OFF-GRID SOLAR MARKET ASSESSMENT BRIEF FOR 14 UNDERSERVED COUNTIES OF KENYA 2020

CONTENTS

INTRODUCTION & BACKGROUND

The Kenya Off-Grid Solar Access Project (KOSAP) is a $150 million flagship project of the Kenya Ministry of Energy (MoE), financed by the World Bank and jointly implemented by the MoE, the Kenya Power and Lighting Company (KPLC), and the Rural Electrification and Renewable Energy Corporation (REREC).

KOSAP, which runs from 2017 to 2023 aims to increase access to modern energy services in the 14 underserved counties of Garrisa, Isiolo, Kilifi, Kwale, Mandera, Marsabit, Tana River, Lamu, Samburu, Taita Taveta, Turkana, Narok, Wajir, and West Pokot. The project is part of the MoE's objective to achieve universal electrification by 2022 and economic growth under the Government's _Kenya Vision 2030_ development program.
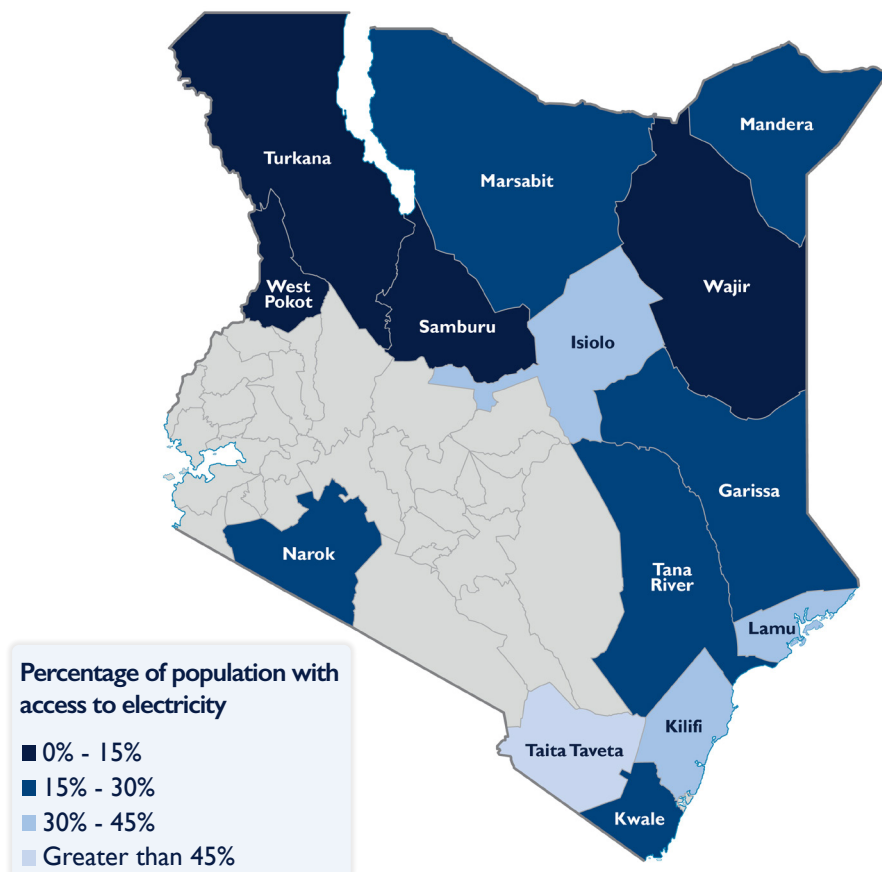
KOSAP 2023 ENERGY ACCESS TARGETS

ENERGY ACCESS

- 277,000 households (approximately1.3 million people)
- 1,100 public and community facilities (e.g. schools, health facilities, administrative offices)
- 380 boreholes

CLEAN COOKSTOVES

- 150,000 households in Isiolo, Marsabit, Samburu, Turkana, and West Pokot Counties

The goal of this brief is to provide market intelligence to companies and service providers that are active in or planning to enter the off-grid solar (OGS) market in the 14 KOSAP counties, referred to as KOSAP service territories (KSTs), as shown in Figure 1. This brief draws from publicly available data and in-depth consultations with the MoE's KOSAP-dedicated County Renewable Energy Officers (CREO) and summarizes the findings of geospatial analyses, which identify off-grid communities in KSTs and assess their potential as markets for OGS companies.

Figure 1. KOSAP Service Territories (KSTs)

Percentage of population with access to electricity

- 0% - 15%
- 15% - 30%
- 30% - 45%
- Greater than 45%

KOSAP Service Territories

The 14 KOSAP counties, which cover 72 percent of Kenya's total land area and 20 percent of its population, are generally remote and have low or unreliable access to energy services. KOSAP target counties also grapple with other challenges, including poor infrastructure; low population density; high poverty levels leading to low disposable incomes; and insecurity.

Access to Electricity and Infrastructure

Just under 23 percent of households in KSTs have access to electricity, compared to 70 percent at the national level. Geospatial analysis conducted by Power Africa estimates that 1.1 million households in KSTs, or 54 percent of the population, are more than five kilometers (km) from the electricity grid, meaning that they are unlikely to be served by grid-expansion projects. While some of these households will eventually get access to mini-grids, most households are strong candidates for electrification with solar home systems (SHS).[1]

The remaining 46 percent of KST households reside within five kilometers of grid service. However, proximity to grid infrastructure is not always a guarantee of reliable access.

In some cases, unreliable electricity supply results in frequent power outages, which makes it necessary for households with grid access to purchase OGS equipment. An estimated 13 percent of KST households live within one km of the grid (referred to in this brief as "under the grid") but lack access to electricity. In some cases, high-voltage transmission lines may pass through small settlements, but the utility does not build out distribution infrastructure to electrify the community. Figure 2 below shows the distribution of households by distance from the grid.

Figure 2. Households by Distance from the Grid in KOSAP Service Territories
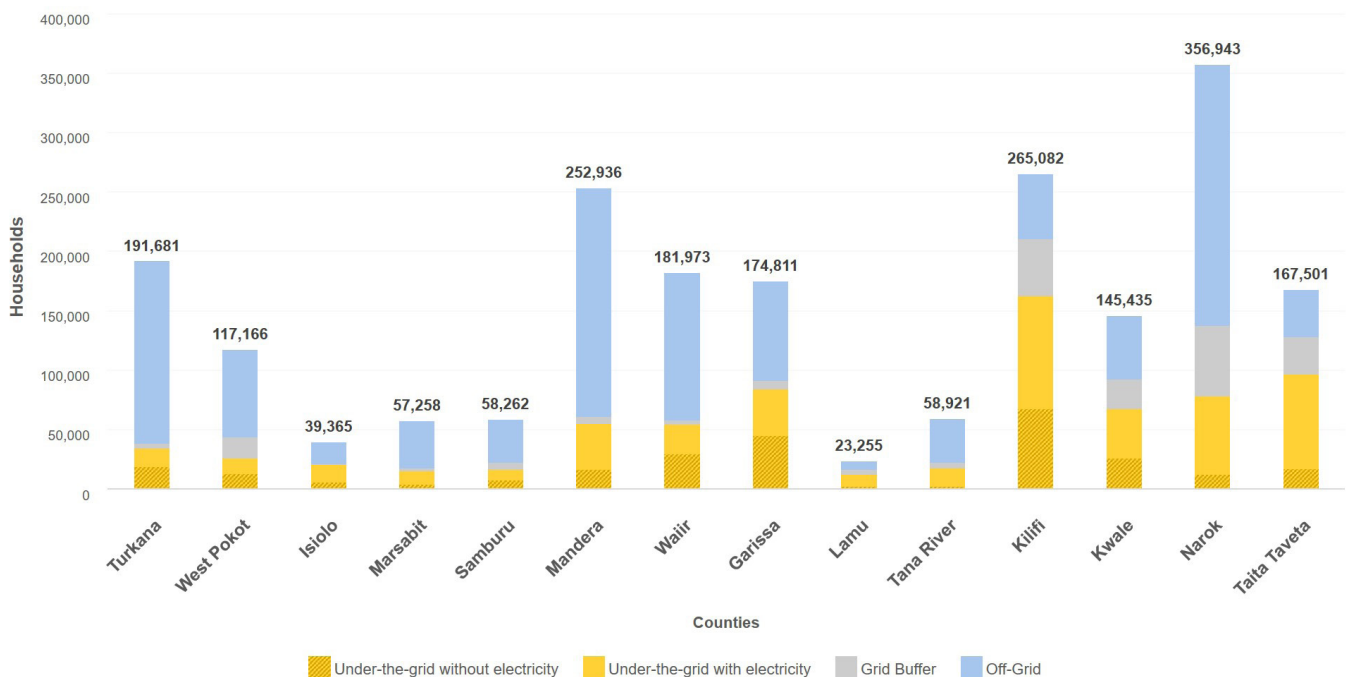
Source: Power Africa Geospatial Analysis

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[1] Kenya National Electrification Strategy, 2018

Scoring Off-Grid Potential

To better understand which settlements may be the most promising markets for OGS companies to enter, Power Africa's geospatial analysis includes assigning an *OGS Potential Score* to each off-grid settlement identified by the analysis.

The *OGS Potential Score* is based on the settlement's physical size, population size, and population density. This brief considers larger and denser settlements more promising for several reasons. First, larger communities offer a larger pool of potential customers. Second, marketing OGS products and supporting them post-sale carries some fixed costs, regardless of the size of a settlement.

If a company can spread these fixed costs across a larger customer base, per-customer acquisition costs and support costs go down. In addition, groups with common interests within communities offer opportunities for peer-to-peer sales to increase the market base. Finally, larger communities tend to be more accessible through existing road infrastructure and will be more likely to have reliable mobile-phone coverage, which can be critical for making PAYGO schemes workable.

Table 2 presents the count of off-grid settlements broken down by low, medium, and high *OGS Potential Scores*.

Table 2. OGS Potential Score by County

Lot	County	Low Potential Settlements		Medium Potential Settlements		High Potential Settlements		Average Potential Score (out of 8)
		Settlements	HHs	Settlements	HHs	Settlements	HHs	
1	Turkana	7	614	75	614	12	25,225	5.0
	West Pokot	16	2,348	65	2,348	0	0	4.3
2	Isiolo	1	27	34	27	7	7,649	5.3
	Marsabit	5	105	50	105	3	3,626	4.8
	Samburu	2	496	30	496	2	2,696	4.9
3	Mandera	16	1,028	50	1,028	26	129,782	5.3
	Wajir	5	63	62	63	22	55,349	5.1
4	Garissa	6	1,382	60	1,382	13	41,346	5.2
	Lamu	4	438	4	438	0	0	3.8
	Tana River	26	4,744	68	4,744	2	4,935	4.4
5	Kilifi	4	761	39	761	2	6,799	4.7
	Kwale	9	1,465	70	1,465	1	2,357	4.4
6	Narok	18	1,630	108	1,630	1	1,617	4.4
	Taita Taveta	5	196	48	196	1	1,507	4.5
	Total	**124**	**15,297**	**763**	**15,297**	**92**	**282,888**	**4.7**

Source: Power Africa Geospatial Analysis

It is important to note that there are many factors that determine a market's potential that are not included in the OGS Potential Score. This scoring approach is intended to be one of many factors that OGS companies consider when deciding where to invest their marketing efforts.

Household Energy Expenditure

Household energy expenditure is a measure of what households can afford and one of the most useful inputs for estimating the size of markets for different off-grid solar products. Multiple reports and studies[2] provide estimates for households' monthly energy expenditures in Kenya. Using household expenditure data from the latest Economic Survey 2018 by KNBS[3], the average monthly household energy expenditure in KSTs is Kenya Shillings (KSh) 1,674 ($15).[4] To put this average energy expenditure in context, the current average daily cost of pay-as-you-go (PAYGO) SHS is KSh 50 ($0.50) for a four-point lighting product, or KSh 1,500 monthly ($14).

Table 1 presents county-level estimates of average energy expenditure. The average monthly household energy expenditure in KSTs of Ksh 1,674 may be somewhat misleading, because counties such as Lamu, Kilifi, Narok, and Taita Taveta all have estimated monthly household energy expenditures of more than KSh 2,000 ($18), which drive the average higher. Eight KSTs have estimated energy expenditures that are below the monthly cost of the PAYGO SHS product example above, suggesting that the addressable market for PAYGO SHS might be smaller for some counties.

On the other hand, these county-level estimates are also averages, which may or may not be a strong indication of how many households have the ability to pay for SHS. All KSTs are above the overall poverty rate of KSh 3,252 ($30) per month in rural and peri-urban areas.[5] Localized surveys of energy expenditures and consumer preferences may be warranted for companies that are entering a new market.

Table 1. Household Energy Expenditure Estimates

Lot[a]	County	Mean Total Monthly Expenditure per Adult (KSh)	Estimated Total Monthly Household Expenditure (KSh)[b]	Monthly Non-Wood Energy Expenditure, 5% of Total expenditure (KSh)	Monthly Non-Wood Energy Expenditure, 10% of Total Expenditure (KSh)
1	Turkana	4,862	14,586	729	1,459
	West Pokot	3,914	11,742	587	1,174
2	Isiolo	6,252	18,756	938	1,876
	Marsabit	4,493	13,479	674	1,348
	Samburu	4,477	13,431	672	1,343
3	Mandera	3,461	10,383	519	1,038
	Wajir	3,784	11,352	568	1,135
4	Garissa	4,622	13,866	693	1,387
	Lamu	7,725	23,175	1,159	2,318
	Tana River	4,952	14,856	743	1,486
5	Kilifi	7,908	23,724	1,186	2,372
	Kwale	6,470	19,410	971	1,941
6	Narok	8,265	24,795	1,240	2,480
	Taita Taveta	6,917	20,751	1,038	2,075

Source: Kenya Integrated Household Budget Survey, 2015/2016.
[a] Counties are categorized in lots for the purposes of funding. Companies and partnerships can apply to market their products and services to one or more lots.
[b] This estimate assumes three adults per household, on average.

[2] Hystra Analysis 2017 https://www.adb.org/sites/default/files/publication/372436/access-energy-lessons.pdf
[3] https://www.knbs.or.ke/?wpdmpro=economic-survey-2018
[4] Based on a conservative number of three adult equivalent per household
[5] Kenya Integrated Household Budget Survey, 2015/2016

Cross-Cutting Challenges and Mitigation Measures

Every KST has unique challenges that require companies to adapt their business models and marketing strategies. This brief presents key cross-cutting challenges and potential mitigation measures, as summarized in Table 3 below.

Table 3. KST Market Conditions and Potential Solutions

Market Condition	Description	Recommendation
Poor transport infrastructure	Supply routes from Nairobi, the main hub for manufacturers and distributors, are long, cover rough terrain, and may pass through unsafe territory, substantially raising distribution costs.	Establish smaller distribution hubs in central locations close to key markets or partner with local businesses and micro-entrepreneurs. This will reduce costs for the distribution and provision of after-sales service.
Limited mobile phone coverage	Patchy mobile phone coverage limits the integration of GSM and mobile money technology, which is necessary for PAYGO SHS.	Provide customers the ability to choose cash purchases. For PAYGO products, consider working with local partners (e.g., microfinance institutions [MFIs] and table banking groups that can collect payments in remote areas.
Few suitable distribution partners	A lack of local or regional distribution partners with entrepreneurial backgrounds means that companies must operate costly distribution infrastructure in house; there are also limited options for inventory storage and warehousing.	Use local partners such as nongovernmental organizations (NGOs) with a longstanding presence in the area, MFIs, county government, and County Renewable Energy Officers (CREO) to identify suitable sales agents and build local capacity. To encourage payments from households, consider competitive compensations and smart incentives (e.g., commission on payments, not sales) for the sales team, which encourages sustainable sales behaviors.
Few commercial centers and low population density	Low population density and levels of urbanization make it costly to access end consumers, even from local distribution centers. This also complicates collections, particularly in the absence of strong mobile phone networks and mobile money.	Multiple companies may consider collaborating to develop distribution centers to lower the cost of developing the last mile of the supply and service chain. Leveraging referrals among customers or village entrepreneurs remains a best practice and further drives satisfaction and market penetration. Consider linking incentives to customer repayments.
Low levels of consumer product awareness	The lack of consumer education means that consumers do not always understand the benefits of solar versus traditional lighting, as well as benefits of Lighting Global-approved products over low-quality alternatives. Failure-prone imitation products harm the overall reputation of the sector along with market spoilage caused by the informal supply from neighboring countries.	Use local structures and institutions to pass messages and leverage existing programs (e.g., especially the livestock value chain). Leverage KOSAP awareness efforts. Partner with awareness-creation companies (e.g., Media Edge). Integrating the distribution chain into the solar results-based financing (RBF) facility to enhance their capacities (sharing RBF along the value chain) is also recommended.
Inadequate understanding of income and consumption patterns	There is uncertainty about the true purchasing power of consumers, as county-level data suggest substantially lower incomes per household, compared to non-underserved counties, and high seasonality of incomes. However, there is often widespread asset ownership in the form of livestock. Operators anecdotally report high demand at isolated sales events.	Use local surveys to better understand the market. Review customer selection and segmentation practices (including reviews of down payments), putting less focus on fast customer acquisition and more focus on retention and satisfaction, investing in strong customer care and service.

COUNTY FACT SHEETS

The following fact sheets highlight important market characteristics and key trends that are likely to influence the OGS markets in each of the 14 KSTs. Fact sheets are ordered by lot number. Counties are categorized in lots for the purposes of funding. Companies and partnerships can apply to market their products and services to one or more lots.

The following notes are important to interpreting the data presented on each fact sheet:

- In the *Population and the Grid* section of each fact sheet, the "under-the-grid" population is within one kilometer of the grid; the "buffer" population is one to 2.5 km from the grid; and the "off-grid" population is beyond 2.5 km of the grid.

- *High Potential Settlements* received a 7 or 8 *OGS Potential Score* – see above for more methodology details.

- Map and population/off-grid characteristics come from the Power Africa geospatial analysis. See Methodology Annex for more details.

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[6] Power Africa. 2019. Off-Grid Solar Market Assessment: Kenya. Available at https://www.usaid.gov/powerafrica/beyondthegrid/off-grid-solar-assessment/kenya.

LOT 1: TURKANA

POPULATION
1,032,055
(191,681 households)

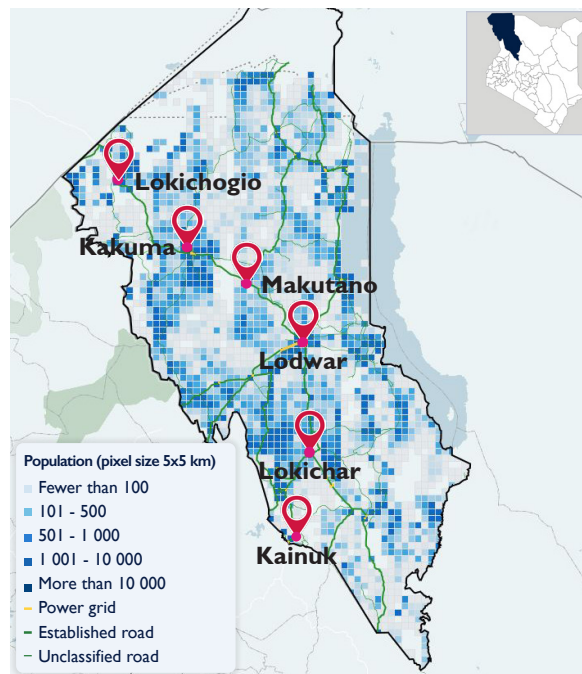**ELECTRICITY ACCESS**
7.8%
(14,951 households)

OFF-GRID POPULATION
80%
(153,269 households)

Turkana is a moderately sized county in northwest Kenya that borders Lake Turkana, Uganda, South Sudan, and Ethiopia.

Most inhabitants of Turkana practice nomadic pastoralism and keep livestock as their primary assets. Livestock markets form economic hubs across the county. Because males often travel with their herds, it is critical for off-grid energy companies to engage women as household decisionmakers when marketing off-grid solar products. Both electricity access and mobile network coverage in the county are sparse. Only Kainuk is connected to the grid, leaving most other urban centers either disconnected or reliant on mini-grids.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	23
Post Offices	2
Courier Services	1
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	7.8% (14,951)
Under-the-grid Population	17.6% (33,676)
Buffer Population	2.5% (4,736)
Off-grid Population	80% (153,269)
Served by Planned Mini-grids	1,379

Off-Grid Characteristics	
Total Settlements	81
High Potential Settlements	None
Health Facilities	68
Schools	197

Off-Grid Accessibility (Distance from Road)	
Within 1 km	23.2% (35,635)
Within 1-5 km	33% (50,538)
Beyond 5 km	43.8% (67,097)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Equity, KCB, Post
Micro-Finance Institutions	KWFT, KADET
Savings and Credit Cooperatives	Elimu, Kapenguria Teachers', Turkana Teachers'

Economic Activities

Pastoralism, fishing, irrigated small-scaling farming, charcoal and wood production, honey production, artisanal mining, and basket weaving.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		Kakuma	Lodwar, Lokichar		

Renewable Energy Officer

✉ Caleb Ewoi Nakain
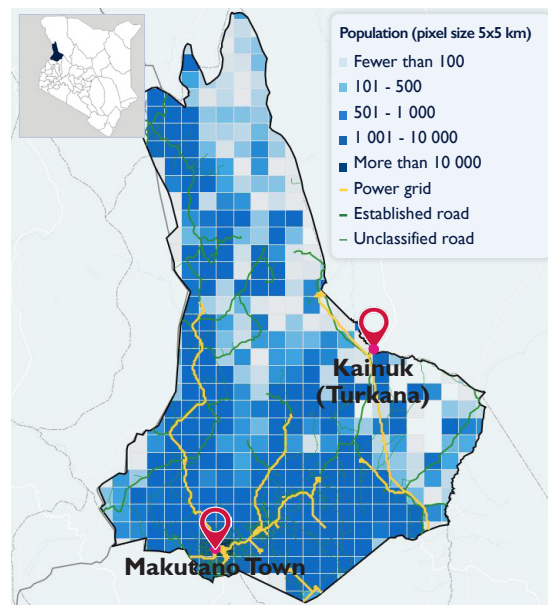
LOT 1: WEST POKOT

POPULATION
624,107
(117,166 households)

ELECTRICITY ACCESS
11.5%
(13,474 households)

OFF-GRID POPULATION
62.7%
(73,500 households)

West Pokot is a small, cosmopolitan county in western Kenya on the Ugandan border. Rural parts of the county are primarily occupied by Pokot communities, which follow a communal way of life. Financial services and mobile/internet connectivity are concentrated in the south, which may pose challenges for reaching rural consumers, particularly with pay-as-you-go schemes.

The most important economic activity in West Pokot is livestock rearing. A livestock market is open six days a week in a different town each day, forming a hub for other services and industries.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Kainuk (Turkana)

Makutano Town

Infrastructure	
Mini-grids	N/A
Post Offices	5
Courier Services	3
Local Radio Stations	1
Paved Road Network (km)	151

Population and the Grid (Households)	
Electricity Access	11.5% (13,474)
Under-the-grid Population	22% (25,788)
Buffer Population	15.3% (17,877)
Off-grid Population	62.7% (73,500)
Served by Planned Mini-grids	None

Off-Grid Characteristics	
Total Settlements	81
High Potential Settlements	None
Health Facilities	68
Schools	197

Off-Grid Accessibility (Distance from Road)	
Within 1 km	45.1% (33,161)
Within 1-5 km	46.9% (34,482)
Beyond 5 km	8.0% (5,857)

Financial Services	
Financial inclusion (%)	23%
Commercial Banks	Barclays, Equity, KCB
Micro-Finance Institutions	Faulu, KWFT, Rafode
Savings and Credit Cooperatives	Kapenguria Teachers', Muruny Rural, Sigor FSA Rural, WEPESA

Economic Activities

Livestock, retail, and wholesale trading; fresh produce and cereals; entertainment and hospitality; and service industries (motor garages; cyber cafes; law firms; livestock auctions; private education businesses; honey processing; banking and financial services; real estate enterprises; and road transport services).

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Kishaunet	Chepkopegh, Orolwo, Sigor	Ortum	Chepareria	Kishaunet	Lomut

Renewable Energy Officer

✉ Stanley Kipchoge Sitienei

LOT 2: ISIOLO

POPULATION
181,664
(39,365 households)

ELECTRICITY ACCESS
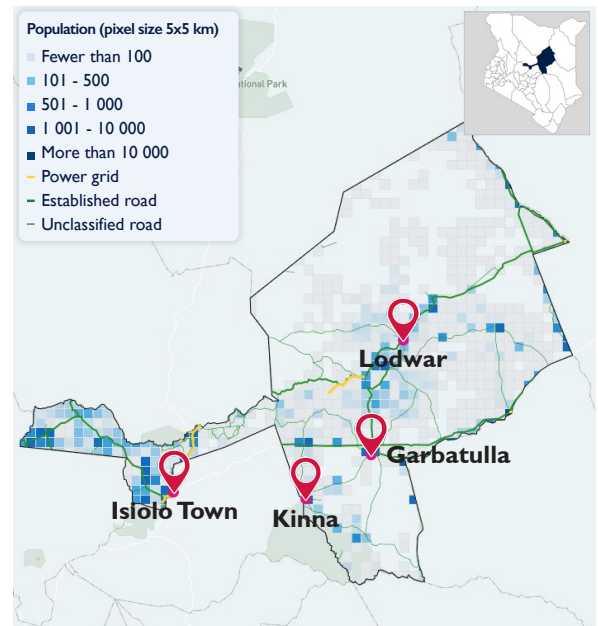**37.7%**
(14,840 households)

OFF-GRID POPULATION
46.8%
(18,416 households)

Isiolo is a county located in the upper Eastern Region of Kenya, bordering seven other counties, including Marsabit, Wajir, Garissa, Tana River, Maru, Laikipia, and Samburu. The major towns of Isiolo and Garbatulla host most of the county's urban population. Much of the electrical connectivity in the county is focused on urban centers and mobile networks, which cover less than ten percent of the county's population. Most rural populations lack any mobile network coverage at all.

Livestock selling is the most common economic activity in the county and small livestock rearing, such as sheep and goats, account for roughly half of household assets. Camels and cattle account for about a quarter of household assets as well. Milk vending and charcoal trading are also practiced in the county.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Lodwar
Garbatulla
Isiolo Town
Kinna

Infrastructure	
Mini-grids	11
Post Offices	3
Courier Services	5+
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	37.7% (14,840)
Under-the-grid Population	51.5% (20,289)
Buffer Population	1.7% (659)
Off-grid Population	46.8% (18,416)
Served by Planned Mini-grids	3,273

Off-Grid Characteristics	
Total Settlements	39
High Potential Settlements	7
Health Facilities	25
Schools	50

Off-Grid Accessibility (Distance from Road)	
Within 1 km	38.8% (7,146)
Within 1-5 km	39.6% (7,300)
Beyond 5 km	21.6% (3,971)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Barclay, Consolidated, Cooperative, Equity, Family, First Community, KCB, National, Sidian
Micro-Finance Institutions	Faulu Kenya, KWFT
Savings and Credit Cooperatives	Isiolo Teachers' Solution, Transnational

Economic Activities

Agriculture, livestock selling (especially small stock like goats/sheep) – small stock make up roughly 50 percent of assets; camels and cattle form about 25 percent; milk vending; charcoal trade.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Isiolo	Isiolo, Oldonyiro	Isiolo	Isiolo	Kipsing, Isiolo	Eskot, Isiolo

Renewable Energy Officer

✉ Abdi Osman Guyo

LOT 2: MARSABIT

POPULATION
330,381
(57,258 households)

ELECTRICITY ACCESS
20%
(11,452 households)

OFF-GRID POPULATION
69.2%
(36,649 households)

Marsabit is the largest county centrally located at the northern tip of Kenya on the border with Ethiopia. The county borders Lake Turkana and Samburu County to the west.

The majority of the population of Marsabit practices pastoralism and livestock herding as productive assets. Communities here are very widespread and dispersed, with settlement patterns adjusting to water availability, land arability, and access to social services. There are more dense populations in the towns of Marsabit and Moyale, where the county's five major banks are located. Mobile network coverage reaches most urban centers and a fair amount of the rural population, but grid connectivity remains low in Marsabit.
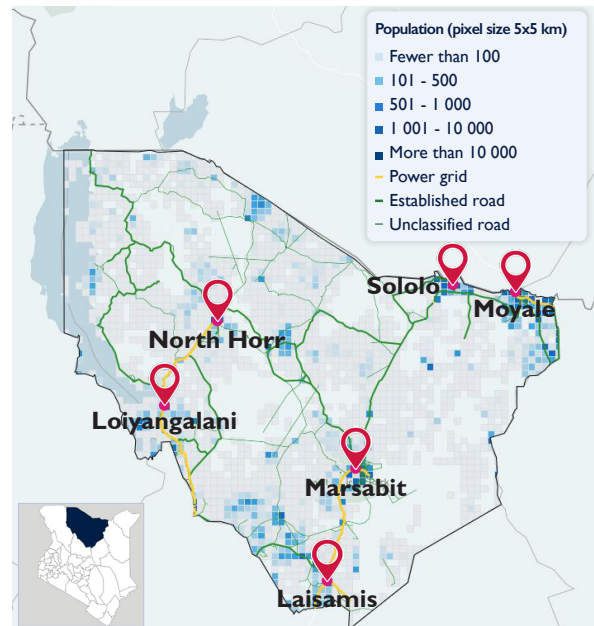
Infrastructure	
Mini-grids	14
Post Offices	5
Courier Services	1+
Local Radio Stations	3
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	20.0% (11,452)
Under-the-grid Population	26.2% (15,017)
Buffer Population	4.5% (2,592)
Off-grid Population	69.2% (39,649)
Served by Planned Mini-grids	521

Off-Grid Characteristics	
Total Settlements	58
High Potential Settlements	3
Health Facilities	50
Schools	77

Off-Grid Accessibility (Distance from Road)	
Within 1 km	30.7% (12,153)
Within 1-5 km	30.2% (11,993)
Beyond 5 km	39.1% (15,503)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Cooperative, Equity, First Community, KCB, Post
Micro-Finance Institutions	Equatorial Debit Solutions, Ltd., Liqui Solve, KWFT
Savings and Credit Cooperatives	N/A

Economic Activities

Pastoralism and livestock herding for productive assets. Small stock like sheep and goats are used for petty cash. They are preferred due to higher reproduction frequency and drought resistance.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Forole, Jirime,	Jirime, Merile, Moyale	Jirime, Moyale	Jirime, Moyale	Jirime, Moyale	Jirime, Moyale

## Renewable Energy Officer

✉ Jalle Gesile Gideon

LOT 2: SAMBURU

POPULATION
272,223
(58,262 households)

ELECTRICITY ACCESS
14.8%
(8,623 households)

OFF-GRID POPULATION
62.4%
(36,329 households)

Samburu is a relatively small county in Kenya, situated at the southern tip of Lake Turkana, between Turkana and Marsabit County.

Pastoralism and herding are the dominant practices among the people of Samburu, although activities are more diversified on the Lorroki Plateau. Livestock marketing, rain-fed maize (corn) cropping, petty trade, and tourism serve as alternate sources of income.
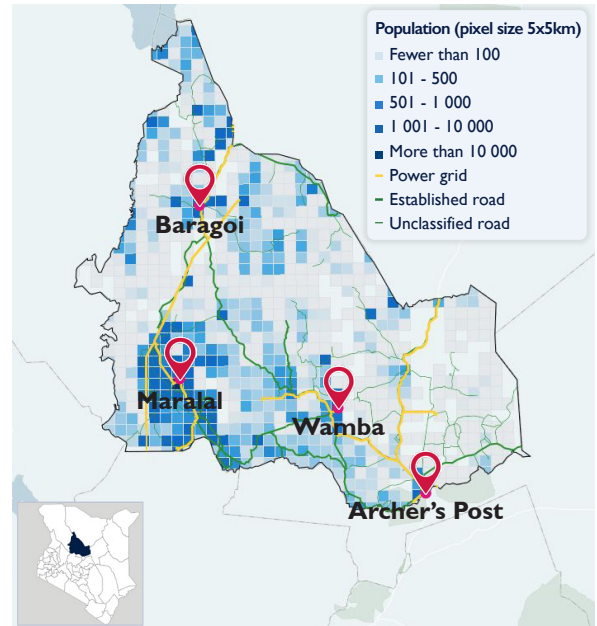
Infrastructure	
Mini-grids	9
Post Offices	4
Courier Services	1
Local Radio Stations	3
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	14.8% (8,623)
Under-the-grid Population	27.4% (15,979)
Buffer Population	10.2% (5,954)
Off-grid Population	62.4% (36,329)
Served by Planned Mini-grids	334

Off-Grid Characteristics	
Total Settlements	34
High Potential Settlements	2
Health Facilities	54
Schools	80

Off-Grid Accessibility (Distance from Road)	
Within 1 km	32.1% (11,657)
Within 1-5 km	36.9% (13,392)
Beyond 5 km	31.0% (11,280)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Equity, KCB, Post
Micro-Finance Institutions	Faulu, KWFT
Savings and Credit Cooperatives	Dumish, Supa, Tower, Transnational

Economic Activities

Pastoralism (cattle, goats, sheep, and camels most importantly), herding, rain-fed maize cropping, petty trade, livestock marketing, and tourism.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Baragoi		Lolkuniani	Suguta	Lekuru

Renewable Energy Officer

✉ Wyclef Munene Ngure
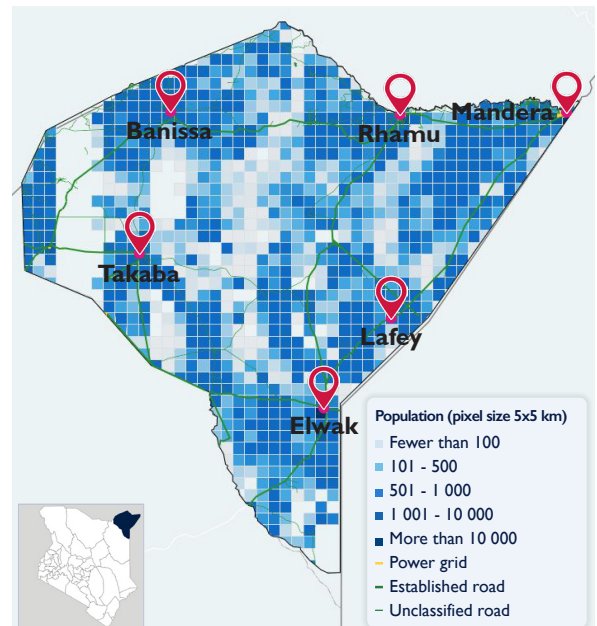
LOT 3: MANDERA

POPULATION
1,705,505
(252,936 households)

ELECTRICITY ACCESS
15.2%
(38,446 households)

OFF-GRID POPULATION
76%
(192,154 households)

Mandera is a relatively small but heavily populated county that is situated in the North Eastern part of Kenya between Ethiopia in the north and Somalia in the east. Mobile network coverage and grid connectivity are very low outside of major urban centers like Mandera town.

An estimated 35 percent of residents in Mandera are wage earners. These include county staff, agricultural and quarry workers, and shopkeepers. Pastoralism trade contributes to 72 percent of the county's total household income. Mobile money is used widely in the county, which could ease access to off-grid solar products through pay-as-you-go.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	30
Post Offices	4
Courier Services	3+
Local Radio Stations	N/A
Paved Road Network (km)	24

Population and the Grid (Households)	
Electricity Access	15.2% (38,446)
Under-the-grid Population	21.7% (54,765)
Buffer Population	2.4% (6,017)
Off-grid Population	76.0% (192,154)
Served by Planned Mini-grids	1,579

Off-Grid Characteristics	
Total Settlements	92
High Potential Settlements	26
Health Facilities	37
Schools	67

Off-Grid Accessibility (Distance from Road)	
Within 1 km	39.9% (76,751)
Within 1-5 km	31.5% (60,524)
Beyond 5 km	28.6% (54,879)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Equity, KCB, National
Micro-Finance Institutions	Takaful Insurance
Savings and Credit Cooperatives	N/A

Economic Activities

Livestock sale, livestock products, casual wage labor, and petty trade.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		Banisa	Mandera, Rhamu	Takaba	

Renewable Energy Officer

✉ Osman Hassan Mohamed

LOT 3: WAJIR

POPULATION
1,102,803
(181,973 households)

ELECTRICITY ACCESS
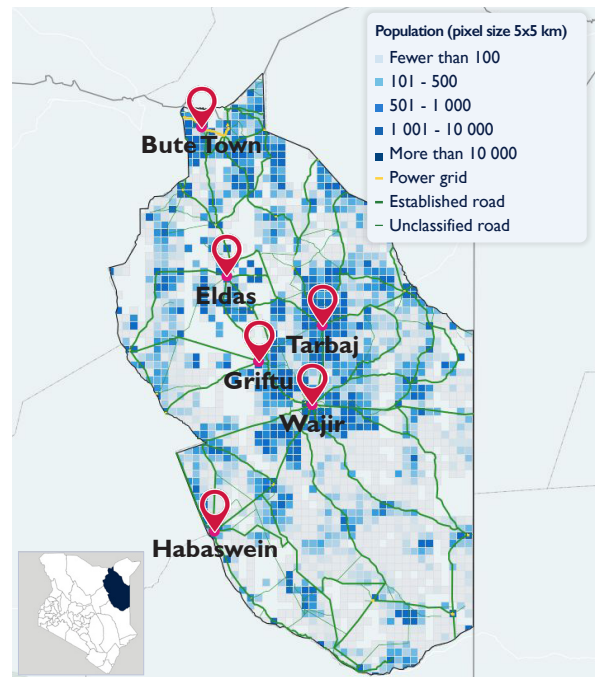**13.9%**
(25,294 households)

OFF-GRID POPULATION
68.2%
(124,106 households)

Wajir is a large county in east Kenya that is located on the border of Somalia, between Mandera and Marsabit Counties. Its capital and largest town is Wajir. In Wajir County, the population density is relatively low except in towns; this is attributed to vibrant economies in towns, driven by businesses, employment opportunities, and income-generating activities of the informal sector that are concentrated there.

The economy in Wajir is largely livestock-based and the county is a major supplier of the beef and small stock sold in Nairobi and Mombasa. Grid connectivity in Wajir is very low, but some of the major urban centers, such as Wajir and Griftu, are connected to diesel power plants.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	25
Post Offices	3
Courier Services	3+
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	13.9% (25,294)
Under-the-grid Population	29.9% (54,366)
Buffer Population	1.9% (3,501)
Off-grid Population	68.2% (124,106)
Served by Planned Mini-grids	1,720

Off-Grid Characteristics	
Total Settlements	85
High Potential Settlements	22
Health Facilities	69
Schools	67

Off-Grid Accessibility (Distance from Road)	
Within 1 km	31.6% (39,240)
Within 1-5 km	41.5% (51,528)
Beyond 5 km	26.9% (33,338)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	N/A
Micro-Finance Institutions	N/A
Savings and Credit Cooperatives	N/A

Economic Activities

Pastoralism, livestock, and livestock products; thriving goat/sheep markets that trade daily; cattle and camels traded every Monday; small-scale crop agriculture.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Bute, Wajir	Bute	Bute	Bute	Bute	Bute, Habaswein

Renewable Energy Officer

✉ Fahma Yussuf Adan
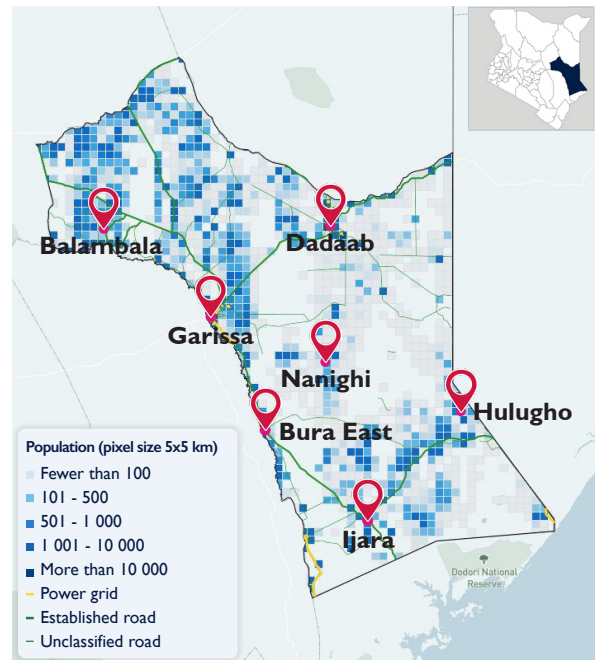
LOT 4: GARISSA

POPULATION
1,013,306
(174,811 households)

ELECTRICITY ACCESS
22.4%
(39,158 households)

OFF-GRID POPULATION
47.8%
(83,583 households)

Garissa is a large county located in eastern Kenya with its side along the Somalian border. This border has been a source of security issues for the county, and there have been attacks in recent years, primarily in Fafi sub-county. The county's settlement pattern consists of six urban and commercial centers with populations of fewer than 10,000 inhabitants, namely Balambala, Bura East, Dadaab, Hulugho, Modogashe, and Nanighi. In addition, Garissa and Masalani Townships have populations of fewer than 10,000 inhabitants.

Most of the county's population practices pastoralism. Livestock include indigenous sheep, goats, and cattle – found in the southern parts of Garissa, which receive more rain – and camels in the drier north. Agriculture is also more active along the Tana River, with an average farm size of 1.3 hectares. Some pastoralists also cross county lines in search of pastures.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	17
Post Offices	6
Courier Services	6+
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	22.4% (39,158)
Under-the-grid Population	48.0% (83,974)
Buffer Population	4.1% (7,254)
Off-grid Population	47.8% (83,583)
Served by Planned Mini-grids	1,092

Off-Grid Characteristics	
Total Settlements	76
High Potential Settlements	13
Health Facilities	70
Schools	66

Off-Grid Accessibility (Distance from Road)	
Within 1 km	39.0% (32,560)
Within 1-5 km	25.5% (21,272)
Beyond 5 km	35.6% (29,751)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Barclays, Cooperative, Equity, First Community, Gulf, KCB, National, Post
Micro-Finance Institutions	KWFT
Savings and Credit Cooperatives	Amaco, Garissa Teacher's, REMA, Takaful

Economic Activities

Pastoralism and agriculture

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Hulugho, Ijara, Modogashe		Garissa			

Renewable Energy Officer

✉ Salah Abdi Maalim

LOT 4: LAMU

POPULATION
99,991
(23,255 households)

ELECTRICITY ACCESS
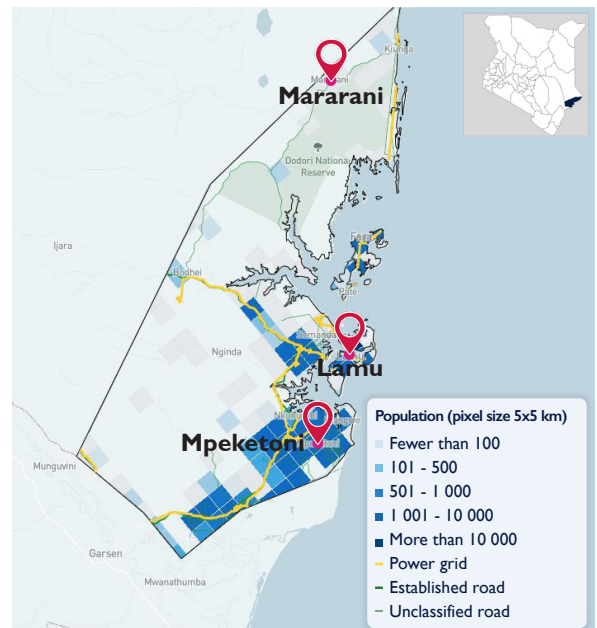**43.6%**
(10,139 households)

OFF-GRID POPULATION
30.9%
(7,196 households)

Lamu is a small county that is situated in southern Kenya, along the Indian Ocean. Lamu's northern border is shared with Garissa County, while Tana River County borders Lamu to the west. The highest population densities are within town centers and archipelago villages. Population distribution is concentrated where economic activities arise, with livestock raising, fishing, and trade being the most common forms.

Ninety percent of rural household incomes are derived from agriculture and agriculture-related activities. Electrical connectivity in Lamu is low, but mobile network coverage reaches roughly 75 percent of the population.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	3
Post Offices	5
Courier Services	1
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	43.6% (10,139)
Under-the-grid Population	50.7% (11,779)
Buffer Population	18.4% (4,280)
Off-grid Population	30.9% (7,196)
Served by Planned Mini-grids	137

Off-Grid Characteristics	
Total Settlements	7
High Potential Settlements	None
Health Facilities	25
Schools	26

Off-Grid Accessibility (Distance from Road)	
Within 1 km	50.9% (3,659)
Within 1-5 km	43.8% (3,150)
Beyond 5 km	5.4% (386)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Cooperative, Diamond Trust, Equity, KCB, Gulf Africa, Selic Capital
Micro-Finance Institutions	Faulu, KWFT, Yehu
Savings and Credit Cooperatives	Lamu Teacher's

Economic Activities

Agriculture and agricultural-related activities, tourism, wage employment, and urban self-employment.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Amu, Faza, Kiunga, Mokowe, Nagele	Amu, Faza, Kiunga, Mokowe, Nagele	Amu, Faza, Kiunga, Mokowe, Mpeketoni, Nagele	Amu, Faza, Kiunga, Mokowe, Nagele	Amu, Faza, Kiunga, Mokowe, Nagele	Amu, Faza, Kiunga, Mokowe, Mpeketoni, Nagele

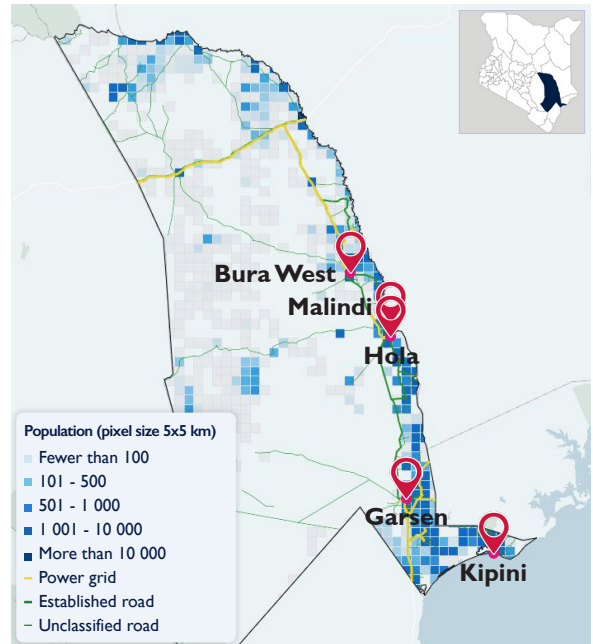### Renewable Energy Officer

✉ George Otula Nyagwa

LOT 4: TANA RIVER

POPULATION
271,724
(58,921 households)

ELECTRICITY ACCESS
25.4%
(14,996 households)

OFF-GRID POPULATION
62.9%
(37,063 households)

Tana River is a large county with a small border along the Indian Ocean, situated between Kilifi and Lamu Counties. The majority of Tana River is situated between Kitui County (west) and Garissa County (east). The road network in Tana River is over 3,000 kilometers long, but grid connectivity remains low. Mobile network coverage reaches just over half of the county's population.

Most people in Tana River have livelihoods in agriculture, but nearly two-thirds of the county's population are experiencing absolute poverty, which makes food security the highest priority for most households. The county is largely dry and prone to drought.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	6
Post Offices	3
Courier Services	4+
Local Radio Stations	1
Paved Road Network (km)	1,688

Population and the Grid (Households)	
Electricity Access	25.4% (14,966)
Under-the-grid Population	29.0% (17,078)
Buffer Population	8.1% (4,780)
Off-grid Population	62.9% (37,063)
Served by Planned Mini-grids	282

Off-Grid Characteristics	
Total Settlements	93
High Potential Settlements	2
Health Facilities	37
Schools	116

Off-Grid Accessibility (Distance from Road)	
Within 1 km	45.6% (16,884)
Within 1-5 km	30.3% (11,241)
Beyond 5 km	24.1% (8,937)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Cooperative, Equity, KCB
Micro-Finance Institutions	1
Savings and Credit Cooperatives	1

Economic Activities

Agriculture

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Bangale	Bura			

Renewable Energy Officer

✉ Jackbed Gakii Mugo

LOT 5: KILIFI

POPULATION
1,279,758
(265,082 households)

ELECTRICITY ACCESS
35.9%
(95,164 households)

OFF-GRID POPULATION
20.6%
(54,571 households)

Kilifi is a moderately sized county that borders the Indian Ocean in southern Kenya. Kilifi also borders Tana River, Taita Taveta, and Kwale County. Out of 78 trading centers in the county, 50 are electrified. Mobile network coverage reaches 75 percent of the total population.

Tourism and fishing are major economic activities due to the county's proximity to the Indian Ocean. The county also has some of the most popular beaches, hotels, and resorts in the country, but **64%** of households in the county still lack electricity access.
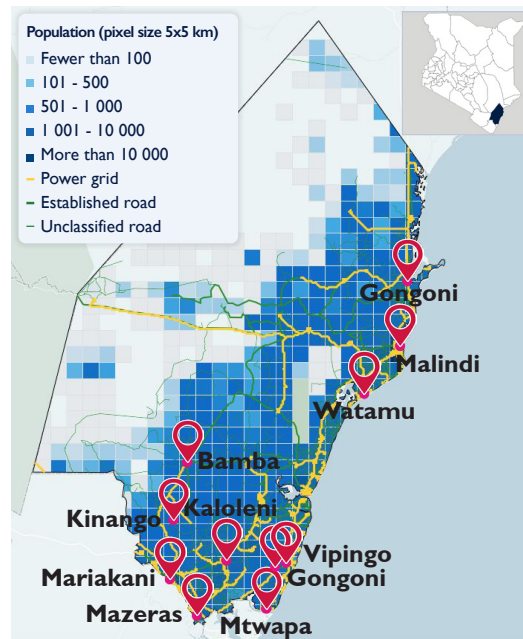
Infrastructure	
Mini-grids	3
Post Offices	7
Courier Services	6
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	35.9% (95,164)
Under-the-grid Population	61.2% (162,304)
Buffer Population	18.2% (48,208)
Off-grid Population	20.6% (54,571)
Served by Planned Mini-grids	33

Off-Grid Characteristics	
Total Settlements	45
High Potential Settlements	2
Health Facilities	67
Schools	163

Off-Grid Accessibility (Distance from Road)	
Within 1 km	74.1% (40,450)
Within 1-5 km	22.9% (12,501)
Beyond 5 km	3.0% (1,620)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Barclays, Chase, Cooperative, Diamond Trust, Eco, Equity, Imperial, Jamii, KCB, KWFT, National, NIC, Post, Sidian, Stanbic, Standard Chartered
Micro-Finance Institutions	Fadhili, Faulu, Jitegemee, KWFT, Platinum Finance, Rafiki Microfinance, SMEP
Savings and Credit Cooperatives	Imarika, Lengo (there are over 171 in the county)

Economic Activities

The Kilifi county boasts 78 trading centers with 31,998 licensed retailers and 641 wholesalers.

Livestock Market Schedule (Not available)

Renewable Energy Officer
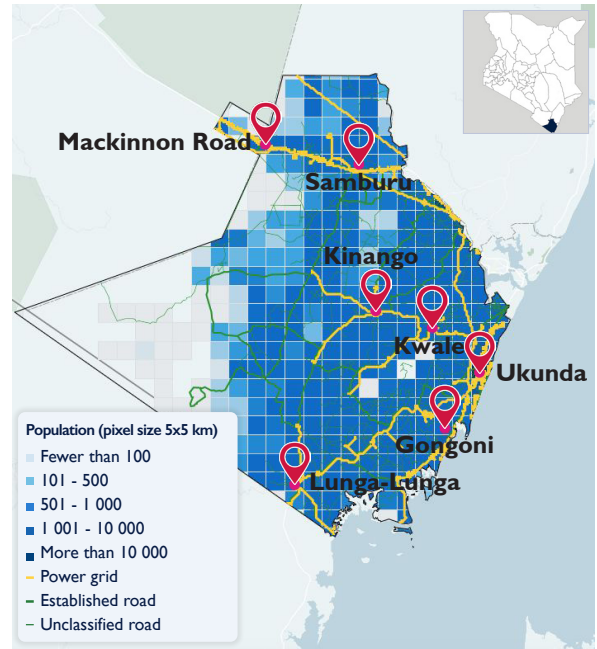
✉ Habel Mwatata Mwarabu

LOT 5: KWALE

POPULATION
721,184
(145,435 households)

ELECTRICITY ACCESS
28.9%
(42,031 households)

OFF-GRID POPULATION
36.7%
(53,380 households)

Kwale is Kenya's southernmost county, which is situated with the Tanzanian border to the south and the Indian Ocean to the east.

Agriculture is one of the main economic activities carried out in Kwale County, with 85 percent households practicing subsistence farming. The agricultural sector plays a crucial role in guaranteeing food security, poverty reduction, and employment creation in the county.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	8
Post Offices	7
Courier Services	4+
Local Radio Stations	6
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	28.9% (42,031)
Under-the-grid Population	46.3% (67,393)
Buffer Population	17.0% (24,661)
Off-grid Population	36.7% (53,380)
Served by Planned Mini-grids	307

Off-Grid Characteristics	
Total Settlements	80
High Potential Settlements	1
Health Facilities	40
Schools	155

Off-Grid Accessibility (Distance from Road)	
Within 1 km	70.6% (37,686)
Within 1-5 km	26.1% (13,957)
Beyond 5 km	3.3% (1,737)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Equity, KCB, Post
Micro-Finance Institutions	KWFT, Yehu
Savings and Credit Cooperatives	N/A

Economic Activities

Agriculture, education, general labor, mining, and tourism. Tourism significantly contributes to the economy of Kwale County, with employment mainly concentrated in the hospitality sector, catering to tourist sites, such as the natural marine reserves, historic sites, forests, coral and sand beaches, and wildlife habitats.

Livestock Market Schedule (not available)

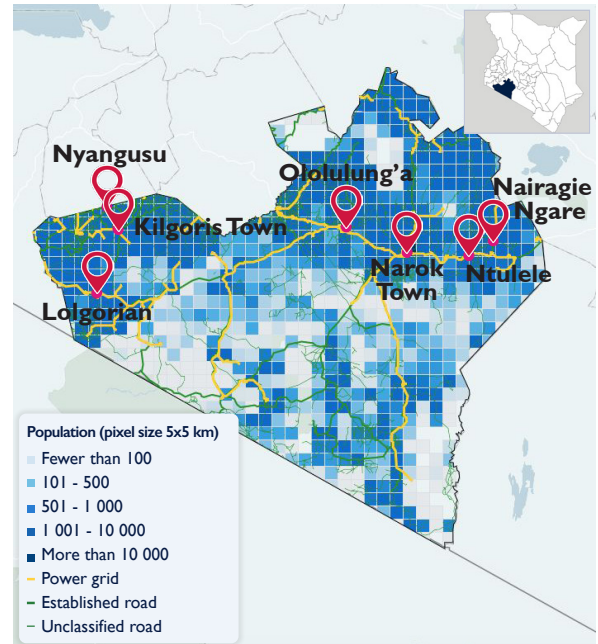### Renewable Energy Officer

✉ Salama Mwafrika Mwasafari

LOT 6: NAROK

POPULATION
1,044,713
(356,943 households)

ELECTRICITY ACCESS
18.5%
(66,034 households)

OFF-GRID POPULATION
61.6%
(219,899 households)

Narok is a moderately sized county situated on the Tanzanian border in southwest Kenya. The county has low electricity access and low telecom penetration. Urban centers with denser populations, such as Narok or Kilgoris, experience patchy mobile connectivity and have slightly higher electricity access rates.

The major challenges adversely affecting economic prosperity in the county include effects of climate change, poorly developed economic infrastructure, unplanned human settlements, and high levels of unemployment among youth. The dominant tribes in Narok are Maasai and Kalenjin.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	2
Post Offices	5
Courier Services	5+
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	18.5% (66,034)
Under-the-grid Population	21.9% (78,105)
Buffer Population	16.5% (58,940)
Off-grid Population	61.6% (219,899)
Served by Planned Mini-grids	98

Off-Grid Characteristics	
Total Settlements	127
High Potential Settlements	1
Health Facilities	96
Schools	413

Off-Grid Accessibility (Distance from Road)	
Within 1 km	70.4% (154,795)
Within 1-5 km	28.5% (62,625)
Beyond 5 km	1.1% (2,479)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Absa, Cooperative, DTB, Equity, Family, KCB, National, Post, Transnational
Micro-Finance Institutions	Faulu, Eclof, KWFT, Musoni, SMEP
Savings and Credit Cooperatives	Narok Eagles, Narok Teachers'

Economic Activities

Pastoralism, crop farming, tourism, trade, mining (Kilimapesa Goldmine, Lolgorian Quarry, and sand). Small livestock (sheep and goats) is sold to meet household needs, including both food and non-food items.

Livestock Market Schedule

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		Suswa		Ewaso Nyiro	Ewaso Nyiro, Mulot

Renewable Energy Officer

✉ Tom Kipkemoi Sego
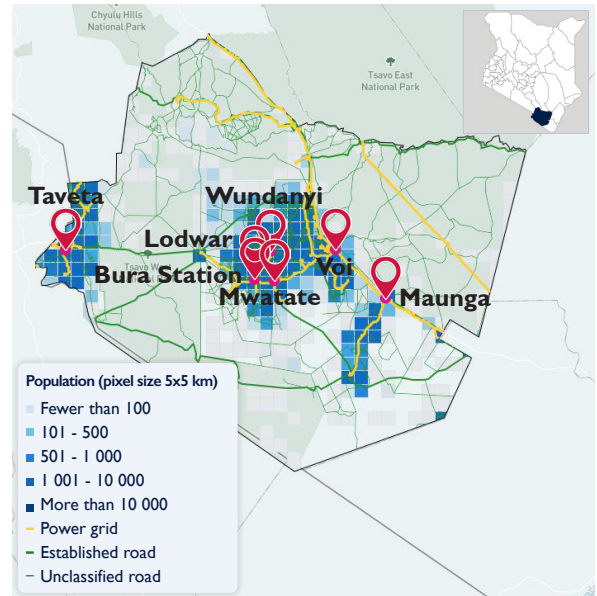
LOT 6: TAITA TAVETA

POPULATION
332,454
(167,501 households)

ELECTRICITY ACCESS
47.3%
(79,228 households)

OFF-GRID POPULATION
23.8%
(39,898 households)

Taita Taveta is a small county situated on the Tanzanian border in southern Kenya, just north of Kwale County. Taveta and Wundanyi are the most densely populated sub-counties, and grid connectivity is stronger in these areas. Mwatate and Voi have more dispersed communities and much lower electricity access. There are also urban centers like Mghange, which are home to government-initiated Community Resource Centers.

Mining is the primary source of income to an estimated 10,000 people working in the mining sites at Lualenyi in Voi, Kabanga, Shako Ranch in Mwatate, Scorpion Mine, Shetani Lava Cave, John Saul Mine (Rockland Mine), and Penny Lane Mine.

Population (pixel size 5x5 km)
- Fewer than 100
- 101 - 500
- 501 - 1 000
- 1 001 - 10 000
- More than 10 000
- Power grid
- Established road
- Unclassified road

Infrastructure	
Mini-grids	N/A
Post Offices	10
Courier Services	5+
Local Radio Stations	N/A
Paved Road Network (km)	N/A

Population and the Grid (Households)	
Electricity Access	47.3% (79,228)
Under-the-grid Population	57.5% (96,256)
Buffer Population	18.7% (62,218)
Off-grid Population	23.8% (39,898)
Served by Planned Mini-grids	None

Off-Grid Characteristics	
Total Settlements	54
High Potential Settlements	1
Health Facilities	19
Schools	70

Off-Grid Accessibility (Distance from Road)	
Within 1 km	86.0% (34,323)
Within 1-5 km	12.5% (4,995)
Beyond 5 km	1.5% (580)

Financial Services	
Financial inclusion (%)	N/A
Commercial Banks	Absa, Cooperative, DTB, Equity, KCB
Micro-Finance Institutions	Faulu, KWFT, SMEP, Yehu
Savings and Credit Cooperatives	Ark, Qwetu, Taita Teachers', Zoghori

Economic Activities

Formal wage earners consist of people in public service, construction sites, and sisal plantations.

Urban: Shops, hotels, money-transfer services, spare-parts outlets, groceries, petrol stations, hardware stores, and the transport sector (especially the motorcycle industry).

Rural: Agriculture, livestock, brickmaking.

Livestock Market Schedule (not available)

Renewable Energy Officer

✉ Deogratious Mwakio Ndonye

MORE INFORMATION

In addition to the data provided in the county fact sheets below, readers may contact the Kenya office of the Power Africa Off-Grid Project at kenya@powerafrica-offgrid.org to request more detailed data from the geospatial analysis.

In 2019, Power Africa also published an off-grid solar market assessment for the entire country of Kenya, which is available on the Power Africa website.[6]

More about Power Africa: www.usaid.gov/powerafrica

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[6] Power Africa. 2019. Off-Grid Solar Market Assessment: Kenya. Available at https://www.usaid.gov/powerafrica/beyondthegrid/off-grid-solar-assessment/kenya.
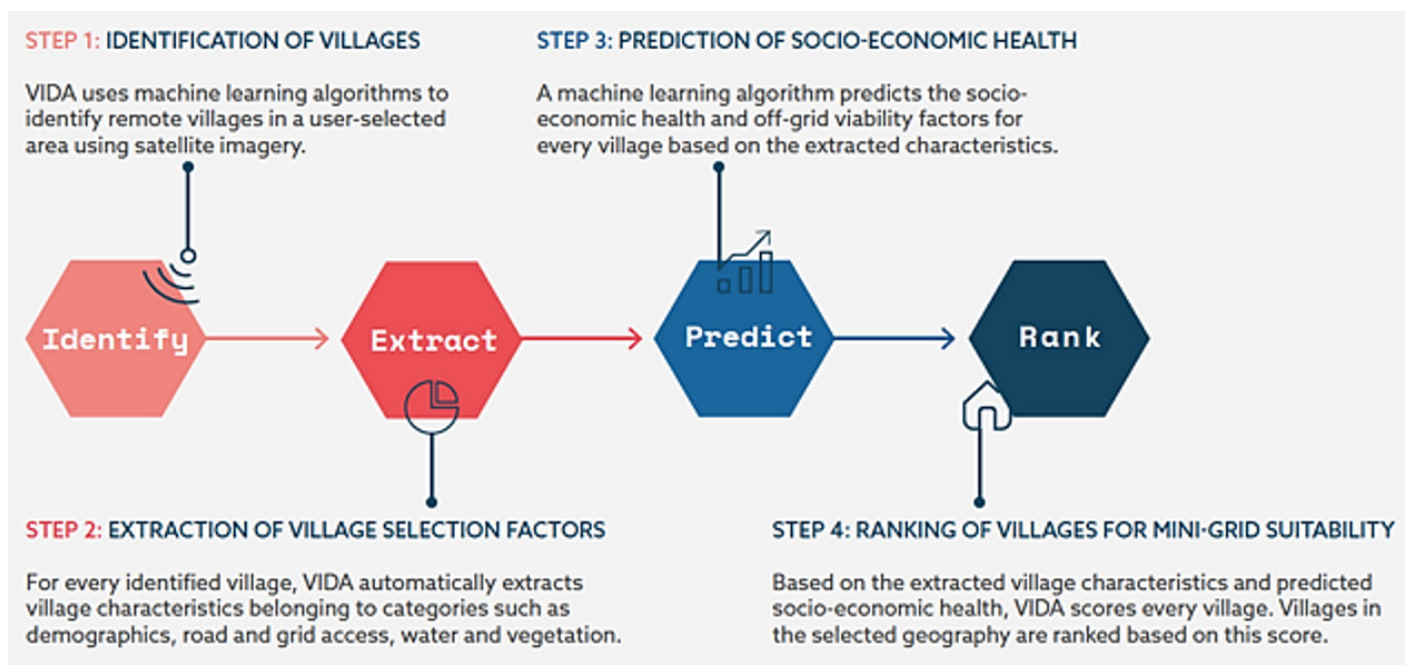
ANNEX 1:
GEOSPATIAL ANALYSIS METHODOLOGY

VIDA by TFE Energy

Village Data Analytics (VIDA) is a technology-enabled service that increases viability and reduces risk, time, and costs for electrification-product sales, infrastructure planning, and investment at scale. It uses artificial intelligence (AI), satellite imagery, geographic information systems (GIS) data, survey data, and energy modeling to generate insights about rural villages. It can be deployed anywhere in the world to assess rural villages for their suitability for off-grid electrification, including grid extension, mini-grids, and solar products. Users include governments, development finance institutions, and companies offering electrification solutions.

VIDA is a product by TFE Energy and is supported by the European Space Agency and by appliedAI.

How it Works: Satellite Imagery, AI, and Socio-Economic Health Prediction

VIDA identifies and ranks off-grid villages across a large area of interest (AOI) and presents the results in an interactive map-based user interface (UI).

STEP 1: IDENTIFICATION OF VILLAGES

VIDA uses machine learning algorithms to identify remote villages in a user-selected area using satellite imagery.

STEP 2: EXTRACTION OF VILLAGE SELECTION FACTORS

For every identified village, VIDA automatically extracts village characteristics belonging to categories such as demographics, road and grid access, water and vegetation.

STEP 3: PREDICTION OF SOCIO-ECONOMIC HEALTH

A machine learning algorithm predicts the socio-economic health and off-grid viability factors for every village based on the extracted characteristics.

STEP 4: RANKING OF VILLAGES FOR MINI-GRID SUITABILITY

Based on the extracted village characteristics and predicted socio-economic health, VIDA scores every village. Villages in the selected geography are ranked based on this score.

The methodology is as follows:

- **Automatic identification of off-grid villages:** A set of AI algorithms automatically identifies off-grid villages in the selected AOI. This module uses daytime (visible), nightlight, and radar-based satellite imagery.

- **Extraction of village characteristics:** The second module of VIDA automatically extracts information layers (characteristics) from satellite imagery of every identified off-grid villages, such as village demographics, roads and accessibility, agricultural details, and water analyses. In total, ten to 15 quantifiable village characteristics are extracted from every identified village.

- **Prediction of socio-economic health:** VIDA uses AI algorithms and energy modeling to predict the socio-economic health of every identified off-grid village. Its AI algorithm is trained using real field data.

- **Ranking:** Based on the predicted socio-economic health of village and extracted village characteristics, VIDA predicts a score reflecting mini-grid viability. Off-grid villages in the AOI are ranked based on this score.

The output of the VIDA analysis is a "smart map" showing a list of identified off-grid villages in the selected country/region (AOI), ranked based on their viability for the development of mini-grids. Extracted data from every identified village is displayed in the map and made available to the customer.

VIDA's Analysis for this Report on Kenya

For this report, VIDA was used initially to conduct geospatial analysis and identify off-grid settlements. Apart from proprietary datasets and VIDA's machine-learning algorithms, VIDA also ingested and analyzed several publicly available datasets. These included: Gridfinder, the high resolution settlement layer from Facebook, OpenStreetMap, the Energy Access Explorer, WorldPop data, World Database on Protected Area (WDPA), and other relevant datasets from the Humanitarian Data Exchange. Before using the data for analysis, the VIDA team conducted quality-testing using triangulation and data-science techniques.

More about VIDA: www.villagedata.io
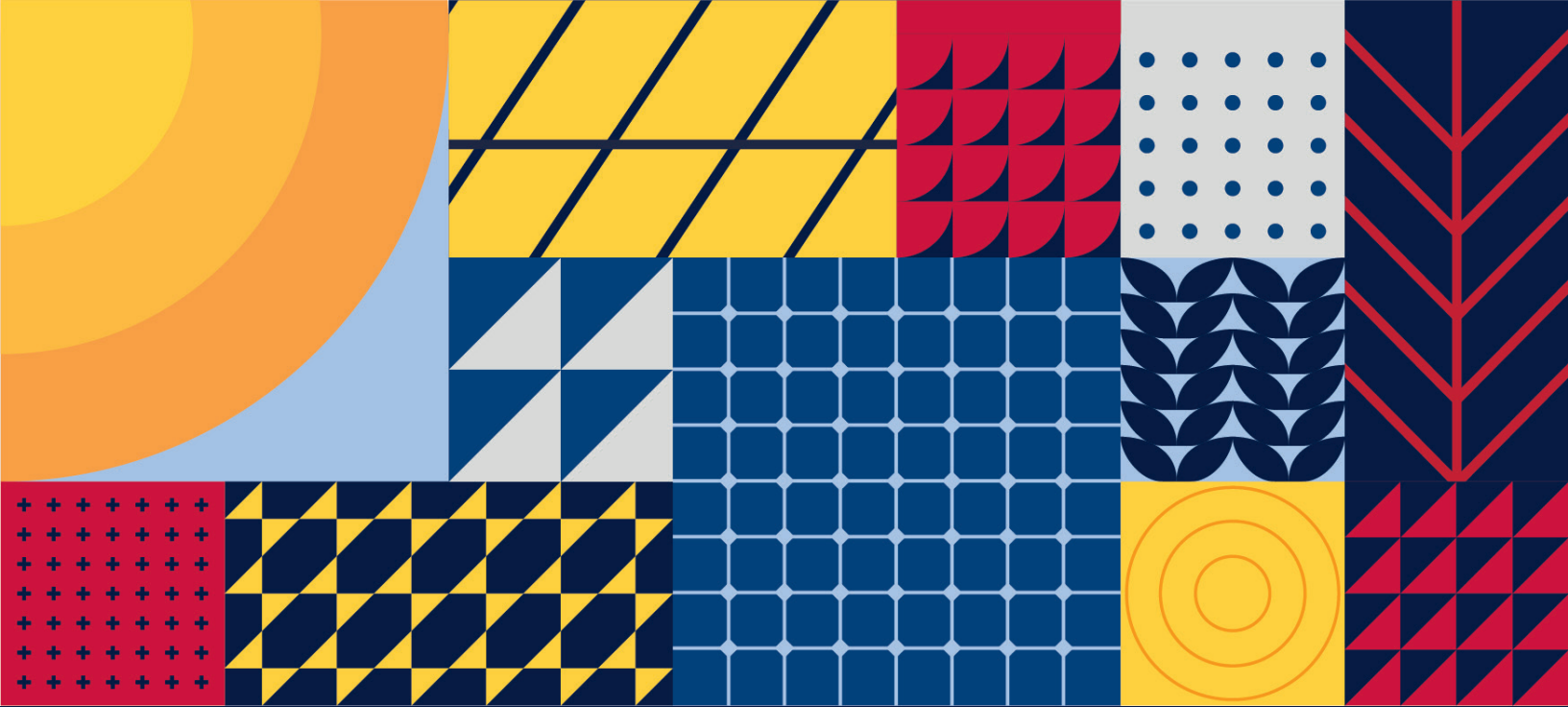
Power Africa aims to achieve 30,000 megawatts of new generated power, create 60 million new electrical connections, and reach 300 million Africans by 2030.

usaid.gov/powerafrica

PowerAfrica

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