Isiolo, Kenya ~ Photo Credit: Mercy Corps

The Resilient Approaches in Natural Rangeland Ecosystems (RANGE) Programme

Energy Landscape Analysis Summary Report

Netherlands

MERCY CORPS

FCDC

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Contents

Abbreviations

ASAL	Arid and Semi-Arid LandsA
CSO	Civil Society Organizations
DHS	Demographic Health Survey
EPRA	Energy and Petroleum Regulatory Authority
FCDC	Frontier Counties Development Council
FGD	Focus Group Discussion
GoK	Government of Kenya
ICT	Information communication Technology
KII	Key Informant Interview
KETRACO	Kenya Electricity Transmission Company Limited
KFS	Kenya Forest Services
KNBS	Kenya National Bureau of Statistics
KNDBP	Kenya National Domestic Biogas Program
KOSAP	Kenya Off-grid Solar Access Project
LAPSSET	Lamu Port-South Sudan-Ethiopia-Transport
LPG	Liquified Petroleum Gas
NGO	Non-Governmental Organisation
NPEA	Nuclear Power and Energy Agency
RANGE	Resilient Approaches in Natural ranGeland Ecosystems
REREC	Rural Electrification and Renewable Energy Corporation
SMEs	Small and Medium Enterprises
USD	United States Dollar

Technical Units

GWh	Gigawatt Hour
kVA	Kilovolt Ampere
kW	Kilowatt
kWh	Kilowatt Hour
MW	Megawatt
MVA	Megavolt Ampere
PV	Photovoltaic

Executive summary

This is the energy landscape report for the RANGE project which is being implemented by Mercy Corps in Marsabit, Samburu and Isiolo Counties.

There has been a massive gain in electricity connectivity in rural Kenya. However, majority of households in Marsabit, Isiolo and Samburu still use Kerosine and firewood for lighting and cooking. The cost of electricity connectivity remains high and unaffordable to households in the three counties under review. In addition, most manyatta settlements are sparsely distributed and are largely, temporary structures which present challenges in connecting such households. Extending the grid to remote areas with low population density is often expensive. In sparsely populated settlements, the infrastructure costs outweigh the benefits due to the small number of households served while the temporary structures are a concern for safety and efficiency.

Key demand centres in the three counties are households, institutions of health and education, SMEs and water supply projects. Use of Firewood and charcoal which leads to deforestation and loss of biodiversity as well as Kerosene, are still in high demand. Therefore, there is a need to comprehensively address cooking and lighting energy needs of the population in the three counties.

Biomass supply in the form of firewood and charcoal is largely localized within the sub- counties of the three counties under review. The scarcity of woodfuel in the three counties is raising prices of biomass fuel higher and making this source of energy for cooking less affordable to many. The woodfuel situation in the three counties is almost reaching crisis level due to unsustainable supply. It is also putting pressure on the forest cover in the remaining natural forests in the three counties under review.

In terms of renewable energy sources, Marsabit, Isiolo and Samburu have abundant resources in the form of wind and solar. Unfortunately, this study could not obtain consistent data on wind speeds and irradiation. Data in the public domain shows significant deviation and therefore very inconsistent.

There is evidence of gender specific problems in relation to roles of women and men in energy production and use including: women and girls are exposed to sexual violence during collection biomass; overburdening of women and girls resulting longer daily schedules for women /girls than men; increased exposure to smoke inhalation and indoor pollution and the risk of burns due to fires, candles and kerosene lamp use. Women and girls are generally disadvantaged in participation in energy production in terms of land ownership, natural resources, credit, information and decision making.

“In terms of renewable energy sources, Marsabit, Isiolo and Samburu have abundant resources in the form of wind and solar, with data in the public domain showing significant deviation and therefore very inconsistent.

Hereunder is the summary of key entry points for Mercy Corps to address gaps in energy demand for productive use in the three counties under review.

Wind and Solar

- Use PV and wind systems to supplement isolated grids
- Implement community micro grids
- Mainstream technical training of technicians in the communities targeted
- Provide training and technical support to local technicians for sizing, installation and maintenance
- Community awareness and sensitization on the benefits of wind and solar energy so as to enhance participation and ownership
- Facilitate installation of wind and solar PV systems for water pumping, lighting and amenity power in institutions of health and education, market centers/ settlements
- Support energy policy development and implementation.
- Support distribution of PICO solar products

Biogas

- Support development of a policy to support biogas deployment.
- Create awareness among communities on the benefits of biogas
- Initiate county biogas programme to promote individual, communal and institutional biogas digesters
- Provide training and technical support to locals in installation and maintenance of biogas
- Implement pilot projects in public institutions and facilities
- Provide financing and /or subsidies for biogas digesters
- Link residents to existing biogas programmes.(e.g. KNDBP)

Firewood/ charcoal

- Develop and implement biomass policy to safeguard depletion of woody biomass
- Support production of pellets and briquettes
- Create awareness among communities on the benefits of efficient cook stoves and charcoal kilns
- Develop and implement afforestation and reforestation programs/Support establishment woodlots
- In collaboration with KFS, support regeneration of indigenous tree species, community tree nurseries, provision of indigenous seedlings and selection of drought resistant varieties for propagation.
- Capacity building for Environment Management Committees including on effective utilization of prosopis for / and charcoal production
- Provide tree seeds and seedlings for planting at household level.
- Promote efficient cook stoves and efficient Charcoal kilns
- Training and technical support for local production of efficient cook stoves and charcoal kilns.
- Create awareness and promote LPG to reduce charcoal use

Mini-grid Electricity

- Awareness and sensitization to encourage community ownership of the mini grids
- Training of technicians to maintain systems
- Link residents to banks and micro finance institutions offering electricity loans

Kerosene

- Promote use of alternatives such as solar lanterns and LPG in households for lighting and cooking

LPG

- Create awareness on the benefits of LPG.
- Encourage substitution of woodfuel with LPG.
- Linking women residents and groups to microfinance institutions with LPG loans.

Marsabit, Kenya. ~ Josephine Kiruku (Mercy Corps)

Introduction and Background

Mercy Corps has initiated Inception Assessments for its newly launched Resilient Approaches in Natural Rangeland Ecosystems (RANGE) program. The RANGE program is a 5-year initiative implemented by Mercy Corps in Marsabit, Isiolo and Samburu counties. It aims to strengthen the resilience of communities to improve sustainable economic and social development in a well-managed landscape of the three targeted ASAL counties. RANGE proposes an integrated package of activities and interventions that will: strengthen rangeland management and encourage regenerative practices, ensuring migratory and sedentary livelihoods can peacefully co-exist; improve herd management and market access for small-scale producers; strengthen the institutions and policy frameworks that govern the livestock sector, and prioritize the development of robust spatial-temporal data sets to strengthen outcomes and help mitigate the impact of climate change and prevent further land and rangeland degradation. The assessments aim to evaluate the initial conditions and context as the program begins its implementation.

These Inception Assessments will provide contextual knowledge ensuring that program activities are tailored to the realities on the ground in the target counties. They will enable the program team and other stakeholders to make informed decisions about adapting interventions to achieve positive outcomes.

The 2022 KNBS Demographic and Health Survey (DHS) reveals a high dependence on traditional fuels for cooking[1]. In total, 68.5% of the population rely on traditional fuels such as wood, charcoal, dung, and agricultural residues for cooking and heating.[2] Firewood remains the predominant fuel for cooking, mainly in rural areas, followed by charcoal and kerosene all of which have impacts on indoor air quality.

Traditionally, pastoral communities in the three counties of assessment have relied on biomass as the primary source of energy. Wood, charcoal, and dung are extensively used for cooking and heating, leading to significant deforestation and land degradation. The Kenya Households Cooking Sector Study indicates that over 80% of the rural population in Northern Kenya depends on traditional biomass for their energy needs[3]. Energy poverty[4] is one of the key issues in the ASALs characterized by low consumption/adoption of energy from the national grid, over-reliance on dirty/polluting fuels (e.g. fossil fuels for lighting and other electrically powered services such as diesel generators for water pumping applications); long trekking distances and time wastage in search of wood fuel among others.

Despite this reliance on traditional energy sources, there has been a gradual shift towards adopting renewable energy technologies, particularly solar and wind energy. Solar lanterns, home solar home systems, and clean cook-stoves are being introduced to pastoral communities through various government and non-governmental initiatives[5].

However, the penetration of clean energy technologies remains low due to several barriers.

One significant barrier is the lack of access to clean energy technologies. Geographic isolation and inadequate infrastructure make it challenging to distribute and maintain these technologies in ASALs. Many areas are off-grid, and reaching them with modern energy solutions is logistically difficult. Additionally, the high costs of energy solutions present a significant obstacle. The initial investment required for clean energy technologies is often prohibitive for pastoral communities, who typically have low and unstable incomes. Although the long-term benefits of clean energy are substantial, the upfront costs deter adoption[6].

Moreover, limited knowledge about the benefits of clean energy hampers its adoption. Awareness and education on the advantages of clean energy solutions are scarce. Many communities are unfamiliar with how renewable energy technologies

1 Kenya Demographic and Health Survey - 2022 - Kenya National Bureau of Statistics (knbs.or.ke)
2 Kenya National Cooking Transition Strategy 2024-2028
3 Kenya_MoE-Kenya Cooking Sector Study_2019.pdf (esmap.org)
4 Energy Poverty- refers to the lack of access to modern energy services in households.

can improve their livelihoods and reduce environmental degradation. The heavy reliance on wood and charcoal also leads to over-exploitation of rangelands, exacerbating soil erosion, loss of vegetation, and reduced biodiversity. This degradation undermines the pastoral way of life, as healthy rangelands are crucial for livestock grazing.

Despite these challenges, there are significant opportunities for conservation and enhancement of rangeland health using clean energy technologies. Implementing solar- powered water pumps can provide reliable water sources for both human and livestock consumption, reducing the need to travel long distances and mitigating degradation of rangelands. Introducing biogas digesters can convert animal dung into a clean source of energy for cooking and heating, thereby reducing dependence on wood and charcoal and improving soil fertility through the use of bio-slurry as a fertilizer. Establishing community solar grids can provide a sustainable and scalable energy solution, enabling access to electricity for households and small enterprises, thereby enhancing economic activities and improving standards of living.

Women in pastoral communities play a critical role in managing natural resources and biodiversity. They are primarily responsible for collecting firewood and water, and their involvement in decision-making processes is essential for the successful adoption of clean energy technologies. Empowering women in the communities through education (including skills building) and participation in clean energy projects can lead to more sustainable and equitable energy solutions.

Climate change poses a significant threat to rangeland ecosystems in Northern Kenya. Adaptation strategies, including the adoption of clean energy technologies are crucial for mitigating these impacts. The unsustainable use of biomass energy contributes to degradation and loss of rangeland vegetation, which in turn affects the availability of forage for livestock and wildlife. Promoting clean energy technologies can therefore help preserve rangeland ecosystems and maintain biodiversity.

The degradation of rangeland ecosystems and loss of biodiversity can lead to resource scarcity, triggering conflicts over grazing land and water. Implementing sustainable energy solutions can alleviate pressure on natural resources, reduce conflicts, and promote peace and stability in pastoral areas. In conclusion, the energy landscape in the three counties is evolving, with new trends in clean energy technologies offering promising solutions to the challenges faced by pastoral communities. Addressing barriers to clean energy access, leveraging opportunities for conservation, and promoting stakeholder involvement are essential for enhancing rangeland health and supporting biodiversity. Integrating gender perspectives and considering the impacts of climate change are crucial for developing sustainable and inclusive energy strategies that benefit both people and the environment.

68.5%

population relying on traditional fuels such as wood, charcoal, dung, and agricultural residues for cooking and heating

Firewood remains the predominant fuel for cooking, mainly in rural areas, followed by charcoal and kerosene all of which have impacts on indoor air quality.

Study indicates that over 80% of the rural population in Northern Kenya depends on traditional biomass for their energy needs3.

Geographic isolation and inadequate infrastructure make it challenging to distribute and maintain clean energy technologies in ASALs.

5 KOSAP-Promotes stand a lone home systems for households. KOSAP leverages on the thriving solar homes system industry and provides incentives to companies currently operating in densely populated areas of Kenya to expand underserved counties. These services provided through portable SHS, are well suited to some of the population in the underserved counties as the households do not always live in permanent structures.

6 KII- Program Manager -EnDev project - GIZ

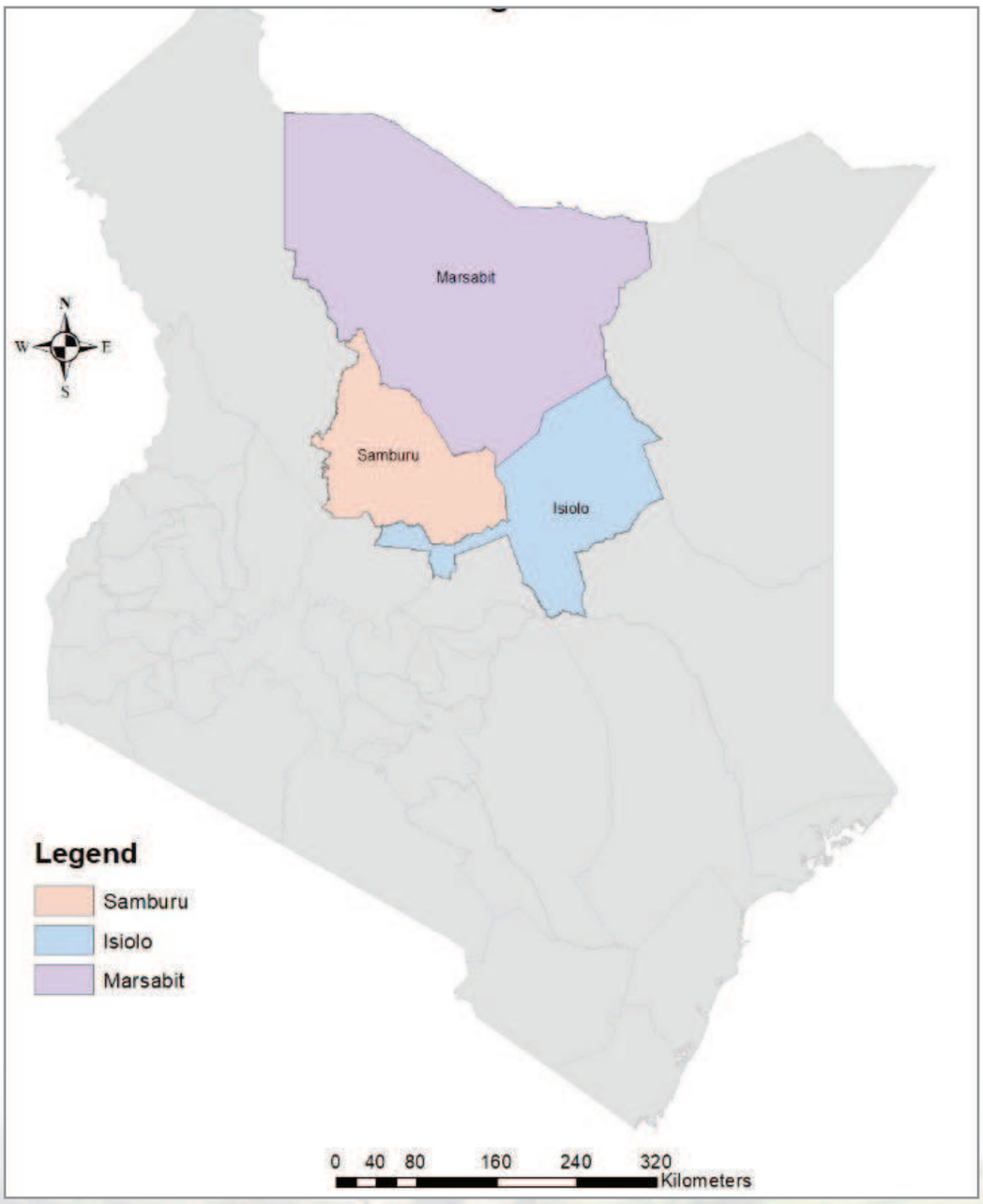
Overview of Isiolo, Marsabit, and Samburu ASAL counties

Agricultural production in Isiolo, Samburu and Marsabit includes diverse activities - livestock keeping, crop production, bee keeping and agroforestry are the main economic activity in the three Counties, the livestock keeping predominates.

Isiolo County is at the heart of Kenya, a crucial and strategic gateway between Northern and Southern Kenya. Isiolo's strategic position in Kenya has made it irresistible and attractive to local and international investors. As a result, the County is poised to become an economic giant, an industrial hub and international trading center. Samburu County has unique physiographic features that influence the County's natural resources. The natural conditions experienced within the County favour a wide array of activities ranging from tourism, to biodiversity conservation.

Marsabit County lies along the Great North Road making it easily accessible by road from Nairobi the capital city of Kenya. The County is a member of Frontier Counties Development Council (FCDC) regional economic block. The county boasts of the presence of other Kenyan communities who have settled in the county because of their employment or for purposes of doing business.

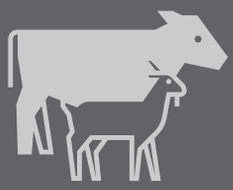
Figure 1 Map of RANGE Target Counties



268,002

population of Isiolo County according to the Kenya Population and Housing Census 2019.

Marsabit is known for its diverse ethnic communities, including the Rendille, Gabra, Borana, and Samburu.



In all three counties, pastoralism forms the backbone of the local economy, with livestock rearing being the primary livelihood for many residents.

Isiolo County, covering an area of approximately 25,336 square kilometers, is strategically positioned at the center of Kenya. It borders Marsabit County to the north, Samburu and Laikipia counties to the west, Garissa County to the southeast, and Wajir and Meru counties to the east and south respectively. The county has a population of about 268,002 according to the Kenya Population and Housing Census 2019. Isiolo's climate is predominantly arid and semi-arid, characterized by hot and dry conditions with two main rainy seasons. According to the third Isiolo County Integrated Development Plan[7], the county is characterized by three major agroecological zones: the Semi-Arid Zone, the Arid Zone, and the Severe Arid Zone, each significantly influencing vegetation, pasture availability, and livestock populations in the region. The county's geography features expansive plains and significant water bodies such as the Ewaso Ng'iro River, which is vital for local livelihoods and wildlife.

Marsabit County, the second-largest county in Kenya, spans an impressive 70,961 square kilometers. It shares borders with Ethiopia to the north, making it a key frontier region.

The county's population was approximately 459,785 as of the 2019 census. Marsabit is known for its diverse ethnic communities, including the Rendille, Gabra, Borana, and Samburu. The county's terrain is varied, featuring mountainous areas like Mount Marsabit, vast plains, and notable water bodies including Lake Turkana. Marsabit experiences erratic and unevenly distributed rainfall, leading to frequent droughts that significantly impact its predominantly pastoralist population. Marsabit County is divided into four agroecological zones: Zone III, suitable for horticultural and food crop production; Zone IV, which supports settled livestock rearing and mixed farming; Zone V, characterized by acacia woodlands suitable for small livestock; and Zone VI, primarily suitable for camel rearing due to its arid conditions

Samburu County, covering about 21,000 square kilometers, is situated in north-central Kenya. It borders Marsabit County to the north, Isiolo County to the east, and other counties including Laikipia, Baringo, and Turkana. As of the 2019 census, Samburu had a population of approximately 310,327. The county is home to diverse ethnic communities, with the Samburu people being predominant, alongside Turkana and Rendille communities. Like its neighbors, Samburu experiences an arid and semi-arid climate with hot and dry conditions punctuated by two rainy seasons. Samburu County encompasses five agro-ecological zones: Upper Highland (UH), Lower Highland (LH), Upper Midlands (UM), Lower Midlands (LM), and Inner Lowland (IL), each characterized by varying rainfall and land use potential. More than 75% of the county is classified as low-potential rangeland, receiving between 250-600 mm of rainfall annually, while only a small percentage is suitable for agricultural production, benefiting from higher rainfall levels.

The county's landscape includes vast plains, hills, and important water sources like the Ewaso Ng'iro River.

In all three counties, pastoralism forms the backbone of the local economy, with livestock rearing being the primary livelihood for many residents. However, these regions face numerous challenges, including frequent droughts, limited access to basic services, poor infrastructure, and periodic conflicts often driven by competition over scarce resources.

7 https://www.isiolo.go.ke/userfiles/media/isiolo.go.ke/23092810563465155be24961ecounty-integrated-development-plan-iii-county-government.pdf

Methodology and Research Questions

This assessment employed a comprehensive mixed-methods qualitative research approach, combining various qualitative data collection techniques and desk reviews to gain a holistic understanding of the complex dynamics in Isiolo, Marsabit, and Samburu counties. The methodology was designed to capture the multifaceted nature of the challenges and opportunities in these arid and semi-arid regions, with a particular focus on biodiversity, climate change impacts, conservation strategies, socio-economic aspects, and governance mechanisms.

The research process began with an extensive literature review, drawing from academic journals, government reports, NGO publications, and other relevant sources. This desk- based research provided a solid foundation of existing knowledge across all thematic areas, helping to identify key trends, gaps, and best practices in current programming.

Primary data collection was conducted through a combination of in-depth interviews (IDIs), focus group discussions (FGDs), and key informant interviews (KIIs) across Marsabit, Samburu, and Isiolo counties, with a gender-segregated approach to ensure balanced representation. In Marsabit 8 FGDs were conducted, segregated into 4 male-only and 4 female-only groups. In-depth interviews in Marsabit targeted at least 40% female representation, resulting in around 7 males and 5 females per ward resulting in 48 in depth interviews in the county.

Table 1 List of the wards targeted

COUNTY	SUB-COUNTY	WARD
MARSABIT	Moyale	Golbo
	Saku	Sagante/Jaldesa
	North Horr	Maikona
	Laisamis	Laisamis
SAMBURU	Samburu East	Waso
	Samburu East	Wamba West
	Samburu Central	Lodokejek
	Samburu North	Baawa
ISIOLO	Merti	Chari
	Isiolo	Burat
	Isiolo	Ngaremara
	Garba Tulla	Kinna

Samburu also saw 8 FGDs with 4 male-only and 4 female-only groups, and 12 in-depth interviews per ward with a similar 40% female target, yielding around 7 males and 5 females. Isiolo had a similar representation.

The key informants interviewed during the field data collection for the energy landscape analysis include the following:

Table 2 List of KIIs interviewed

Key informants	Number
County Directors of Energy in Isiolo, Marsabit and Samburu	3
Director Renewable Energy - Ministry of Energy and Petroleum	1
Director Clean Cooking Association of Kenya	1
Director KOSAP- Isiolo, Marsabit and Samburu	3
Director REREC - Isiolo, Marsabit and Samburu	3
Last Mile entrepreneurs - at least 2 in each county	6
Head of institutions - At least a school, A hospital and an SME	3
Program manager Energy for Development project (EnDev) GIZ	1

These qualitative methods allowed for a nuanced exploration of the complex interrelationships between the various thematic areas in the target counties. In-depth interviews were conducted with household heads or senior female members, with a quota system ensuring at least 40% female respondents to capture gender-specific perspectives. Focus group discussions were organized separately for men and women, including youth representation, to encourage open dialogue and capture diverse viewpoints. Key informant interviews targeted individuals with specialized knowledge or unique perspectives on the research topics, including government officials, community leaders, and subject matter experts.

The sampling strategy employed a purposive, non-probability approach to ensure the selection of information-rich cases across all thematic areas. This approach allowed for the capture of diverse perspectives and experiences relevant to the study's objectives. Participants were selected based on their relevance to the research questions and thematic areas, with efforts made to ensure diversity among participants in terms of demographic groups, socio-economic backgrounds, and roles within the community.

Qualitative data from interviews and focus group discussions were analyzed using thematic analysis techniques, facilitated by NVivo[8] qualitative data analysis software.

The research questions guiding this study include:

Energy Demand and Consumption

1. What are the current patterns of energy demand and consumption within the target area across different sectors (residential, commercial, industrial, transportation)?
2. How have energy demand trends evolved over time, and what are the drivers of changes in energy consumption patterns?
3. What are the current patterns of energy demand and consumption within the livestock and other agricultural value chains (production, post-production handling and marketing - both referred to as "middle value chain", end-use)?

Energy Sources and Technologies

4. What sources of energy are currently used within the target area, including fossil fuels (e.g., oil, coal, natural gas), renewable energy (e.g., solar, wind, hydroelectric), and biomass (e.g., traditional biomass, biogas)?
5. What types of green technologies (energy sources and equipment/appliances) are currently available to stakeholders for supporting livestock systems, enhancing land management practices, and mitigating climate threats?

6 What are other entry points for these green technologies to further support food systems, land/resource management, and livelihoods?

8 QSR International. (2024). NVivo (Version 14) [Software]. https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home

Drivers, Barriers, and Policy Framework

7 What are the key drivers and barriers to energy uptake and consumption in the target areas (including changes to consumption patterns)?
8 Are there any barriers or challenges hindering the adoption of clean energy technologies and investment in renewable energy projects?
9 How supportive is the policy and regulatory framework for promoting renewable energy deployment, energy efficiency measures, and decentralized energy solutions at the county level?

Environmental and Ecological Impact

10 How do energy-related activities affect local ecosystems, biodiversity, and natural resource management?

These research questions guided the data collection, analysis, and structure of this report, ensuring a comprehensive examination of the complex issues surrounding the energy landscape in Isiolo, Marsabit, and Samburu counties.

Insene Fodder Farm In Bulesa, Chari Ward. ~ Rashid Jattani Boru (Mercy Corps)

Energy Sector Review

On a national scale the main sources of energy in Kenya are wood fuel, petroleum and electricity accounting for 68.5%[9], 22%[10], and 15% [11]of total energy use respectively. Over 85 % of the population rely on traditional fuels such as wood, charcoal, dung, and agricultural residues for cooking and heating[12]. Many urban and rural poor are not reached by grid- based electrical power nor is there adequate distribution of LPG or other cooking and heating fuels. Firewood remains the predominant fuel for cooking, mainly in rural areas, followed by charcoal and kerosene all of which have impacts on indoor air quality. Despite these realities, the government's policies have tended to focus more on petroleum and electricity, with less focus on the development of the biomass energy sector.

While it is estimated that in Kenya, 76.5 %[13] of the population have access to electricity connections, over 55 % of households use kerosene-based lamps for lighting[14]. The current peak demand in Kenya for electricity is 2,056.67 MW with growth estimated at 13.5% and demand projected to reach 15 GW in 2030. To support the growth of the renewable energy sector, the Government of Kenya (GoK) has had plans to invest up to US$ 50bn over 20 years which started in 2014.

58.11% of electricity is generated using renewable energy sources which are predominantly Hydro and Geothermal with 27.24% and 30.87% respectively, while 41.89% is from other sources including wind, solar biomass as shown in the table below.

Table 3 Electricity production statistics

Energy sources	Installed capacity (GWh)	% Electricity generated
Hydro	3,348.71	27.24%
Geothermal	1,647.75	30.8%
Wind	2,052.26	14.17%
Thermal	4,953.15	21.02%
Solar	0.38	5.53%
Biomass	337.50	0.07%
Off-Grid	312.99	1.10%
Total	12,652.74	100.0%

Source: Energy and Petroleum Regulatory Authority- Energy and Petroleum Statistics report 2022

The three County are endowed with huge potential of renewable energy, especially wind and solar which remain largely untapped. Despite these resources, Marsabit is still largely powered by diesel while only parts of the main urban areas of Samburu and Isiolo are on national grid electricity. Many upcoming urban centres lack access to electricity thus inhibiting socio-economic growth.

The main source of energy in the three counties is wood fuel which is used for cooking while kerosene is used for lighting. Households also use charcoal, Kerosene and biomass residue for cooking. Despite massive gains in electricity connectivity in rural Kenya the majority of the households in Marsabit, Isiolo and Samburu still use firewood as their main source of lighting.

9 Kenya National Cooking Transition Strategy 2024-2028

10 Energy and Petroleum Statistics report 2022

11 Energy Situation Report 2022

12 https://rise.esmap.org/data/files/library/kenya/Electricity%20Access/Kenya_MoE- Kenya%20Cooking%20Sector%20Study_2019.pdf

13 https://tradingeconomics.com/kenya/access-to-electricity-percent-of-population-wb-data.html

14 Energy Situation Report 2022

Energy Demand

Key demand centres for energy in the three counties are households; institutions of health and education, SMEs and water supply schemes. Firewood and charcoal are primarily used for cooking although some households reported using firewood for lighting. Kerosene is the principal source of fuel for lighting which is extremely flammable and can cause fire, harmful to health if inhaled for a long time and harmful to the environment. Kerosene is largely accessible due to improved distribution infrastructure in the three counties.

The tables below summarise the energy end-use matrix for households, institutions and SMEs.

Energy end-use matrix for Marsabit

User Category/ Application	Cooking	Lighting	Entertainment/ ICT	Mechanical Power	Cold Storage	Water Pumping
Households **n=12**	Firewood Charcoal LPG Biogas	Firewood Kerosene Solar PV Mini grid	Dry Cells/Batteries Solar PV Diesel generator Mini grid electricity	Diesel generator Mini grid Electricity	Dry Cells/ Batteries Solar PV Diesel generator Mini grid electricity	Solar PV/ Petrol/diesel Generator sets Diesel generators mini grid electricity
Schools-Hospitals/ Health centre/ Dispensary/ county offices **n=5**	Firewood Charcoal Biogas LPG	Kerosene Solar PV Wind Electricity Diesel generator Mini grid	Solar PV Diesel generator Mini grid electricity	Diesel generator Mini grid Wind	Solar PV/Solar Mini grid Diesel generator Mini grid electricity	Solar PV/Solar Mini grid Diesel generator mini grid electricity
SMEs **n=8**	Firewood Charcoal LPG		Solar PV Diesel generator Mini grid Electricity			Solar PV Diesel generator Mini grid

Energy end-use matrix for Isiolo and Samburu

User Category/ Application	Cooking	Lighting	Entertainment/ ICT	Mechanical Power	Cold Storage	Water Pumping
Households **n=24**	Firewood Charcoal LPG	Firewood Kerosene Solar PV National Grid electricity	Dry Cells/ Batteries Solar PV Generator sets National Grid electricity	Diesel/petrol generator sets National Grid electricity	Solar PV-Diesel /petrol generator sets-National Grid electricity	Diesel/Petrol generator sets-Solar PV/ Solar mini-grids- National Grid electricity

Energy end-use matrix for Isiolo and Samburu

User Category/ Application	Cooking	Lighting	Entertainment/ ICT	Mechanical Power	Cold Storage	Water Pumping
Schools Hospitals/ Health centre/ Dispensary/ county offices **n=10**	Firewood Charcoal LPG	Kerosene Solar PV National grid electricity Diesel/Petrol Generator sets	Solar PV Diesel/Petrol generator sets National grid electricity	Diesel/petrol generator sets National grid Electricity	LPG-Solar PV Diesel/petrol generator sets National grid Electricity	Solar PV/Solar mini grids National grid electricity
SMEs[15] **n=16**	Firewood Charcoal LPG		Solar PV Diesel/Petrol generator sets National grid electricity			Solar PV/ Solar mini- grids Diesel/Petrol generator sets National grid electricity

Based on the in-depth interviews conducted, typically households both in the rural and urban settings use wood fuel either in the form of firewood or charcoal in the three counties under review. Kerosene, LPG, solar PV, petrol/diesel Gensets and the Diesel generator mini-grid in Marsabit provide energy for lighting and electrical appliances (TVs, radio, etc.).

Isiolo and Samburu are connected to the national electricity grid in the main urban and major shopping centres around the counties. Households in main urban and major shopping centres use energy from the nation's electricity grid for lighting and to power electrical appliances (TVs, radio, etc).

Across the three counties, solar mini-grids provided by development partners/NGOs or built by government agencies power boreholes, and are also used by institutions and businesses for lighting, heating, and milling, welding, entertainment and refrigeration. For example, in Samburu, the solar mini-grid built by Renewvia Solar Africa in Gurunet, serves both households, businesses and community utilities such as boreholes. In Marsabit, KOSAP has finalized the Mini-grid in South horr-Kargi ward which serves community facilities and households. In addition, ACDI/VOCA solarized water borehole in Kalacha which pumps water from a natural spring into an elevated tank that distribute water to the community waterpoint through gravity. Finally, in Isiolo, the Kenya Red Cross Society has built a micr-grid in Sericho which pumps water for households and livestock use.

Lack of a reliable source of power to provide essential services such as lighting, heating, water pumping and refrigeration is hampering the growth and development of commercial, health and education facilities. Moreover, commercialization of the livestock sector requires modernized equipment and processes and energy is a basic input in value addition and growth of cottage industries such as meat and milk processing as well as leather works.

Demand for petroleum products in the county could not be established as procurement, supply and distribution is carried out by independent private sector operators and therefore not centralised and accurately documented. Petroleum is mainly used for transport with limited volumes going to electricity generators and pumps as well as kerosene for lighting in households. Petroleum used in electricity generation at the isolated thermal plants is procured centrally by Kenya Power and Lighting Company through a tender process and delivered to the plants. With the opening-up of the counties through improved road infrastructure, the demand for petroleum is expected to grow steadily.

15 SMEs targeted in this study are enterprises employing between 5- 10 people. Examples include SMEs (e.g. Garages, carpentry, welding, shops, bars, restaurants, etc)

Energy Supply

Electricity

Urban centres and the settlements around Isiolo are connected to the national grid which received a boost through the Kenya Electricity Transmission Company Limited's (KETRACO) construction of its 132kV Meru – Isiolo project; a solution geared towards meeting the country's power demand. This project involved the construction of a 26km 132kV single circuit line from Meru substation to the new Isiolo substation with a 23MVA transformer. Generally, the project enabled extension of the transmission and distribution lines as well as new and reinforced distribution lines with the aim of reducing technical losses, stabilizing voltage conditions and thereby coping with additional demand. In addition, Kenya Off-grid Solar Access Project (KOSAP) is constructing solar mini-grids to serve as the main energy source. These solar mini-grids shall provide electricity to community facilities, enterprises and households in Badana, Eras Ha Boru, Garfasa, Kipsing, Bassa, Kombolla, Oldo nyiro, Malkadaka, Malkaghala and Rapsu.

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Similarly, main urban and shopping centres in Samburu County are on the national grid and plans are underway to develop wind turbines to generate 60 MW of electricity which will be supplied to the national grid. A part of South Horr around Gurunet has a solar mini-grid serving 1000 households which was developed by Renewvia Solar Africa. The solar power plant is connected to the community via 11 kV line and is providing clean and reliable power with the ability to expand as energy needs grow over time. Other sites which have been identified for development of solar mini-grids under KOSAP project are Barsaloi, Sereolipi, Tuum, Latakweny and Suraadoro.

Electricity supply in Marsabit is largely through isolated grids and a grid interconnection from Ethiopia. Marsabit town relies on a hybrid of wind and diesel generators owned and operated by Kenya Power and Lighting Company. At the time of this study, the wind mini-gridhad broken down and was yet to be repaired. Moyale town is connected to the electricity grid from Ethiopia with an extension of the grid to Sololo town and neighbouring markets. The County currently has 22 isolated power stations (mini grids) situated in Laisamis, Saku, Maikona and North-Horr.

It is important to note that, across the three counties, KOSAP promotes stand-alone solar systems which are distributed through Last Mile entrepreneurs such as Sun King and DLIGHT.

Biomass

Biomass energy is derived from forest formations, rangelands and agricultural residues. Wood fuel remains the highest component of household energy consumption in Marsabit, Isiolo and Samburu Counties. In addition, institutions and SMEs rely heavily on wood for their energy needs.

Marsabit County, being arid, has limited availability of biomass stocks. Major areas with woody biomass availability are the woodlands of Hurri Hills, Funan Nyata, Uran and Somare; the forests of Mt. Marsabit and Mt. Kulal which are protected but are increasingly being encroached. Other sources of biomass are found in the mountains around Sololo-Moyale escarpment and the Ol Donyo ranges. The demand for wood fuel has heavily depleted the vegetation cover around Mt. Marsabit.

In Isiolo, biomass energy is mainly sourced from Mt Kenya and Aberdare Forest. The coverage includes the rangeland vegetation and the invasive species such as prosopis juliflora. In Samburu,the biomass comes from Ndoto, Mathews Ranges, Nyiro and Lorroki forests.

The invasive species Prosopis Juriflora, locally known as 'Mathenge' is emerging as a sustainable fuelwood supply option given its increased incidence across the three counties. It is fast growing, nitrogen-fixing and tolerant to arid conditions and saline soils. Under the right conditions, prosopis can produce a variety of valuable goods and services including: construction materials, charcoal, soil conservation and rehabilitation of degraded and saline soils. It produces good quality fuel and high-quality charcoal.

Petroleum

Supply of petroleum products – diesel, petrol and LPG is exclusively through private sector businesses or individuals with their own supply chains. Supply is typically from Nairobi and is delivered in tankers and trucks to the market through various outlets found in major urban centres and towns across the County. Given the distances involved and the state of roads in the counties that currently pose logistical challenge, the three counties offer some of the most expensive petroleum fuels in Kenya. SMES and institutions in Moyale and Sololo also receive supplies from Ethiopia.

As part of the Vision 2030, the Lamu Port-South Sudan-Ethiopia-Transport (LAPSSET)Project and the Isiolo Resort City initiative, there are plans to set up a large petroleum terminal in Isiolo[16]. This and the completion of the Isiolo-Marsabit-Moyale road have contributed immensely to improving the petroleum supply chain in the Counties and beyond. Increased availability of Kerosene, diesel and LPG through an improved petroleum supply chain will be essential in addressing the basic energy needs of many residents in the counties.

As part of the Vision 2030, the Lamu Port-South Sudan-Ethiopia-Transport (LAPSSET)Project and the Isiolo Resort City initiative, there are plans to set up a large petroleum terminal in Isiolo.

16 Kenya Vision 2030

Solar technologies in the market

Households sampled in the three counties under review had heard of the solar lighting technologies and cited some of the solar lighting technologies available in the Kenyan markets. The respondents cited solar lanterns, solar torches, solar home systems-fixed and mobile solar home systems. Further, the households indicated that the solar technologies are unavailable in their local markets but are readily available from towns housing the county headquarters.

The readily available solar technologies include solar radios, solar lanterns, mobile solar homes systems and lighting bulbs. There are technicians from the dealers who are readily available to resolve technical problems with solar products and home systems. There are no local technicians to handle technical problems on solar products.

Clean cooking energy sources

While there are many clean cooking energy sources in the Kenyan market, households were only familiar with Liquified petroleum Gas (LPG). On whether they use LPG, the study noted that households especially those in the rural areas have challenges of access and could not afford the cost of refilling the cylinders and therefore are not using LPG.

Clean cooking technologies

Households sampled during the in-depth interviews know improved cookstoves as a clean cooking technology. Despite the high level of awareness of the improved cook stoves, nearly all the households sampled were still using three stones with firewood.

The study noted that there were several brands of improved cookstoves in the markets in the three counties under review. The most common brand of cookstove which the study observed were those which are promoted by Rural Electrification and Renewable Energy Corporation (REREC) to save energy and reduce the amount of firewood used during meal preparations. REREC estimates that, the stoves have fuel saving potential of at least 40% for firewood and 30% for charcoal stove[17]. The agency promotes energy saving stoves, fireless cookers and establishment of woodlots in communities in the three counties under review. It also provides training in production of liners and energy saving stoves to youth and women groups in the three counties. The pictures below are liners produced by groups REREC works with in communities in Marsabit, Isiolo and Samburu.

Picture 1 Images of linings produced by groups REREC works with in Samburu, Isiolo and Marsabit

improved cook stoves including various iterations of Kenya ceramic18 and Uhai19 cookstoves. Prices range from Ksh.350 to 600 depending on the make of the stoves. There are also other small-scale retailers that sell the improved cookstoves alongside their regular products.

17 KII-REREC County Energy Technician Samburu

Challenges accessing clean cooking

The respondents reported that there is a need to create more awareness among households in their communities to attain widespread adoption of improved cooking solutions. Further awareness creation should include information on benefits of clean cooking and technologies. There is also reluctance to pay higher prices for new products. The respondents said that: ***"While the use of traditional cookstoves contributes to issues such as harmful emissions, household air pollution, and use of excessive wood fuel, and the traditional cookstoves are still cheaper. Can we have much more cheaper ones"*** ~ FGD Laisamis

Unique challenges that have hindered the advancement of greener cooking solutions in the three counties were identified as:

Lack of awareness and affordability: There is low level of awareness on clean and efficient cooking solutions, such as LPG, biogas and bioethanol. They also face financial constraints that limit their ability to purchase or access these solutions, especially in remote areas where distribution networks are weak or non-existent.

Cultural and behavioural barriers: Households in the three counties have strong preferences for traditional cooking methods, such as the three-stone open fire, which they perceive as more convenient, reliable, and culturally appropriate. They may also resist changing their cooking habits or adopting new technologies that require different skills or maintenance. Typical households in the three counties are pastoralists. They indicated that: ***"Most of the emerging improved cooking technologies require permanent installation or minimal disturbance and therefore, they do not match our lifestyles and preferences"*** ~ FGD Wamba

Policy and regulatory gaps: The government of Kenya has committed to achieving universal access to clean cooking by 2028, but there are still policy and regulatory gaps that hamper the development of the sector. For example, ***"there is no clear definition or standard for clean cooking solutions, no specific incentives or subsidies for promoting them, and no effective monitoring and evaluation system to track progress and impact-KII*** ~ Isiolo County

Environmental and climatic factors: The three counties under review face harsh environmental and climatic conditions, such as drought, desertification, and land degradation, that affects the availability and quality of biomass fuels, such as firewood and charcoal. The harsh environmental condition such as drought leads to reduction in vegetation, soil degradation, biodiversity loss and increased soil erosion. Degraded soil loses its structure which affects quality of the linings used in improved cookstoves. These factors also pose challenges to the adoption and performance of some clean cooking solutions, such as solar cookers, biogas systems, or electric stoves, that depend on natural resources or infrastructure.

There is low level of awareness on clean and efficient cooking solutions, such as LPG, biogas and bioethanol in remote areas where distribution networks are weak or non-existent.

The three counties under review face harsh environmental and climatic conditions that affects the availability and quality of biomass fuels, such as firewood and charcoal, and pose challenges to the adoption and performance of some clean cooking solutions.

Households in the three counties have strong preferences for traditional cooking methods, and may resist adopting new technologies that require different skills or maintenance.

18 KCJ - Cookswell Jikos Limited

19 Improved Uhai Locally Produced Energy Saving Cookstove Device | Climate Chance (climate-chance.org)

Barriers of access to clean energy technologies

While the three counties are endowed with significant renewable energy resources, the respondents identified the following key challenges to the development and utilization of these resources. The challenges include but not limited to:

Table 4 Barriers of access to clean energy technologies

SOURCE OF INFORMATION	REPORTED CHALLENGES
COMMUNITY RESPONSE	Inadequate public awareness on the economic opportunities offered by renewable energy and renewable energy technologies.
	Unsustainable use of biomass with attendant negative impacts on the environment
	Widening gap between supply and demand for wood fuel.
KIIS - COUNTY REPRESENTATIVES, REREC	Inadequate data and information on potential of emerging renewable energies.
	Inadequate criteria for allocation of energy resource areas to investors especially by the national government
	Lack of clear and agreeable formula for working out national government, county government and local community benefits sharing
	Lack of a framework for management of cross-county energy resource areas.
	Lack of incentives for exploitation.
	Inadequate infrastructure and capacity for integration of intermittent power generation especially wind and solar into the national grid
	Inadequate data on biomass production and consumption
	Inadequate recognition of alternative clean modern energy sources to reduce overreliance on biomass energy source
	Poor infrastructure inhibits supply and distribution of alternative energy sources like LPG.

County policy as well as practical interventions are necessary to address these challenges in order to harness the renewable energy resources and provide sustainable energy supplies within the counties. Given that biomass supplies more than 90% of the energy in the counties and given the increased scarcity of biomass in the counties, the most important activity to enhance the planning process is the collection of detailed, accurate and comprehensive biomass data covering households, institutions and SMEs in terms of production and consumption. Policies regarding tree regeneration, production, conversion and use of biomass will need to be put in place to address the twin issues of increased demand and dwindling supplies.

Changes households wish for in their community

The respondents were very passionate about the future they would like to have with regards to energy use. The communities would want a future where they shall maximize the efficient use of both traditional and renewable energy resources, contribute to economic growth and social justice while preserving the environment.

In addition, the communities are wishing for increased access to clean cooking and lighting technologies; highly affordable clean cooking and lighting technologies and a future where all barriers to harnessing renewable energy resources and accessing clean cooking solutions are resolved.

The Gender perspective in the counties

The study noted gender specific problems in relation to roles of women and men in energy production and use including: women and girls are exposed to sexual violence during collection of biomass; overburdening of women and girls resulting longer daily schedules for women /girls than men; increased exposure to smoke inhalation and indoor pollution and the risk of burns due to fires, candles and kerosene lamp use; women are generally disadvantaged in participation in energy production in terms of ownership of land, natural resources, credit, information and decision making. In addition, time poverty- time that could be used for education or productive ventures is wasted because of the traditional role of women in production and energy use.

Other gender challenges that were reported as affecting the energy production and use include:

i. Inadequate gender responsive institutional frameworks
ii. Gender neutral energy policies, plans and budgets at the National and County Government levels.
iii. Inadequate gender responsive programs and projects.
iv. Inadequate gender sensitive monitoring and evaluation.
v. Inadequate gender disaggregated data management systems at National and County Government levels.
vi. Lack of Gender Policy in Energy at county level
vii. Inadequate access to sustainable energy resources
viii. Gender inequality in energy labour markets in exploration, generation, transmission and distribution/retail of various energy types
ix. Underrepresentation in energy-related technical education at tertiary level and universities, with disproportionately higher male enrolments than females

Impact of energy-related activities on local ecosystems, biodiversity, and natural resource management

Discussions with key informants revealed that energy related activities in the three counties under review may lead to the following negative impacts:

Habitat destruction and fragmentation: Energy infrastructure in the three counties such as solar mini-grids and wind farms often require large pieces of land. This leads to habitat destruction and fragmentation, which disrupts local wildlife and plant species.

Climate change: There is high use of kerosene for lighting households in the rural areas of the three counties under review. There is also high penetration and utilization of motorbike transport in the three counties under review and the motorbikes use petroleum products to power the engines. In addition, vehicular transport is also available in the counties which also uses fossil fuels. The use of fossil fuels releases greenhouse gases, contributing to global warming and climate change. This may alter ecosystems, affect species distribution and increase frequency of extreme weather events.

Renewable energy impacts; While renewable energy sources like wind and solar are generally more environmentally friendly, they are not without impacts. Wind turbines can pose threats to birds and large solar farms disrupt local land use and ecosystems.

Deforestation and resource depletion: Production of cookstoves relies on use of firewood or charcoal in the kilns leading to deforestation in areas where these materials are harvested. Furthermore, extraction of raw materials for cookstoves production can deplete natural resources and disrupt local ecosystems. Digging of soil used in making linings can degrade land and destroy habitats. Overharvesting of soil can lead to soil erosion and loss of biodiversity.

Kenya Energy Policy

How supportive is the energy policy

The Energy Act 2019, is to ensure affordable, competitive, sustainable, and reliable supply of energy at the least cost to achieve the national and county development needs, while protecting and conserving the environment for inter-generational benefits.

Just like the RANGE program, the policy through various documents is focused on promotion of renewable energy, universal energy access, clean cooking and development and promotion of bioenergy and Energy efficiency.

Key highlights of the Act that promote increased use of renewable energy and enhanced energy access include:

a. Setting up sector entities with expanded mandates to develop and regulate the energy sector. These include Energy and Petroleum Regulatory Authority (EPRA), Energy and Petroleum Tribunal (Tribunal), Rural Electrification and Renewable Energy Corporation (Corporation) , Nuclear Power and Energy Agency (NPEA)
b. Vesting of Rights over Renewable Energy Resources and geothermal energy to the national government to manage and develop them for the benefit of all Kenyan people and not just the regional county governments and communities where the resources are located.
c. Payment of royalties for Extraction of Geothermal Resources to be shared by three key stakeholders -the local communities 5%, the county government 20% and the national government 75%.
d. Preparation of Renewable Energy Resources Inventory and Resource Map by the government through the Ministry of Energy & Petroleum to reduce the burden on prospective investors of conducting exploratory and feasibility studies.
e. Net-Metering to allow consumers to supply any excess capacity to the grid. Any licensed distributor or retailer must make available a net metering service to a consumer upon request.
f. The Renewable Energy Feed-in-Tariff-System (FiT) anchored in the Act providing further legislative backing the 'Feed-In-Tariffs Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity' (FiT Policy) developed by the Ministry of Energy in 2008. The FiT is intended to encourage the generation of energy from renewable sources and its supply through localized distribution networks. It is also intended to encourage the uptake and innovation of renewable energy technology and in sum to help reduce the greenhouse gas emissions and Kenya's reliance on non-renewable energy sources.
g. Penalize electricity suppliers and compensate consumers for unwarranted power outages or for the provision of irregular or poor-quality electricity which leads to damage to consumers' property, financial losses and even loss of life.
h. Requirement that county governments together with the relevant state agencies develop county energy plans to be used to develop the integrated national energy plan to be reviewed every 3 years.

In addition to aligning the energy regulatory framework in Kenya to the global energy landscape, the new pieces of legislation are intended to: create increased competition; enhance the investment environment for grid, off-grid and micro-grid projects; and create a platform for achieving the Government development initiatives

Opportunities for CSO engagement

CSOs in Kenya have continued to support and work in partnership with Ministry of Energy to provide data, advice on policy formulation and demonstrated solutions to secure last-mile energy solutions including overcoming barriers for investment and on inclusive energy service planning and delivery. key entry points for CSO influencing at both at national and county level include:

The development of the Energy Policy and Integrated Energy Plan at county and national levels.

Engagement with the National Energy Entities especially the Rural Electrification and Renewable Energy Corporation (REREC).

Participation in the establishment of, and engagement with the Renewable Energy Resources Advisory Committee.

Support for capacity building of county and national technical staff on planning and implementation as well as policymakers within the County Government to develop and enact policies and regulations that will accelerate access to modern energy services.

County Energy Legal Frameworks

The three counties have developed energy Acts which are largely aligned to the national energy policy to guide the development of the energy sector within the counties. The Acts highlight the obligations of the county government to facilitate the provision of affordable and uninterrupted supply of energy to all citizens in all areas of the counties. The key policy objectives under the Acts include:

(a) ensure uninterrupted supply of energy to the Counties;
(b) promote diversity of supply of energy and its sources;
(c) facilitate effective management of energy demand and its conservation;
(d) promote energy research;
(e) promote appropriate standards and specifications for the equipment, systems and processes used for producing, supplying and consuming energy;
(f) ensure collection of data and information relating to energy supply, transportation and demand;
(g) provide for optimal supply, transformation, transportation, storage and demand of energy that are planned, organized and implemented in accordance with a balanced consideration of security of supply, economics, consumer protection and a sustainable development;
(h) provide for certain safety, health and environment matters that pertain to energy;
(i) facilitate energy access for improvement of the quality of life of the people
(j) commercialize energy related technologies;
(k) ensure effective planning for energy supply, transportation and consumption; and
(l) Contribute to sustainable development of the County's economy.

The Acts mandates the government in the three counties to facilitate and fund as necessary the provision of affordable energy services even where such services are established to be uneconomical or commercially inexpedient. In undertaking to provide affordable energy services, the County government shall support the development and use of modern and efficient emerging technologies.

The Acts further obligates the Member of the executive committee for energy to develop and on an annual basis review, publish and gazette on an annual basis an Integrated Energy Plan (IEP)

The Acts mandates the government in the three counties to facilitate and fund as necessary the provision of affordable energy services even where such services are established to be uneconomical or commercially inexpedient.

to address issues of generation, supply, transformation, transport, storage and demand for energy within the energy sector and integrated development plans of sub-counties and villages.

The development of the IEP shall consider sustainable development; optimal use of indigenous and regional energy resources; balance between supply and demand; economic viability; environmental, health, safety and socio-economic impacts and developmental requirements of the National Government. The IEP is to serve as a guide for energy infrastructure investments, take into account all viable energy supply options and guide the selection of the appropriate technology to meet energy demand.

The three counties' Energy Bills and the national energy policy are aligned. The County Energy Bills are cognizant of the energy supply constraints within the county and broadly outlines objectives to ensure effective planning, supply and transformation of energy. Given the scarcity of woodfuel in the counties, opinion leaders, planners and residents reinforced the need to manage woodfuel flows especially out of the counties. In order to reduce the reliance on wood fuel, the Counties should sensitise the public on the benefits of the use of biomass as opposed to wood fuel. It was also noted that the improved road infrastructure is beginning to open the Counties to woodfuel and charcoal exports despite there being scarcity. Controls including road block checks should be instituted to ensure that no biomass exports in the form of charcoal and wood occur. A biomass non- export policy should be put in place to protect the environment from further degradation.

Marsabit, Kenya. ~ Josephine Kiruku (Mercy Corps)

Recommendations Samburu , Marsabit and Isiolo

With a rapidly growing population, there is need to look at sustainable provisions of biomass for domestic and industrial use. Processing of agricultural residues to solid biomass fuels is becoming an increasingly important path for moving towards circular economies and cascading use of biomass. Pellet and briquette production should be promoted together with their appropriate appliances - stoves and boilers.

The project should promote establishment of woodlots to increase afforestation and avail Biomass for use in energy efficient cooking appliances which reduces the amount of biomass used in cooking and reduce pollution.

In the implementation of the RANGE project, MC should partner with KOSAP and REREC to provide technical support in training and increase adoption of clean cooking and lighting solutions.

MC to promote management of the invasive species Prosopis Juriflora locally known as 'Mathenge' which is emerging as a sustainable fuelwood supply option given its increased incidence across the three counties. It is fast growing, nitrogen-fixing and tolerant to arid conditions and saline soils. Under the right conditions, prosopis can produce a variety of valuable goods and services including: construction materials, charcoal, soil conservation and rehabilitation of degraded and saline soils. It produces good quality fuel and high-quality charcoal.

Deepening market access through LME linkages: The LMEs are in response to a lack of product distribution channels and offer direct access and or linkage to end-users of clean cooking and lighting solutions. With the existence of few LMEs in Marsabit, Samburu and Isiolo marketplace, there is need for a dynamic and effective last mile distribution network to reach most households in the areas targeted by RANGE project.

Local production of stoves and increased range of fuel offering: To overcome the clean cooking challenge, the project need to support the stoves and fuels supply chains by developing a local production facility for cost competitive stoves that still meet the quality standards outlined by KIRDI and through the introduction of higher tier stoves and new fuels streams – LPG (which was later dropped), Ethanol and pellets//briquettes.

There is need to create awareness of the various lighting technology available in the market and work with the LMEs to supply products which fits the lightening needs, attitudes and habits of households in RANGE project target areas.

Mercy Corp should support and work in partnership with Ministry of Energy to provide data, advice on policy formulation and demonstrated solutions to secure last- mile energy solutions including overcoming barriers for investment and on inclusive energy service planning and delivery. key entry points for MC influencing at both at national and county level include:

a. The development of the Energy Policy and Integrated Energy Plan at county and national levels.
b. Engagement with the National Energy Entities especially the Rural Electrification and Renewable Energy Corporation (REREC).
c. Participation in the establishment of, and engagement with the Renewable Energy Resources Advisory Committee.
d. Support for capacity building of county and national technical staff on planning and implementation as well as policymakers within the County Government to develop and enact policies and regulation. Particularly, the development of Energy policy in the three counties.

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