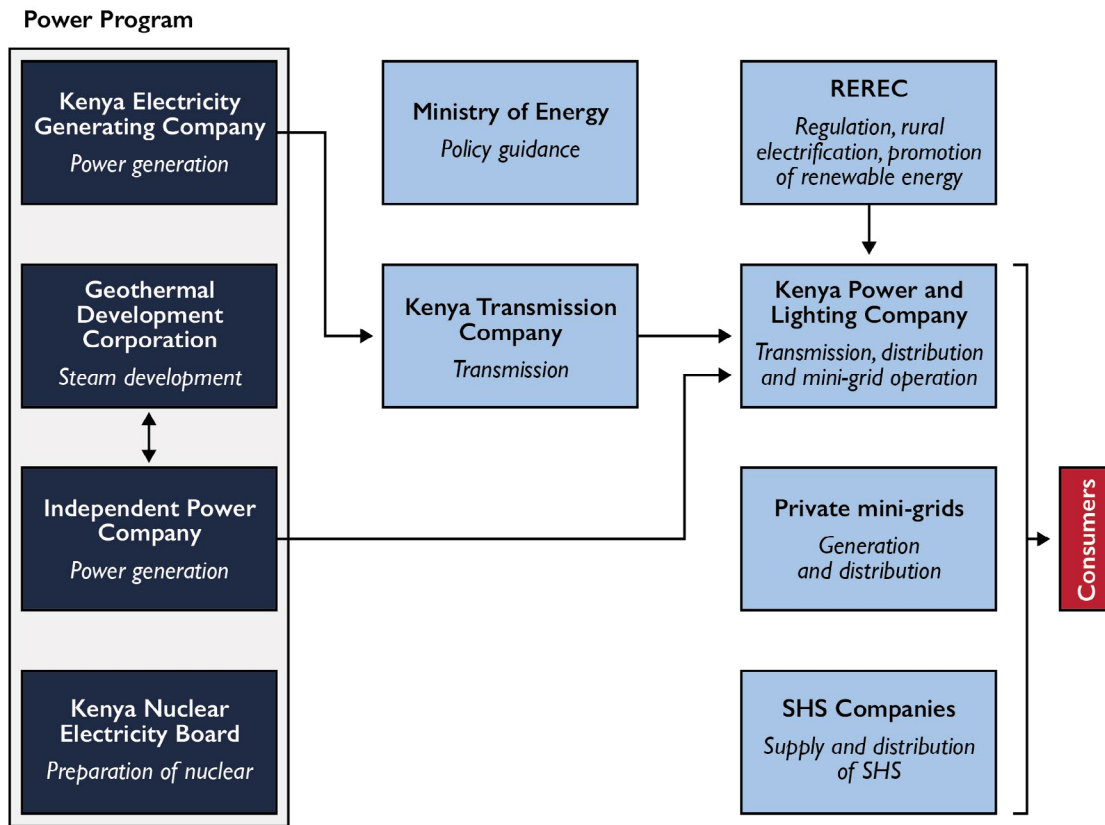
Rapid grid expansion is leading to a steady increase in the number of under-grid customers. This market represents an opportunity for off-grid suppliers as is discussed later.

## 2.6 POLITICAL LANDSCAPE AND INSTITUTIONAL FRAMEWORK

Overall, the GoK has been supportive of off-grid electrification, as demonstrated by KNES 2018, which has a strong off-grid component and provides direction for the approximately two million new connections by 2022 (SHS and mini-grid). This is a significant portion of the expected 5.7 million total connections expected in the same time frame to achieve universal access to electricity. Additionally, Kenya has generally taken a hands-off or lightly regulated approach to private sector engagement in the sector, which has allowed the sector to grow unencumbered. This approach has helped Kenya maintain its status as the leading country for off-grid solutions in Africa.



FIGURE 10. INSTITUTIONAL FRAMEWORK



Note: The arrows indicate the directional flow of electricity.

The Ministry of Energy develops and adopts policies and regulation, which it then passes to EPRA for implementation. EPRA falls under the Ministry of Energy. A key function of EPRA is to provide due diligence for SHS companies to enable them to qualify for tax exemptions from the Kenya Revenue Authority (KRA). These exemptions and qualifications of products for them have been important in keeping prices affordable for customers.

The Ministry of Energy has been supportive of the off-grid sector and often goes to East African Community (EAC) meetings to support positions that are beneficial to the off-grid sector. Unfortunately, competing priorities among ministries have caused issues with the consistent application and interpretation of taxes. While the Ministry of Energy has the mandate of improving energy access, the Ministry of Finance has a similar mandate for collecting revenues. This means that when there are gray areas in terms of tax collection (particularly for value-added tax [VAT] and import duties), KRA (under the Ministry of Finance) will lean toward collecting revenue when it can. The best example of this is when a company imports components separately, KRA will argue that the components (e.g., lights or electronic components) are not tax-exempt because they do not come with solar and/or battery components. KRA might also claim that the components can be used for other purposes. These ministries meet regularly, but off-grid issues are typically not the priority and often get skipped.

This inter-ministry issue of competing priorities also shows up at the EAC level, where working groups among different ministries propose policies in their respective sectors. Ministries of finance might have the final vote on which policies to adopt. A ministry of energy in one EAC country may support a unified import tariff scheme for the EAC that is beneficial for the off-grid sector, but this support may face opposition from their own or another EAC country’s ministry of finance due to the ministries’ competing priorities.

## 2.7 RELEVANT POLICIES, STRATEGIES, AND REGULATIONS



Kenya has just recently updated the two most relevant documents for the energy sector, the National Electrification Strategy and the Energy Act, 2019. These new laws and strategies provide a new, clear direction for the sector, which had been waiting for guidance for the last two years when the draft energy bill was first released.

### 2.7.1 VISION 2030

As the country's long-term development blueprint, Vision 2030 aims to transform Kenya into a newly industrializing middle-income country offering a high quality of life to all citizens. Vision 2030 is being implemented through successive five-year medium-term plans. Energy has been recognized as a key enabler in the Third Medium-Term Plan 2018–2022 (Kenya Vision 2030 2018).

### 2.7.2 KENYA NATIONAL ELECTRIFICATION STRATEGY

KNES launched in December 2018. It provides a roadmap to achieving universal access to electricity for all Kenyans by 2022. It identifies least-cost and most-effective solutions for electrification coverage. The supply options considered in the KNES include grid densification, intensification, and expansion as well as off-grid solutions. The strategy has a strong off-grid component and expects to provide approximately two million new connections by 2022 (SHS and mini-grid). This is a significant portion of the expected 5.7 million total connections expected in the same time frame to achieve universal access to electricity. The KNES estimates a total investment requirement of \$2.8 billion if SHS are used extensively within the Kenya Power and Lighting Company (KPLC) service territory.<sup>43</sup>

### 2.7.3 RURAL ELECTRIFICATION AND RENEWABLE ENERGY CORPORATION (RREC) (RURAL ELECTRIFICATION AGENCY [REA]) STRATEGIC PLAN 2017–2021

RRECs current strategic plan (2016/2017–2020/2021 financial year) was developed before the assent of the Energy Act 2019. The plan provides a roadmap for electrification of public facilities and nearby households. By 2020, The plan projects to electrify 28,323 public facilities, 3,787 of which will be off-grid areas electrified through solar PV. The remaining 24,536 will be connected to the national grid. Standalone solar systems and mini-grids are recognized as a cost-effective electrification solution for households and community facilities in the dispersed areas. The plan expects to establish 450 mini-grids and interconnect existing diesel mini-grids. The plan recognizes the role of stakeholders, including the private sector, in the achievement of targets.<sup>44</sup>

### 2.7.4 SUSTAINABLE ENERGY FOR ALL (SE4ALL) ACTION AGENDA

Kenya opted in to the SE4All Initiative and has developed an action agenda, which is a sector-wide, long-term vision covering 2015–2030. The agenda outlines how the country will achieve its SE4All goals of universal access to modern energy services, increase the rate of energy efficiency, and increase to 80 percent the share of renewable energy in the energy mix by 2030.<sup>45</sup>

<sup>43</sup> Kenya Ministry of Energy, "Kenya National Electrification Strategy: Key Highlights 2018."

<sup>44</sup> Rural Electrification Authority, "Strategic Plan 2017-2021."

<sup>45</sup> Republic of Kenya, "Sustainable Energy For All: Kenya Action Agenda."

### 2.7.5 KENYA ELECTRICITY DISTRIBUTION MASTER PLAN, 2013

The Kenya Electricity Distribution Master Plan was developed by KPLC in 2013, to guide distribution grid investment, expansion, and intensification. It provides a forecast of electricity demand for each of the counties up to 2030. In addition, it identifies the distribution infrastructure required to meet that demand while achieving acceptable levels of power quality and reliability. The plan is currently due for review.<sup>46</sup>

### 2.7.6 KENYA ELECTRICITY SECTOR INVESTMENT PROSPECTUS 2018–2022

The current Kenya Electricity Sector Investment Prospectus was developed by energy sector institutions. It presents investment and financing opportunities in geothermal development, power generation, electricity transmission and distribution, off-grid electrification, and energy efficiency. This investment prospectus outlines areas for mobilization of resources and multi-stakeholder engagement to facilitate implementation of priority projects in the electricity sector. It also presents the opportunity for increased private-sector participation across all sub-sectors through the private-public partnerships framework, feed-in tariffs, and renewable energy auctions frameworks, among other things.

### 2.7.7 ENERGY ACT, 2019

The Energy Act, 2019, passed in March 2019, aims to align the energy policy and regulation with the changes brought about by the 2010 Constitution of Kenya.

The Act outlines obligations between national and county governments for the provision of affordable energy services. It provides for the establishment, powers, and functions of energy sector entities, including the EPRA, Energy and Petroleum Tribunal, REREC, and Nuclear Power and Energy Agency.

- › The EPRA's function is to regulate, monitor, and supervise upstream petroleum as well as regulatory issues that previously fell under the Energy Regulatory Commission (ERC). Notably, EPRA is responsible for certifying that companies qualify for import exemptions from KRA.
- › The Energy and Petroleum Tribunal's mandate is to hear and determine disputes and appeals in accordance with the act and any other written law.
- › REREC has combined the former REA and the state department of renewable energy roles. It is expected to play an oversight role to improve efficiency.
- › The Nuclear Power and Energy Agency will oversee matters related to nuclear energy.

In addition, the act has provided direction in the promotion of renewable energy, exploration, recovery, and commercial utilization of geothermal energy; the regulation of midstream and downstream petroleum and coal activities; and the regulation, production, supply, and use of electricity and other energy forms for connected purposes.

### 2.7.8 THE ENERGY (MINI-GRID) REGULATIONS, 2018

The Kenyan mini-grid regulations were drafted in 2018 but awaited the enactment of the 2019 Energy Act.<sup>47</sup> EPRA is expected to publish the Mini-Grid Regulations and the Regulatory Impact Assessment for public comment in the second half of 2019. The public has 40 days from the publication date of the notice to submit comments that EPRA will analyze and include for a final draft. The final draft will be sent to the

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<sup>46</sup> Kenya Power & Lighting Company Limited, "KPLC Distribution Master Plan Study - Final Report."

<sup>47</sup> Otuki, "Energy Agency Plans Tariff Cuts for Small Power Producers"; Bungane, "Kenya."

Minister of Energy, who will send it to the Parliament for consideration by the Energy Subcommittee. EPRA estimates that the mini-grid regulations will be enacted in the third quarter of 2019. Parliament for consideration by the Energy Subcommittee. EPRA estimates that the mini-grid regulations will be enacted in the third quarter of 2019.

### 2.7.9 FINANCE ACT, 2018

The Finance Act, 2018, was ratified and passed in September 2018.<sup>48</sup> The VAT Act, 2013, exempted all specialized solar equipment and accessories from paying VAT. However, the act restricts specialized equipment to only those used in the development and generation of wind and solar energy, including deep-cycle batteries which use or store solar power.<sup>49</sup>

Other provisions in the act that may impact energy businesses are the harmonization of the excise duty, applicable to kerosene and diesel. Duties on diesel may further bridge the gap between the prices of kerosene and diesel and discourage adulteration. This measure, coupled with the introduction of eight-percent VAT on petroleum products (including kerosene), significantly increases the price of kerosene and may render kerosene out of reach for the off-grid community. This may increase the demand for solar lighting devices.<sup>50</sup>

### 2.7.10 DATA PROTECTION BILL, 2018

The Data Protection Bill, 2018, seeks to regulate the processing of personal data, to ensure that the handling of personal data is guided by the overarching principles of data protection. The bill lays out the rights of data subjects to protect personal data from unlawful processing. One provision likely to affect off-grid energy companies is the condition for transfer out of Kenya, which prevents employee and customer data from being transmitted or stored in another country unless that country also has similar data protection regulations. Currently, Rwanda and Uganda have similar laws, so they would be exempt from this, but transmitting data to any other country in the region may be prohibited.<sup>51</sup> The intent of this bill is understandable, but for companies that have already invested in systems that might not necessarily comply with this, there will clearly be a negative effect<sup>52</sup>.

## 2.8 GOVERNMENT INSTITUTIONS

### 2.8.1 MINISTRY OF ENERGY

The Ministry of Energy is responsible for formulating policies, setting guidelines for the sector, and guiding rural electrification. It recently split from the Ministry of Energy and Petroleum in January 2018 and it oversees the newly formed REREC.<sup>53</sup>

### 2.8.2 THE NATIONAL TREASURY

The National Treasury derives its mandate from the Constitution of 2010, the Public Management Act, 2012, and the Executive Order No. 2/2013. The National Treasury is responsible for Kenya's national

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<sup>48</sup> Ernst & Young, "Kenya Enacts Finance Act 2018."

<sup>49</sup> Republic of Kenya, The Finance Act 2018.

<sup>50</sup> Republic of Kenya.

<sup>51</sup> Nkusi, "New ICT Law Embodies Data Privacy Protection"; Government of Uganda, The Data Protection and Privacy Act, 2019.

<sup>52</sup> Government of Kenya, "The Data Protection Bill, 2018."

<sup>53</sup> Janvrin, "Private Sector Could Solve Kenya's LNG Impasse."

government finances, including spearheading efficient and sustainable public financial management, which is fundamental in promoting equitable socioeconomic development and efficient delivery of services to Kenyans. For the off-grid sector, the agency is responsible for approving VAT and import tax exemptions for specialized solar equipment.<sup>54</sup>

### 2.8.3 RURAL ELECTRIFICATION AND RENEWABLE ENERGY CORPORATION

REREC was established by the Energy Act, 2019, as a successor of REA. Under the Act, REREC has an expanded mandate for spearheading Kenya's renewable energy drive, in addition to implementing rural electrification projects. Of the REREC functions outlined in Section 44(1) of the Energy Act, 2019, those related to the off-grid energy sector include the following:

- › Oversee the implementation of the Rural Electrification Program
- › Manage the Rural Electrification Program Fund established under Section 143, with the objective of accelerating electricity access in the country
- › Source additional funds for the Rural Electrification Program and renewable energy
- › Develop and update the rural electrification master plans in consultation with county governments
- › Undertake feasibility studies, maintain data, and provide these data to developers of renewable energy resources
- › Develop, promote, and manage, in collaboration with other agencies, the use of renewable energy and technologies, including but not limited to biomass (biodiesel, bio-ethanol, charcoal, fuel-wood, biogas), municipal waste, solar, wind, tidal waves, small hydropower, and co-generation, but excluding geothermal.

### 2.8.4 ENERGY AND PETROLEUM REGULATORY AUTHORITY

EPRA was established as the successor to ERC under the Energy Act, 2019. EPRA's mandate includes licensing; technical and economic regulation; enforcement and compliance; and handling of complaints and disputed regulation. Notably, EPRA is responsible for certifying that companies qualify for import duty and VAT exemptions from KRA.<sup>55</sup>

### 2.8.5 KENYA POWER AND LIGHTING COMPANY

KPLC, established as a limited liability company under the Companies Act, Chapter 486, produces, supplies, and sells electricity according to the mandate of its memorandum of association. KPLC owns most of the transmission and distribution systems in Kenya and is responsible for retailing electricity to end customers. It is partially privatized, GoK owns 50.1 percent of KPLC, and private investors own 49.9 percent. Under its strategic plan for 2016/2017 to 2020/2021, KPLC plans an annual increase of 1.2 million customers, through both on-grid and off-grid solutions, to reach at least nine million customers by 2021.<sup>56</sup>

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<sup>54</sup> Republic of Kenya, "The National Treasury."

<sup>55</sup> Energy & Petroleum Regulatory Authority, "Energy Regulatory Commission of Kenya."

<sup>56</sup> Kenya Power, "Kenya Power: Who We Are."

## 2.8.6 KENYA REVENUE AUTHORITY

KRA was established by an act of Parliament, the Kenya Revenue Authority Act, Chapter 469, which became effective on July 1, 1995. The authority is charged with collecting revenue on behalf of the GoK and provides advice on matters relating to the administration and collection of revenue. KRA is responsible for processing VAT and import tax exemptions upon approval by the National Treasury. Taxes and exemptions can affect off-grid entities.<sup>57</sup>

## 2.8.7 NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

The National Environment Management Authority (NEMA) was established under the Environmental Management and Coordination Act No. 8 of 1999 as the principal GoK instrument for implementation of all policies relating to regulations for environmental protection. Significant to the off-grid market are the Environmental (Impact and Audit) Regulations, 2003, which require proponents of projects, such as mini-grid developers, to conduct environmental impact assessments for NEMA approval. Other relevant regulations, though still in draft form, are e-waste regulations requiring e-waste producers to apply for registration from NEMA. This would likely include all off-grid companies intending to introduce new or used electrical and electronic equipment into Kenya

NEMA is the designated national authority for the Clean Development Mechanism and other multilateral environmental agreements.<sup>58 59 60</sup>

## 2.8.8 KENYA BUREAU OF STANDARDS

The Kenya Bureau of Standards (KEBS) is the government agency responsible for harmonizing standards, measurements, and conformity with internationally recognized measurements. KEBS operates the National Enquiry Point in support of the World Trade Organization Agreement on Technical Barriers to Trade. It ensures compliance with international standards and secures evidence of such compliance, especially from those looking to enter the Kenyan market, through an internationally recognized accreditation system. KEBS promulgated the solar PV standards and adopted the IEC standards, which are aligned with the Lighting Global Quality Assurance Framework

## 2.8.9 COUNTY GOVERNMENTS

There are 47 political and administrative counties in Kenya, as determined by the Constitution of 2010. It is a requirement in the Energy Act, 2019 that counties develop county energy plans outlining energy requirements.

## 2.9 DEVELOPMENT PARTNER PROGRAMS

### 2.9.1 KENYA OFF-GRID SOLAR PROJECT

KOSAP is the flagship electrification project for the Ministry of Energy, financed by the World Bank. The project aims to provide electricity to parts of the country that are not served by the national grid, targeting

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<sup>57</sup> Republic of Kenya, “Kenya Revenue Authority Act Cap.469.”

<sup>58</sup> National Environment Management Authority, “National Environment Management Authority (NEMA) - Home.”

<sup>59</sup> Republic of Kenya, “The Environmental Management and Co-Ordination Act, 1999 No 8 of 1999 (Kenya).”

<sup>60</sup> Republic of Kenya, “Environmental (Impact Assessment and Audit) Regulations, 2003 (Cap. 387).”



1.3 million households in northeastern and northern Kenya, including the counties of Garrisa, Isiolo, Kilifi, Kwale, Lamu, Mandera, Marsabit, Narok, Samburu, Taita Taveta, Tana River, Turkana, Wajir, and West Pokot. The project will go a long way in contributing to the National Electrification Strategy that will ensure universal access to electricity by 2022. The project is a key part of Vision 2030, the country’s long-term development plan. It is jointly implemented by the Ministry of Energy, KPLC, and REA, now REREC. <sup>61</sup>



To encourage solar service providers to expand their services from more urban areas to underserved counties, KOSAP will provide incentives, including a results-based financing facility. This financing facility will compensate the providers through competitive awards for initial, ongoing incremental, and opportunity costs associated with service expansion.

KOSAP will also establish a debt facility to support both the providers, which can expect up-front costs for market entry. It will also assist consumers to pay off systems over time. To ensure that consumers are aware of new technologies that will be available to them, KOSAP will conduct a consumer education campaign, including mass media tools, opportunities for one-on-one engagement with the products, and interaction with service providers. <sup>62</sup>

## 2.10 INDUSTRY ASSOCIATIONS

### 2.10.1 KENYA RENEWABLE ENERGY ASSOCIATION



The Kenya Renewable Energy Association (KEREAA) is an independent nonprofit association dedicated to facilitating the growth and development of renewable energy business in Kenya. The current membership is 31 organizations, mainly drawn from the private sector.

The association operates through working groups established along the lines of sub-sectors, such as solar PV, solar water heating, and mini-grids. The bioenergy sub-sector issues are handled by the Biogas Network and the clean cooking association of Kenya. <sup>63</sup>

The associations’ main roles include promoting the interests of its members: government, donor organizations, nongovernmental organizations, the general public, and any other organizations that may have an impact on the development and general wellbeing of the industry. KEREAA also provides a platform for the dissemination and exchange of information in the renewable energy sector and promotes professionalism in the industry by encouraging the adoption of best practices and standards among the members. KEREAA advocates for the protection of consumers of renewable energy products and services in all aspects.

In the last few years, KEREAA has been implementing activities to support the development of the solar PV sector: developing PV standards, advocating on behalf of the industry during the development of the solar PV regulations, and facilitating stakeholder and public input in the review process. Other activities include the institutionalization of a solar PV curriculum, and more recently the voluntary accreditation framework for solar PV businesses. One aim is to reduce market spoilage and increase consumer confidence in solar PV as a viable electrification option.

<sup>61</sup> Ministry of Energy, “About KOSAP.”

<sup>62</sup> Ministry of Energy, “The Kenya Off-Grid Solar Access Project (K-OSAP).”

<sup>63</sup> KEREAA, “KEREAA Brochure and Membership Details.”

KEREA is a member of the Kenya Private Sector Association (KEPSA), which serves as a voice for the private sector to the GoK. KEPSA membership accords members the opportunity to meet with key policy makers to address urgent emerging issues in the energy sector.

Growth and changes in the energy sector, including the changes brought about by the Energy Act, 2019, may result in increased demand for KEREA's services, such as market and regulatory information, advocacy, networking and business linkages, coordination, and capacity-building. KEREA has good standing and may reposition itself to serve the needs of the sector and promote growth, sustainability, and prosperity of its members. However, the association still faces many challenges. Key among them is the lack of resources that has hampered the functionality of the secretariat (currently with only one staff member) and has led to weak service offerings to members and, to an extent, to the sector at large. KEREA'S staffing and finances compare poorly, for example, to the Uganda solar energy association, which received significant financial and technical support and currently employs a team of four staff.<sup>64</sup>

### 2.10.2 KENYA PRIVATE SECTOR ASSOCIATION

Set up in 2003, KEPSA is the private-sector umbrella organization that brings together business membership organizations and corporate members. KEPSA is a key player in championing the interests of the Kenyan business community in trade, investment, and industrial relations. It engages and influences public policy to enable a better business environment. One notable advocacy mechanism is the public-private dialogue, which provides a platform for engagement with various governance structures including national and state executives, development partners, ministries, and regional forums. These dialogues provide an opportunity for private engagement on national issues and sector-specific issues.<sup>65</sup> In addition to its advocacy role, KEPSA represents its members' interests and develops their capacity. Other energy sector associations, such as KEREA, stand to benefit from membership in KEPSA not only for capacity-building opportunities but also for support in sector-specific advocacy.

### 2.10.3 GOGLA

GOGLA is the global association for the off-grid solar energy industry, established in 2012. It currently represents over 140 members as a neutral, independent, nonprofit industry association. GOGLA helps build sustainable markets. It helps profitable businesses deliver quality, affordable off-grid electricity products and services to as many customers as possible across the developing world. GOGLA provides market intelligence, knowledge-sharing and networking opportunities, advocacy for growth-enabling policy and investment, and industry standards and guidelines, such as quality assurance and consumer protection.<sup>66</sup>

### 2.10.4 AFRICAN MINI-GRID DEVELOPERS ASSOCIATION

The African Mini-Grid Developers Association (AMDA) is a pan-African organization mini-grid trade association established in 2018<sup>67</sup>. It has chapters in Kenya, Tanzania, and Nigeria with plans to expand to 12 countries by 2020. Current membership comprises 16 mini-grid developers. The association's goal is to promote best practices in policy and regulation and attract finance to the mini-grid sector.

Before the formation of AMDA, there was no specific platform to address issues on mini-grids or to serve as a link between the developers, the government, and other stakeholders. AMDA's involvement in Kenya is poised to grow, given the recognition of the contribution of mini-grids and the private sector in achieving universal access to energy.

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<sup>64</sup> CIO East Africa, "United Kingdom to Support Solar Energy Industry in Uganda"; USEA, "Management & Team | USEA."

<sup>65</sup> KEPSA, "Public Private Dialogue."

<sup>66</sup> GOGLA, "Publications."



AMDA's focus is on the following:

- › Intelligence sharing through an online platform that enables transparency in industry performance, providing data for the sector in financial and technical efficiencies for better advocacy on the role of mini-grids in energy access.
- › Advocacy, working with financiers and policy makers and other stakeholders to create an enabling environment for mini-grids.
- › Coordination of sector actors, acting as the voice of the mini-grid industry to promote sector sustainable growth.

## 2.11 OTHER STAKEHOLDERS

### 2.11.1 TRAINING INSTITUTIONS

Several institutions in Kenya work on skills development in this sector, and since new regulations mandate that solar installers be certified, training in this area has become particularly important. While skills development is always needed, it is something that development partners are reluctant to fund, so programs are somewhat limited. Different initiatives are outlined in Table 5.

**TABLE 5. SUMMARY OF TRAININGS OFFERED IN AFRICA**

INSTITUTION	TRAINING OFFERED
Spire	SHS companies pay Spire for staff training on management and customer service
National Industrial Training Authority	The national body that provides training and testing certifications for licenses
Women in Sustainable Energy and Entrepreneurship (WISEE)	WISEE has developed a solar curriculum with a gender focus on the solar industry
Strathmore University, Jomo Kenyatta University of Agriculture and Technology, University of Nairobi	These universities all offer a curriculum in renewable energy, and they have synchronized this curriculum
The Micro-Grid Academy (MGA)	The MGA is a regional capacity-building platform that provides theoretical and practical training on energy access and decentralized renewable energy solutions to young East African and international technicians, entrepreneurs, and engineers <sup>68</sup>

### 2.11.2 CREDIT BUREAUS

Three credit reference bureaus (CRB) have been licensed by the Central Bank of Kenya to provide credit information services: Metropol, Creditinfo, and Transunion Africa.<sup>69</sup> Lenders report information to these CRBs regarding defaults and repayment history, and the CRBs use this information to blacklist those who default. Recently, large numbers of people have been reported for defaults, with many of the loans reported as very small amounts. In 2016, Transunion completed a study that showed 52.7 percent of a group of 600,000 defaulters had balances less than Sh100, or \$97.<sup>70</sup> While it is good that credit information is starting to be common in Kenya, over 500,000 people were reported to be on the list in 2018<sup>71</sup>, which could negatively affect the off-grid sector, especially if the number grows in coming years.

<sup>67</sup> AMDA, "AMDA – Africa Minigrad Developers Association."

<sup>68</sup> Res4Africa, "Micro-Grid Academy."

<sup>70</sup> Ngigi, "Pain of Kenyans Blacklisted for Amounts as Small as Sh100 in Mobile Loans, Bank Fees."

<sup>71</sup> Ndege, "500,000 People in Kenya Blacklisted with Credit Reference Bureau (CRB) for Defaulting on Their Mobile Loans."

### 3 SOLAR HOME SYSTEMS

#### 3.1 BACKGROUND

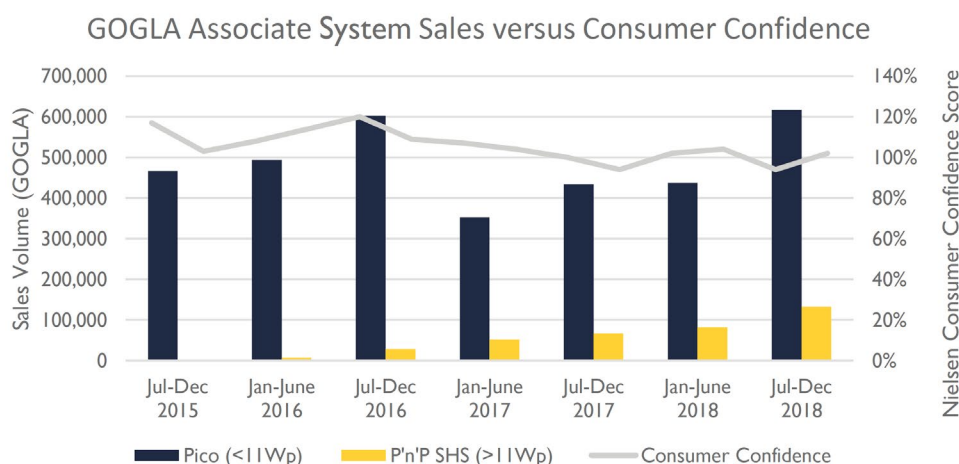
Kenya is the leader in SHS sales in Africa, with approximate total sales of over \$5 million in off-grid products reported . In the last three years alone, GOGLA affiliates reported sales of \$3.4 million in products. SHS continue to gain interest from governments and development institutions to rapidly electrify households. The role of SHS is recognized in the KNES, with the minimal level of service requirement of Tier I of the World Bank Multi-Tier Framework <sup>72</sup> adopted as the basic level of service for a household to receive electricity access in off-grid areas. The attributes of the Multi-Tier Framework are as shown in Table 6. Figure II tracks sales volume for GOGLA members.

**TABLE 6. MULTI-TIER FRAMEWORK ELECTRICITY TIERS**

ATTRIBUTE	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Available Peak Power	At least 3 W	At least 50 W	At least 200 W	At least 800 W	At least 2 kW
Monthly Consumption per Consumer	At least 12 Wh	At least 200 Wh	At least 1 kW	At least 3.4 kW	At least 8.2 kWh
Daily Availability	At least 4 hrs	At least 4 hrs	At least 8 hrs	At least 16 hrs	At least 23 hours
Evening Availability	At least 1 hr	At least 2 hrs	At least 3 hrs	At least 4 hrs	At least 3 hours (with total duration of less than 2 hours)
Reliability (Outages per Week)	Not applicable	Not applicable	Not applicable	At most 14 hrs per week	Max 3 disruptions per week of total duration < 2 hours

Source: Kenya Ministry of Energy 2019

**FIGURE II. GOGLA SYSTEM SALES IN KENYA**



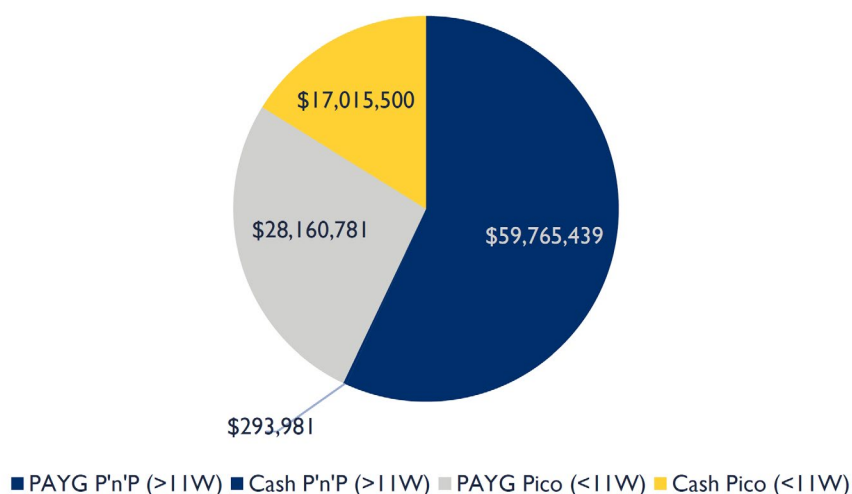
Source: Original analysis based on GOGLA data and Nielsen Consumer Confidence data (Njanja 2018, Janardhanan 2018, and Janardhanan 2019)

Sales of pico systems of less than 11 picowatts (Wp) constitute the greatest share of the market in terms of sales volume, showing steady growth to late 2016, before suffering a distinct drop in sales (Figure 11). This fall in sales coincides with the start of a period that saw consumer confidence start a lengthy slide, before reaching an all-time low in late 2017. The drop in sales can be attributed mainly to external factors, with sales in the first half of 2017 impacted by both the national election and droughts. Sales have shown steady growth since this period. Elections cycles <sup>73</sup> and drought <sup>74</sup> impact Kenya’s economy and consumption on a regular basis, and it is expected that drought will impact 2019 sales yet again.

Sales volumes of larger plug and play (P’n’P) systems ( $\geq 11$  W) by GOGLA associates have shown steady and consistent growth since 2006 and are expected to be a continued area of growth, as SHS manufacturers continue to introduce larger products to their lines and as distributors push existing customers to upgrade their systems. While the sales volumes for these systems remain far below those of smaller systems, their higher value means that they represent a much more significant share of market value.

FIGURE 12. GOGLA SYSTEM MARKET VALUE IN KENYA

### GOGLA Associate Market Value 2018



Source: GOGLA

GOGLA associates do not represent the full SHS market in Kenya; GOGLA estimates that its members account for 60 percent to 70 percent of total sales in Kenya, while other estimates put this figure lower. Figure 13 estimates the total Kenyan market size based on GOGLA’s estimates.

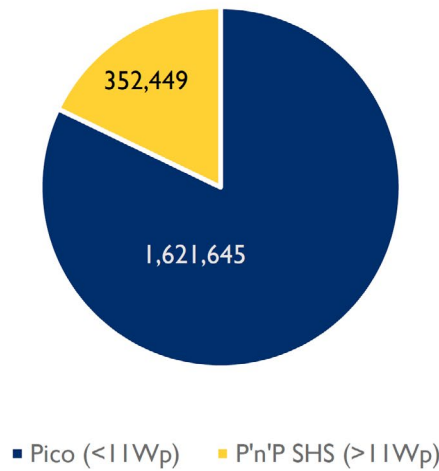
<sup>72</sup> Kenya Ministry of Energy, “Kenya National Electrification Strategy: Key Highlights 2018.”

<sup>73</sup> Kinuthia, “INDEPTH.”

<sup>74</sup> Ngugi, “Persistent Drought Hurts Economy.”

FIGURE 13. GOGLA ESTIMATED TOTAL SALES VOLUMES

### 2018 Estimated Total Sales Volumes



Source: GOGLA 2018b



KNES projects 2.2 million SHS installations by 2023 to be mainly driven by the private sector.<sup>75</sup> To support this, the GoK is adopting conducive regulations that enable the private sector to operate and grow, such as favorable taxes, and facilitating duty exemption requests during procurement and delivery cycles.

With the sheer number of systems already sold and companies operating in the country, some have questioned whether the market is saturated, with little potential for companies looking to enter the market. However, there is reason to believe that the market is not saturated yet. See Section 3.5 (Future of the Sector) for a case study demonstrating that space remains for new market entrants.

#### 3.1.1 REGULATORY CHALLENGES

The GoK has taken a relatively hands-off approach to the off-grid sector, which has allowed the sector to grow without unnecessary impediments and allowed the country to maintain its status as a leader in SHS. Aside from the aforementioned issues that affect all off-grid companies (the data protection and financial markets bills, VAT/duty exemptions, and customs clearance), the Draft National E-waste Management Strategy, which places responsibility for waste on the producer, poses a risk to SHS entities that may not be able to manage the waste on their own. E-waste is a sector issue, and therefore the burden of e-waste management should be placed at the sectoral level.<sup>76</sup>

#### 3.1.2 QUALITY ASSURANCE

KEBS is the government agency responsible for the development of standards and certification services. However, the enforcement of its standards has been weak given the insufficient institutional capacity at the customs level and slow implementation of regulations. A 2016 Lighting Global report on the solar retail market noted the presence of 122 brands of solar lanterns (83 percent of them uncertified by Lighting Global) and 59 brands of SHS (of which 53 percent were not certified under Lighting Global). However,

<sup>75</sup> Kenya Ministry of Energy, “Kenya National Electrification Strategy: Key Highlights 2018.”

<sup>76</sup>Ministry of Environment and Forestry, “National E-Waste Management Strategy.”

Lighting Global brands accounted for 60 percent to 65 percent of sales volumes across both product categories.<sup>77</sup> There are limited data on the current status of the quality of products in the Kenyan market (certified verses uncertified and counterfeit).

### 3.1.3 UNINTENDED REGULATIONS

Recently there have been two examples of regulations enacted in other sectors that could have effects on the Kenyan off-grid market. These were the Data Protection Bill and Financial Markets Conduct Bill described previously. Both bills could introduce burdensome regulations and compliance requirements that could impact the off-grid sector. Data protection, though in the best interest of the consumers and integral in any best practice compliance program, comes with drawbacks. Solar companies that have adopted the PAYGO model have to process a vast array of personal individual data as part of know-your-customer due diligence procedures. The Data Protection Bill restricts how the customer data are acquired and managed, while the Draft Financial Markets Conduct Bill requires licensing of entities providing financial products and services. These bills and other legislation, if passed, can increase the cost of doing business and lay down obstacles to younger companies that lack resources for compliance.<sup>78</sup>

### 3.1.4 VAT/DUTY EXEMPTIONS

The SHS market has enjoyed a favorable taxation framework. Current exemptions under the VAT Act, 2013, VAT (Amendment) Act, 2014, and Finance Act include exemption from VAT and import duties for supplies imported or bought for the construction of a power-generating plant or for geothermal exploration, as well as certain plant machinery. The VAT exemption does not cover non-specialized components, such as steel.

In addition, the Finance Act, 2019, prescribes that “specialized solar equipment and accessories used for development and generation of wind and solar energy, including solar water heaters and deep cycle-sealed batteries, which exclusively use or store solar power” are also exempt. This provision is also found in the East Africa common agreement on import duty waivers (Part B-General Exemptions, paragraph 26).

In practice, all energy-specific equipment has been VAT-exempt, excluding non-specialized components (e.g., steel). Sufficient specifications need to be provided on VAT and import duty exemptions to reduce the systemic reliance on the judgment calls of individual officials, which creates uncertainty. Other potential risks include the spillover effects of regulations enacted in neighboring countries, such as the Tanzania Tax Administration (Transfer Pricing) Regulations, 2018.<sup>79</sup> It is a recognized trend within East Africa that the introduction of new legislation in one country in the region can have a cascade effect, causing others to follow suit with similar legislation.

## 3.2 CORPORATE FINANCE

Kenya has clearly been a “first mover” in sub-Saharan Africa from the perspective that its off-grid companies have attracted substantial corporate finance. There are few examples of international investors active in the off-grid sector in Africa that have not invested in Kenya. However, this early flow of equity investment into Kenya’s off-grid market has made it difficult for many off-grid companies to attract follow-on capital (equity) from investors worried about market concentration and country risk. First investors, such as NovaStar, KIVA, Acumen, and DOB Foundation, and front-running grantors, such as AECF and EEP, are now targeting more productive-use companies (e.g., solar water pumping) or financing the solar-sector

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<sup>77</sup> GOGLA, “Off Grid Lighting Market Research Kenya. Report on Retailer Deep Dive Interviews.”

<sup>78</sup> Government of Kenya, “The Data Protection Bill, 2018”; Government of Kenya, The Financial Markets Conduct Bill, 2018.

<sup>79</sup> Ratansi, “Tax Administration (Transfer Pricing) Regulations, 2018.”

logistics value chains.<sup>80</sup> All off-grid companies—even the largest, most established players with hundreds of thousands of customers—are still raising equity capital. Given KNES projections that two million households will have SHS, Kenya needs new investors, particularly equity investors that are new to the off-grid space.

This same dynamic is also true for grants. SHS companies have been able to attract meaningful private financing, so many donors are reluctant to provide grants since they perceive the sector as having matured and moved beyond the need for grant financing. In some respects, this is true, but there are still some areas that could benefit from grant financing. This is the case for the SHS sector in the northern counties of Kenya, where last-mile distribution is a challenge. The mini-grid sector overall could also benefit from grant financing, since there has yet to be a purely commercial business model proven for that asset class. Programs like KOSAP are helping to fill this need, but new programs and fresh capital are required.

### 3.2.1 EQUITY

There are two main issues facing equity investment in the Kenyan market:<sup>81</sup>

1. Current investors (mainly impact investors but some private equity funds and development finance institutions) have already invested and have not exited. This makes it difficult to invest in new off-grid companies and recycle capital in the market, because many investors have either reached saturation limits or are concerned about investing in new off-grid companies that compete with early investments.
2. There is an erroneous assumption that the equity market is saturated, which is discouraging to new investors. Further, potential new investors have been dissuaded by initially high company valuations, which can make it difficult to participate in a later equity round. Identifying additional new investors and demonstrating the market potential is an important next step for stakeholders.

### 3.2.2 DEBT

Debt financing is crucial for companies looking to finance short-term working capital, inventory, and, in the case of PAYGO companies, customer receivables. The development of this space has been supported by donors over the years to create viable options for companies. From these efforts, lenders such as SunFunder and SIMA Fund have emerged as market-based financing options with more flexible lending terms than local commercial banks, for example. As companies have grown in Kenya, ticket sizes for debt have also grown, but this has made it more difficult for smaller companies to obtain financing. This has led to the rise of crowdfunding companies (Trine, Lendahand, and Bettervest to name a few) as an alternative, where debt with local banks has been successful for larger companies taking on multimillion-dollar facilities.

<sup>82</sup>

#### Current debt issues identified include the following:

- › Intermediary transaction cost is too high, which gives priority to larger players.
- › Local debt was capped by a bill last year at 14 percent. This resulted in banks becoming more risk-averse and limiting their lending. Companies often complain about interest rates, but banks need to cover their risk.
- › Companies do not necessarily understand banks or have accounts with the bank from which they want a loan. The bank wants to see revenue and sales.
- › Banks are able to go around the cap by adding “fees.”
- › It can take at least 12 months to get a loan with a local bank. For instance, the Stanbic transaction took 24 months to finalize with M-Kopa.

- › Companies have to make decisions, for instance, to go with impact funds for near-term lending needs or create relationships with local banks with a longer-term view.

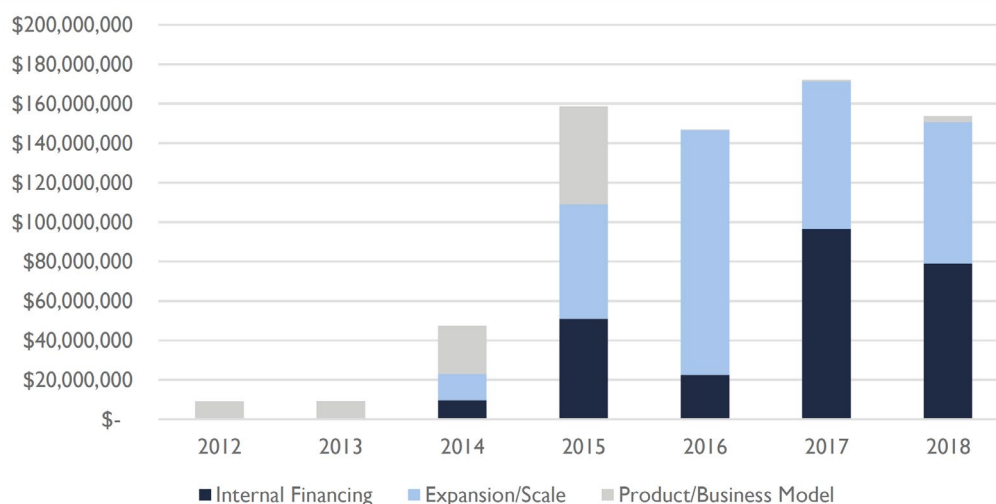
### 3.2.3 GRANT

Grants were one of the main catalysts in the Kenyan SHS market during the early stages of the sector from 2010 to 2015. Main grantors included AECF funds from DFID and EEP, which provided grants to most large international companies such as Fenix, Mobisol, BBOXX, and several others. Both GIZ and SNV have offered market access programs with various forms of subsidy and results-based financing since 2009. This allowed distributors to test rural value chains and expand into remote markets. Today both AECF and EEP are focused on providing finance to more locally owned companies, productive-use appliances, and women-owned companies. EEP has also done additional work in mini-grids and C&I. AECF still funds locally owned SHS companies across Africa but has refrained from previously funded markets of SHS. The World Bank has provided funding for KOSAP, which will provide grants for companies that expand their operations to serve the identified underserved counties.<sup>83</sup>

### 3.2.4 REGIONAL FINANCING TRENDS

The SHS sector in East Africa has undergone a dramatic increase in the financing it now attracts annually. The sector has experienced significant changes to the purpose, source, and type of financing required by off-grid companies, as the market continues to develop. Figures 14, 15, and 16 illustrate financing trends in East Africa.

FIGURE 14. FINANCIAL TRANSACTIONS IN EAST AFRICA BY PURPOSE



Early in the life of the sector, financing was needed almost exclusively for product and business model development. Financing for these kinds of start-up costs grew steadily between 2012 and 2015 before dropping to much lower levels from 2016 onwards. While start-up remains a key area of financing as second or third generation companies enter the market, the scale has diminished dramatically.

<sup>80</sup> Shell Foundation and Persistent Energy Capital, “Bridging the Gap to Commercial Success for Energy Access Businesses.”

<sup>81</sup> Shell Foundation and Persistent Energy Capital.

<sup>82</sup> Shell Foundation and Persistent Energy Capital.

<sup>83</sup> Kenya Power and Rural Electrification Authority, “Kenya Off-Grid Solar Access Project (K-OSAP): Environmental and Social Management Framework.”



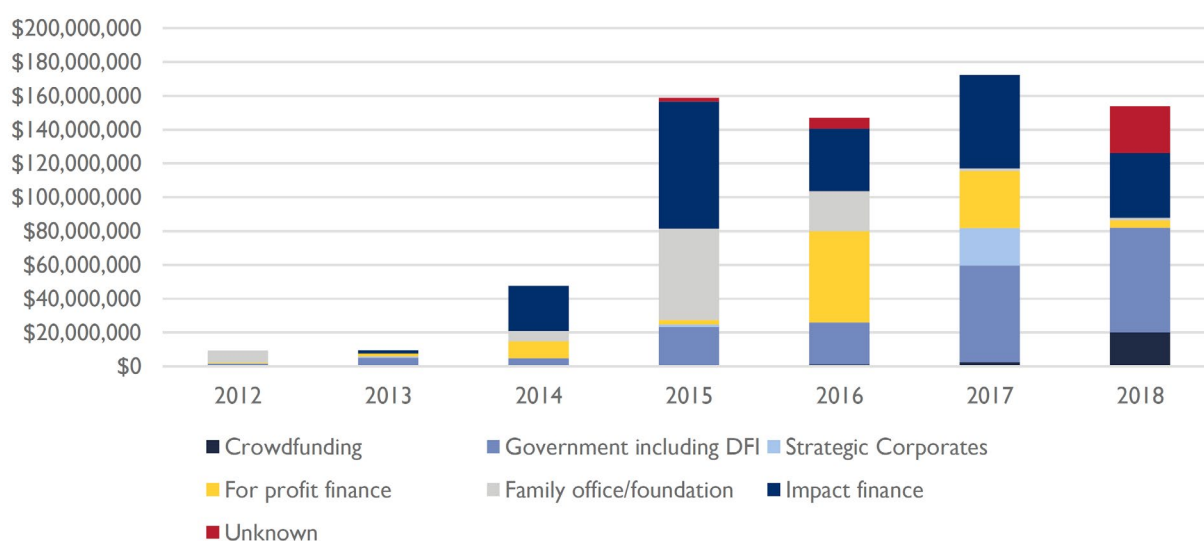
The market first saw significant investments targeted at achieving scale and expansion to new geographies in 2014, with financing for expansion peaking in 2016, but remaining significant thereafter. This reduction in spending on expansion coincides with the end of the rapid expansion of several first-generation companies, as they consolidated focus to key, more profitable geographies instead of continued rapid expansion. This is not to say that geographical expansion is not still a key area of investment for companies but that the market has now entered a stage of more considered, strategic expansion. Also, many SHS companies have evolved their business models to focus on existing customers rather than exclusively focusing on acquiring new ones.

Finance for working capital and the refinancing of existing liabilities has followed an upward trajectory (grouped together in Figure 14 as Internal Financing). This trend is expected to continue to increase as the market in East Africa continues to develop.



The evolution by the number of off-grid companies to offer financing to their customers for an expanding range of both SHS and non-SHS products is likely to continue to drive the need for this form of finance. Companies are experimenting with follow-on products such as insurance, agriculture products, and small loans for school fees.

FIGURE 15. FINANCIAL TRANSACTIONS IN EAST AFRICA BY SOURCE



Source: GOGLA 2018b

The earlier stages of the market for the off-grid sector saw a reliance on impact investors, family offices, and foundations. As the market has matured the need for such patient capital has remained, but for-profit and strategic corporate finance are starting to play an increasingly prominent role. The recent influx of strategic corporate investment is expected to continue, as the market increasingly attracts interest from this area.<sup>84</sup>

Crowdfunding, a potential source of financing in the industry for some time, has seen significant recent growth. Part of this growth is attributable to the increasing ticket sizes from crowdfunding, such as the

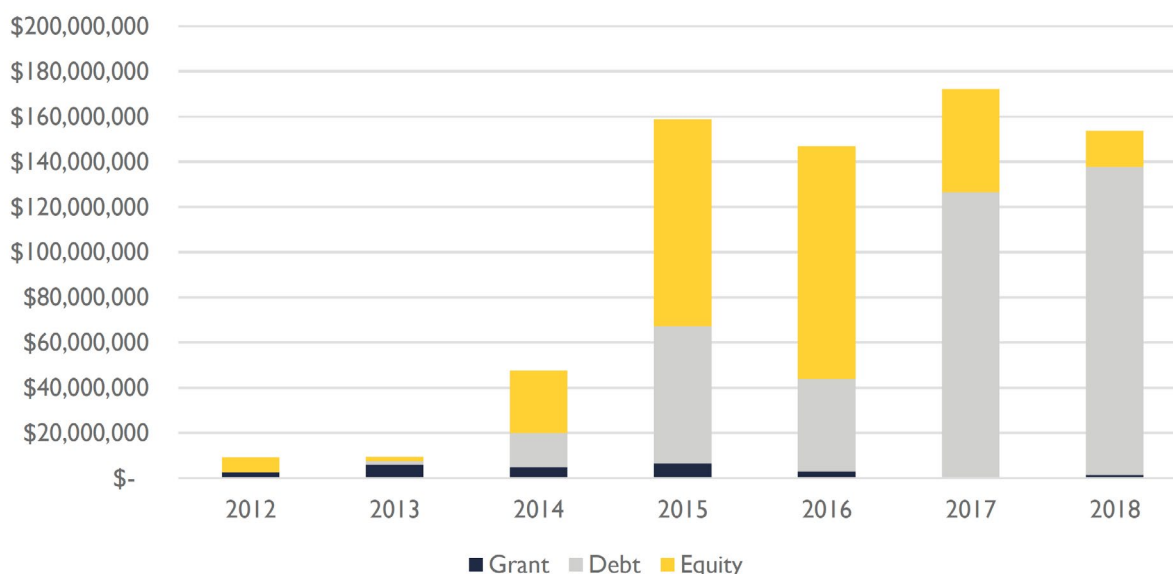
<sup>84</sup> Abuya, "Solar Firm Azuri Receives US\$26 Million Investment for Africa-Wide Expansion."



recent BBOX and Trine transaction of €6 million (\$6.6 million).<sup>85</sup> This trend is expected to continue, as crowdfunding platforms continue to offer more favorable rates, greater risk appetite, and better value impact for more commercial debt providers.

Despite the market showing increasing maturity, the role of government and development finance institutions funding has remained ever-present throughout the life of the industry. Such institutions continue to play an important role in leveraging commercial lending, as SHS companies continue to ask for local currency debt and more structured financial transactions like off-balance sheet lending.

FIGURE 16. FINANCIAL TRANSACTIONS IN EAST AFRICA BY TYPE



Source: GOGLA 2018b

While the market in East Africa relied heavily on grant and equity finance in its earlier stages, debt has slowly grown to become the main driver of financing in the sector. This said, both grant and equity still play important roles, with the former in particular continuing to allow and encourage companies to innovate and expand geographically.

### 3.2.5 FOREIGN EXCHANGE ISSUES

Foreign exchange risk has been a key issue that companies face in the acceptance of customer payments in local currency, but much of their financing is in hard currency. A solution for this issue comes in the form of insurance offered by two companies, MFX Currency Risk Solutions and Steinitz HAS MTF. The cost of hedging ultimately results in fronting the cost of KSh currency devaluation and overall market fluctuations up-front, making the cost of the local currency debt significantly higher. This has led to many companies continuing to borrow in hard currency and have their equity investors bear the foreign-exchange risk.

### 3.2.6 INVESTORS

Table 7 presents a summary of Kenyan investors.

<sup>85</sup> Burroughs, "This London Firm Just Crowdfunded the Most Ever for an African Solar Project."

**TABLE 7. SUMMARY OF SELECTED INVESTORS IN KENYA INCLUDING FINANCE TYPE**

NAME	SUMMARY	FINANCE
SunFunder	Provides debt financing to solar companies (including off-grid, C&I, and others). It has financed 45 companies with over 60 total debt facilities. Investors include the Overseas Private Investment Corporation and the Rockefeller Foundation. <sup>86</sup>	Debt
Responsability	Acts as asset manager in the field of development investments and offers professionally managed investment solutions to private, institutional, and public investors. Its main targets are non-listed firms in emerging and developing economies. <sup>87</sup>	Debt and Equity
Frontier Investment Management	Provides equity mezzanine capital and short-term debt. <sup>88</sup>	Debt and Equity
CrossBoundary	Finances mini-grids and other off-grid solar projects. <sup>89</sup>	Debt and equity
Energy and Environment Partnership Africa	Multi-donor fund that provides early-stage grant and catalytic financing for clean energy. Fund is managed by the Nordic Development Fund. <sup>90</sup>	Debt, grants
Africa Enterprise Challenge Fund Renewable Energy and Adaptation to Climate Technologies Sub-Saharan Africa	Supports SHS and mini-grid companies with a focus on access and climate change mitigation, supported by Swedish International Development Cooperation Agency and United Kingdom Department for International Development. <sup>91</sup>	Debt, grants
Sunref	Provides long-term loans to local banks to support green growth as well as technical assistance for local banks to be able to provide loans to companies in this area, supported by the French Development Agency (Agence Française de Développement) <sup>92</sup>	Debt

### 3.3 CONSUMER FINANCE

#### 3.3.1 MICRO-FINANCE INSTITUTIONS

Micro-finance institutions (MFIs) provide customer financing of SHS systems in Kenya but play a much smaller role than PAYGO. This is partially due to the ticket size of a typical SHS compared to an MFI loan, where MFI products typically cost more than \$500. PAYGO companies are also more willing to provide financing to unbanked customers, while MFIs typically prefer customers with existing credit histories. MFI partnerships with SHS companies have been supported by donors but still face some issues. First, MFIs

<sup>86</sup> SunFunder, “Invest in Solar Projects.”

<sup>87</sup> responsAbility, “ResponsAbility.”

<sup>88</sup> GOGLA, “Frontier Investment | GOGLA.”

<sup>89</sup> CrossBoundary, “Home: CrossBoundary.”

<sup>90</sup> EEP Africa, “About Us – EEP Africa.”

<sup>91</sup> Africa Enterprise Challenge Fund, “REACT Household Solar Programme | AECF.”

<sup>92</sup> Sunref, “An Innovative Approach - Sunref.”

do not have the technical expertise to install and maintain the products. In some cases, the SHS company that has already been paid for its product has little motivation to provide service. Second, SHS companies often have agents in the same areas as MFIs, so they end up competing against each other for customers. Finally, unlike PAYGO systems, MFIs cannot so easily and reversibly enforce payments, which can lead to nonpayment issues.

### 3.3.2 MOBILE MONEY

Mobile money started in Kenya and provided an ideal platform to facilitate the growth of PAYGO, which is the primary method for collecting payments among SHS companies.<sup>93</sup> In addition to this, a couple of interesting stories have emerged in the past couple years relating to mobile money. There are more than 49 mobile loan applications in Kenya, and the sector still sees some growth. Though the applications have enabled easy access to loans, ranging from a few dollars to hundreds of dollars, lately there has been an outcry from Parliament and the Central Bank of Kenya for the need to regulate the mobile lenders.<sup>94</sup> These lenders are perceived to have saddled borrowers with high interest loans. Some of them charge interest of up to 15 percent per month.<sup>95</sup>

#### Tala and Branch

Tala and Branch offer loans through mobile money that range from \$2 to \$2000 within five minutes. They have a unique credit scoring system that looks at M-Pesa receipts as well as social media activity to determine creditworthiness. For example, using the same name for an email address and social media would signal that a person is lower risk. Considering that the amounts loaned are up to \$2000, these offerings could have applicability, as households look to move to higher tiers of service or productive uses.

#### Kopo Kopo

Kopo Kopo is a mobile money payment facilitator for M-Pesa and other services, particularly for small and medium enterprises. Kopo Kopo is one of the premier gateways for easy API connection to Safaricom. Kopo Kopo can provide data analytics for revenue for different types of businesses, which could be transferred to the off-grid sector to predict repayment behavior. As an anecdote, if an individual makes payments for three months on a \$150–200 SHS, that person is more likely to make the remaining payments. More advanced analytics could bring down the cost of financing potential customers.

### 3.3.3 PAYGO VERSUS CASH SALES

While PAYGO is certainly the dominant method for sales among GOGLA associates in Kenya, cash sales still play an important role. Numerous companies have reported that cash sales are stronger in lesser developed regions, and it will be interesting to see the balance of cash versus PAYGO or other consumer financing options in the underserved counties under KOSAP. Figure 17 illustrates GOGLA associates' revenue in sales.

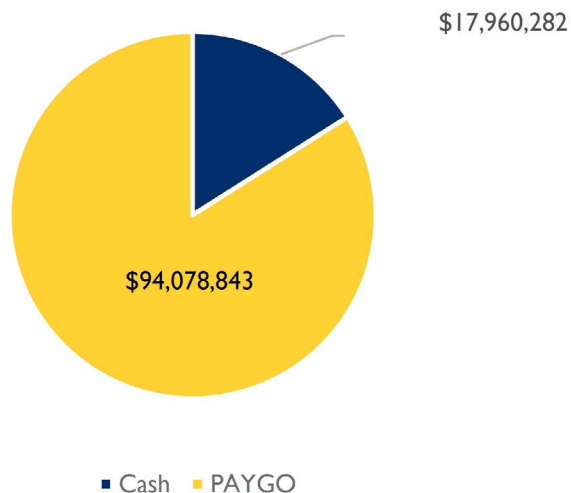
<sup>93</sup> Rice, "Kenya Sets World First with Money Transfers by Mobile | Money | The Guardian."

<sup>94</sup> Wanambisi, "MPs Want Mobile Lenders to Be Regulated and Sharing of Mobile Money Agents."

<sup>95</sup> Reuters, "Kenya Moves to Regulate Mobile Money Fuelled Lending Craze."

FIGURE 17. GOGLA ASSOCIATES REVENUE BY SALES TYPE IN KENYA

### 2018 GOGLA Associate Revenue



### 3.4 DISTRIBUTION

Most first-generation SHS companies in Kenya have vertically integrated out of necessity, as the value chain did not exist yet. However, as SHS manufacturers such as Green Light Planet, BioLite, and d-light and other service providers like Angaza have developed, companies no longer needed to do everything themselves. This has opened the door for companies such as Pawame that focus on energy distribution (see the case study below). Since early movers in Kenya were all vertically integrated, the market today is still dominated by this model, but as SHS companies start to look toward the northern counties to participate in KOSAP, the existing distribution models could become more attractive to them than developing distribution channels in hard-to-reach places.

Raj Ushanga House (RUH) is a good example of a distributor using a distribution network that was previously used for another purpose (in this case distributing beads for Maasai jewelry) and repurposing it to sell SHS. In 2012, RUH signed an agreement to distribute Azuri SHS, and today RUH is the largest distributor for Azuri, with 150,000 systems sold.<sup>96</sup> One Acre Fund is another example of an organization that uses an existing distribution network—this time for distributing inputs to farmers—to sell solar products.<sup>97</sup> Partnerships like these can be very valuable for manufacturers, but these relationships must be nurtured to help the distributor understand the product in order to sell it and possibly service it, since distributor expertise is not necessary in this sector.

<sup>96</sup> Raj Ushanga House Ltd, “Home: Raj Ushanga House Ltd.”

<sup>97</sup> Tucker, “A Loan And A Light.”

## Specializing in a Vertical World: Pawame

Pawame entered the market after the first entrants and intended to follow their model of vertical integration. However, in order to get off the ground, Pawame contracted a manufacturer to supply its initial units, and as they say, the rest is history. Pawame soon realized that focusing on building up its distribution network and outsourcing manufacturing provided certain advantages to the vertically integrated model. First, the company can be more responsive to changing customer demands by sourcing from multiple manufacturers without investing time and money into new product development. This also allows Pawame to look at productive use products at a considerably lower cost than can a vertically integrated company. Second, it allows Pawame to focus attention on what it is good at (distribution and building relationships with customers) without having different and competing priorities.

Of course, it is also important to understand the parts of the ecosystem that are important for particular business models. For Pawame, these important parts are its control software and branding products. Developing its own software has given Pawame a competitive advantage, as it can leverage data collected to increase its sales. Also, building customer relationships is an important part of its business model. Branding is a key aspect to build brand recognition and customer loyalty for Pawame.



### 3.5 FUTURE OF THE SECTOR

Recently, there was concern that the sector was saturated. However, with the addition of companies like Solar Panda that have been successful as late entrants and with the number of remaining households with no access, there is still space for new and existing companies to deploy systems. As projected in the KNES, the achievement of universal access to electricity by 2022 will require an additional 2.2 million and 38,661 SHS and mini-grid connections, respectively, which represents a significant opportunity.

## Coming Late to the Party: Solar Panda

Solar Panda is the newest kid on the block in Kenya, with less than two years' experience. And yet, it is producing amazing results, with over 60,000 pieces sold, 21 current shops, and two more being established every month. Its founders are Canadians Scott Remborg, who came out of semi retirement to set up the company in Kenya, and Andy Keith, the 33 year old chief executive officer who sold his first successful company before the age of 30. They attribute their success to four key themes: market exploration and best practices, keeping it affordable, keeping it local, and focusing on gender integration. They explored the market, the technology, and the best practices already established in a mature market. Armed with this information, they were able to pick the right country, the right product, and the right price point.

Solar Panda has been able to keep its products affordable and provide a healthy commission that allows its agents to make a living wage. Their philosophy of keeping it local means 99 percent of the team in Kenya is Kenyan. Their team has local market expertise, knows their customers, and works hard to reach them. In many instances, they have given chances to young Kenyans with limited opportunities and helped them excel.

Gender integration also has played a big role in Solar Panda's success. Its team is 62 percent women, including a female engineer who leads quality control and warranty management. The majority of the field team consists of women who are connected to community women's groups, churches, and schools.

### 3.5.1 ON-GRID SALES

In recent years, a significant portion of SHS sales have come from on-grid customers looking for backup during blackouts, those who cannot afford appliances, and those who have found off-grid solutions complementary to grid access.<sup>98 99</sup>

### 3.5.2 APPLIANCE SALES

Increasingly Kenya has recorded growth in sales of off-grid solar appliances, namely TVs, fans, refrigeration units, and solar water pumps, with the sale of 69,361 appliances reported in the second half of 2018. Sales have mainly been through PAYGO (65,189). The bulk of appliances sales has been TVs, at 67,343, which represents 42 percent of total reported TV sales worldwide (Figure 18). The categories of TVs range from medium to large, driven by the small difference in price and energy consumption of large versus small TVs.

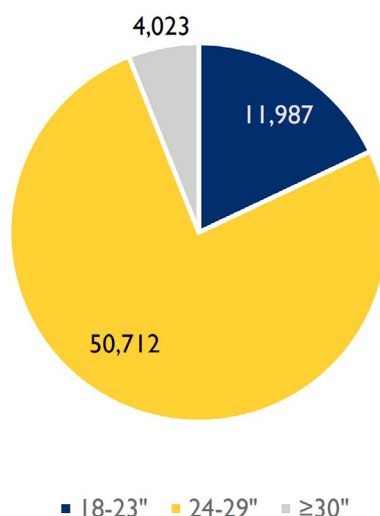
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<sup>98</sup> M-Kopa, "M-KOPA Labs off-Grid R&D Brings Whole New Grid Classifications."

<sup>99</sup> Shulman, "New Study."

FIGURE 18. GOGLA ASSOCIATES TV SALES IN EAST AFRICA

### GOGLA Associate TV Sales (H2 2018)



Source: GOGLA 2018b

TV sales are complemented by sales of small volumes of fans and solar water pumps. Kenya’s average temperature ranges between 20°C/68°F and 28°C/82°F, which correlates with the low demand for fans, apart from the coastal and northern areas, which have average temperatures of 35°C/95°F. There are limited data on the current sale of refrigerators. With the relatively high cost, solar refrigerators will require financial support mechanisms for market penetration.

### 3.5.3 GEOGRAPHICAL EXPANSION

Despite the growth in SHS sales in the Kenyan market, roughly 80 percent of households currently with SHS are located within five to ten kilometers of the national grid. The footprint of SHS in off-grid areas is negligible. These largely underserved areas include the northern part of the country and parts of the coast. Sales to these areas have been hampered mainly by the poor transport and communication infrastructure, due to the remoteness and sometimes to the dispersed nature of the target populations. Other factors include the perceived low affordability of SHS and the mainly nomadic lifestyles of populations inhabiting these areas. KOSAP aims to provide incentives to the private sector to establish and expand operations to such underserved areas.

### 3.5.4 GENDER INTEGRATION

Access to modern energy increases household time savings, creates opportunities for women, and promotes the wellbeing of families. However, ignoring the local context of women’s and men’s roles and needs has undermined the effectiveness and sustainability of energy projects and policies.<sup>100</sup> In the recent past, solar companies have strategized better, more flexible, and more affordable services, which have contributed to women’s empowerment through business or employment opportunities.<sup>101</sup> Solar companies have incorporated women in their distribution models as consumers and entrepreneurs (as distribution agents, for example). The case below illustrates the integration of women in one SHS company’s supply chain as sales agents.

<sup>100</sup> USAID, “ADVANCING GENDER IN THE ENVIRONMENT: Making the Case for Women in the Energy Sector.”

<sup>101</sup> Winther, Ulsrud, and Saini, “Solar Powered Electricity Access.”

## Bidhaa Sasa: Building a Profitable Business by Leveraging Rural Women's Networks

Bidhaa Sasa means “Products Now!” in Swahili. The company launched in 2015 to deliver quality household goods to its target market of rural women, for whom it provides in house credit. Through its innovative business model of offering micro credit to groups of clients without preconditions or collateral, Bidhaa Sasa makes modern solar products accessible and affordable.

Bidhaa Sasa uses a woman to woman direct sales model to overcome women's limited mobility and lack of trust in new technologies. Its referral program is a cost effective way to acquire new clients by offering micro credit to groups of five or more clients. Almost all of Bidhaa Sasa's clients repay on time, even in the absence of expensive and inconclusive credit tests and without PAYGO technology that switch electrical circuits off if payments are late. Company data show that women are more reliable customers than men in terms of repayment rates.

Aside from intentionally serving the energy access needs of primarily rural women, whereby 69 percent of its clientele are women, Bidhaa Sasa applies innovative gender inclusive measures to its business. For example, Bidhaa Sasa does the following:

- › Creates employment opportunities for rural women by actively recruiting women (75 percent of its entire workforce is comprised of women)
- › Uses gender-smart data collection methods to ensure an understanding of the needs of men and women in the communities served
- › Engages with husbands of the women who serve as group leaders and employees to foster understanding and support for their spouses' work
- › Offers maternity and paternity leave and flexible working conditions
- › Provides training on gender bias for group coordinators

These and other measures have led to many documented positive business and social impacts. The company has a reported 90 percent customer satisfaction rate

Source. <sup>102</sup>



<sup>102</sup> ICRW Advisors, “Gender Smart Investing: Off-Grid Energy Case Study of Bidhaa Sasa.”



## 4 MINI-GRID

### 4.1 MINI-GRID OVERVIEW AND APPLICABILITY TO THE COUNTRY

Decentralized mini-grids have played an historical role in Kenyan electrification strategies. Certain communities in Kenya have used continuous mini-grid solutions for more than 50 years. <sup>103</sup> GoK identifies mini-grids as the most cost-effective way to provide electricity access to major centers isolated from the interconnected grid, particularly in northern counties. <sup>104</sup>



In more recent years, Kenya has shown significant interest in using private-sector-owned mini-grids to expand energy access more quickly than through traditional, centralized grid infrastructure while providing higher levels of service than do many SHS products.

After strong growth in the early 2010s, the market found itself at a turning point in the latter part of the decade <sup>105</sup>, with growth slowing due to uncertainties faced by developers. In particular, the long gestation of the Energy Act, 2019, has forced the sector to be wary of making significant investments, as Kenya redefined its model of mini-grid regulation and deployment. However, with the passing of the Energy Act, 2019, and new mini-grid regulations expected to shortly follow suit, the sector finds itself in a position of increased certainty.

The GoK's ongoing projects and strategies highlight a clear role for mini-grids in granting a significant proportion of the population access to electricity:

- › KNES plans for 138,661 additional mini-grid connections by 2022, with 100,000 coming from intensification of existing mini-grids and 38,661 coming from new mini-grids. <sup>106</sup>
- › KOSAP will deploy 121 new mini-grids.
- › REREC is currently deploying 26 mini-grids.
- › The Kenya Electricity Modernization Project (KEMP) plans to construct eight wind or solar mini-grids.
- › The hybridization of 20 existing diesel mini-grids to incorporate solar and/or wind generation. <sup>107</sup>

The expected new mini-grid regulations and GoK's ongoing commitment to mini-grid electrification are likely to ease investor concerns. One area that may require further clarification is compensation of asset owners and operators upon grid arrival.

<sup>103</sup> Nygaard et al., "Market for the Integration of Smaller Wind Turbines in Mini-Grids in Kenya."

<sup>104</sup> Kenya Ministry of Energy, "Kenya National Electrification Strategy: Key Highlights 2018."

<sup>105</sup> Castalia and Ecoligo, "Mini Grids in Kenya."

<sup>106</sup> Kenya Ministry of Energy, "Kenya National Electrification Strategy: Key Highlights 2018."

<sup>107</sup> Rural Electrification and Renewable Energy Corporation, "Successor of Rural Electrification Authority Is Now Established."

Due to its scope, KOSAP will play a larger role in the immediate future of the sector, and its public-private partnership model is already influencing the design of regulations and programming in other countries and regions. This model for mini-grid development is not without drawbacks, but it was seen by GoK as the most effective way to include the private sector in a time-efficient manner and is discussed below.

## 4.2 RELEVANT GOVERNMENT AND DONOR MINI-GRID PROGRAMS

### 4.2.1 KOSAP

The KOSAP program discussed above will deploy 121 mini-grids expected to cover 27,000 households by 2022 at a cost of \$40 million. These will be deployed in a public-private partnership model and coordinated by KPLC and REREC.

KOSAP will employ a unique method of procurement and ownership for mini-grids financed under the project. KPLC will own the customers, REREC will own the assets, and companies will provide to mini-grids the following services: engineering, procurement, construction (EPC), power purchase agreement (PPA) and operations and maintenance (O&M). This method is significant because in the past the government has been skeptical of trusting companies to provide operations and maintenance services. The hope is that this arrangement increases trust between the government and the private sector.

Unfortunately, because companies will not own the infrastructure assets, they will not be able to leverage them to obtain further financing, and this is a major complaint of companies. There is also concern that other countries will adopt this model, and this will further hinder raising capital and expanding mini-grids.

### 4.2.2 KENYA ELECTRIFICATION MODERNIZATION PROGRAM (2015–2020)

KEMP is a \$562-million World Bank electrification program that is mostly focused on on-grid activities; however, \$10 million was used to build six mini-grids on islands, including sites at Mageta Island, Siaya County; Ngodhe and Takawiri Islands, Homa Bay County; Shimoni Island, Kwale County; Chardende, Tana River County; and Kadaina Island, Kilifi County.<sup>108</sup>

### 4.2.3 GREEN MINI-GRID FACILITY

The facility was initially funded by DFID, but is now funded by the EU, and is implemented by AFD via Innovation Energie Développement (IED), I-Dev, and Practical Action Consulting. The facility provides technical assistance, investment grants, and output-based grants to catalyze investment in the mini-grid sector while providing support to KNES.<sup>109</sup> It has also published many knowledge products, particularly on the topic of productive use.

### 4.2.4 GERMAN SOCIETY FOR INTERNATIONAL COOPERATION (DEUTSCHE GESELLSCHAFT FÜR INTERNATIONALE ZUSAMMENARBEIT [GIZ]) PROGRAM FOR THE PROMOTION OF SOLAR-HYBRID MINI-GRIDS (2013–2018)

GIZ's Program for the Promotion of Solar-Hybrid Mini-grids (PROSOLAR) aimed to improve the overall framework, the technical expertise of government actors, and the implementing capacity of private businesses for the sustainable installation and operation of climate-friendly, solar-hybrid village power systems. The focus has been in remote rural areas. The project developed many mini-grid guidebooks,

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<sup>108</sup> Climate Investment Funds, "Upscaling Mini-Grids for Least Cost and Timely Access to Electricity Services."

<sup>109</sup> Green Mini Grid Facility Kenya, "Green Mini Grid Facility Kenya."

namely, Where Shall We Put It?, How Do We License It?, and What Size Shall It Be? It also supported the development of energy sector plans in Turkana and Marsabit Counties, which informed the design of the county energy planning template that has been adopted by the Ministry of Energy.

#### 4.2.5 FACILITY FOR ENERGY INCLUSION—AFRICAN DEVELOPMENT BANK (2018-)

The Facility for Energy Inclusion (FEI) was designed by the African Development Bank (AfDB) to provide senior and mezzanine debt to off-grid, mini-grid, and small-scale independent power producers with a target ticket size of \$1 million to \$15 million, with a maximum of \$30 million. The overall size of this fund is \$500 million with on-grid (including mini-grids) and off-grid windows. FEI provides loans in hard and local currency. This facility specifically mentions mini-grids, but in a project assessment document, some doubt is expressed at the amount of “bankable” mini-grid projects that can be financed in the project period.<sup>110</sup> Additionally, it is expected that FEI would prefer to fund a pipeline of projects rather than fund them one by one, and companies might not be ready to do this. Importantly, FEI will allow tenors of up to 14 years (but typically not longer than 10 years), and this is the type of patient capital that mini-grids require. This fund is managed by Lion’s Head.

### 4.3 MINI-GRID FINANCING OVERVIEW

Investors looking for emerging opportunities are actively looking for investments in mini-grids.<sup>111</sup> However, the business model for mini-grids has yet to be proven, which is discouraging a lot of investors.<sup>112</sup> Additionally, there has been uncertainty in the market waiting for mini-grid regulations to be adopted, which has slowed down access to all types of financing, including grants. However, these are soon expected to be adopted with the passage of the Energy Act, 2019. There should be more certainty going forward.

In terms of financing, mini-grids have always been compared to SHS models, and these almost inevitably lead to poor comparisons for mini-grids due to the high up-front costs and longer payback periods (in addition to the aforementioned issues around regulations and business models). Recently, some have begun to reframe the discussion around financing mini-grids in a way that compares them to grid extension instead. Across the globe, governments have traditionally provided some sort of subsidy for rural electrification going all the way back to Europe and the United States.<sup>113</sup> This new type of thinking is reflected in KOSAP, which looks to take advantage of the models that mini-grid companies have developed while providing financial support for the initial infrastructure.

As with SHS, Kenya is among the leaders in Africa, with two companies that have already attracted large investments. Together, these companies have already attracted over \$36.5 million in investments (Powerhive \$32 million and Powergen \$4.5 million)<sup>114 115</sup>, which demonstrates the potential for the sector given the relatively few systems deployed to date.

*Together, these companies have already attracted over \$36.5 million in investments (Powerhive \$32 million and Powergen \$4.5 million)<sup>114 115</sup>*

<sup>110</sup> Global Environment Facility, “Regional (Africa): Investing in Renewable Energy Project Preparation under the Fund for Energy Inclusion (FEI) Proposal.”

<sup>111</sup> Hillig, “Rural Electrification Minigrids to Become Investors’ New Darling.”

<sup>112</sup> Green Mini-Grid Help Desk, “Mini-Grid Business Models.”

<sup>113</sup> Davies, “Building the Grid of the Future, Today.”

<sup>114</sup> Crunchbase, “PowerGen Renewable Energy - Funding Rounds.”

<sup>115</sup> Crunchbase, “Powerhive.”

While KOSAP is seen as an important step, by itself it will not lead to the kind of growth that SHS companies experienced a few years ago, and a system that facilitates that kind of growth will be needed to attract more equity financing from angel investors or private equity firms that are looking for companies with large growth potential. To achieve this, a clear path of subsidies is required with a clear funding source. The closest thing to this is the Green Mini-Grid Facility, but more work remains to be done.

The financing needs for SHS companies and mini-grids are different, and these differences often lead to a mismatch for investors that have invested in SHS and are looking to mini-grids. SHS companies typically sell consumer goods, while mini-grids are building infrastructure that requires a longer payback period. A payback period of one to three years might work for an SHS company, but this would likely be too short for a mini-grid company. Additionally, in order to make the business model viable, mini-grid companies need to build a pipeline to take advantage of economies of scale, and this might require an investment in the range of \$10–20 million which is an order of magnitude larger than a lot of investments in SHS companies.

#### **4.4 CURRENT/NEXT OPPORTUNITIES FOR MINI-GRID FINANCING**

As there has been limited interest in market-based financing to this point, the opportunities for financing mini-grids in the short term will likely come from donors, development finance institutions, or impact investors. <sup>116</sup> There have been important tools developed that will play a key role in moving the financing of mini-grids forward.

##### **4.4.1 RESULTS-BASED-FINANCING**

Results-based financing has been popularized in the past few years through programs such as the Energizing Development Program (EnDev). <sup>117</sup> This mechanism provides a company with a subsidy payment once it has completed a given action (like selling an SHS system or building a mini-grid). This ensures that expected results are achieved before grant funds are disbursed and therefore increases accountability for results. AMDA among others has championed this form of financing for mini-grids. AMDA is expected to play a more significant role in the coming years. <sup>118</sup>

##### **4.4.2 CROWDFUNDING FOR BRIDGE FUNDING**

Crowdfunding platforms, such as Trine, have raised significant funding for solar companies while providing investors with an interest rate that averages 6 percent. <sup>119</sup> This has been helpful for earlier-stage companies that need lower levels of financing than the larger entities. In addition, it has been identified as a possible way to provide bridge funding for mini-grid projects that expect to receive results-based financing funds, since the process for obtaining these funds can sometimes take a while.

##### **4.4.3 FEI FROM AFDB FOR LONGER TERM FINANCING**

While results-based and bridge financing are part of the picture, they still fail to provide patient capital that is needed to finance the infrastructure of mini-grids. FEI could be an attractive option for mini-grid developers looking for patient capital (10–14-year tenors), but FEI is expected to be more interested in a pipeline of projects than in a project-by-project approach.

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<sup>116</sup> USAID, “Challenges and Needs in Financing Mini-Grids.”

<sup>117</sup> Energising Development, “Call for Proposals for Development of Solar PV Hybrid Mini-Grids in Marsabit County.”

<sup>118</sup> AMDA, “Africa Mini-Grid Developers Association (AMDA) SMART RBF Program Recommendation.”

<sup>119</sup> Trine, “Our Progress.”

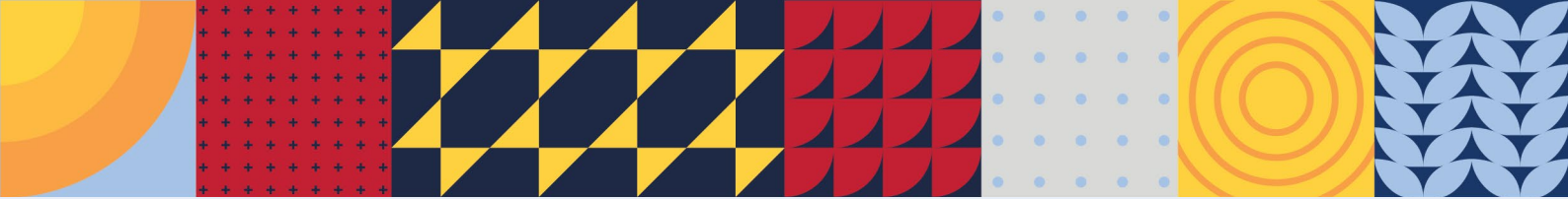
## 4.5 LIST OF DEPLOYED AND PLANNED MINI-GRIDS

Despite mini-grids' potential for electrifying off-grid communities, to date, approximately 63 mini-grids have been commissioned in Kenya. Twenty-nine are operated by either KPLC or REREC, 23 by private developers, and 11 by community organizations.<sup>120</sup> Other mini-grids under development or planned for construction mostly are donor-funded but implemented and co-financed by the private sector. These include the 121 green-field mini-grids under KOSAP to be implemented under a public-private partnership model jointly by REREC and KPLC. REREC plans to develop another 53 sites with funding from the exchequer and other donors. While the private sector is currently at varying stages of development on at least 133 more.<sup>121</sup>

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<sup>120</sup> Nygaard et al., "Market for the Integration of Smaller Wind Turbines in Mini-Grids in Kenya."

<sup>121</sup> AMDA, "AMDA – Africa Minigrid Developers Association."



## 5 AGRICULTURAL AND PRODUCTIVE USE OF ENERGY

### 5.1 AGRICULTURE AND PRODUCTIVE USE OF ENERGY COMMERCIAL OVERVIEW

The SHS industry has shown companies the potential to sell energy products to customers in off-grid areas, and in recent years there has been a push to use energy to improve outcomes in other areas. Energy has long been a facilitator for positive outcomes in other sectors, such as health, education, and agriculture. With the decrease in the price of solar and other technologies, off-grid products are becoming increasingly viable for a variety of uses. It should be noted that while there is excitement about the potential for productive use, the technological developments for agriculture productive use have been limited. Also, the sector is still at an early stage for technology and financing.<sup>122</sup> Extensive support is required in the forms of financing through grants and engineering expertise to secure appropriate technologies for smallholder farmers that are energy-efficient and can operate in off-grid areas.

It should also be noted that one of the main reasons GoK wants to support mini-grids is to access productive-use equipment to grow local economies through by increasing their capacity to process raw materials.

#### 5.1.1 DEFINITION OF PRODUCTIVE USE

Productive use of energy is defined by a number of authors<sup>123</sup> as the applications of energy appliances to create goods and services directly or indirectly for the production of income or value add to raw materials. Products that fall into this category are commonly referred to as productive-use, but there is some disagreement about how broad the definition should be, with some definitions only considering products that improve economic situations while others include education and health outcomes. This discussion will focus on innovations that improve the economic situation of rural people.

#### 5.1.2 PRODUCTIVE USE OF ENERGY APPLICATIONS

Due to the broad definition of productive use, this report will identify products (or sub-sectors) that have already developed in the Kenyan market. Business models and needs vary quite significantly for each different product. For that reason, the discussion will focus on the most developed sub-sectors in Kenya for productive uses: solar water pumping, solar irrigation, and cold storage, while noting the potential for other sub-sectors.

### 5.2 SOLAR WATER PUMPING

#### 5.2.1 SOLAR WATER PUMPING FOR DOMESTIC AND INDUSTRIAL USE

More than 42 percent of Kenyans, mainly living in rural areas, do not have access to potable water.<sup>124</sup> Solar water pumps have several applications for domestic and industrial use.

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<sup>122</sup> Khare and Economu, “Solar Water Pump Technology Roadmap.”

<sup>123</sup> Energypedia, “Productive Use of Electricity.”

<sup>124</sup> Water Services Regulatory Board, “Impact: A Performance Report of Kenya’s Water Services Sector.”



Solar pumps allow households and families to end their long commute for water. A household solar water pump brings drinking water to both the family and the livestock. A solar water pump connected to drip irrigation can be used by smallholder crop farmers as well.

At the industrial level, solar water pumps are used in large-scale farming and in cleaning and processing of goods.

Solar water pumping provides municipal water for businesses, households, schools, and health centers. Local water taps may be connected to the pump and offer local water collection points. Under KOSAP, 380 boreholes serving community facilities (schools, health facilities, administrative offices) will be equipped with solar pumping systems.<sup>125</sup>

## 5.2.2 SOLAR WATER PUMPING AND IRRIGATION

Solar water pumping connected to irrigation holds significant potential to directly raise incomes through increased crop yields and more planting seasons per year. This is particularly true for high-value horticulture crops, which have the potential to raise income significantly and have a high rate of return on investment (ROI) to the farmer/end user if connected to the greater value chain. There are several companies that operate in this market that provide more appropriate technology for smallholder farmers.<sup>126</sup>

## 5.2.3 ACTIVE COMPANIES AND STATUS

Distribution and retail companies of solar water pumps include SunCulture, Futurepump, Chloride Exide, and Davis and Shirliff. Popular manufacturers are firms such as Lorentz, Grundfos, Shur-flow, and Pedrello.

The growth of solar water pumping is hampered by the cost of reaching out to potential farmers who are spread across the country. This hurdle can be overcome through partnerships between suppliers and farmers groups.

## 5.3 SOLAR IRRIGATION

With at least an estimated 3,000 solar pumps deployed, the sector in Kenya has demonstrated significant potential for the future.<sup>127</sup> Solar pumps could be used for large-scale irrigation, but the discussion here focuses on systems for smallholder farmers. With options that range from \$480–\$750 for systems that can irrigate approximately 0.4 hectares (ha), which is the equivalent of one acre, solar irrigation has lowered the price of irrigation significantly for smallholder farmers. A United Nations Food and Agriculture Organization report cites a cost of \$1800–\$3100 for a system as of 2014.<sup>128</sup> This is one reason that the sector is seeing growth today.

### 5.3.1 POTENTIAL MARKET

The potential for the solar irrigation sector is huge. The Vision 2030 blueprint envisioned development land under irrigation in Kenya (Kenya Vision 2030). In addition, The Development of the National Water Master Plan 2030 sets forth an aggressive path for increasing irrigation use in Kenya and it envisions approximately 161,000 ha of irrigated land, up from 51,923 ha in 2011 when the plan was completed.<sup>129</sup> It should be noted

<sup>125</sup> KOSAP, “The Kenya Off-Grid Solar Access Project (K-OSAP) / KOSAP RBF and Debt Facility.”

<sup>126</sup> Holthaus et al., Accelerating Solar Water Pump Sales in Kenya: Return on Investment Case Studies.

<sup>127</sup> Hartung and Pluschke, “The Benefits and Risks of Solar Powered Irrigation.”



that at the time this plan was done, solar irrigation was not considered, but the number indicates irrigation potential for smallholder farmers. Alternatively, Water Resources Group estimates that as of 2016, 56,000 ha had been irrigated by smallholder farmers, but ten times this number (559,000 ha) could be irrigated with further investment in water infrastructure.<sup>130</sup> Given that the average farm size in Kenya is reported to be 0.86 ha<sup>131</sup>, even with these rough estimates, it is clear that there is the potential to reach thousands of farmers with solar water pumps for irrigation.

### 5.3.2 CHALLENGES

Some of the challenges faced by solar irrigation are like those faced by SHS companies, especially in the early days of the market. Potential customers are dispersed geographically, many have no banking history, and cash flows are inconsistent or seasonal. However, solar pumping and irrigation products also face some challenges that differ from those of SHS companies. First, they are generally selling a considerably more expensive product that can average \$2000/ha<sup>132</sup>, and this is considerably more risky for a company to give to a customer with limited or no credit, compared to a \$100–\$200 SHS. This means that different financing evaluation methods and criteria are needed for solar irrigation products. Second, supply chains for getting certain products to markets are sometimes informal, which can make incomes less predictable if markets for selling crops are limited.

### 5.3.3 CROP POTENTIAL

Horticultural crops are usually mentioned first when discussing solar irrigation as these are high-value crops that can potentially double a farmer's yield or income.<sup>133 134</sup> Crops such as tomatoes, chilis, and onions have been identified as having high potential for solar irrigation.

### 5.3.4 NEED FOR MORE DEVELOPED SUPPLY CHAINS

One aspect that is sometimes overlooked is that farmers with newly installed irrigation systems must get their crops to market. Sometimes a farmer growing a new type of crop might not know who the buyers are. Additionally, one of the major advantages of irrigation is being able to sell crops at times other than peak periods when rain-fed crops are being sold. However, if a farmer lives in a remote area, the supply chain might look very different at off-peak times. In fact, farmers who irrigate sell 73 percent of their crops on the local market, which can reduce the price they can get for them.<sup>135</sup> Clearly, more support is needed to develop supply chains and assist farmers in selling their crops. To mitigate this, one company, SunCulture, arranges contracts with large distributors for their farmers to ensure there is an off-taker.<sup>136</sup> Farmers can be linked to off-takers and grow a given variety of crop to enable bulking through aggregation. The off-takers should enter into contractual agreements with the farmer groups and cooperatives to ensure that farmers are guaranteed of the market and income after selling the produce.

### 5.3.5 ACTIVE COMPANIES AND STATUS

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<sup>128</sup> Machado Mendes and Paglietti, "Kenya: Irrigation Market Brief."

<sup>129</sup> WASREB, "National Water Master Plan 2030 – Welcome to Wasreb."

<sup>130</sup> 2030 Resources Group, "Agricultural & Irrigation Opportunity in Kenya: 2030 WRG Roundtable #3: Moving Towards Solutions."

<sup>131</sup> Food and Agriculture Organization of the United Nations, "Family Farming Knowledge Platform: Kenya."

<sup>132</sup> Food and Agriculture Organization of the United Nations.

<sup>133</sup> Davies, "Tapping into Sunshine - Smallholder Farmers Benefiting from Solar Powered Irrigation Using the Futurepump SFI."

<sup>134</sup> Agrawal and Jain, "Sustainable Deployment of Solar Irrigation Pumps."

<sup>135</sup> REEEP, "The Business Case for Solar Irrigation in Kenya."

<sup>136</sup> REEEP.



## The Customer is Right—SunCulture

When some early customers of SunCulture saw its new solar pumps, they not only saw a way to irrigate their crops but a power source that could provide light and cell phone charging. Of course, there's a very good reason that the original RainMaker (and almost every other solar pump) is not ideal for lighting: It has no battery so cannot be used without sunshine. Additionally, some farmers noted a limitation in a battery less system from the irrigation perspective. If there are clouds, the system will provide little or no water.

Observations of this nature have no doubt been made to other solar pump companies, and there are valid reasons for not including a battery in the system—namely the added cost to an already expensive system. However, SunCulture decided to listen to customer concerns. RainMaker2 includes a battery and the ability to charge devices. This brings the system's functionality closer to a cross between an SHS and a solar pump than strictly a solar pump.

### SunCulture

SunCulture is one of the major companies, a vertically integrated company that markets its own brand of solar pumping system. It is currently on the second iteration of its system, "RainMaker2," which brings in internet technology for remote monitoring and battery backup to allow the system to be used for lighting and phone charging. It has developed its own PAYGO platform, "Pay-As-You-Grow," that allows for payment after harvest. SunCulture also offers its original product, "RainMaker," which is lower priced at approximately \$480 for a system that can cover approximately 0.4 ha.<sup>137</sup> Notably, it has a total dynamic head of 70 meters, which is significantly more than other competing products. The max flow rate is 3000 liters per hour. SunCulture has been successful in raising funding and has received funding or support from USAID, EDF, Shell Foundation, PG Impact Investments, Microsoft, and Energy and Environment Partnership. More details are included in the case study, which describes the transition from RainMaker to RainMaker2.

### Futurepump

Futurepump is a Kenya-based company that distributes pumps in countries in Africa and Asia. Its latest pump, "SF2," costs \$675 for a surface pump and has been optimized for shallow water sources. It offers a total dynamic head of 15 meters and a max flow rate of 3600 liters/hour.<sup>138</sup> Their system also offers remote monitoring for free, and it is ready to be integrated with third-party PAYGO systems like Angaza and Lumeter. It comes with a five-year warranty. For most of the countries in which it operates, Futurepump has employed distributors to sell the product to the end customer. It has positioned itself as a manufacturer.

<sup>137</sup> REEEP.

<sup>138</sup> "Datasheet - The Futurepump SF2 - Solar Irrigation."

## Chloride Exide

Primarily known as a battery company, Chloride Exide has recently ventured into the solar pumping space as part of its solar offerings. It offers the lowest-priced system on the market at approximately \$350 per system with similar specifications to the others mentioned: submersible pump with total dynamic head of 17 meters and a max flow rate of 16,500 liters per day in a low head condition.<sup>139</sup> Kenya solar panel manufacturer, Solinc, is a subsidiary of the parent company of Chloride Exide,<sup>140</sup> and Solinc provides solar panels for Chloride Exide solar products.

## Davis and Shirtliff

Davis and Shirtliff is an equipment distributor for several different industries, including solar products and pumps. As part of these activities, the firm distributes solar pumping systems from several different manufacturers, including Grundfos, Lorentz, Futurepump, Pedrollo, and Shurflo pumps. It sells both alternating current and solar (direct current) pumps.

## 5.4 COLD STORAGE

Given the long distances between farms and demand centers for produce, spoilage during transit is a significant concern for some crops. Cold storage has been proposed as a solution and is being piloted to reduce spoilage and increase incomes across different value chains. In particular, the horticulture value chain is one that could benefit from cold storage. Cold storage encompasses products that are more like traditional refrigerators (Sun Danzer) to 20- or 40-foot containers (Solar Freeze and Inspira Farms).

Cold storage at the coast in Kenya has helped local fishers store and sell their daily catches with less spoilage. Sollatek Electronics (Kenya) Ltd., in partnership with Indian Ocean Water Body, the managing body for the coastal beach management units, ran a project funded by the PAOP Energy Challenge Grant from GE Africa, U.S. Africa Development Foundation (USADF), and the U.S. Agency for International Development (USAID), through which it installed 15 solar cooling stations for the fishers to store their catches. The cooling stations enable the fishers to store fish so that they can then sell them to middle agents or directly to retail outlets, tourism houses, and restaurants, including as far away as Nairobi through daily flights. It is expected that this could be expanded to lake fish with a little research on the value chain.

## 5.5 OTHER POTENTIAL PRODUCTIVE USE OF ENERGY

### 5.5.1 POULTRY LIGHTING AND EGG INCUBATION

The rural poultry industry offers an opportunity for off-grid broiler house lighting as well egg incubation for more rural chains. Broiler and egg houses tend to surround larger centers, such as Nairobi, Eldoret, and Kisumu, granting them access to electricity. As the out-grower model expands, however, farmers in rural

<sup>139</sup> USAID and Winrock International, "Solar Water Pumps for Smallholders."

<sup>140</sup> Ngugi, "SA Firm in Sh730m Kenyan Battery Maker Buyout."

<sup>141</sup> Sollatek, "Sollatek Electronics Kenya Ltd Awarded Power Africa Off-Grid Energy Grant."

<sup>142</sup> Raballa, "INDEPTH."

areas see raising broilers and chickens as an easy cashflow. Broiler and egg houses require lighting. Broilers require light for 24 hours a day to keep the hens eating, to regulate their hormones, and to manage their short growth cycle. <sup>141</sup>

Egg incubation requires a relatively large amount of energy to keep the eggs warm, and solar can be used to supplement a potentially unreliable grid connection or to power an off-grid situation. Smaller incubators can be used for a local enterprise to hatch eggs to sell to neighbors.

### 5.5.2 FISHING LIGHTS

Fishers go out at night to fish and use kerosene lights to attract fish on the lakes. Fishers were spending an average of 35 percent to 50 percent of their total income on kerosene fuel for their lights, with an average of four lights on each boat. <sup>142</sup>



In the last two to three years, solar fishing lightings, particularly those manufactured by Omnivoltaic, have made their way to the fishing communities in Kenya. With the average price of \$150 (KSh15,000) retail for a light, fishers drastically cut their expenditure on kerosene within six months to one year of their purchases.

Fishers also need ice makers and cooler boxes to store the fish throughout the night and throughout the following days until the fish can be sold.

## 5.6 AGRICULTURE AND PRODUCTIVE USE RELEVANT REGULATIONS

Products that have a solar component are subject to the same regulations as SHS for taxation. For solar pumping, this means that solar pumps and panels are exempt from VAT and import taxes while accessories are not.

## 5.7 AGRICULTURE AND PRODUCTIVE USE FINANCING OVERVIEW


There is a lot of excitement in this area, but since the business model has yet to be proven, there is not much to report in terms of financing, other than the financing that SunCulture and Futurepump have received. SHS companies are interested in moving into this area, but since the business model is significantly different (especially related to price points of the respective products), SHS companies will need to adjust the models designed for SHS. SHS companies will have one significant advantage compared to new companies trying to enter the space: they can leverage their track record, distribution network, and current customer base to sell products and raise financing.

The first sub-sector that is likely to achieve enough maturity to attract significant financing attention is likely to be solar irrigation for horticulture, as the companies in this area seem to have figured out the model for this.


### 5.7.1 CONSUMER FINANCE

Given the high up-front cost for productive use in agriculture products, consumer financing is very important. SunCulture offers PAYGO service in house, and Futurepump has integrated third-party PAYGO software to enable distributors to employ PAYGO payment plans. The challenge with the PAYGO model is that distributors must be able to finance the products to the end consumer, which then alters the nature of the business, which needs a solid business proposal and ability to raise large amounts of capital for debt. There is the opportunity for many micro-finance organizations to finance these products, and with the right expertise these organizations can be successful partners to solar water-pumping partners.

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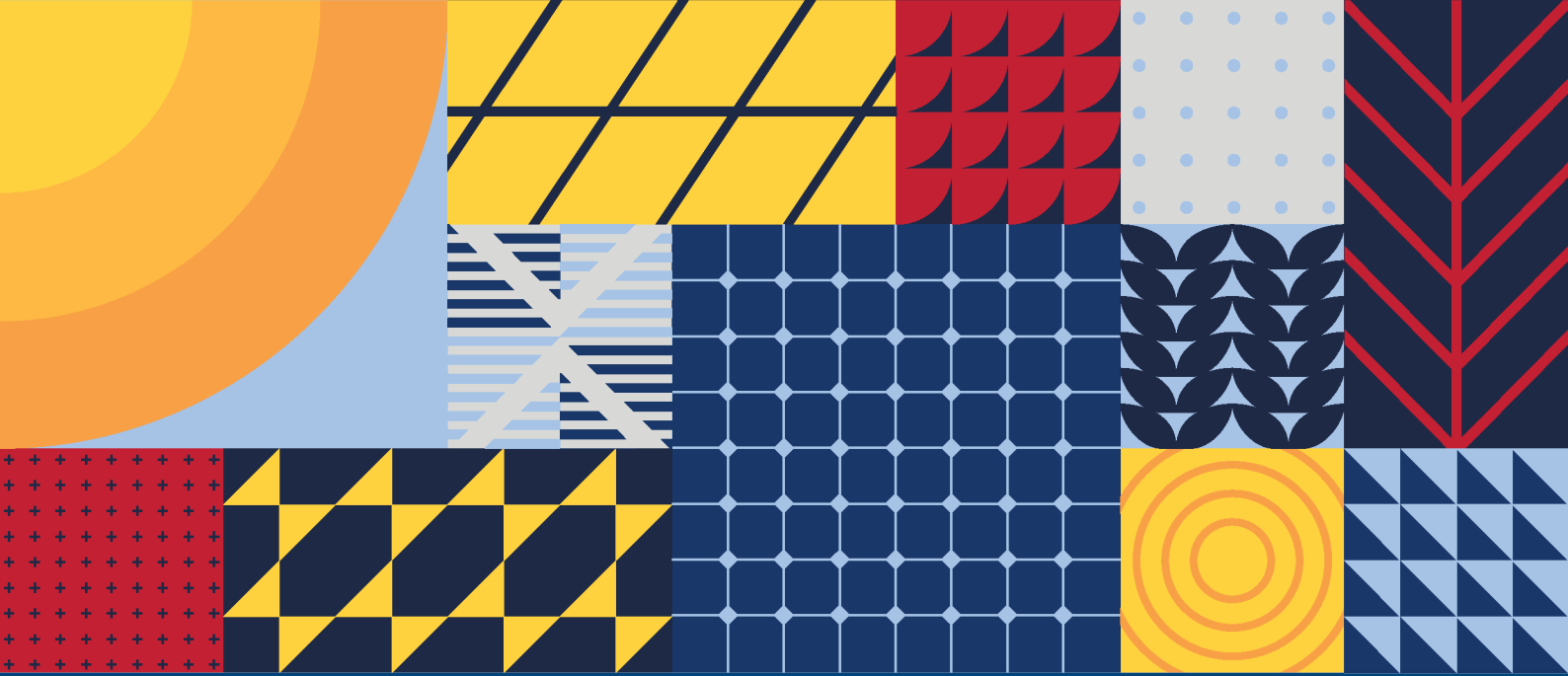
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