REPUBLIC OF KENYA

MINISTRY OF ENERGY
AND PETROLEUM

COUNTY GOVERNMENT OF TAITA TAVETA

DIRECTORATE
OF ENERGY

TAITA TAVETA COUNTY ENERGY PLAN 2024–2033

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ACTS
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Technical Support

SETA
Sustainable Energy Technical Assistance

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Table of Contents

List of Tables

List of Figures

List of Acronyms, abbreviations and symbols

AC	Alternating Current
ABC	African Biodigester Component
AD	Anaerobic Digestion
ADPs	Annual Development Plans
BAU	Business-As-Usual
BCC	Behaviour Change Communication
CAPEX	Capital Expenditure
CBO	Community Based Organization
CEC	County Executive Committee
CECM	County Executive Committee Member
CEP	County Energy Plan
CEPC	County Energy Planning Committee
CETC	County Energy Technical Committee
CFLs	Compact Fluorescent Lamps
CGTT	County Government of Taita Taveta
CHP	Combined Heat and Power
CIDP	County Integrated Development Plan
CO_2	Carbon dioxide
DC	Direct Current
ECDE	Early Childhood Development and Education
EE&C	Energy Efficiency and Conservation
EPC	Electric Pressure Cooker
EPRA	Energy and Petroleum Regulatory Authority
FAO	Food and Agricultural Organization
FiT	Feed-In-Tariff
FW	Firewood
GCF	Green Climate Fund
GCP	Gross County Product
GDC	Geothermal Development Company
GDP	Gross Domestic Product
Genset	Generator set
GEOSIM	Geospatial Simulation Model
GHGs	Green House Gases
GHI	Global Horizontal Irradiation

GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GJ	Gigajoule
GoK	Government of Kenya
GSA	Global Solar Atlas
GWA	Global Wind Atlas
HAP	Household air pollution
HC	Health Center
H. E.	His Excellency
HH	Household
ICS	Improved Cookstove
ICT	Information Communication Technology
IEA	International Energy Agency
IEBC	Independent Electoral and Boundaries Commission
INEP	Integrated National Energy Plan
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
Kcal	Kilo Calories
KCAP	Kenya Country Action Plan
KCJ	Kenya Ceramic Jiko
KDHS	Kenya Demographic Health Survey
KenGen	Kenya Electricity Generating Company
KEREA	Kenya Renewable Energy Association
KES	Kenya Shillings
KETRACO	Kenya Electricity Transmission Company
KFS	Kenya Forest Service
kg	kilogram
KIIs	Key Informant Interviews
km	kilometre
KNBS	Kenya National Bureau of Statistics
KNECCS	Kenya National Efficiency and Conservation Strategy
KNES	Kenya National Electrification Strategy
KOSAP	Kenya off-grid Solar Access Project

KPLC	Kenya Power and Lighting Company
KS	Kenya Standard
kV	kilovolt
kWh	kilowatt-hour
KWS	Kenya Wildlife Service
LCEP	Least Cost Electrification Plan
LCOE	Levelized Cost of Electricity
LCPDP	Least Cost Power Development Plan
LCV	Low Calorific Value
LED	Light Emitting Diode
LFGC	Landfill Gas Capture
LMCP	Last Mile Connectivity Project
LN	Legal Notice No.
LPG	Liquefied Petroleum Gas
LV	Low Voltage
M&E	Monitoring and Evaluation
m^2	Square metre
m^3	Cubic metres
MEC	Modern Electric Cooking
MEPS	Minimum Energy Performance Standards
MoE	Ministry of Energy
MoEP	Ministry of Energy and Petroleum
MJ	megajoule
MRF	Materials Recovery Facility
MPs	Members of Parliament
MSME	Micro-, Small and Medium-sized Enterprises
MSW	Municipal Solid Waste
MV	Medium Voltage
MVA	megavolt-amperes
MW	megawatt
MWh	megawatt-hour
NDMA	National Disaster Management Authority
NEMA	National Environment Management Authority
NGOs	Non-governmental Organizations
NMT	Non-Motorized Transport

NPV	Net Present Value
NTSA	National Transport and Safety Authority
NuPEA	Nuclear Power and Energy Agency
OPEX	Operating Expenses
PAYG	pay-as-you-go
PPAs	Power Purchase Agreements
PPP	Public Private Partnership
PV	Photovoltaic
PVOUT	PV Power Output
PWD	Persons Living with Disability
REA	Rural Electrification Authority
REREC	Rural Electrification and Renewable Energy Corporation
SCH	Sub-County Hospital
SDG	Sustainable Development Goals
SEACAP	Sustainable Energy Access and Climate Action Plan
SEforALL	Sustainable Energy for All
SEP	Slum Electrification Project
SETA	Sustainable Energy Technical Assistance
SHS	Solar Home System
SLF	Sanitary Landfill
SMEs	Small and Medium-sized Enterprises
SNV	Stichting Nederlandse Vrijwilligers
SPV	Special Purpose Vehicle
SWH	Solar Water Heating
TSOF	Three-Stone Open Fire
TTI	Technical Training Institute
USB	Universal Serial Bus
USD	United States Dollar
VAT	Value-added tax
VTC	Vocational and Technical College
W	Watt
W2E	Waste to Energy
WHO	World Health Organization

Definition of Technical Terms

Improved Cookstove (ICS) — There is no universally accepted definition of an improved cookstove. However, despite the variations in definition, ICS designs aim to achieve either or a combination of fuel efficiency, reduced emissions, and enhanced safety in usage, relative to traditional stoves.

Traditional Stoves — The two main traditional stoves referred to in this document are the three-stone open fire and the metallic charcoal stove.

e-Cooking — Refers to cooking with electricity. The main electric stoves include ordinary electric hotplates, electric pressure cookers (EPC), and electric induction cookers.

Bellerive Institutional Stove — A popular stove used in institutions. It consists of a cylindrical metallic frame with a stainless-steel inner surface. The fire chamber is made of bricks, and the stove is equipped with a chimney.

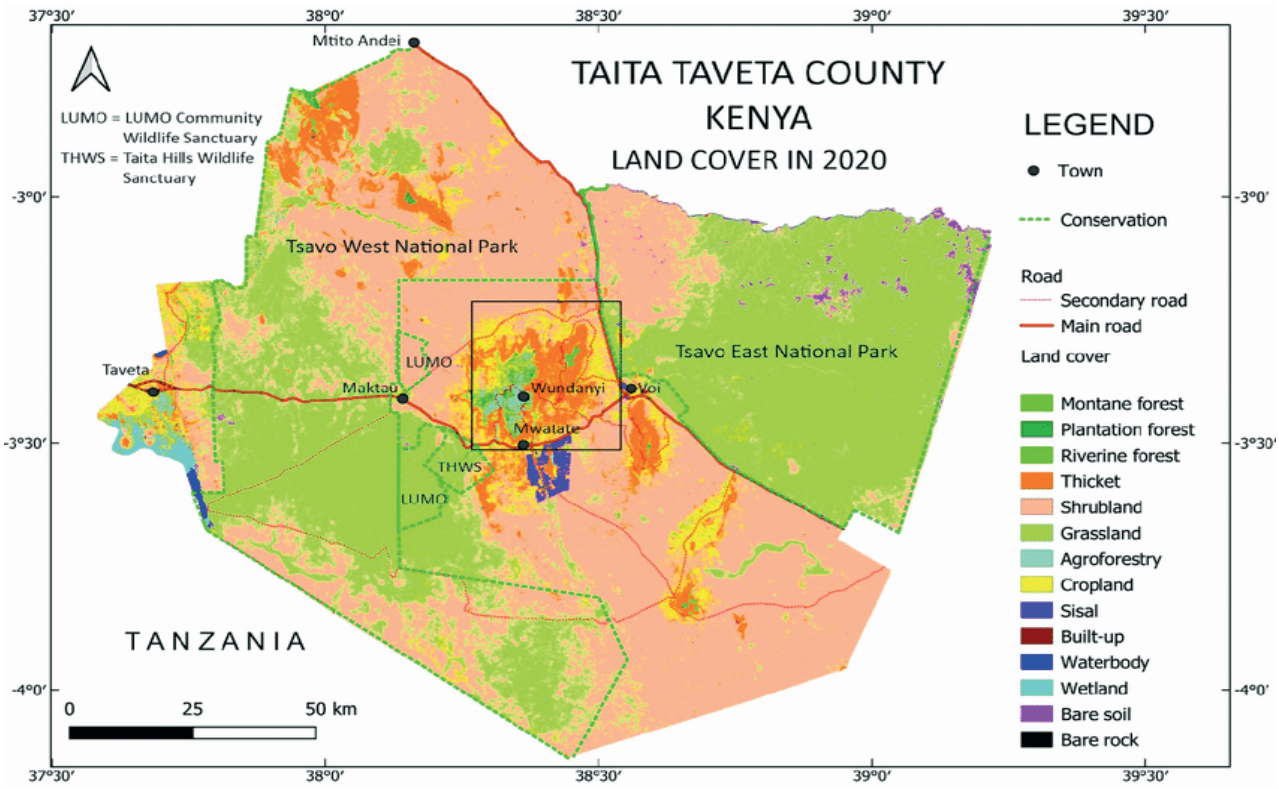
Grid Extension — Entails extending the grid network to areas without grid coverage.

Grid Densification — Achieved by installing additional transformers on existing medium-voltage lines to connect housing clusters within 600 metres of existing distribution transformers.

Grid Intensification — Achieved by extending short (up to 2 km) medium-voltage lines and adding transformers to connect more consumers.

Mini-Grids — Consist of electricity generators and energy storage systems connected to a distribution network. They provide electricity to a localised group of customers who are not served by the interconnected national power grid.

MISSION AND VISION



County Energy Plan Vision

A county that has access to clean sustainable reliable and affordable energy for social economic development and improved livelihoods for all.

County Energy Plan Mission

Empowering our county towards a sustainable future through strategic energy planning, fostering efficiency, promoting renewables, and ensuring resilience for generations to come.

FOREWORD

It is with great pleasure and a sense of purpose that I introduce the County Energy Plan (CEP) for Taita Taveta County, covering the period from 2024 to 2033. This document represents a significant milestone in our collective efforts to address the energy needs of our county and to chart a sustainable path forward. This plan also aligns with my manifesto pledge to the residents of Taita Taveta County, focusing on promoting and investing in renewable energy—particularly solar and wind energy, partnering with stakeholders in the development of small hydro-power stations, promoting the use of energy-saving cooking stoves for all rural households, encouraging the uptake of domestic solar power systems by subsidising the installation costs for low-income earners, and investing in public participation and training on modern energy conservation measures to save money, time, and protect the environment.

The CEP is a testament to our commitment to fulfilling the mandates outlined in these foundational documents. It embodies months of collaboration and consultation with stakeholders representing various sectors, including county and national government, development partners, state agencies, and non-governmental organisations.

As we embark on the implementation of this Plan, we are guided by a vision of ensuring universal access to clean, reliable, and affordable energy for all residents of Taita Taveta County. Through strategic investments, innovative approaches, and a focus on sustainability, we aim to transform the energy landscape of our county and unlock new opportunities for growth and development.

I would like to extend my sincere gratitude to all those who have contributed to the development of this Plan. Your dedication, expertise, and commitment have been instrumental in shaping this document and laying the foundation for our energy future.

As we progress, let us continue to collaborate across sectors and boundaries to actualise the vision delineated in this Plan. Embracing an open-door policy, I extend a heartfelt invitation to partners, stakeholders, donors, and private firms to consider Taita Taveta as their premier destination for investing in energy-related projects. Together, we possess the capacity to forge a brighter and more sustainable future for Taita Taveta County.

H. E. ANDREW MWADIME
Governor
Taita Taveta County

PREFACE

This plan was crafted in accordance with the Constitution of Kenya 2010, which decentralised certain roles of the national government to counties, including energy planning. Additionally, it adheres to the Energy Act of 2019, which provides the framework for the development of county energy plans to be integrated into the Integrated National Energy Plan (INEP).

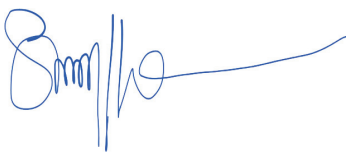
Furthermore, other devolved energy functions include energy regulation and licensing, the promotion of renewable energy, extending last-mile connectivity to rural and underserved areas through rural electrification programmes, energy efficiency and conservation initiatives, and capacity building and training efforts.

The rationale behind devolving the energy planning process lies in the recognition that, historically, this process was centralised at the national level, often overlooking the diverse energy needs, resources, and potentials of each region. Consequently, significant portions of the country were neglected in these plans, resulting in an inequitable distribution of energy resources and investments nationwide.

This comprehensive plan incorporates input from all four sub-counties—Voi, Mwatate, Wundanyi, and Taveta—accurately reflecting the diverse energy access levels across our county. The inclusion of community perspectives ensures that the plan captures the true essence of our county's energy landscape. This authenticity is further reinforced by baseline surveys conducted among households, public facilities, and Small and Medium-sized Enterprises (SMEs), highlighting the current energy access status and identifying existing gaps.

The formulation of the Taita Taveta County Energy Plan comes at a crucial juncture. Currently, the absence of an energy policy has adversely impacted the promotion of energy investments within our county. Moreover, as we embark on the development of our County Integrated Development Plan (CIDP III 2023–2027), integrating the proposed energy programmes and activities for the next five years is imperative. By having this plan in place, we anticipate a significant boost in energy investments within our county, positioning us as one of the leaders in energy security.

In my capacity as the County Executive Committee Member (CECM) responsible for this directorate, and chair of the County Energy Planning Committee (CEPC), I am committed to mobilising all available resources, both locally and through partnerships, to ensure the meticulous implementation of this plan. Our overarching goal is to meet the national target of universal access to clean cooking energy and electricity by 2028, thereby enhancing the quality of life for all residents of Taita Taveta County.



HON. ARCH MARTIN TAIRO MASEGHE
CECM—Department of Public Works, Infrastructure, Housing and Energy
Taita Taveta County

ACKNOWLEDGEMENT

First and foremost, as the county government of Taita Taveta, we wish to extend our sincere gratitude to the Sustainable Energy Technical Assistance (SETA) team, led by Jechoniah Kitala, in collaboration with other esteemed institutions, including the Ministry of Energy and Petroleum (MoEP) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Kenya, along with all other partners who generously funded and actively participated in this comprehensive process since its inception in 2021. We deeply appreciate the decision to include our county among the pioneering few to develop their county energy plans.

Secondly, we wish to express our heartfelt gratitude to all the stakeholders within our county, as well as other county departments such as health, water, education, agriculture, livestock, environment and climate change, mining, and economic planning. Additionally, we extend our appreciation to key state agencies, including the Kenya Power and Lighting Company (KPLC), the Rural Electrification and Renewable Energy Corporation (REREC), the Kenya Off-grid Solar Access Project (KOSAP), the National Environment Management Authority (NEMA), the Kenya Forest Service, and many others for providing essential data and information, which has been integral to the formulation of this County Energy Plan document.

We are also thankful for the invaluable contributions of non-governmental agencies such as Mercy Corps, represented by project assistant Ms Millicent Mghoi, the Food and Agricultural Organization (FAO), Taita Biogas, and civil society organisations like the Taita Taveta Human Rights Watch, led by Haji Mwakio. Their effective community mobilisation and engagement efforts have ensured comprehensive representation of all communities, capturing their perspectives and feedback in this document.

Lastly, we would be remiss not to acknowledge the commendable efforts of our consultant, Mr James Gatimu, who worked tirelessly to ensure that all relevant information regarding our county's energy needs was thoroughly documented and presented.

Collectively, these partners and stakeholders have played a pivotal role in the development of a reputable County Energy Plan that aligns with our county's energy requirements.

EXECUTIVE SUMMARY

Energy access is a critical prime mover that propels socio-economic development. It serves as a cornerstone for advancing progress across various sectors essential for human well-being. At the household level, energy access directly influences the quality of life, enabling essential activities such as cooking, heating, and lighting. In healthcare, energy plays a pivotal role in enhancing services by powering medical equipment, providing refrigeration for vaccines and medicines, and supplying electricity for lighting in health facilities. In the education sector, energy facilitates learning by providing lighting for study, powering electronic devices, and supporting the integration of Information Communication Technology (ICT) into learning activities. Additionally, energy is indispensable for agricultural activities, including irrigation, processing, and storage, thereby contributing to food security and livelihood enhancement. With regard to water access and sanitation systems, energy is needed for pumping, purification, and reticulation, ensuring clean and safe water for communities. In essence, energy access provides the foundation for socio-economic development, driving progress and prosperity across all facets of human existence.

The Energy Act of 2019 (section 5 and the 5th schedule), the INEP framework, and the draft Energy regulations of 2023 provide for integrated energy planning, where county governments are required to prepare County Energy Plans (CEPs). These plans will be forwarded to the Cabinet Secretary for Energy and consolidated into one national integrated plan, guiding the implementation of energy projects and programmes in the country. The CEPs will guide the implementation of energy projects in the county for 10 years and will be reviewed every 3 years on a rolling basis.

This County Energy Plan for Taita Taveta County has been developed to comply with these requirements while also providing a roadmap for mainstreaming energy access issues into the county's development agenda. Its contents have been informed by detailed baseline data analysis and extensive stakeholder consultations. Although the plan is meant to cover a 10-year period, it was agreed, through the deliberations of the County Energy Technical Committee, to tie the energy access projects, to the extent possible, to the life of the current CIDP, which is CIDP3. As such, most projects are scheduled to run from 2024 to 2028. However, a few projects, notably the least-cost electrification planning and clean cooking for households, are structured to continue until 2030 and 2033, respectively. In line with INEP regulations, this plan will be due for review in 2028.

The document is structured into eight primary chapters, each addressing specific aspects of the county's energy landscape and development objectives.

Chapter 1 is an introduction. It captures the process of developing this document, explores the modalities of integrating the CEP with CIDP3, provides a high-level overview of the county's development and demographic indicators, and examines the energy access profile. It also reviews the national and county-level policies and regulations relevant to energy planning.

Chapter 2 takes stock of the county's energy resources. Specifically, the chapter delves into wood fuel, agricultural residues, livestock population and the feasibility of biogas generation from livestock waste, municipal solid waste, and hydro, solar, and wind resources.

Chapter 3 focuses on energy access. It has two subtopics: electricity access and access to clean cooking services. Under the electricity access component, the focus is on households, educational institutions, health facilities, agri-based facilities, irrigation, water access, and the mining sector. The plan documents the status of electricity access and proposes interventions to achieve universal electricity access. Regarding access to clean cooking services, the focus is on households, educational institutions, health facilities, and mining sites.

Chapter 4 focuses on energy efficiency and conservation, outlining various measures aimed at promoting efficiency across households, buildings, industries, and transportation. The Energy Act of 2019, sections 193, 194, 195, and 196, has given county governments a broad mandate to champion Energy Efficiency and Conservation (EE&C) matters in the county. Section 193 mandates the county governments to take all necessary measures to promote the efficient use of energy and its conservation in buildings, industries, and households.

Chapter 5 delves into bioenergy resources, highlighting various aspects such as the potential for biogas generation from livestock waste for household use, the potential for biogas generation from human waste for institutional applications, the potential for harvesting landfill gas from sanitary landfills at main dumping sites, and bioethanol fuel.

Chapter 6 documents the projects and programmes needed to achieve the energy access objectives detailed in Chapters 3, 4, and 5. The realisation of these objectives will require concerted efforts and unity of purpose across the national government, county government, development partners, and the private sector. To facilitate clarity and accountability, the projects are categorised according to the implementing agency responsible for their execution.

Chapter 7 presents the implementation, coordination, monitoring, and evaluation framework. This section outlines the mechanisms and structures required to execute, coordinate, and assess the progress of the energy plan. It delineates roles, responsibilities, and monitoring protocols to ensure effective implementation and the attainment of set targets.

Finally, Chapter 8 provides the conclusion. A key recommendation is the need to bolster manpower capacity within the energy department for the successful implementation of the CEP and the achievement of its objectives. There is also a need to prepare a policy framework upon which the implementation of this plan will be anchored. It is envisioned that the CEP will inform future Annual Development Plans (ADPs: 2024–2025, 2025–2026, 2027–2028) and will ultimately propel energy access matters into the heart of the county's development agenda.

Chapter 1: INTRODUCTION

1.1 Background

The Constitution of Kenya (2010) established 47 counties and instituted a framework that, for the first time in the country's history, devolves some energy planning and administrative functions to the sub-national level. This is expected to lead to a more equitable sharing of resources, increased participation in energy planning at the sub-national level, and targeted investments, particularly in areas that have historically been neglected. These diverse functions devolved to county governments are enumerated in Chapter 11 and the Fourth Schedule of the Constitution. The Energy Act (2019) builds on the provisions of the Constitution and provides details of this new structure under Sections 5, 193, 194, 196, 199, 222, and the Fifth Schedule. Section 5, Sub-section 3 states that "each County Government shall develop and submit a county energy plan to the Cabinet Secretary in respect of its energy requirements."

The objective of the county energy plan is to develop a socially inclusive energy supply infrastructure that gives all residents sustainable access to energy for their various needs. This planning will also help identify environmentally sound and climate-friendly technologies and resource options for providing energy access, alongside associated investment opportunities.

1.2 Process of developing the County Energy Plan (CEP)

Inception Workshop

The process of developing this CEP has been deliberately inclusive. It began with a two-day inception workshop in Voi on 18th and 19th July 2022. During this event, it was explained that the Ministry of Energy and Petroleum (MoEP), with support from the European Union, was implementing the SETA project. The SETA project aimed to build the capacity of counties and government agencies on energy planning. Through this project, the County Government of Taita Taveta would be supported to develop its CEP in line with Section 5 and the Fifth Schedule of the Energy Act (2019), which obligates county governments to develop CEPs. Upon completion, the CEPs are to be forwarded to the national government for consolidation into one Integrated National Energy Plan (INEP), which will guide the implementation of energy projects and programmes in the country. In addition to the energy department, other nexus departments represented at the meeting included agriculture, livestock, water, health, education, public works, housing and infrastructure, lands, physical planning, mining, climate change, and environment. During this meeting, key informant interviews with relevant county departments and non-state actors such as Energy 4 Impact and Taita Taveta Artisanal Miners Association were also conducted.

Literature Review

A thorough and coordinated review of all existing and relevant national and county government plans, strategy documents, laws, policies, and project reports was undertaken. Specifically, the following documents were reviewed: the County Integrated Development Plan (CIDP) for 2023–2027, the Annual Development Plan (ADP) for 2024–2025, relevant county laws and policies, the Kenya Population and Housing Census (2019), the Kenya Demographic and Health Survey (2022), the Energy Act (2019) and its subsidiary legislation, the National Energy Policy (2018), the INEP framework, the Kenya National

Efficiency and Conservation Strategy, the Kenya National Electrification Strategy, the Kenya Bio-energy Strategy, project reports, and published academic work. This exercise enabled a deep understanding of the legal and policy frameworks underpinning energy planning in general and their implications for county energy planning. Furthermore, through this literature review, it was possible to gain insights into demographics, energy access levels, proposed plans, and allocated budgets. All this information was crucial in building a solid contextual foundation on the county's existing energy access situation.

Baseline Surveys

To better understand the energy access landscape, two baseline surveys were conducted: one targeting households and the other targeting ward administrators. These surveys provided critical insights into energy access issues, including main energy sources, consumption levels, and energy budgets. The household survey specifically delved into aspects such as the primary sources of energy used for cooking, lighting, and heating, as well as energy consumption levels and associated budgetary considerations. It also explored factors influencing energy choices and preferences among households, such as socio-economic status, geographical location, and cultural norms. On the other hand, the ward administration survey offered valuable insights into energy access developmental needs at the grassroots level. This feedback was instrumental in identifying solutions for various energy access needs, as detailed in this document.

Cooperation with Nexus Sectors

A concerted effort was made to comprehensively understand the energy requirements of the nexus sectors, recognising their pivotal role in the energy planning process within Taita Taveta County. Identified as key stakeholders in energy consumption and service provision, these sectors are crucial to ensuring that energy access needs are accurately profiled and effectively integrated into the county's energy plan. Five nexus sectors were identified: agriculture, health, education, water access, and mining. Tailored data collection templates were crafted and disseminated to gather insights into the unique energy demands of each sector. Through diligent data collection, baseline information was obtained and rigorously analysed to derive critical insights. This collaborative effort ensures that the CEP transcends conventional boundaries, embodying inclusivity and a comprehensive understanding of energy access needs across various sectors. By adopting this broad-spectrum approach, the CEP emerges as a dynamic and responsive document poised to address the multifaceted energy challenges facing the county and paving the way for applicable energy solutions that cater to the diverse needs of its unique context.

Community Engagement Forums

This activity was designed to fulfil the constitutional requirement of ensuring public participation at both the planning and implementation stages. Taita Taveta community engagement forums were held in May and August 2023 in Voi, Mwatate, Taita, and Taveta sub-counties. These forums provided a platform to interrogate the needs and expectations of local communities, especially through the lens of energy access and its role in driving socio-economic development. Feedback from these sessions varied, but revolved around energy poverty in households, the agricultural sector (notably the role of energy in enhancing the shelf life and market value of perishable agricultural produce), water pumping (e.g. smallholder farmers in Taveta Sub-county spending significant amounts on petrol and diesel to run water pumps), health, education, and the mining sector. This feedback has been crucial in shaping the interventions proposed in this document.

Solutions Validation Workshop

Through the activities discussed above, several energy access issues were prioritised. This prioritisation was based on identified energy access needs across different nexus sectors and the prescription of the INEP framework regarding the chapters that should feature in the CEP document. Based on these considerations, the following priorities were adopted: electricity access, clean cooking, agriculture (crops, livestock, and fisheries), health, water access, education, mining, biofuels, and energy efficiency and conservation.

In response to the identified energy access needs, gaps, and barriers, a series of appropriate solutions were developed and organised into programmatic, policy, and regulatory interventions around the priorities listed above. These solutions were crafted to address the diverse challenges and opportunities inherent in the county's energy landscape. From 23rd to 26th January 2024, a meeting with the County Energy Technical Committee (CETC) was held in Voi. This meeting provided a platform to deliberate upon and validate the proposed solutions, fostering collaborative dialogue and collective input from key stakeholders. The meeting offered an opportunity to scrutinise the solutions, leveraging the expertise and insights of CETC members to enrich and refine the proposed interventions. Through rigorous discussion and constructive engagement, the solutions were refined to align more closely with the county's unique context and aspirations, setting the stage for effective implementation and impactful outcomes in advancing energy access and sustainability across the county.

1.3 Integration of CEP into CIDP

Ideally, the CEP should have preceded CIDP 3. However, now that both documents have been finalised, it will be important to harmonise the two going forward. It is noted that CIDP 3 has earmarked and allocated budgets for several energy access projects. For example, there are budgets for increasing the number of households using alternative energy from 15% in the first year to 35% in the fifth year, improving the utilisation and distribution of renewable energy, transitioning households using clean cooking solutions from 30% in the first year to 70% in the fifth year, supporting charcoal producer associations, modernising fish demonstration centres, constructing fish markets and aggregation centres, supporting artisanal and small-scale mineral exploration, procuring sanitary landfills, and increasing energy efficiency. It is envisioned that the implementation of the CEP will leverage the already earmarked projects and continue to inform future Annual Development Plans (ADPs: 2024–2025, 2025–2026, 2027–2028) and ultimately mainstream energy access matters into the county's development agenda.

1.4 County Overview and Energy Profile

1.4.1 Location and Size

Taita Taveta County is one of the six counties located in the coastal region and is approximately 200 km northwest of the coastal city of Mombasa and 360 km southeast of Nairobi, the capital city of Kenya. The county covers an area of 17,084.1 km², with 10,649.9 km² (62.3%) being within Tsavo East and Tsavo West National Parks. The county borders Kitui, Makueni, and Taita Taveta counties to the north; Kilifi and Kwale counties to the east; Kajiado County to the northwest, and the Republic of Tanzania to the south. The county lies between longitude 37°36' east and 30°14' east, and latitude 2°46' south and 4°10' south.

The county covers a total area of 17,084.1 km², with 10,649.9 km² (62.3%) being within Tsavo East and Tsavo West National Parks, providing a major tourism destination. Water bodies within the county occupy 106 km², comprising Lakes Jipe and Chala in Taveta Sub-county. The rest of the area is spread across public and private land, such as ranches. Sisal estates and hilltop forests occupy less than 100 km².

1.4.2 Demographic Features

The projected 2022 population of the county stands at 360,000, with a gender split of 51% male and 49% female. The population density per km² in the county ranges from 6 persons in rural areas to more than 900 persons in urban areas. The population distribution is influenced by cultural heritage, rainfall, and terrain. The main ethnic groups in the county include Taita, Taveta, Kamba, Maasai, Luo, Kikuyu, and Somalis.

Table 1: Population Projections by Sub-County and Sex

Sub-County	2019 Base Population				2022 Projections				2025 Projections				2027 Projections			
	Male	Female	Inter-sex	Total	Male	Female	Inter-sex	Total	Male	Female	Inter-sex	Total	Male	Female	Inter-sex	Total
Taveta	47,410	43,812	0	**91,222**	50,170	46,310		**96,480**	51,981	47,983		**99,964**	53,737	49,604		**103,341**
Wundanyi	28,386	27,573	0	**55,949**	30,110	28,930		**59,040**	31,198	29,974		**61,172**	32,251	30,987		**63,238**
Mwatate	41,426	40,231	2	**81,659**	44,064	44,336		**86,400**	45,655	43,865		**89,520**	47,197	45,347		**92,544**
Voi	56,115	55,711	5	**111,831**	59,158	58,922		**118,080**	61,294	61,050		**122,344**	63,365	63,112		**126,477**

(Source: Taita Taveta's CIDP 3)

1.4.3 County Socioeconomic Status

According to CIDP 3, the main economic activity in the county is crop farming, with food crops and cash crops being cultivated. The total acreage under food crops is 44,787.85 acres, and 8,144.59 acres are under cash crops. The main food crops are maize, beans, rice, green grams, and bananas, while the main cash crops are macadamia, avocados, assorted vegetables, mangoes, sisal, and French beans.

The monetary poverty rate for Taita Taveta is 32%, which is slightly below the national rate of 35.7%, with approximately 109,061 people in the county being monetarily poor. Taita Taveta has a multidimensional poverty rate of 40%, which is 8 percentage points higher than the monetary poverty rate, with a total of 136,647 people being multidimensionally poor.

When disaggregated by age groups, 32% of children in Taita Taveta are multidimensionally poor, 20 percentage points lower than the national average of 52.5%. Among the youth, 42% are multidimensionally poor compared to a national average of 48.1%, while for the elderly population, 42% are multidimensionally poor compared to a national average of 55.7%.

Among children aged 0–17, the core drivers of multidimensional poverty are nutrition (58%), housing (54%), information (29.5%), and water (23.2%). For youth aged 18–34, the core drivers of multidimensional poverty are education (54.3%), housing (53.4%), nutrition (42.3%), and economic activity (38.2%). Among adults aged 35–59, the core drivers of multidimensional poverty are education (60.8%), economic activity (66.7%), housing (53%), and nutrition (42.7%). Among the elderly aged 60+, the core drivers of multidimensional poverty are nutrition (64.7%), housing (62%), education (48%), and water (28.8%).

1.4.4 Energy Profile

Based on GIS analysis conducted during the development of the LCEP, which is discussed in detail in Chapter 3, as of 2023, 66% of households, representing about 67,000 households, are connected to the national grid. Encouragingly, the county has good grid network coverage, as 93% of households are within connection distance of an existing transformer.

According to the household survey conducted in 2023, firewood and charcoal are the predominant fuels used for cooking by 71% and 24% of residents, respectively. Additionally, 74% of residents use a three-stone open fire to burn firewood. Encouragingly, there is a good uptake of charcoal improved cookstoves.

1.5 Policy and Regulatory Framework

1.5.1 National Level Policies and Regulations

The enabling environment for County Energy Planning is anchored in the Constitution of Kenya, 2010. Under the Fourth Schedule, the Constitution distributes roles between the national and county governments. Part 1 of the Fourth Schedule provides that the national government shall be responsible for energy policy, including electricity and gas reticulation, and energy regulation. Part 2 provides that county governments shall be responsible for county planning and development, including electricity and gas reticulation, and energy regulation. It is clearly observed that energy is a concurrent function of both the national and county governments. Furthermore, sustainable development is one of the national values and principles of governance that all state organs, state officers, public officers, and all persons are required to observe as stipulated under Article 10 (2)(d). It is thus imperative that County Energy Planning ensures environmental sustainability and is integrated and mainstreamed into all development action planning. In addition, Article 60 (c) of the Constitution calls for the sustainable and productive management of land resources (including energy).

Constitution of Kenya 2010

The Constitution has enhanced the protection and enforcement of fundamental rights, among other gains. It provides for a two-tier structure of government, i.e., the national and county governments. It distributes functions and powers between the two levels, as detailed in Chapter Eleven and the Fourth Schedule.

Part 1 of the Fourth Schedule provides that the national government shall be responsible for:

a. Protection of the environment and natural resources with a view to establishing a durable and sustainable system of development, including water protection, securing sufficient residual water, hydraulic engineering, and the safety of dams;
b. Energy policy, including electricity and gas reticulation and energy regulation; and
c. Public investment.

In relation to the energy sector, Part 2 of the Fourth Schedule provides that the county government shall be responsible for planning and development, including electricity and gas reticulation, and energy regulation.

The Energy Act, 2019

The Energy Act 2019 is a revised edition of the Energy Act 2006. The revision was necessitated by the need to align the Energy Act 2006 to the 2010 Constitution. The 2010 Constitution ushered in two levels of governance: the National Government and the County Governments. The Energy Act 2019 consolidates the laws relating to energy and aligns the legal and regulatory framework of the energy sector with the Constitution of Kenya, 2010. It does this by clearly setting out the specific roles of the National and County Governments in relation to energy.

Public Private Partnerships Act, 2013

Under the Public Private Partnerships Act, a contracting authority that intends to finance, operate, equip, or maintain an infrastructure facility or provide a service may enter into a project agreement with any qualified private party for the financing, construction, operation, equipping, or maintenance of the infrastructure, development facility, or provision of the service of the government in accordance with the provisions of this Act.

A contracting authority shall, prior to entering into public-private partnership arrangements, pursuant to section 19, undertake a sector diagnostic study and assessment covering the following:

a. Technical issues;
b. Legal, regulatory, and technical frameworks;
c. Institutional and capacity status;
d. Commercial, financial, and economic issues; and
e. Such other issues as the Cabinet Secretary may stipulate.

Part VI, under project identification and selection of a private party, clearly states that all procurement must be through a competitive bidding process: “Except as otherwise provided for under this Act, all projects shall be procured through a competitive bidding process.” In procuring and awarding a contract to a private party under this Act, counties must be guided by the principles of transparency, free and fair competition, and equal opportunity, in accordance with the guidelines made under this Act.

The County Governments Act, 2012

The County Governments Act, 2012 states that a county government shall plan within a framework that integrates economic, physical, social, environmental, and spatial planning and protects and develops natural resources in a manner that aligns with national and county government policies. Environment and climate change are functions of both national and county governments, requiring concurrent jurisdiction across both levels.

Energy Regulations

A number of regulations are in place to enhance the adoption of energy access, energy efficiency, and renewable energy (RE) in Kenya. These include:

Electricity Regulations

a. The Electric Power (Electrical Installation Work) Rules, 2006,
b. The Energy (Complaints and Dispute Resolution) Regulations, 2012
c. The Energy (Electricity Licensing) Regulations, 2012
d. Kenya Green Code

Renewable Energy Regulations

a. The Energy (Solar Photovoltaic Systems) Regulations, 2012
b. Designation of Energy Users Gazettement
c. The Energy (Energy Management) Regulations, 2012
d. The Energy (Solar Water Heating) Regulations, 2012
e. Charcoal Rules, 2009.
f. Biogas Regulations (Draft)
g. Improved Biomass Cook Stove Regulations, 2012 (Draft)
h. The Energy (Biodiesel Licensing) Regulations, 2009 (Draft);
i. Kenya Mini-grids Regulatory Framework (under development)
j. Feed-In-Tariff (FiT) Policy

Petroleum Regulations

a. The Energy (Gasohol Blending) Regulations, 2010
b. The Petroleum (Amendment—No 2) Rules, 2003 — LN 197
c. The Petroleum (Amendment) Rules, 2002 — LN 31
d. The Petroleum (Amendment) Rules, 2000 — LN 64

e. The Energy (Petroleum Regulation Levy) (Amendment) Regulations, 2008 (August) – LN
f. The Energy (Liquefied Petroleum Gas) Regulations, 2009
g. The Energy (Importation of Petroleum Products) (Quota Allocation) Regulations, 2010
h. The Energy (Minimum Operation Stock) Regulations, 2008
i. The Energy (Strategic Stock) Regulations, 2008
j. LPG Policy 2015 (Draft)
k. The Petroleum (Exploration, Development and Production) Act, 2015
l. Model Production Sharing Contract
m. The Petroleum Act No. 2 of 2019
n. The Local Content Bill, 2018

Other Policies, Laws, and Regulations Influencing Clean Energy

a. National Climate Change Action Plan
b. The Climate Change Act, 2016

Strategic and Planning Documents

a. Kenya Vision 2030
b. County Integrated Development Plans
c. Kenya Sustainable Energy for All (SE4All)
d. Least Cost Power Development Plan (LCPDP)
e. Rural Electrification Master Plan
f. Kenya Country Action Plan (KCAP), 2013

1.5.2 County Level Energy Policies and Legislations

Taita Taveta Climate Change Policy

The overall goal of this policy is to ensure that climate change is mainstreamed in the economically and socially vulnerable sectors of the economy and to steer the county towards a climate-resilient, blue economy and green development pathway.

Some of the policy objectives related to energy access include:

- Promote renewable energy technologies such as solar, biogas, and improved stoves at the household level;
- Increase investment in the use of renewable energy;
- Promote the use of renewable energy in the agricultural sector;

- Promote agroforestry practices to increase tree cover and provide domestic energy;
- Promote futuristic building design with green technology for self-sufficiency and installation of solid and liquid waste disposal management in public sector and commercial buildings;
- Create awareness of the use and benefits of solar energy in reducing greenhouse gas (GHG) emissions and shifting to energy-saving appliances;
- Review building codes to incorporate green technology and the use of biodegradable construction material;
- Enhance the use of renewable energy to run buildings' appliances;
- Encourage low-emission transport by constructing walkways and cycling lanes;
- Foster energy-efficient buildings, towns, and industries, e.g., solar lighting, energy-saving bulbs, and solar water pumps; and
- Promote tree planting in compounds and renewable energy use.

Taita Taveta County Climate Change Act, 2022

The Act establishes the legal framework for implementing the climate change policy. Specifically, it creates the County Climate Change Directorate, the County Climate Change Steering Committee, and the County Climate Change Planning Committee. It also establishes the County Climate Change Fund.

Chapter 2: COUNTY ENERGY RESOURCES

2.1 Wood Fuel

Forest Cover

According to the Kenya Forest Service (KFS) Voi office, there are 25 gazetted forests in the county, occupying a total of 1,310.14 hectares. An additional 29 forests, with a total area of 5,072.7 hectares, have been proposed for gazettement. The main tree species include indigenous shrubs, Newtonia, Albizia, pine, cypress, wattle tree, prunus, eucalyptus, etc. The current tree cover stands at 8%. The figure below depicts the county's land cover as of 2020.

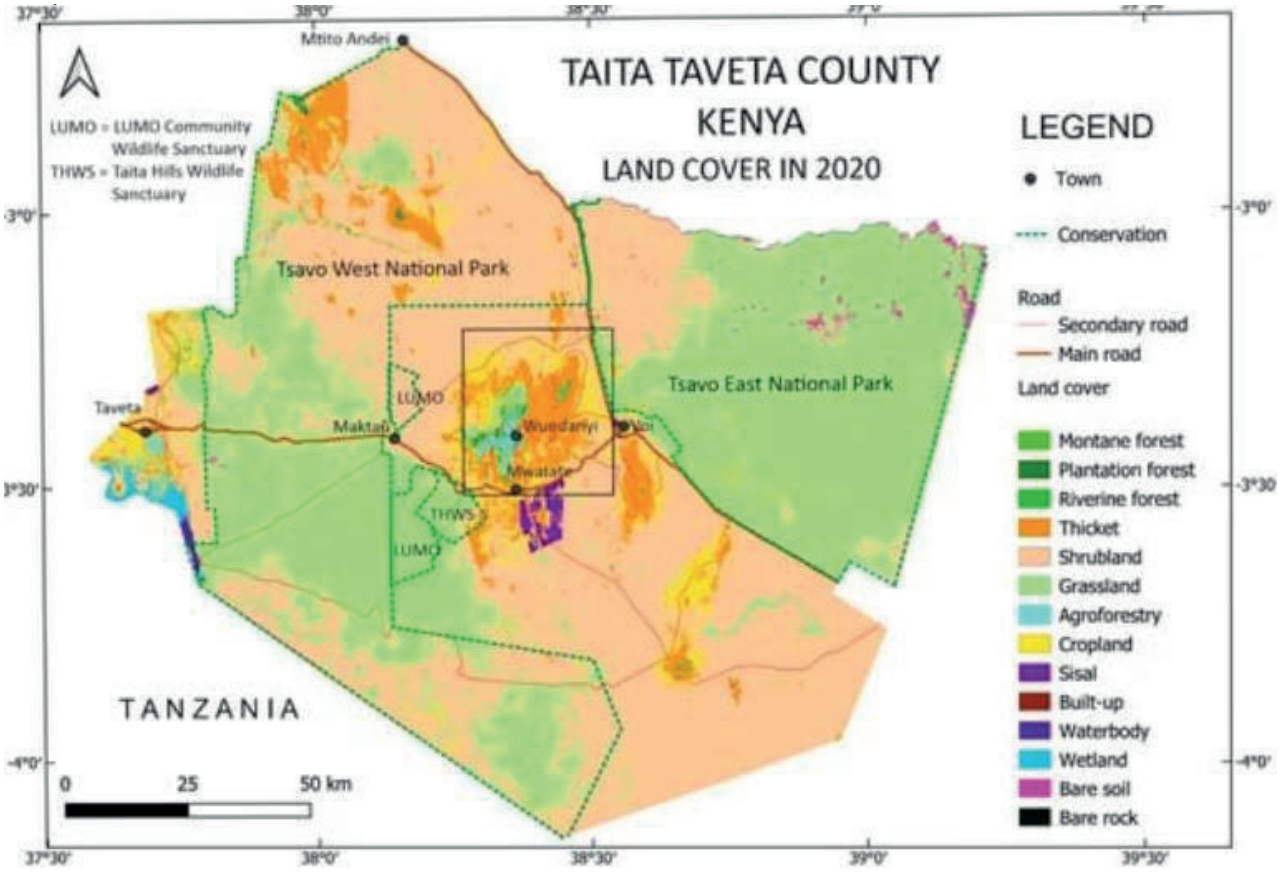


Figure 1: County's Land Cover

2.2 Agricultural Residues

Sisal estates and hilltop forests occupy less than 100 km². The sisal plantations in the county generate about 7,952 tons of sisal fibre annually. According to Konyo et al. (2023), the sisal fibre produced through the decortication process accounts for only 4–6% of the total crop weight, with the remainder being sisal

waste. This translates to around 176,711 tons of sisal waste annually. However, all this waste is ploughed back as manure during planting.

The total acreage under food crops is 44,787.85 acres, and 8,144.59 acres under cash crops. The main food crops are maize, beans, rice, green grams, and bananas, while the main cash crops are macadamia, avocados, assorted vegetables, mangoes, sisal, and French beans. However, most of the field-based crop waste from these crops is used as animal feed and feedstock for compost manure.

2.3 Livestock Population and Biogas

Table 2: Livestock Population in the County

County/Sub-County	Farmers	Exotic cattle–Dairy	Exotic cattle–Beef	Indigenous cattle	Sheep	Goats	Camels	Donkeys	Pigs	Indigenous Chicken	Exotic Chicken–Layers	Exotic Chicken–Broilers	Beehives	Rabbits	Fishponds	Fish Cage
Mwatate	16,123	2,634	331	4,422	1,436	7,021	7	480	62	9,776	209	135	498	362	49	1
Taita	12,139	3,762	473	2,684	2,216	2,989	2	590	29	7,372	261	140	440	464	85	6
Taveta	14,591	527	134	5,155	2,367	7,211	16	247	28	8,803	135	81	414	466	85	12
Voi	14,067	970	150	4,330	1,171	7,291	38	211	29	8,609	290	285	505	263	43	8
Total	**56,920**	**7,893**	**1,088**	**16,591**	**7,190**	**24,512**	**63**	**1,528**	**148**	**34,560**	**895**	**641**	**1,857**	**1,555**	**262**	**27**

(Source: KNBS 2019)

Livestock farming is a crucial aspect of agricultural livelihoods in Taita Taveta County, contributing significantly to the local economy and food security. According to the 2019 census data, the county has a diverse array of livestock populations, comprising both exotic and indigenous species across various sub-counties. The total number of farmers stands at 56,920, rearing cattle, sheep, goats, camels, donkeys, pigs, and poultry.

Mwatate emerges as a prominent hub for livestock rearing, with sizable populations of exotic cattle, sheep, goats, camels, and poultry. The sub-county boasts a total livestock population of 26,875 and a total of 16,123 farmers. Taita, Taveta, and Voi sub-counties also have significant livestock populations, with Taita housing 20,982 livestock reared by 12,139 farmers, while Taveta has a total of 25,170 animals and 14,591 farmers. Voi has 23,637 livestock and 14,067 farmers.

Livestock population in a household is a key parameter used in evaluating the potential for adopting biogas technology. Water access, education level, income levels, exposure to information, access to credit, distance to firewood sources, and farmland size are other factors instrumental in determining the likelihood of a household adopting biogas technology (Shallo, Ayele & Sime 2020). While the livestock population data provides valuable insights into the county's agricultural landscape, it presents limitations in assessing the potential uptake of biogas technology. The absence of information on livestock distribution per household impedes a precise estimation of households with the propensity to adopt biogas technology.

In this regard, the county Directorate of Livestock assisted by providing data on a profile of farmers with potential to adopt this technology. Drawing upon their deep understanding of the county's agricultural landscape and extensive interactions with the farming community, the Directorate identified a total of 19,016 farmers. By targeting these farmers with tailored interventions—such as information dissemination, access to finances, training programmes, and incentives—the county can facilitate a significant uptake of biogas technology. This data is presented in the table below.

Table 3: Farmers with Potential to Uptake Biogas Technology

Sub-County	No. of farmers without biogas systems & have sufficient livestock (a)	No. of farmers with potential to uptake biogas (50% * a)
Taita	5,362	2,681
Mwatate	4,720	2,360
Voi	13,975	6,988
Taveta	13,975	6,988
COUNTY GRANT TOTAL	**0**	**19,016**

(Source: County Department of Livestock)

2.4 Municipal Solid Waste

According to the County Directorate of Environment and based on a previously conducted feasibility study, there are two dumpsites where municipal waste from major towns and municipalities is accumulated. These are Chakaleri dumpsite, which serves Voi Municipality, Mwatate Municipality, Wundanyi town and its environs, and Riata dumpsite, which serves Taveta Municipality. The monthly and annual waste outputs are shown in the table below.

Table 4: Municipal Solid Waste at Chakaleri and Riata Dumpsites

Dumpsite	Waste Source (Municipality/Town)	Monthly Generation (Tonnes)	Annual Waste Quantities (Tonnes)
Chakaleri	Voi Municipality	1,920	51,120
	Mwatate Municipality	1,410	
	Wundanyi Town	930	
Riata	Taveta Municipality	1,590	19,080
Total		**5,850**	**70,200**

(Source: County Department of Environment)

2.5 Hydropower

Taita Taveta has a hydropower potential of 1–3 MW along its border with Makueni County, i.e., to the north of Tsavo West National Park. As indicated by the spots on the map, River Sabaki (Galana) provides potential for hydropower generation along the northern border of Taita Taveta.

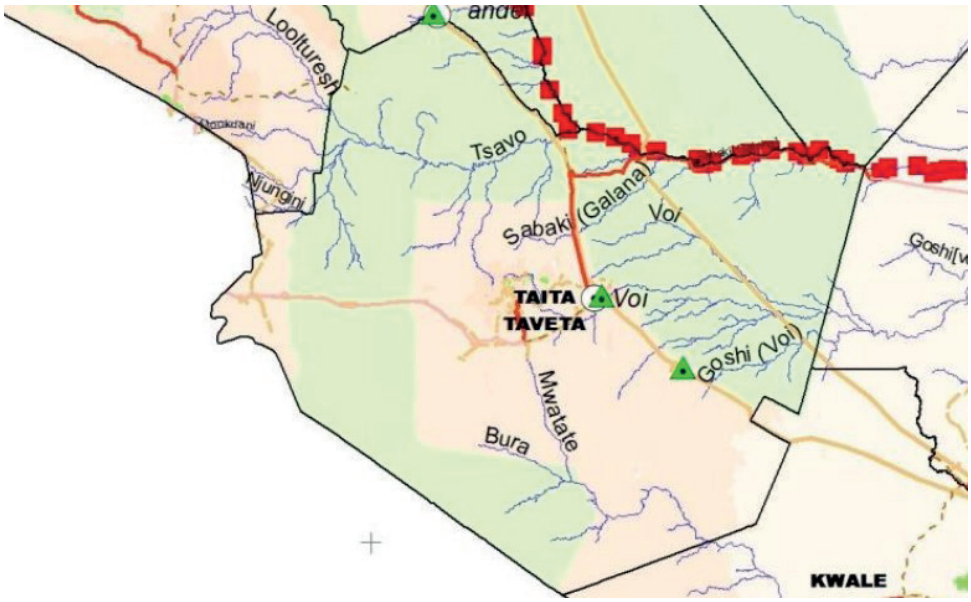


Figure 2: Taita-Taveta Hydropower Distribution 1–3 MW

Hydropower potentials of about 0.5 to 1 MW are scattered within the northern parts of Taita-Taveta County, along the Tsavo River to the northwest and towards River Sabaki in the northeast. These potential areas are within Tsavo National Park.

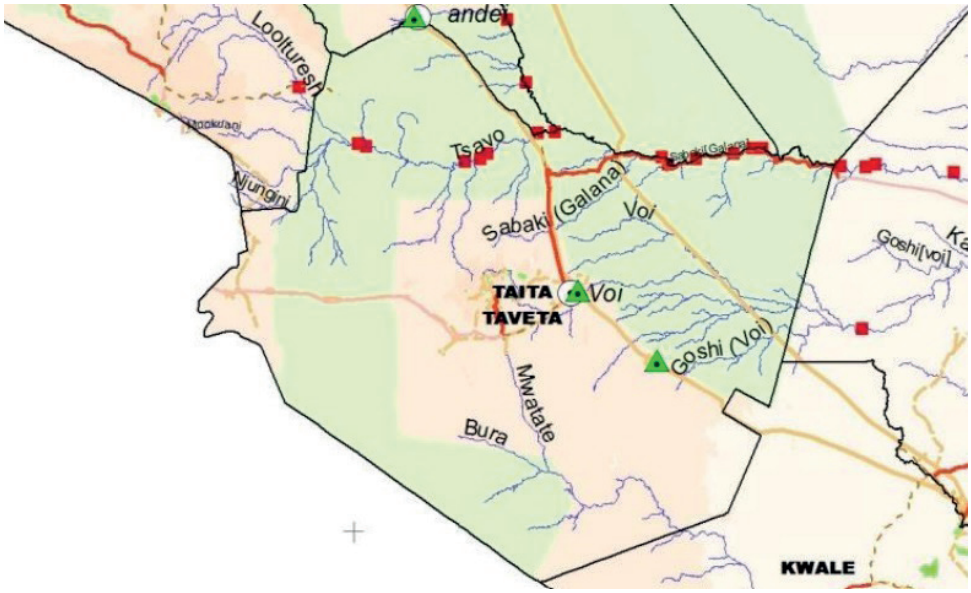


Figure 3: Taita-Taveta Hydropower Distribution 0.5–1 MW

Numerous spots with hydropower potential of 0.1 to 0.5 MW are distributed along the borders of Taita Taveta County. Several potential sites are located along the Tsavo River in the northern parts of the county, as well as in the sub-counties of Voi and Mwatate.

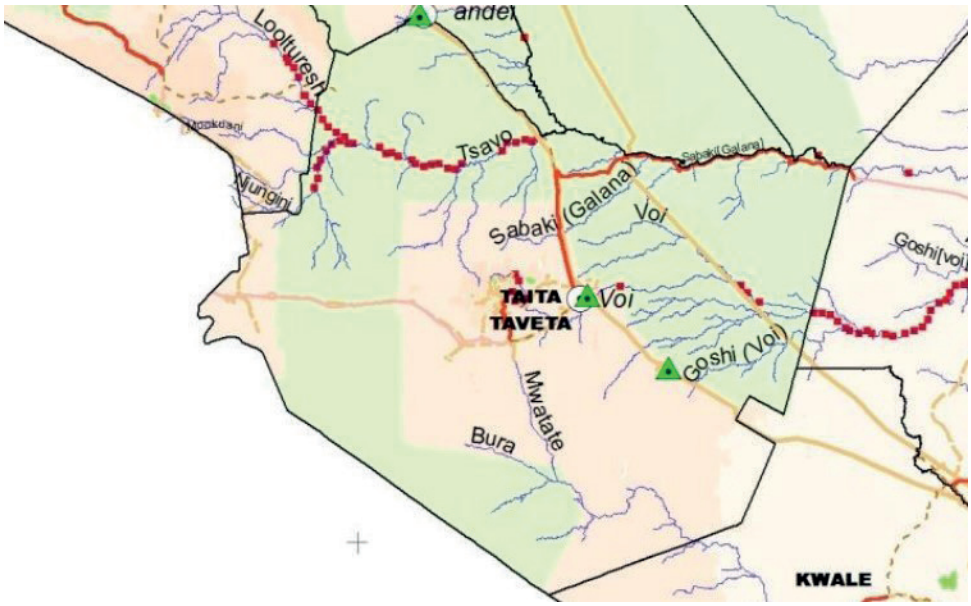


Figure 4: Taita-Taveta Hydropower Distribution 0.1–0.5 MW

2.6 Solar Energy

According to the Global Solar Atlas[1], the solar potential in Taita-Taveta is significant, particularly in the northern parts of the county. Figure 4 shows the long-term yearly average Global Horizontal Irradiation (GHI) in Taita-Taveta County, with the average GHI being about 2,032 kWh/m²/year. This indicates a high potential for photovoltaic electricity production (see Figure 5).

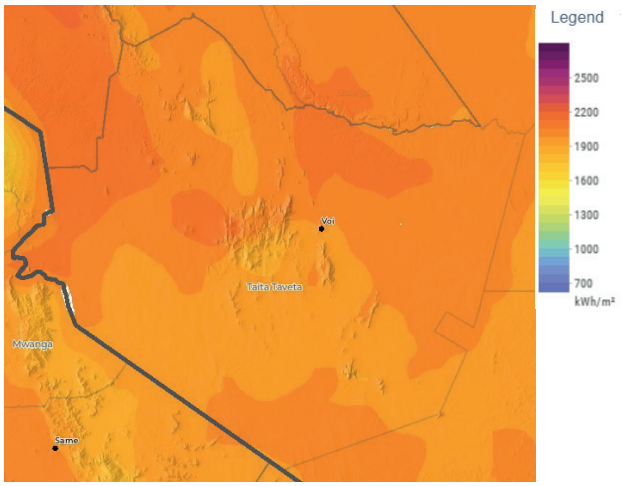


Figure 5: Global Horizontal Irradiation in kWh/m²/day

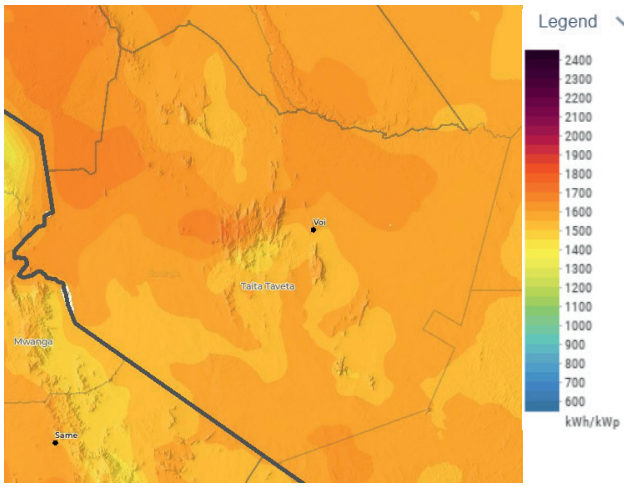


Figure 6: PV output in kWh/kWp/year

[1] Global Solar Atlas — https://globalsolaratlas.info. Datasets are on long-term yearly average of global horizontal irradiation (GHI) in kWh/m² and potential photovoltaic electricity production (PVOUT) in kWh/kWp, covering the period 1994–2018.

Regarding solar irradiation, the best resources are found in Wundanyi Sub-County and parts of Tsavo Park, where the GHI is close to 6 kWh/m²/day.

The less-endowed areas in terms of solar resources are in the central part of Taita-Taveta County (areas near the border between Mwatate and Wundanyi), where the GHI is around 5.15 kWh/m²/day, particularly in hilly areas. Two-thirds of the county receive an average of 5.55 kWh/m²/day.

Zone	Min	Max
Southern	4.12	4.40
Central	4.00	4.28
Northern	4.25	4.58

The photovoltaic power output refers to the total output produced by PV panels.

This does not account for system losses, which can vary depending on the type of PV technology application.

Generally, the losses range from 10–14% for grid-connected systems to more than 20% for solar mini-grids supported by battery storage.

The average potential photovoltaic power output is about 4.29 kWh/kWp per day. In other words, a 1 kWp solar system will produce on average roughly 1,566 kWh per year. This indicates strong potential for solar PV to power small residential settlements, solar plants for SMEs and factories, as well as solar thermal applications such as solar water heating and solar drying.

2.7 Wind Energy

The Global Wind Atlas[2] provides data that was used to visualise the mean annual wind speed and the wind power capacity factor of Taita-Taveta County, shown below. The capacity factor is defined as the average power generated, divided by the rated peak power *(the amount of energy produced by a wind turbine compared to the energy produced if the machine ran at its rated power over a given period)*. It is used as a performance parameter for comparing the potential for wind power generation at different sites.

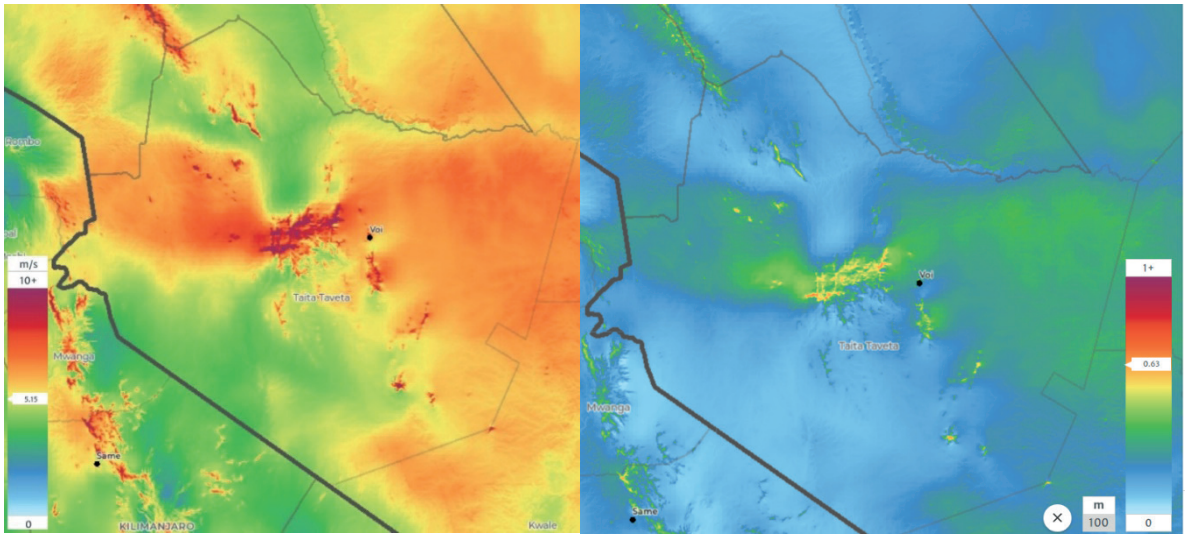
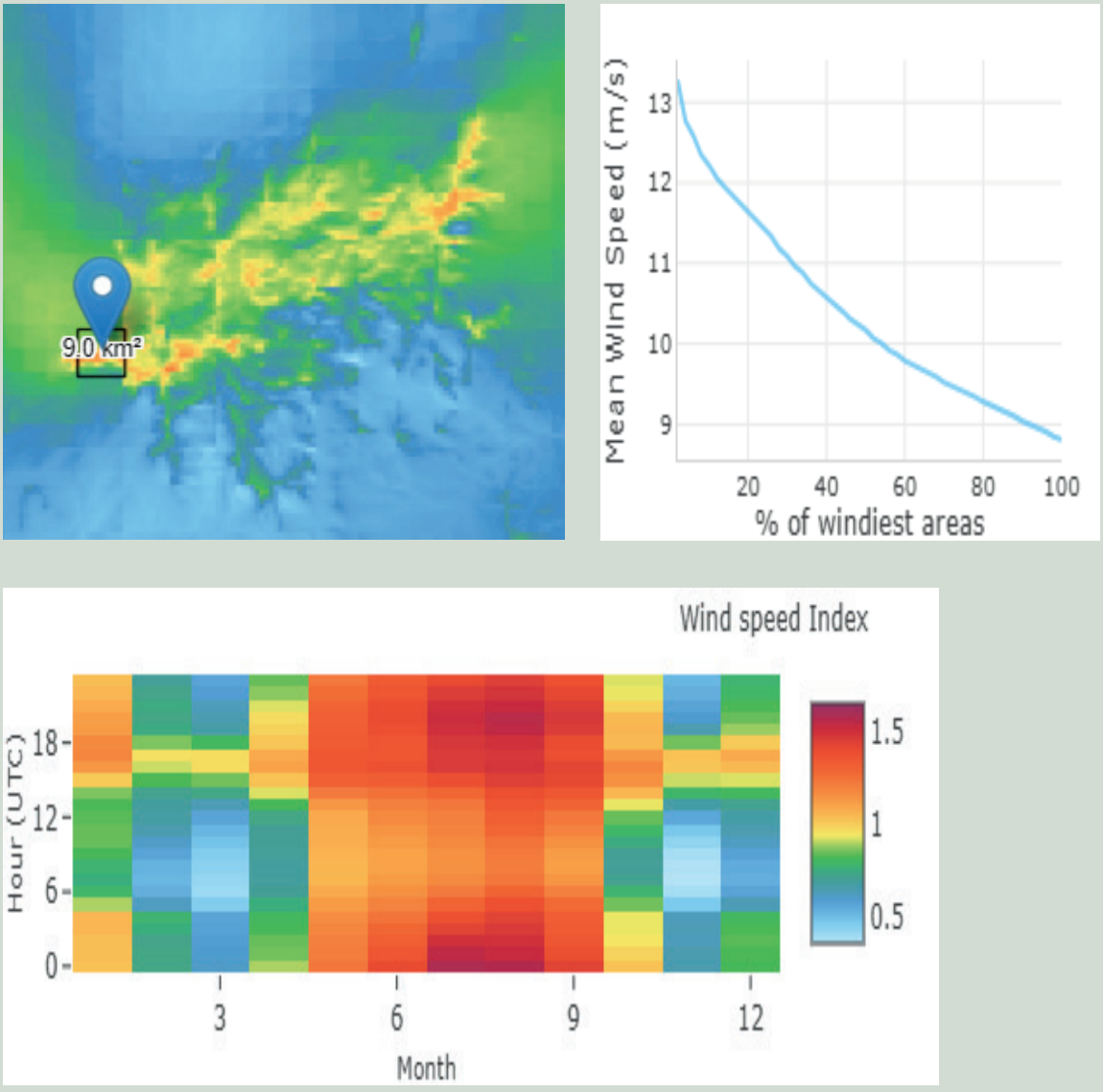


Figure 7: Mean annual wind speed at 100 metres height and corresponding capacity factor—IEC Class I for Taita-Taveta County

[2] Global Wind Atlas— https://globalwindatlas.info/ — An open access, web-based application that maps the mean annual wind speed and the wind power capacity factor across the world at high-resolution.

According to the wind speed map of Taita-Taveta County, higher wind speeds of above 9 m/s at a height of 100m are located in the centre of the county, near the Voi locality (brown to dark brown areas on the map, with wind speeds between 8 and 10 m/s on the crests). Translated into energy value, the map of capacity factors highlights areas with the best potential for wind energy production. The best locations are on the crest areas (yellow on the map) with a capacity factor close to 63%.

As illustrated in the following figure, the wind atlas tool identifies sites with significant potential. The selected spot shows a capacity factor of 63% (1 MW installed can theoretically produce 4,300 MWh per year with an efficiency of 90%), with 80% of wind speeds ranging between 9.5 and 12.2 m/s.



The wind distribution throughout the year is shown in the chart below, indicating that the windiest periods are between May and September, consistent throughout the day.

Figure 8: Additional data on wind potential provided by the wind atlas

Table 5: A summary of County Energy Resources

PROSPECTIVE SOURCES					
Sector	**General description**	**Potential energy capacity**	**Unit of Measure**	**Status of Exploitation**	**Location**
Waste					
Cattle manure (for conversion into biogas)	Number of farmers with potential to uptake biogas technology	19,016 farmers with good potential to uptake	No. of potential 8–12 cubic metre digesters	Marginal	All over the county
Municipal waste					
	Waste collected and transported to dumping sites per annum	70,200	Tonnes	Nil	Chakaleri & Riata dumpsites
Solar					
	Global Horizontal Irradiation (GHI)	2,032	kWh/m²/year	Minimal	Good potential all over the county, with the highest potential in Wundanyi Sub-County and parts of Tsavo Park
Wind					
	Wind speeds of above 9 m/s at a height of 100m above ground level 9 m/s			Nil	Windiest areas are around Voi town
Hydropower					
	Sites with generation potential above 0.5 MW	Several sites	No. of sites	Nil	Sites along rivers Sabaki & Tsavo (refer to figures 1, 2 & 3 above.

Chapter 3: ENERGY ACCESS

3.1 Electricity Access

Energy is the prime mover for socio-economic development, powering a wide array of activities and sectors essential for growth, prosperity, and human well-being. At its core, energy drives industrialisation by providing the power necessary for manufacturing processes, machinery operation, and production activities. This industrial growth not only creates jobs but also enhances productivity and economic diversification, laying the foundation for sustainable development.

In agriculture, energy plays a pivotal role in boosting productivity and food security. Energy-powered irrigation systems, mechanised farming equipment, and processing facilities improve crop yields and enable efficient farming practices. This, in turn, supports rural livelihoods, strengthens food supply chains, and contributes to economic stability.

At the household level, modern energy services enhance living standards and well-being. Access to electricity enables lighting, cooking, heating, and access to information and communication technologies, improving health, education, and overall quality of life. Furthermore, cleaner cooking solutions reduce indoor air pollution, mitigating health risks and enhancing family welfare.

From an economic standpoint, energy availability and affordability are key drivers of growth and competitiveness. Countries with robust energy systems attract investments, stimulate business development, and foster innovation across various sectors. Additionally, transitioning to cleaner and renewable energy sources promotes environmental sustainability, mitigates climate change, and minimises pollution. In conclusion, the pivotal role of electricity in socio-economic development cannot be overstated.

3.1.1 Key stakeholders in electricity access and projects

The Ministry of Energy (MOE) holds responsibility for crafting policies and overseeing their implementation to foster an environment conducive to the efficient operation and expansion of the energy sector. It establishes the strategic trajectory for sector development and offers a long-term vision guiding all stakeholders within the industry.

The Kenya Power and Lighting Company (KPLC) serves as the system operator and primary off-taker within the power market, procuring bulk power from various generators through negotiated Power Purchase Agreements (PPAs) for distribution to consumers. Additionally, KPLC is responsible for owning and managing a portion of the current transmission infrastructure and the majority of the interconnected distribution network. According to KPLC, the customer base in Taita Taveta as of September 2023 stood at 69,920, comprising domestic consumers (66,934), SMEs (2,752), commercial and industrial consumers (22), and streetlights (212). The following is a description of various projects under implementation.

Table 6: KPLC Projects in the County (Completed, Ongoing and in the Pipeline)

COMPLETED PROJECTS			
	Name	**Location**	**Aim**
1	Wundanyi Substation and 33KV line	Voi, Mwatate, Wundanyi Constituencies	To improve on power reliability in Wundanyi
2	Street lighting projects in Voi Sub-County	Mabomani	Security enhancement
3	Installation of additional capacity		
ONGOING PROJECTS			
1	Kishushe Last Mile—GoK	Kishushe	Supply of power to area locals
2	Last Mile 4&5 projects	All Sub-Counties	To increase electricity access, awaiting contract with donors
FUTURE PLANS			
1	Street lighting projects being followed up by the elected MPs	All Sub-Counties	Improve on security and foster business running beyond dusk

(Source: Kenya Power—Voi Office)

As per the Energy Act of 2019, the REREC has been designated as the principal authority responsible for advancing renewable energy resources, excluding geothermal and large hydropower. This expanded mandate complements its existing role in rural electrification efforts. Between 2021 and 2023, REREC implemented a total of 41 projects in Taita Taveta County, including the construction of 39 km of medium voltage lines and 52 km of low voltage lines, resulting in the connection of 2,078 customers. In this financial year (2023–2024), 12 projects have been rolled out in the county. These projects are at different stages of implementation and are expected to connect an additional 1,265 customers.

Table 7: REREC's Projects in Taita Taveta County

REREC PROJECTS STATUS—TAITA TAVETA COUNTY					
	Constituency	**No. of Projects**	**MV Length (km)**	**LV Length (km)**	**No. of Connected Customers**
i. Projects Implemented Between FY 2021–2023					
1	Taita	23	14.792	81.658	1,207
2	Mwatate	5	5.685	19.775	356
3	Voi	8	13.25	32.16	366
4	Taveta	5	5.70	19.058	149
	Total	**41**	**39.427**	**152.651**	**2,078**
ii. Projects to be Implemented FY 2023–2024					
1	Taita	2	11.151	16.295	199
2	Mwatate	1	0	4.915	71
3	Voi	0	0	0	0
4	Taveta	9	27.355	58.085	995
	Total	**12**	**38.506**	**79.295**	**1265**

(Source: REREC)

The Kenya Electricity Transmission Company (KETRACO) is tasked with planning, designing, constructing, owning, operating, and maintaining new high-voltage (132 kV and above) electricity transmission lines. These lines serve as the core infrastructure of the National Transmission Grid and regional interconnections. This initiative aims to foster the development of an open-access system within the country.

The Kenya Electricity Generating Company (KenGen) serves as the primary power generation entity within the country and is renowned for its extensive expertise in geothermal technology development.

The Energy and Petroleum Regulatory Authority (EPRA) oversees the economic and technical aspects of the energy sector. Its responsibilities encompass licensing power sector facilities and technicians, conducting energy audits, setting tariffs, and providing sector oversight. Additionally, EPRA develops and implements regulations, ensuring compliance and enforcement across the sector.

The Kenya Off-Grid Solar Access Project (KOSAP) is a flagship initiative of the Ministry of Energy, funded by the World Bank, with the goal of delivering electricity and clean cooking solutions to 14 remote, sparsely populated, and historically underserved counties across Kenya. Taita Taveta is among the 14 beneficiary counties. It is jointly implemented by the Ministry of Energy, KPLC, and REREC. KOSAP initially earmarked 19 boreholes for solarisation, although discussions are still ongoing to confirm the actual number of boreholes that will be solarised. There are also ongoing discussions regarding the possibility of electrifying several schools and health facilities through stand-alone solar PV systems.

The Nuclear Power and Energy Agency (NuPEA) is tasked with advancing the nuclear energy programme in Kenya, promoting the development of nuclear electricity generation, and conducting research, development, and dissemination activities of energy-related research findings. Additionally, NuPEA facilitates and coordinates capacity-building initiatives within the energy sector.

The Geothermal Development Company (GDC) operates as a Government Special Purpose Vehicle (SPV) responsible for surface exploration of geothermal fields, conducting exploratory, appraisal, and production drilling, and overseeing proven steam fields. Additionally, GDC engages in steam sales agreements with investors in the power sector.

Independent Power Producers (IPPs) are private investors in the power sector engaged in electricity generation, either on a large scale or for the development of renewable energy projects under the Feed-in-Tariff Policy.

Mini-grids consist of electricity generators and energy storage systems connected to a distribution network. They provide electricity to a localized group of customers who are not served by the interconnected national power grid, as authorised by EPRA.

Solar home systems companies provide Solar Home Systems (SHS) to households located in remote areas without access to the main electricity grid, and they will play a crucial role in achieving universal electrification access.

County Government: According to Schedule Four of the Kenyan Constitution of 2010, section 5(b) and 8(e), the county government, through the relevant county departments, is tasked with the responsibility of overseeing street lighting in the county.

3.1.2 Access Situations, Interventions and Envisioned Progression to Universal Access

3.1.2.1 Households

Electricity Access Status

As part of the INEP, the CEP aims to explore the least-cost electrification options to achieve universal access in Taita Taveta County by 2030. In 2023, 66% of households in the County are connected to the national grid. At the same time, analysis conducted as part of developing the Taita Taveta CEP shows that 93% of households are within connection distance of an existing transformer (600 metres, as per the accepted government definition). The reasons for this gap likely include affordability, challenges in getting connected, relatively low electricity consumption, and associated demand from many lower-income households.

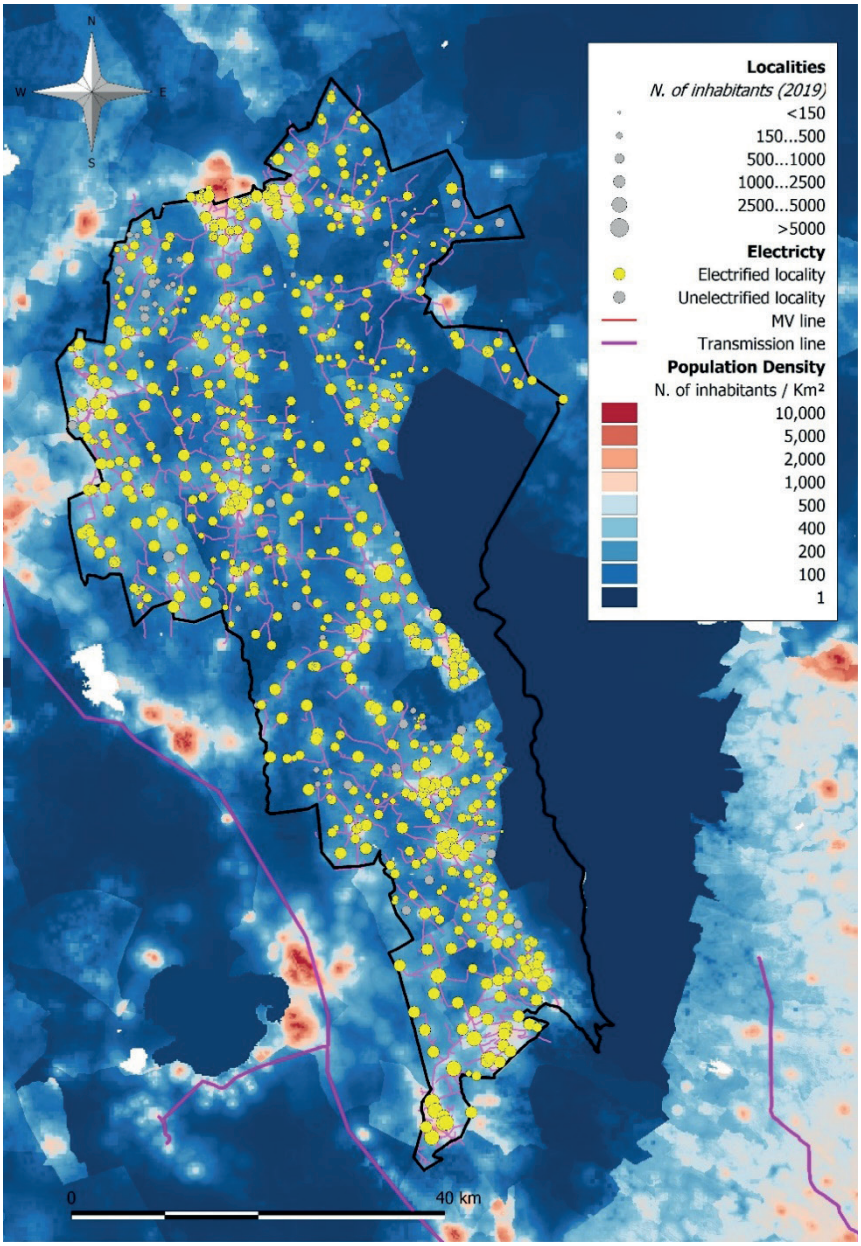


Figure 9: Electrification Status of Population Clusters in Taita Taveta County

To assess the range of electricity demand, three scenarios corresponding to different levels of consumption (Tiers) were tested for rural and urban areas in order to quantify the required investment and identify the best electrification option for each community across the geography of Taita Taveta County. The geographically dispersed population is divided into small units of analysis referred to as population 'clusters', of which 30% have fewer than 500 inhabitants, 36% between 500 and 1,000 inhabitants, and 33% between 1,000 and 5,500 inhabitants.

As indicated in the following table, consumption levels ranged from Tier 1+ (a level of service sufficient to power task lighting and phone charging or a radio) to Tier 5 (allowing the use of medium- and high-load appliances such as a laptop, fridge, rice cooker, washing machine, iron, hair dryer, toaster, microwave, or air cooler) as well as small business operation—known as the productive use of energy.

Table 8: Energy Consumption Scenarios Explored for Taita Taveta Least-Cost Electrification Planning

Scenario	Urban	Rural		
	Tier	Tier	Annual Energy (kWh)	Capacity (W)
1	5	Tier 1+	40.15	40
2		Tier 3	365	200
3		Tier 5	2,993	2000

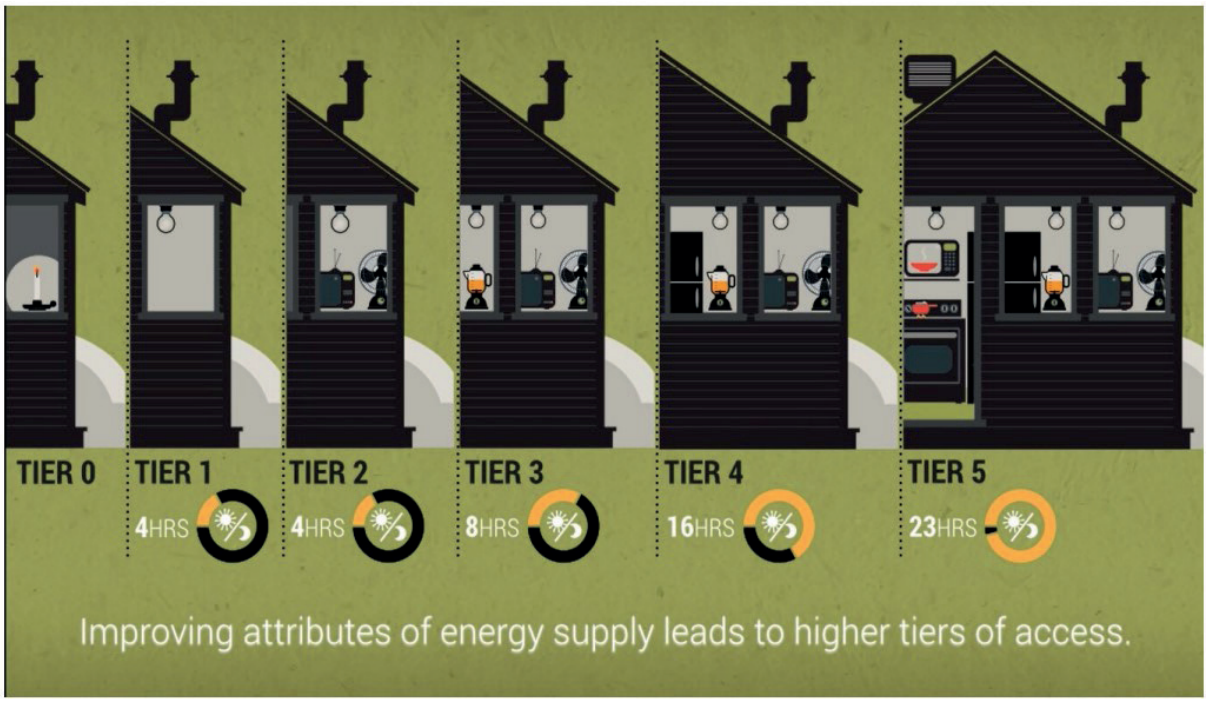


Figure 10: The Multi-Tier Access Definition (SE4ALL)

Methodology

All the analyses were conducted using a GIS developed specifically for the Taita Taveta County electrification plan. To achieve the greatest accuracy, **374 population clusters were defined** using a continuous raster surface representing the population density of the County. Population estimates for both rural and urban clusters were then cross-checked with the population data from the 2019 census. Electrification status of clusters was defined based on the location of step-down transformers through a GIS layer provided by KPLC, and then cross-checked with County representatives. Clusters located fully or partially within a 600-metre buffer around transformers (the maximum distance at which households are generally located from transformers) were considered 'electrified'. Clusters that didn't overlap with the buffer were considered unelectrified.

Using these population clusters as a starting point, the geospatial electrification tool GEOSIM was used to calculate the investments and operating costs related to the development of electrification projects. Different supply options were proposed to achieve universal access:

i. **Grid densification**—to connect unelectrified households in already electrified cluster

ii. **Grid intensification**—to electrify housing clusters within a perimeter of 601 to 1,500 metres from an existing transformer

iii. **Grid extension**—extending the interconnected grid to clusters in unserved areas

iv. **Mini-grids** (both PV and hybrid)—deployed in small and medium-sized clusters located far from the interconnected network

v. **Solar home systems (SHS)**—standalone systems to reach households in sparsely populated areas (fewer than 200 inhabitants/km²) or in densification/intensification areas when the price of an SHS becomes lower than a grid connection for an equivalent level of consumption. This tends to be the case with lower levels of consumption.

The choice of the best electrification option is made according to the lowest levelised cost of electricity (LCOE), which is the ratio between lifetime costs divided by electricity production. For conventional electrification solutions like grid or mini-grid connections, as the size of the localities and consumption levels increase (from Tier 1+ to Tier 5), the LCOE decreases. The LCOE of SHS does not change as these are individual solutions. The investment for each electrification project, as well as the OPEX costs, were calculated based on the current costs of equipment in Kenya.

Least-Cost Electrification Results for Taita Taveta County

Considering the 67,000 households already electrified, this means that **44,000 households will need to be electrified** to achieve universal access. The locations of these households are shown in a separate annexure to this document. As illustrated in the graph below, the total investment required to achieve this objective varies greatly between Scenario 1 and Scenarios 2 & 3.

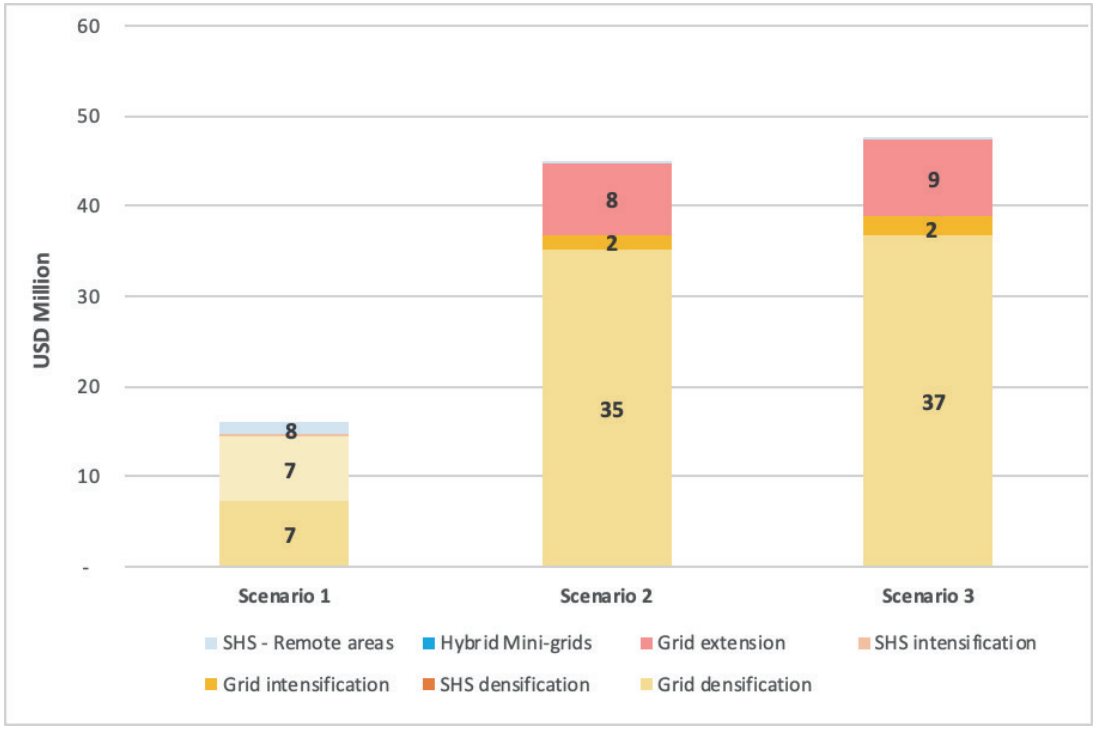


Figure 11: Summary of Investments by Scenario for Universal Access in the County

Scenarios 2 and 3 are very similar. With high levels of consumption (equivalent to Tiers 3 and 5 in rural areas), electrification will primarily take place through the development of the existing medium voltage (MV) network. In both scenarios, almost 100% of households would be electrified via grid connection: 94.4% through grid densification, 4.3% through grid extension, and 1.3% through grid intensification. Only 200 households in remote villages will be electrified via SHS. Altogether, **Scenario 2 would require an investment of USD 45.1 million, and Scenario 3, USD 47.8 million.** The small difference is explained by the use of more powerful and therefore more expensive transformers in Scenario 3.

Table 9: Electrification Investment Costs by Scenario and Supply Options

Supply Option	Scenario 1	Scenario 2	Scenario 3
Grid densification	7 317 408	35 245 674	36 830 296
SHS densification	7 051 556	-	-
Grid intensification	-	1 681 200	1 964 202
SHS intensification	368 463	-	-
Grid extension	-	7 882 194	8 681 130
Hybrid Mini-grids	-	-	-
SHS—Remote areas	1 250 828	322 364	322 364
Total	**15 988 255**	**45 131 432**	**47 797 992**

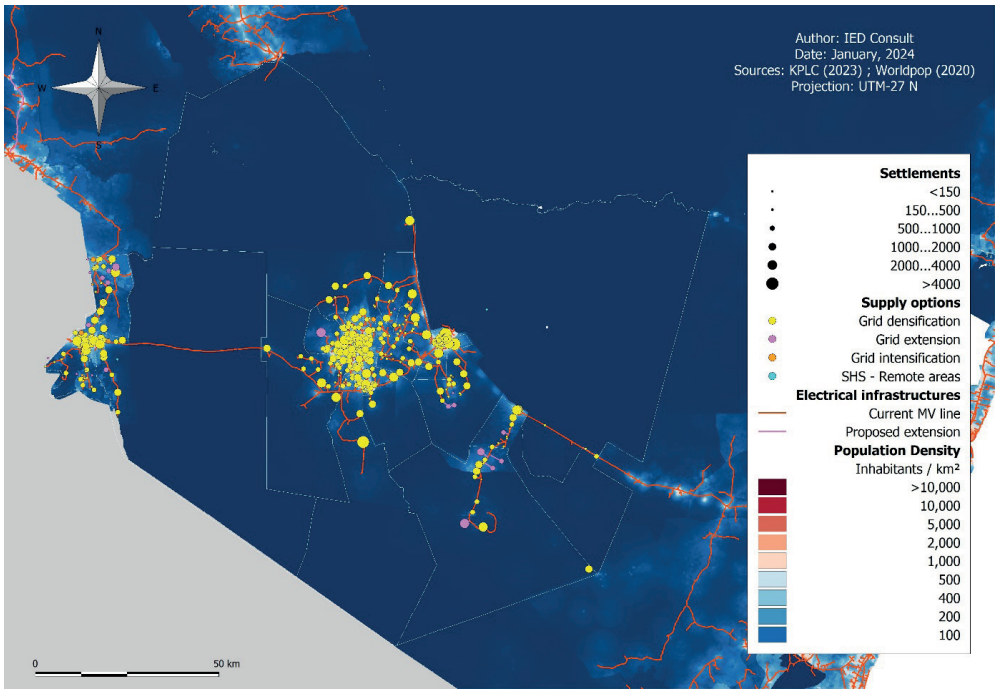


Figure 12: Electrification Planning of the County—Scenarios 2 & 3

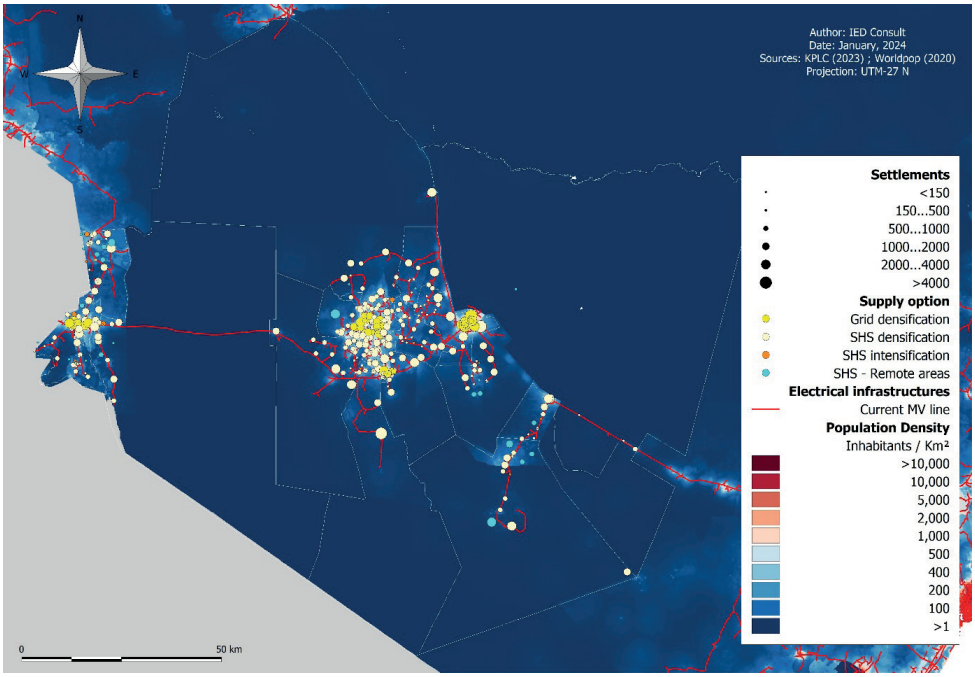


Figure 13: Electrification Planning of the County—Scenario 1

The investment for the County's **electrification plan changes drastically in Scenario 1** compared to the two upper scenarios. In Scenario 1 **(requiring USD 16 million)**, only urban households located in the densification area would be electrified via the national grid due to their expected high levels of consumption (Tier 5). All others (75% of households to be electrified) would be connected via SHS.

Table 10: Number of New Connections by Supply Option and Scenario

Supply option	Scenario 1	Scenario 2	Scenario 3
Grid densification	10 889	37 701	37 701
Sharing (%)	25	86	86
SHS densification	26 812	-	-
Sharing (%)	61	-	-
Grid intensification		1 401	1 401
Sharing (%)	-	3	3
SHS intensification	1 401	-	-
Sharing (%)	3	-	-
Grid extension		4 553	4 553
Sharing (%)	-	10	10
Hybrid mini-grids		-	-
Sharing (%)	-	-	-
SH —remote areas	4 756	203	203
Sharing (%)	11	0	0
Total	**43 858**	**43 858**	**43 858**

Discussion

Since 2007, Kenya's Rural Electrification Authority (REA) has rapidly expanded the national grid, installing electricity distribution lines and transformers across many rural areas. In Taita-Taveta County, the national grid is already very dense. Currently, 90% of the population clusters are electrified, and only 6% of population clusters are located more than 1.6 km (one mile) from the interconnected network. Furthermore, 91% of the total population already lives in an electrified settlement. Therefore, Taita-**Taveta County has a solid base for electrifying** the remaining clusters, which could be connected with limited effort.

Even though the population coverage rate is high, achieving universal access to electricity in the County remains a challenge. Despite the density of the national network, many "under-grid" households remain unconnected, highlighting real problems with connectivity. Beyond the various technical and social factors that can impact access and service quality, low connectivity is mainly due to the cost of **connection, which is out of reach for most poor and rural households.**

Since 2004, the electricity connection price for a household within 600 metres of a transformer has been set at USD 398 (35,000 KES). This typically includes two poles, the meter, and the service line, but the full cost of supplying a single connection in a grid-covered area was estimated by KPLC at USD 1,435. Since the launch of the Last Mile Connectivity Project (LMCP) in 2015, the price has been lowered to USD 171 (15,000 KES) with support from the World Bank and the African Development Bank. However, a 2019 study by Lee et al. (2020) found that only 23.7% of rural households would take up a connection even at this price.

The unit cost of electricity could also be a significant obstacle to some households' willingness to connect (Lee et al. 2020**).** Currently, base power prices are USD 0.086 and USD 0.11 per unit for those consuming less than 30 and 100 units, respectively. However, simulations for this plan show that prices could rise above USD 0.17 in Scenario 3, or above USD 0.7 in Scenario 2.

Whether household electrification is achieved via the interconnected network or SHS, **it is important to expand access through funded installation payments**, allowing consumers to repay connection costs in instalments through monthly or daily payments over several years. This solution already exists in Kenya (e.g. M-Kopa Solar) and reduces the upfront payment required by households, although it necessitates pre-financing connection costs by operators. Pre-financing could be supported by the County via a commercial loan. In Scenario 1, the connection cost would involve a daily payment of KES 50 for two years, with a deposit of KES 6,000. For a grid connection in urban areas, the same payment structure would apply for three years, with a deposit of KES 10,000.

Table 11: Summary of Connection Costs to Supply a Single Household

Column 1	Scenario 1	Scenario 2	Scenario 3
Densification (urban/rural)	672 / 263	672 / 1041	672 / 1100
Intensification	263	1 200	1 402
Extension		1 788	1 927
Hybrid mini-grids		2 631	-
PV SHS	263	1 588	1 588

Conclusions

In this plan, we have identified various opportunities to achieve universal access by 2030 in Taita-Taveta County. The investment required for each scenario is calculated based on a household connection rate of 100%, implying around 6,000 new connections per year, which is technically feasible. However, it is important to recognise that **this objective is ambitious,** particularly given the ability of rural households to finance their connections. Furthermore, the projected connectivity rate for the medium term is often overestimated by decision-makers.

The evidence from this report clearly shows that the investment to electrify the remaining households will be almost the same whether the expected demand reaches that of Scenario 2 or Scenario 3. Given the connection costs for households, their demand, and the current connectivity rate, despite subsidies, it does not seem appropriate to extend the network in rural areas to achieve universal access. With a funded installation payment system to be developed between the County and REREC, Scenario 1 seems a more credible alternative, particularly due to its rapid deployment. Additionally, efforts must be made to electrify the remaining unelectrified social infrastructure in rural areas, where electricity access should be developed through standalone solar systems.

3.1.2.2 Education Institutions (ECDEs, Primary Schools, Secondary Schools and Tertiary Institutions)

Electricity Access Status

Early Childhood Development and Education (ECDEs)

277 out of 318 ECDEs do not have access to electricity. Of these, 268 are on-grid while 9 are off-grid. The ECDEs that are on-grid will be connected to grid power, while those that are off-grid will be fitted with Solar PV systems.

Table 12: ECDEs in Need of Electrification (names as per annex)

Sub-County	Number	On-grid & not connected	Off-grid
Wundanyi/ Taita	64	64	
Voi	92	92	
Mwatate	84	84	
Taveta	37	28	9
Total	**277**	**268**	**9**

(Source: County Department of ECDEs)

Primary and Secondary Schools

According to the County Directorate of Education (National Government), nearly all primary schools have access to reliable electricity, supplied either by the grid (majority) or Solar PV systems. Only 2 primary schools lack any source of power, and an additional 3 primary schools have faulty PV systems that require rehabilitation. It is proposed to install a Solar PV system at Marungu Primary School and to rehabilitate the faulty PV systems at the 4 schools listed in the table below. All secondary schools have access to reliable electricity.

Table 13: Primary Schools in Need of Electrification Solutions

Institution	Source of power	Grid proximity	Remarks
Marungu primary	None	Off-grid	
Mgeno jrn/primary school	None	Off-grid	Existing faulty PV system
St. Nobert Tangini	Grid & solar	On-grid	Existing faulty PV system
St. John's Mwema	Grid & solar	On-grid	Existing faulty PV system
Ngambenyi	Several stand alone solar PV systems	Off-grid	Existing faulty PV system

(Source: County Directorate of Education—National Government)

Vocational and Technical Colleges (VTCs)

According to the County Directorate of Vocational Training, there are 32 VTCs in the county. Out of these, 3 have no source of power despite being on-grid. These include Mate (not yet operationalised), and Ndome and Nyache. Out of the 29 that are electrified, 5 are supplied by single-phase power and require an upgrade to 3-phase power. These include: Kambungu, Mlambenyi, Marungu, Kishushe, and Kiloghwa. The remaining 24 are connected to 3-phase supply.

Costing of Proposed Electrification Solutions

The costs are based on prevailing market prices and previous experiences in the county while implementing similar projects. They include the cost of site assessment and design, installation/connection and commissioning, and relevant associated works.

Table 14: Costing of Proposed Electrification Solutions for Educational Institutions

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Connecting ECDEs to grid power	Single phase supply (additional poles needed in some instances)	300,000	268	80,400,000
Solar PV systems for ECDEs which are off-grid	1kW An average of 7$/W (IRENA 2016 & previous experiences in the county while implementing similar projects) Exchange rate—(130–150 KES/ $)	1,000,000	9	9,000,000
Solar PV system for the 1 primary school without power	2–3 kW An average of 7$/W (IRENA 2016 & previous experiences in the county while implementing similar projects) Exchange rate—(130–150 KES/ $)	2,000,000	1	2,000,000
Rehabilitating faulty PV systems at primary schools	(30% of the initial cost of a PV system—IRENA 2016)	600,000	4	2,400,000
Connecting VTCs to grid power	3-phase	500,000	3	1,500,000
Upgrading grid supply to 3-phase at VTCs	3-phase	500,000	5	2,500,000
Total				**97,800,000**

3.1.2.3 Health Facilities (Levels 2, 3 & 4)

Electricity Access Status

Level 4 Hospitals

The county has a total of 4 level four hospitals, also called Sub-County Hospitals (SCH). The electrification status of these facilities is summarised below.

Table 15: Electrification Status and Cost of Power at the Level 4 Hospitals

Facility	Main source of power	Back-up power supply	Average Monthly cost of grid power (KES)	Average Monthly running cost for Genset (KES)	Solar Water Heating system
Taveta SCH	KPLC—Three phase	Genset	600,000	231,000	None
Moi County Referral	KPLC—Three phase	Genset	1,000,000	231,000	None
Mwatate SCH	KPLC—Three phase	Genset	600,000	50,000	None
Wesu SCH	KPLC—Three phase	Genset	600,000	231000	None

(Source: County Department of Health)

All 4 facilities are connected to 3-phase power and have back-up diesel generators. None of the facilities has a solar water heating system. Given the high-power bills incurred at these hospitals (KES 7.2 million per annum at Taveta, Mwatate and Wesu, and KES 12 million at Moi Referral), along with the high cost of running diesel generators, it is advisable to invest in alternative sources of power (e.g., a solar PV system), which can potentially reduce costs over the long term. Energy audits are also recommended to identify energy-saving opportunities. Solar water heating systems are necessary as well.

Table 16: Costing of Proposed Electrification Solutions for Level 4 Hospitals

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
SWH systems	8 SWHs, 200-litre systems for maternity, wards, kitchen, & laundry. Accessories including: • Elevated tank • Plumbing works • Labor	6,000,000	4	24,000,000
Energy audits	According to KS ISO 50002	2,000,000	4	8,000,000
Grid complementary solar PV systems	≥20kW An average of 7 $/W (IRENA 2016 & previous experiences in the county while implementing similar projects) Exchange rate—(130–150 KES/ $)	20,000,000	4	80,000,000
Total cost				**112,000,000**

Level 3 Facilities

Table 17: Electrification Status and Cost of Power at Level 3 Facilities

Facility	Main source of power	Back-up power supply	Average Monthly cost of grid power (KES)	Average Monthly running cost for Genset (KES)	Solar Water Heating system
Rekeke HC	KPLC—Single phase (upgrade needed)	None	80,000	Not given	None
Njukini HC	KPLC—Single phase (upgrade needed)	None	80,000	Not given	None
Tausa HC	KPLC—Single phase (upgrade needed)	None	80,000	Not given	None
Ndovu HC	KPLC—Single phase	None	80,000	Not given	None
Maungu Model HC	KPLC—Single phase (upgrade needed)	Genset	80,000	63,000	None
Bughuta HC	KPLC—Single phase (upgrade needed)	None	80,000	Not given	None
Bura HC	KPLC—Single phase (upgrade needed)	Genset & solar	80,000	10,500	None
Moda mbogho HC	KPLC—Single phase	None	80,000	Not given	None
Wundanyi HC	KPLC—Single phase (upgrade needed)	None	80,000	Not given	None
Mgange Nyika HC	KPLC—Single phase (upgrade needed)	None	80,000	Not given	None

(Source: County Department of Health)

There are 10 operational Level 3 facilities (also called Health Centres—HCs) in the county. The electrification status is detailed in the table above. To achieve universal electricity access, it is proposed to install emergency diesel generators at the 8 facilities without them. Solar water heating systems will also be installed at all facilities. Furthermore, 8 facilities need an upgrade from single-phase to 3-phase power. Given the high monthly power bills, it is also prudent to invest in solar PV systems of adequate capacity to complement grid power.

Table 18: Costing of Proposed Electrification Solutions for Level 3 Hospitals

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
SWH systems	4 SWHs, 200-litre systems for maternity, wards, kitchen, & laundry. Accessories including: • Elevated tank • Plumbing works • Labor	4,000,000	10	40,000,000
Diesel generators	30 KVA	1,500,000	8	12,000,000
Grid complementary solar PV systems	≥10kW An average of 7 $/W (IRENA 2016 & previous experiences in the county while implementing similar projects) Exchange rate—(130–150 KES/ $)	10,000,000	10	100,000,000
Upgrading grid supply to 3-Phase	3-phase	500,000	8	4,000,000
Total cost				**156,000,000**

Level 2 Facilities

Table 19: Electrification Status and Cost of Power at Level 2 Facilities

No. of operational facilities	No source of power & on-grid	Mainly powered by KPLC			Mainly powered by solar PV but on-grid	No. of facilities with defective PV systems	With Solar Water Heating system
		With PV back-up system	With Genset	Without power back-up/ complementary system			
56	1	25	1	21	8	7	0

(Source: County Department of Health)

There are 56 Level 2 facilities in the county. The majority (47) are connected to KPLC grid power. Of these, 25 have PV back-up systems, 1 has a back-up generator, and 25 do not have power back-up systems. 8 facilities are on-grid but powered by solar PV systems. One facility, Kachero Dispensary, is on-grid but currently has no source of power. A total of 7 facilities have defective PV systems. None of the facilities have a solar water heating system; however, the health department has indicated that only 8 facilities need these systems.

To achieve universal electricity access, it is proposed to connect all facilities that are on-grid but not connected. It is also proposed to install PV back-ups at 22 facilities, rehabilitate the 7 defective PV systems, and install solar water heating systems at the 8 facilities in need. The list of these facilities is included in the annex.

Table 20: Costing of Proposed Electrification Solutions for Level 2 Hospitals

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
SWH systems	2 SWHs, 200-litre systems to cater for maternity. Accessories including: • Elevated tank • Plumbing works • Labor	3,000,000	8	24,000,000
Grid connection	Single phase	300,000	9	2,700,000
Back up solar PV systems	3–5 kW An average of 10$/W (IRENA 2016 & previous experiences in the county while implementing similar projects) Exchange rate—(130–150 KES/ $)	4,000,000	22	88,000,000
Repairing faulty PV systems	30% of the initial cost of a PV system (IRENA 2016)	1,200,000	7	8,400,000
Total cost				**123,100,000**

3.1.2.4 Agri-based Facilities

Electricity Access Status

Hatcheries

There are 12 hatcheries in the county, spread across Taita, Voi, and Mwatate sub-counties. Out of the 12, 9 are powered by KPLC, while 3 are powered by solar. Power supply for all the hatcheries is indicated as inadequate. None of the hatcheries has a back-up power supply. For the 9 powered by grid power, the average monthly power bill per facility is KES 5,000. All of them are communally owned and operated.

Table 21: List of Hatcheries in the County

Sub-County	Village	Name	Main source of power
Taita	Kishushe	Kishushe hatchery	KPLC—single phase
Voi	Sagalla	Irika youth hatchery	KPLC—single phase
	Sagalla	Jibebe hatchery	KPLC—single phase
	Sagalla	Wakwethu hatchery	KPLC—single phase
	Sagalla	Talio wajane hatchery	KPLC—single phase
	Sagalla	Kajire hatchery	Solar (off grid)
	Sagalla	Mwambiti hatchery	Solar (on -grid)
	Sagalla	Ndara hatchery	Solar (on-grid)
Mwatate	Kidaya	Maradada CBO	KPLC—single phase
	Vichwala	Maghomatini youth survivors	KPLC—single phase
	Mbumbunyi	Mawono youth	KPLC—single phase
	Masungunyi	Muungano group	KPLC—single phase

(Source: County Department of Livestock)

A recommendation was made by the Department of Livestock to upgrade the power supply from single-phase to three-phase. In this regard, all the 11 hatcheries that are on-grid will be connected to three-phase (9 upgrades and 2 new connections). When it comes to back-up power supply, it would be more prudent to consider introducing dual-powered incubators as opposed to diesel generators. In this regard, all the 12 hatcheries will be equipped with eco-friendly dual-powered incubators. These solutions are costed in the table below:

Table 22: Costing of Proposed Electrification Solutions for Hatcheries

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Grid connection upgrade	Three-phase	500,000	**11**	5,500,000
Provision of dual power incubators including solar PV infrastructure	>5000 eggs capacity with AC/DC compatibility	2,000,000	**12**	24,000,000
Total cost				**29,500,000**

Milk Chillers

There are 9 operational milk aggregation and chilling facilities in the county. There is also one more proposed to be set up in the near future. All the 9 existing facilities are powered by KPLC. Out of these 9, 4 are supplied by three-phase, while 5 are supplied by single-phase. Typical monthly power bills range between KES 10,000 and KES 45,000. Only 3 facilities have back-up diesel generators. Eight are communal while 2 are public. This information is summarised in the table below.

Table 23: List of Milk Chillers in the County

Sub-County	Facility	Main source of power	Monthly KPLC bills (KES)	Back-up
Taita	Tagho Cooling Plant	KPLC—three-phase	23,000	Diesel Generator
	Ngache Cooling Plant	KPLC—three-phase	36,000	Diesel Generator
	Mwafugha cooling plant	KPLC—three-phase	45,000	Diesel Generator
	Dawida Cooling plant	KPLC—three-phase	1,000	N/A
	Ndisha Cooling plant	KPLC—three-phase	1,000	N/A
Voi	Sagalla milk cooling plant	KPLC—three-phase	10,000	N/A
	Wumweri cooling plant	KPLC—three-phase	10,000	N/A
Mwatate	Diwadane farmers' cooperative warehouse	KPLC—three-phase	Not given	N/A
	Mwasinenyi cooperative	KPLC—three-phase	10,000	N/A
Taveta	Eldoro milk cooling plant (proposed)	N/A	N/A	N/A

(Source: County Department of Livestock)

For the 5 plants powered by single-phase, an upgrade to three-phase has been recommended by the Department of Livestock. At the facilities, milk cooling is the main business and therefore the main power consumer. Therefore, when it comes to back-up power supply, instead of opting for conventional diesel generators, dual-powered bulk milk chillers are recommended at all the 9 existing cooling plants. The technology is relatively new but is gradually gaining traction in the Kenyan dairy sector. The bulk chillers

are powered by both solar and grid. Examples of these bulk chillers can be viewed at this site: http://www.sav-circuit.com/. Introducing dual-powered milk chillers, capable of operating on both the grid and solar energy, offers several significant benefits for milk processing facilities in regions like Taita Taveta. Firstly, such chillers provide increased reliability and flexibility in power supply, ensuring uninterrupted operations even in areas prone to electricity outages or grid instability. By harnessing solar energy during daylight hours, these chillers can reduce reliance on the grid, thereby lowering energy costs and enhancing energy resilience. Additionally, the integration of solar power promotes environmental sustainability by reducing carbon emissions and mitigating the environmental impact associated with conventional energy sources. The two solutions are costed in the table below.

Table 24: Costing of Proposed Electrification Interventions for Chillers

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Grid connection upgrade	Three-phase	500,000	5	2,500,000
Provision of dual power chillers including solar PV infrastructure/ retrofitting the existing ones	5000 litres	7,000,000	**9**	63,000,000
Total cost				**65,500,000**

Fish Aggregation Cold Stores

There are 3 fish aggregation and marketing centres, and 4 fish farms. The aggregation centres do not have a source of power, while the fish farms are powered by diesel. It's not clear why all fish farms are using petrol pumps, yet the farms are in on-grid areas, but it's surmised that it's due to proximity between electrified buildings and the farming locations where the ponds are situated. The energy access situation is summarised below.

Table 25: List of Fish Aggregation and Farming Sites in the County

Sub-County	Facility	Main source of power	Monthly power bills (KES)	On-grid/ Off-grid	Ownership
Taveta	Mkwajuni fish landing site	None	N/A	Off-grid	Public
	Kachero fish landing site	None	N/A	Off-grid	Public
	Challa fish landing site	None	N/A	Off-grid	Public
Voi	Irende fish farmers	Fuel (generator)	2,000	On-grid	Communal (SHG)
	Voi prisons fish farm	Fuel (generator)	2,000	On-grid	Public
	Coast Institute of Technology fish farm	Fuel (generator)	1,000	On-grid	Private
	Vijana Birikani fish farm	Fuel (generator)	4,000	On-grid	Communal

(Source: County Department of Fisheries)

In terms of the solutions, it is recommended to install solar-powered flake ice machines at Mkwajuni, Kachero, and Challa fish landing sites. For the fish farms, no intervention is recommended.

Table 26: Costing of Interventions for Fish Aggregation Sites

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Provide solar-powered flake ice-making machine to 3 landing sites without power	3,000 kg/24 hours	5,000,000	**3**	15,000,000
Total cost				**15,000,000**

Vaccine Storage Centres

There are 4 vaccine centres, distributed as shown in the table below. All of them are powered by KPLC, which is indicated as inadequate—probably due to outages, considering that there are no back-up power supplies. The energy access situation is summarised below.

Table 27: List of Vaccine Storage Centres in the County

Sub-County	Facility	Main source of power	Power adequacy	Monthly power bills (KES)	Power back-up	Ownership
Taita	Wundanyi Cold Storage (Vaccine Centre)	KPLC	Not adequate	7,000	None	Public
Voi	Voi Cold Storage	KPLC	Not adequate	12,000	None	Public
Taveta	Taveta Cold Storage (Vaccine Centre)	KPLC	Not adequate	7,000	None	Public
Mwatate	Mwatate Cold Storage (Vaccine Centre)	KPLC	Not adequate	7,000	None	Public

(Source: County Department of Livestock)

It is recommended to retrofit the cold rooms (subject to technical feasibility evaluation) and introduce the aspect of dual powering so that the facilities can mainly run on solar and switch back to grid at night and during times of bad weather. If this retrofitting is not feasible, then back-up solar-powered fridges can be considered.

Table 28: Costing of Electrification Interventions for Vaccine Storage Centres

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Retrofitting cold rooms/acquisition of solar-powered fridges	N/A	1,000,000	**4**	4,000,000
Total cost				**4,000,000**

Banana Ripening and Honey Processing Facilities

There is 1 banana ripening chamber and 1 honey processing factory. A second banana ripening chamber is proposed to be set up in Taveta Sub-County. The Tataba banana ripening chamber is supplied by a 3-phase grid, and the supply is rated as adequate; it has a genset back-up. Tsavo honey is supplied by single-phase, the supply is rated as inadequate, and it has no back-up supply.

Table 29: Banana Ripening and Honey Processing Plants in the County

Sub-County	Facility	Main source of power	Power adequacy	Monthly power bills (KES)	Power back-up	Ownership
Voi	Tataba banana ripening chamber	KPLC—3-phase	Adequate	15,000	Diesel genset	Communal (cooperative)
Taveta	Taveta banana plant (proposed)	On-grid	N/A	N/A	N/A	Communal (cooperative)
Mwatate	Tsavo honey cooperative	KPLC—single-phase	In-adequate	5,000	None	Communal (cooperative)

(Source: County Department of Crops)

It is recommended that the power supply at Tsavo honey factory be upgraded to 3-phase. A diesel genset is also necessary.

Table 30: Costing of Electrification Interventions for Banana Ripening and Honey Processing Plants

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Diesel generators	30 KVA	1,500,000	**1**	1,500,000
Upgrading grid supply to 3-phase	3-phase	500,000	1	500,000
Total cost				**2,000,000**

Slaughterhouses

There are a total of 19 abattoirs (11 public and 8 private) in the county. Sub-county distribution is as shown in the table below. Out of the 19, 14 are powered by KPLC, and power supply is rated as inadequate due to frequent outages, considering that slaughtering happens in the early morning when it is still dark. Five abattoirs do not have any source of power. Out of these 5, 1 (Kasighau) is a public facility, and it is on-grid. The remaining 4 are privately owned. None of the facilities has a power back-up. Average daily slaughter capacity is shown in the table below.

Table 31: List of Abattoirs in the County

Sub-County	No	No. connected to KPLC	Power adequacy	Back-up power	Monthly power bills (KES)	No. without power	Average daily slaughter capacity		
							Cattle	Small Stock	Shoats
Voi	4	3	Inadequate	None	6,750	1	7	15	33
Mwatate	6	3	Inadequate	None	4,000	3	2	2	2
Taita	6	5	Inadequate	None	6,625	1	3	7	15
Taveta	3	3	Inadequate	None	7,000	0	7	17	36
Total	**19**	**14**				**5**			

(Source: County Department of Livestock)

Kasighau abattoir, which is a public facility, will be connected to grid power since it is on-grid. The other 4 private abattoirs will benefit from grid extension, intensification, and densification initiatives covered under the least-cost electrification methodology. It is also desirable to provide light PV systems for back-up power supply at the 11 public abattoirs. The names of these 11 abattoirs are contained in the annex.

Table 32: Costing of Electrification Interventions for Abattoirs

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Connecting Kasighau abattoir to grid power	Single-phase supply (additional poles needed in some instances)	300,000	1	300,000
Solar PV systems for back-up	0.5kW An average of 7$/W (IRENA 2016 & previous experiences in the county while implementing similar projects) Exchange rate—(130–150 KES/ $)	500,000	11	5,500,000
Total				**5,800,000**

Regarding utilising the waste generated to produce biogas, there exists good potential, as can be seen from the slaughter capacity. However, the size of biogas digesters, as well as the modalities around biogas utilisation, would need to be evaluated further. This project can be included in the second-generation County Energy Plan.

3.1.2.5 Water Sources Supplying Water for Irrigation

Electricity Access Status

Table 33: Water Pumping from Rivers for Irrigation—Approximate No. of Farmers and Pumping Methods

Parameter	Statistic
Sub-counties	All
Wards	Wushi, Kishamba, Mwatate, Bura, & Kaloleni
Villages	Kidaya, Mlambenyi, Mcholo, Wusi, Kishamba, Mkamenyi, Msisinenyi, Kipusi, Bura, Gimba, Kaloleni & Msinga
Main crops grown	Maize and other horticultural crops
Average acreage per farmer	0.25
No. of seasons per year	2
Water sources	Lwanda falls, Ngulu dam, Bura river & Voi river etc.
Approximate total no. of farmers	950
Average daily water demand per farmer (litres)	1500
Average Water Lifting Head (metres)	Unknown
Present source of pumping energy	Petrol
Average cost of pumping energy per month (KES)	3,000.00

(Source: County Department of Crops)

Table 34: Water Pumping from Canals for Irrigation—Approximate No. of Farmers and Pumping Methods

Parameter	Statistic/Value
Sub-counties	Taveta
Wards/ villages	Chala/Njukini, Mahoo, Mata & Mboghoni
Schemes	15 schemes (see the annex for names)
Main crops grown	Tomatoes, Onions, Beans, Maize, Green leafy vegetables, French Beans, Rice, Bananas
Average acreage per farmer	1.5
No. of seasons per year (average)	2–3
Water sources	Njukini river, Lumi river, Njoro Kubwa canal etc.
Approximate total no. of farmers	5,228
Average daily water demand per farmer (litres)	4000
Average Water Lifting Head (metres)	Unknown
Present source of pumping energy	Petrol
Average cost of pumping energy per month (KES)	11,200

(Source: County Department of Crops)

As can be seen from Tables 33 and 34 above, all the farmers are pumping irrigation water using petrol-powered pumps. A project is therefore proposed to introduce solar-powered pumps, which can completely displace the petrol pumps or significantly reduce their usage.

Table 35: Capex Cost of Solar-Powered Pumps for River and Irrigation Canals Water Pumping

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Solar-powered pumps	• Suitable for irrigating up to 1 acre • Flow rate: up to 10,000 litres/day • Suction lift: 7m • Total lift: 15m • Warranty	70,000	6200	434,000,000.00

Introducing solar-powered pumps to replace fuel pumps for irrigation offers several compelling justifications. Solar-powered pumps offer significant cost savings over fuel-powered pumps in the long term. While the initial investment for solar pumps may be higher, they have lower operating and maintenance costs since they rely on free solar energy. Farmers can save substantial amounts on fuel expenses, reducing their overall irrigation costs and improving their financial sustainability (World Bank 2018).

However, given the high Capex cost, the county government would rather pursue a market-based approach. The market-based approach will aim to leverage market forces, private sector engagement, and consumer demand to facilitate the adoption of renewable energy solutions for agricultural irrigation. The project will involve collaboration between private sector stakeholders, financial institutions, technology

providers, and local farmers to create a sustainable market ecosystem for solar-powered pumps. Through this market-based approach, the project aims to catalyse the growth of a vibrant market for solar-powered pumps in these regions, enabling farmers to access affordable, clean energy solutions for irrigation while promoting economic development, food security, and environmental sustainability in the area.

The project will be implemented by the county department of Agriculture, supported by the county directorate of energy. The county government will play the following facilitative roles:

- Providing market assessment data on approximate market size. As can be seen from Table 35 above, there is already a sizable market. Nevertheless, further market analysis is necessary to assess market dynamics, including pricing, distribution channels, and consumer preferences.
- The county government will further support the roll-out of targeted marketing campaigns, awareness-raising activities, and demonstration events to promote the benefits of solar-powered pumps and educate farmers about the advantages of renewable energy for irrigation. Farmer field days, technology showcases, and testimonials from early adopters will be used to showcase successful case studies and generate interest among potential buyers.
- The county government will also establish robust monitoring and evaluation mechanisms to track the adoption, impact, and scalability of solar-powered pumps among the farming community. Key performance indicators, such as the number of installations, water savings, crop yields, and income generation, will be monitored to assess the effectiveness of the interventions and inform strategic decision-making.

With the above support in place, the private companies will be able to enter the market and establish distribution networks and sales channels to make solar-powered pumps accessible and available to farmers across the Taita Taveta region. Partnerships with local retailers, agro-dealers, farmer cooperatives, and community-based organisations will be forged to facilitate product promotion, sales, and after-sales support services. The private companies will also be expected to innovate business models that ensure access and affordability. This goal will be achieved through the deployment of affordable financing instruments, such as loans, leasing, or pay-as-you-go (PAYG) financing, with a view to enabling farmers to invest in solar irrigation systems. Subsidies, grants, or incentives may be offered to early adopters or marginalised groups to reduce upfront costs and promote uptake among underserved communities.

Costing (Cost to be Borne by the County Government)

Table 36: Costing—Introducing Solar Pumps for River Water Pumping

Activity	Unit	Unit cost (KES)	No. of units	Cost (KES)
Offering market activation support through; • Demonstration & product promotion events • Farmer field days • Technology showcases	Lump sum			5,000,000
Monitoring and evaluation	Lump sum			1,000,000
Total				**6,000,000**

3.1.2.6 Water Sources Supplying Water for Consumption

Electricity Access Status

Boreholes

Table 37: Pumping Methods at County Existing Boreholes

Sub-County	No. of boreholes	Current source of pumping power						
		None	Genset	Grid	Solar	Solar/ Genset	Solar/ Grid	Solar/Grid/Genset
Voi	5		3	1	1			
Mwatate	18	1	4	4	4	2	2	1
Taita	2	1		1				
Taveta	15	4	2	2	5		2	
Total	**40**	**6**	9	**8**	**10**	**2**	**4**	**1**

(Source: County Department of Water Access)

Initially, it is proposed to equip the 15 boreholes (6 unequipped and 9 currently using gensets) with solar water pumping systems. However, priority should be given to the 6 that are not equipped at all. As can be seen from the annex, in most cases, the required pumping duration exceeds the daily sunshine hours available. As such, solar pumping will need to be augmented with either a genset or grid power. The finer details will be worked out during implementation. Solar water pumping systems offer a renewable and environmentally friendly solution for powering boreholes, leveraging the abundant solar energy resources available in the county. A list of these boreholes is contained in the annex. In future, it would also be desirable to solarise the 8 boreholes currently using grid power, so that solar can be the main source of pumping with the grid serving as a back-up.

Costing

Table 38: Cost of Solarising 15 Boreholes

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Installation of solar water pumping systems: • Site assessment, planning & design • Pumping system installation and commissioning • Training and Capacity Building	• Average demand—60–300 72m^3/day • Average yield—5–72m^3/hour • Pump capacity—7.5 to 30 kW	7,000,000 (Cost based on previous similar projects implemented by the county)	15	105,000,000.00
Total				**105,000,000.00**

Water Pans

Communal Water Pans (List Provided in the Annex)

According to data provided by the county directorate of water, there are a total of 17 communal water pans in the county, which primarily supply water for human and livestock consumption. The water holding capacity ranges from 15,000 to 3,000,000 litres. The water lifting head is also unknown. Grid proximity status is also unknown. However, the directorate recommends solar pumping as the most ideal method of delivering water to points of use.

Conservancy Water Pans (List Provided in the Annex)

According to data provided by the county directorate of water, there are a total of 151 water pans in the conservancies, which primarily supply water for wildlife consumption. All the water pans are reportedly in need of pumping solutions. However, the water holding capacity, lifting head, and grid proximity status are all unknown. Nonetheless, the directorate and conservancies umbrella association recommend solar pumping as the most ideal method of delivering water to points of use.

Access to clean and reliable water is essential for agricultural activities, livelihoods, and community well-being. However, many rural areas, including those in our county, face challenges in accessing water due to unreliable or inadequate pumping infrastructure (Kunen et al. 2015). In light of this, we propose an intervention to equip 168 water pans with solar pumping solutions. This initiative aims to harness renewable energy to provide sustainable and efficient water access for communities, livestock, and wild animals, thereby promoting socio-economic development and resilience in our county. The financial costs of these investments will be borne by the county government for 17 pans and the national government through Kenya Wildlife Service and its various partners for the 151 pans.

Costing

Table 39: Cost of Equipping and Fencing Off Water Pans and Small Earth Dams

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Installation of solar water pumping systems: • Site assessment, planning & design • Pumping system installation and commissioning • Training and Capacity Building	• DC pumps with solar panels (head >10 m, flow >10 m^3/hr overhead tank & support structure & fencing off the structure	1,200,000	168	201,600,000.00
Total				**201,600,000.00**

Cost apportionment

Table 40: Apportionment of Solarising Water Pans and Small Earth Dams According to Sponsoring Agencies

S/No.	Implementing agency	Number of water pans/ earth dams	Unit cost (KES)	Cost (KES)
1	County government	17	1,200,000	20,400,000.00
2	National government	151	1,200,000	181,200,000.00
	Total	**168**		**201,600,000.00**

3.1.2.7 Mining Sites

According to the county department of mining, there are 19 main mining sites in the county. At these sites, there is an average of 216 mine owners who have employed an estimated 4,317 mine workers. During the day, the miners spend an average of 8 hours inside the mining tunnels, while at night they spend an average of 6 hours. Battery-powered flashlights are the main source of lighting. The average monthly cost of lighting energy per mine owner is estimated at KES 7,200. Full data is contained in the annex.

It was reported that the obsolete batteries from the flashlights are littered across the mining sites and are causing environmental pollution. As such, the department of mining recommended the introduction of

solar lanterns to replace battery-powered flashlights. The lanterns should have the capacity to produce adequate illumination for up to 8 hours of operation. Working with about 2 lanterns per mine worker, a total of about 8,700 lanterns need to be disseminated. For outside illumination, a total of 36 high mast floodlights are also required. The distribution of these floodlights at the mining sites is shown in the annex. The capital expenditure (capex) cost of these interventions is tabulated in the table below. However, regarding portable solar lanterns, dissemination will mainly be anchored on market-based models, as they are more effective and sustainable. The department of mining will work closely with the department of energy to craft a project that will deliver these solar lanterns.

Table 41: Capex Cost of Interventions to Sustainably Light the Mining Sites

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Installing High Mast Flood Lights in off-grid market centres	• Solar powered High masts • Height = 30 metres • No. of lamps = 10 pcs • Lamp wattage 200w to 250w	4,500,000	36	162,000,000.00
Solar lanterns	Battery can last up to 8 hrs, portable, bright torch function, USB charger	7,000	8,700	60,900,000.00
Total				**222,900,000.00**

3.1.2.8 Summary of Electricity Generation and Consumption in the County

Table 42: Existing Grid Network

Transmission sub-stations		Sub-transmission lines (Length in km)			Distribution primary sub-stations		Medium voltage distribution lines (Length in km)		Distribution transformers	
No.	Installed Capacity (MVA)	66 kV	132 kV	220 kV	No.	Installed Capacity (MVA)	11 kV	33 kV	No.	Installed Capacity (MVA)
2	45		126.2		2	5	557.06	731.40	953	81.57

(Source: Kenya Power)

Table 43: Customers Connected to the Grid Network and Power Consumption

Customer base					Total annual units (kWh)
Commercial & Industrial	Domestic	Street lights	SMEs	Grand Total	
22	66,934	212	2,752	69,920	5,582,384

(Source: Kenya Power)

3.1.2.9 Barriers to Universal Access and Mitigation Measures

Electrification efforts are primarily coordinated and executed by national-level actors, although there has been a growing emphasis on decentralised structures and technologies in recent electrification policies. The primary obstacle lies in the limited capacity of county governments to implement electrification

projects, with additional challenges stemming from issues of legitimacy, overlapping responsibilities, transparency, and information-sharing. Moreover, accountability among national actors is lacking, alongside insufficient inclusiveness and participation of local communities (Volkert and Klagge 2022). However, the enactment of the Energy Act of 2019 was timely since it adequately addresses this challenge. Indeed, the 5th schedule vests the role of 'Implementation of County Electrification Projects' with the county government. The county government must therefore rise to the occasion, leverage this provision, and proactively push for the implementation of the above proposed electrification projects.

Another expected hurdle concerns the mobilization of adequate financial resources. Funding electrification initiatives across various sectors requires a substantial budget. Counties primarily depend on the equitable share of revenue allocated by the national government to finance their projects. However, this funding faces numerous competing priorities and is often disbursed irregularly. This barrier notwithstanding, the county government must innovatively explore all opportunities to ensure that the various proposed interventions are actualised within the shortest time possible. In this endeavour, the county government must begin by appreciating the unique role played by electricity access as a key prerequisite for socio-economic development. With this appreciation, it will be possible to prioritise energy projects. Secondly, the county government must forge strategic partnerships with all partners—national government agencies (e.g. REREC, which has a matching fund arrangement of KES 5 million per constituency for electrification projects), development partners, and private sector players so as to aggressively mobilise resources and make the universal county electrification goal a reality.

3.2 Access to Clean Cooking Solutions

3.2.1 Key Stakeholders in Clean Cooking Services and Projects

Clean cooking plays a pivotal role in fostering socio-economic development by addressing multiple interconnected challenges. Access to clean cooking fuels and technologies enhances health outcomes by reducing indoor air pollution, which is a significant contributor to respiratory diseases, particularly among women and children who are often responsible for household cooking. Moreover, transitioning to clean cooking solutions can alleviate the time burden on women and girls, who typically spend hours collecting traditional fuels like firewood, enabling them to pursue education and income-generating activities. Additionally, the adoption of clean cooking technologies promotes environmental sustainability by mitigating deforestation and reducing greenhouse gas emissions. By unlocking these benefits, clean cooking contributes to improved public health, gender equality, and environmental conservation, ultimately driving inclusive socio-economic development.

Clean cooking initiatives in the county have been scarce, reflecting a lack of prioritisation from both the national and county governments, as well as development partners. This oversight has led to widespread reliance on biomass fuels and inefficient cooking practices, exacerbating environmental and health challenges in the county. Indeed, the literature review and informant interviews identified only three clean cooking projects being rolled out in the county. Firstly, there is the GCF project, funded by GIZ and implemented by Mercy Corps. The project aims to promote 'Climate Friendly Cooking in the Coastal Region of Kenya,' to accelerate Improved Cookstove (ICS) sector growth by unlocking the potential of last-mile distribution channels through market development support and consumer education. The second project is the 'African Biodigester Component (ABC) Project,' which seeks to create a sustainable, stable, and expanding market for bio-digesters in Kenya. This project is being implemented by a consortium of

GIZ, SNV, in collaboration with Africa Bioenergy Programs Limited. In Taita Taveta, the project aims to facilitate the installation of biogas digesters through technical and financial support. The last project is the KOSAP project, which is supporting clean cooking companies to enter and penetrate the clean cooking market in the county.

While the efforts outlined above are commendable, their impact in addressing the overarching need for clean cooking solutions remains relatively insignificant. This underscores the necessity of this document, which aims to serve as a catalyst for mobilising resources and uniting all stakeholders—including the national government, county government, development partners, and the private sector—behind the shared objective of prioritising the clean cooking agenda in the county. By raising awareness, highlighting the importance of clean cooking, and outlining actionable steps for intervention, this document seeks to galvanise concerted efforts towards achieving widespread adoption of clean cooking technologies. Through collaborative action and sustained commitment, it is envisioned that significant progress can be made in improving household health, reducing environmental degradation, and fostering socio-economic development in the county.

3.2.2 Access Situations, Interventions and Proposed Progression to Universal Access

3.2.2.1 Households

There is high dependency on local woody resources (firewood), with 71% of households (HHs) relying on firewood as their primary fuel. Charcoal and LPG are the primary fuels for 24% and 4% of the HHs, respectively.

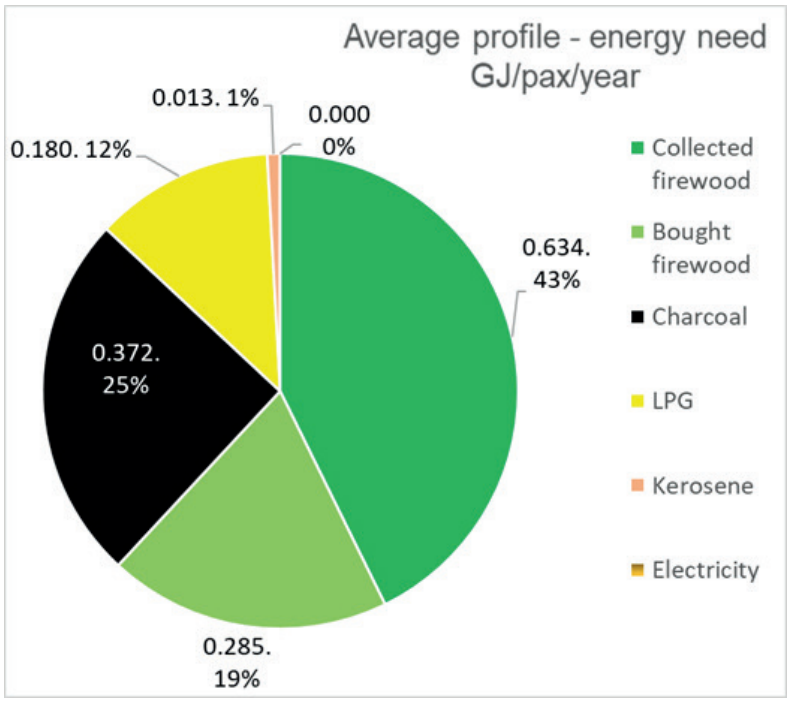


Figure 14: Summary of Cooking Energy Consumption by Fuel Type

Firewood covers 72% of the cooking needs, with 69% of the firewood being collected and 31% purchased, on average. Charcoal covers 25% of the needs and LPG 12%, even though only 4% of HHs reported using LPG as a primary fuel. LPG is mainly used as a secondary fuel for charcoal users. There is poor performance in terms of the efficiency of firewood stoves, as 74% of HHs using firewood rely on the Three Stone Open Fire (TSOF). Only 20% of the HHs have a masonry stove, while 3% have a firewood ICS. However, there is good penetration of charcoal ICS.

The cooking situation is likely to evolve with the transformation of the county due to urbanisation. In 2023, the urban population is estimated to represent 28% of the total population, with urban HHs representing 31% of the total HHs, as shown in Figure 1. This is expected to change in the next 10 years, with the urban population growing faster, and the number of urban HHs increasing from 34,045 in 2023 to 52,000 HHs in 2033.

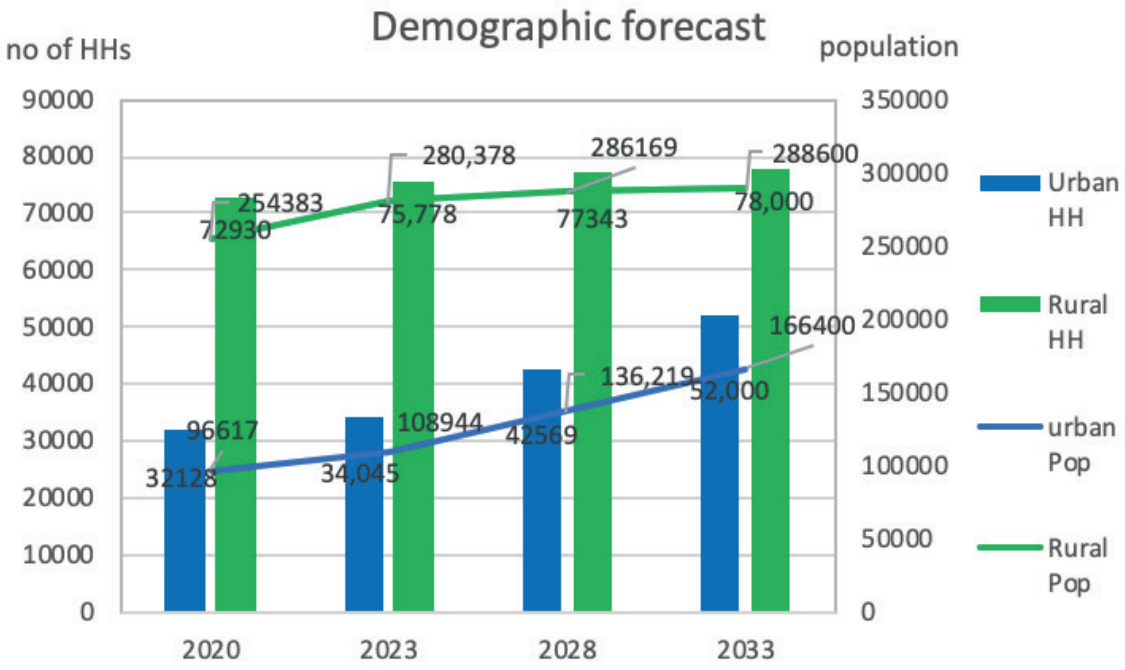


Figure 15: Demographic Projection for Taita Taveta County

Discussed Transitional Pathways

Rural HHs:

- Revitalise the development of masonry stoves through training of artisans and adoption of modern ICS stoves for firewood, tied to sensitisation on sustainable use of natural resources through:
  - Promotion of woodlots and tree planting on farms.
  - Enforcement of existing regulations (10% of farm area covered by trees).

- Mapping of charcoal production and elaborating a strategy to progressively offset this production (charcoal requires approximately 6–7 tonnes of firewood to produce 1 tonne of charcoal, depending on the efficiency of carbonisation—15% to 18%).

- Installation of biogas plants for dairy farmers. The ABC programme is currently ongoing, with a target of 20,000 small-to-medium-scale (farm-size) biogas plants and 250 institutional plants over the next 5 years. The proposed target for the dissemination of biogas plants in Taita Taveta is as follows:
- By 2033: A target of an additional 1,600 biogas plants to be constructed, pushing the number of biogas plants to 2,000 by 2033.
- Adoption of modern clean cooking solutions such as bioethanol and EPCs.

Urban HHs:

- Adoption of modern firewood and charcoal ICS between 2023 and 2028.
- Adoption of LPG and bioethanol stoves and fuels from 2028 to 2033.
- Transition to electric cooking (EPCs) to complement LPG and bioethanol.
- Total Energy Demand Comparison Under Different Scenarios

Table 44: Total Energy Demand Comparison under different scenarios

Three scenarios have been developed for the purposes of the county energy plan:

- Baseline or Business as Usual—without any interaction or intervention from the county.
- Policy Scenario—based on the discussion of the expected transitional pathways to a cleaner situation.
- SDG 7 Scenario—proposing a clean cooking situation by 2028 by completely offsetting the use of firewood and charcoal.

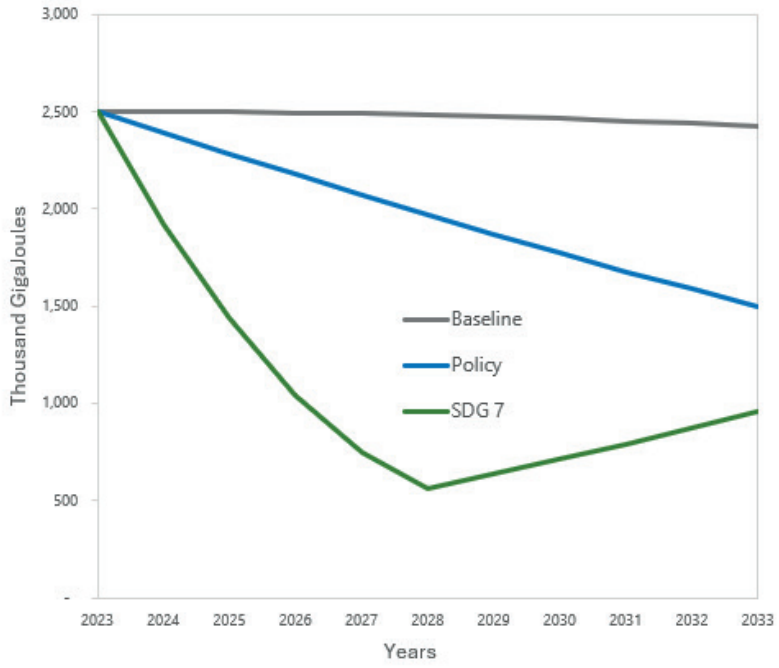


Figure 16: Energy Demand Comparison for All Scenarios

Table 45: Total Energy Demand Comparison Under Different Scenarios

Scenario	2023	2028	2033
Baseline (1,000GJ)	2,501	2,484	2,423
Policy (1,000 GJ)	2,501	1,971	1,498
SDG 7 (1,000 GJ)	2,501	560	955

Baseline Scenario Results

Table 46: Technology Adoption Urban and Rural (Baseline Scenario)

Technology	Urban			Rural		
	2023 (%)	2028 (%)	2033 (%)	2023 (%)	2028 (%)	2033 (%)
TSOF	33	26.5	20	72	59	45
Wood ICS	16	20.5	25	21	33	45
Metallic Charcoal stove	35	22.5	10	31	23	15
Charcoal ICS	34	29.5	25	29	25	20
LPG Meko	44	47	50	10	15	20
LPG Stove	7	9.5	12	8	9	10
Kerosene	4	2	-	5	3	-
EPC	-	1.5	3	-	1	2
Electric Stove (coil/induction cookers)	-	1	2	-	1	1
Bio-ethanol	-	5	10	-	3	5
Biogas	-	-	-	1	1	1.5

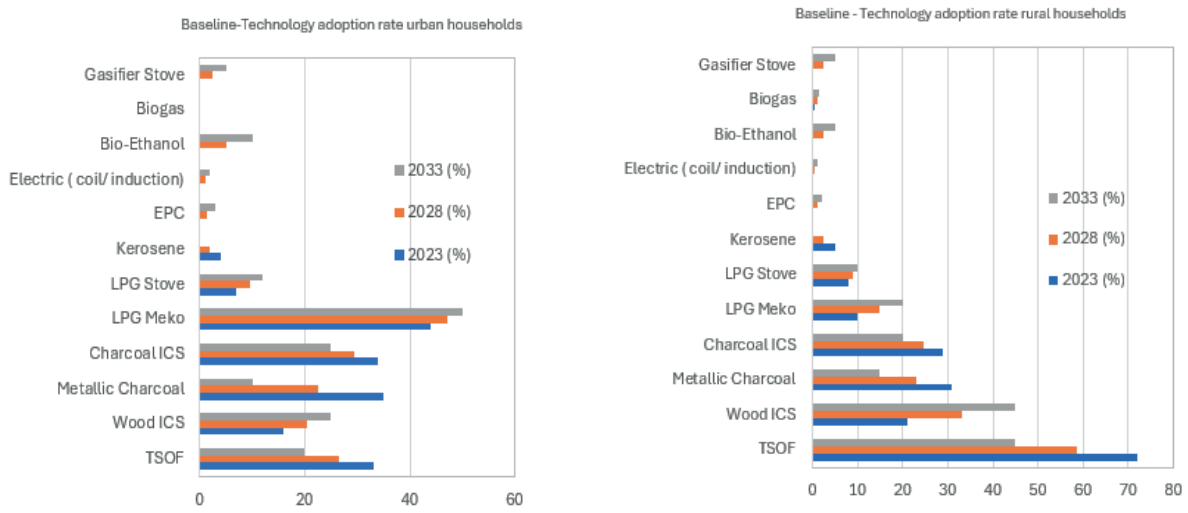


Figure 17: Technology Adoption Rate Urban and Rural Households

This scenario represents the Business-As-Usual (BAU) / reference scenario, which only includes current initiatives such as the Ministry of Energy (MoE) Behavioural Change Communication (BCC) Campaign, construction of demonstration biogas plants, and the exemption of the 8% VAT on LPG, which was enacted in August 2023. The demand for cooking energy under the baseline scenario will remain dominated by firewood, as can be seen in Figure 18, along with a breakdown of the fuel demand in Table 46.

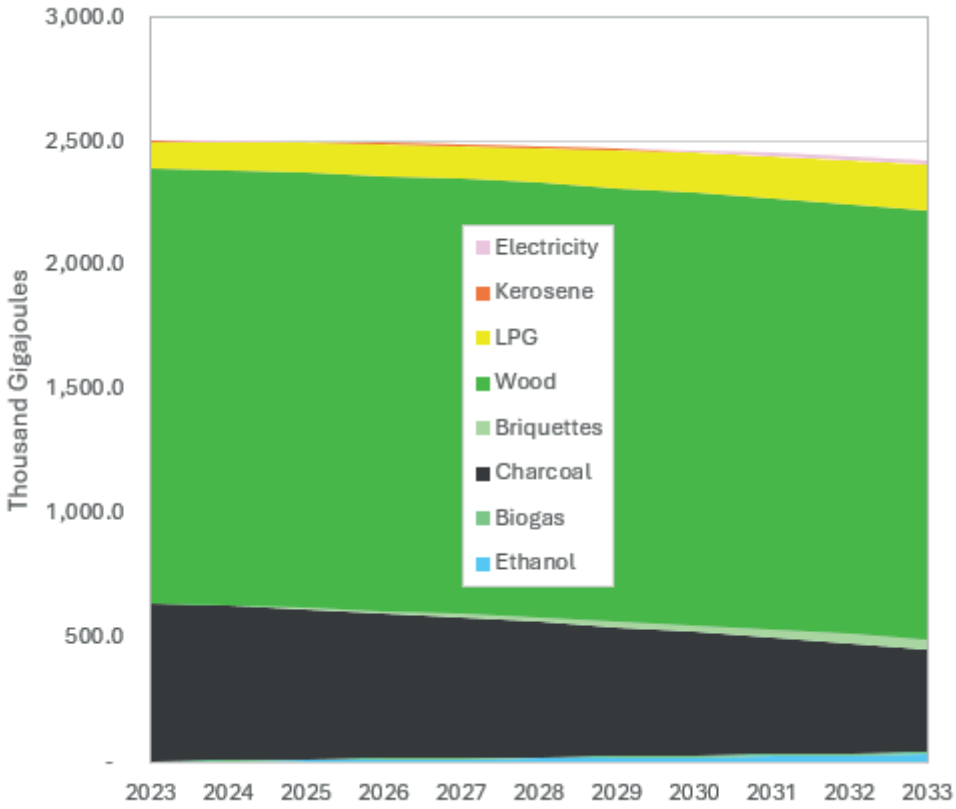


Figure 18: Energy Demand Under the Baseline Scenario (2023–2033)

Table 47: Summary of Fuel Demand under Baseline Scenario

Fuel	2023	2028	2033
Firewood (Tonnes)	112,912	112,822	111,280
Charcoal (Tonnes)	22,114	18,803	14,318
LPG (Tonnes)	2,224	3,058	3,996
Kerosene (1,000 litres)	104	56	-
Electricity (MWh)	-	1,503	3,339
Ethanol (1,000 litres)	-	602	1,350
Biogas (1,000m^3)	133	272	412
Briquettes (Tonnes)	-	899	1,950

Firewood consumption reduces over the years as the population increases, due to the shift from using TSOF to wood ICS stoves, as households become more aware of energy efficiency and the impacts of Household Air Pollution (HAP).

Policy Scenario

Table 48: Technology Adoption Urban and Rural (Policy Scenario)

Technology	Urban			Rural		
	2023 (%)	2028 (%)	2033 (%)	2023 (%)	2028 (%)	2033 (%)
TSOF	33	16.5	-	72	46	20
Wood ICS	16	25.5	35	21	46	70
Metallic Charcoal stove	35	17.5	-	31	16	-
Charcoal ICS	34	17	-	29	15	-
LPG Meko	44	52	60	10	23	35
LPG Stove	7	11	15	8	10	12
Kerosene	4	2	-	5	3	-
EPC	-	2.5	5	-	2	3
Electric Stove (coil/induction)	-	2.5	5	-	1	2
Bio-ethanol	-	10	20	-	8	15
Biogas	-	-	-	1	2	2.5
Gasifier Stove	-	2.5	5	-	5	10

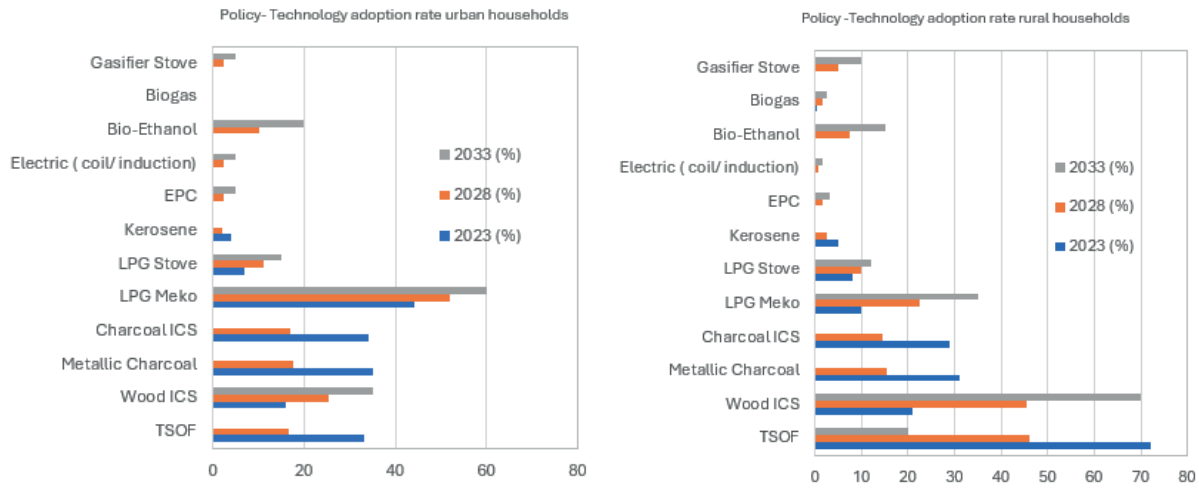


Figure 19: Technology Adoption Rate Urban and Rural Households

The policy scenario is designed to assess the effect of policy interventions that can stimulate the adoption of clean cooking technologies and fuels within the county and includes transitional technologies such as Improved Cookstoves (Tier 2 and 3) in the development pathway. Some policies that can be implemented include the expansion of existing regulations on kerosene and charcoal to support the adoption of clean cookstoves. Allocating funds for the promotion of clean cooking technologies will complement national initiatives such as the BCC Campaign, while also ensuring that there is a skilled labour force for the construction and installation of technologies such as biogas and masonry ICS. Lastly, the county government should establish partnerships with development partners and financial institutions to enhance consumer financing mechanisms available in the market, offering moderate to low-interest rates.

The demand for cooking energy under the policy scenario will be as per Figure 20, with the breakdown of fuel demand given in Table 48.

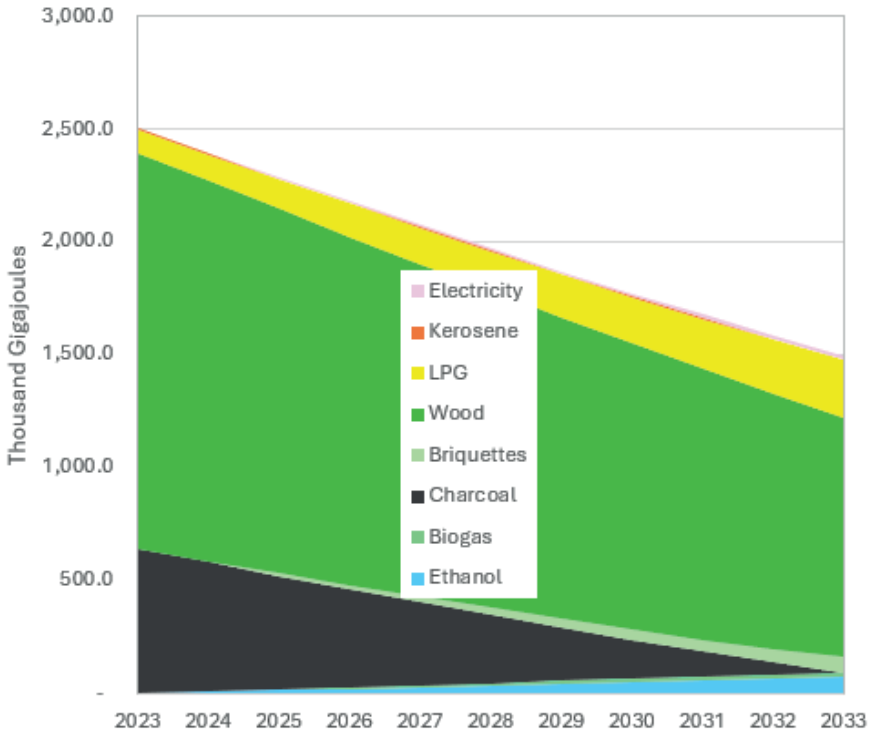


Figure 20: Energy Demand under the Policy Scenario (2023–2033)

Table 49: Summary of Fuel Demand under Policy Scenario

Fuel	2023	2028	2033
Firewood (Tonnes)	112,912	90,759	68,380
Charcoal (Tonnes)	22,114	10,390	-
LPG (Tonnes)	2,224	3,722	5,421
Kerosene (1,000 litres)	104	56	-
Electricity (MWh)	-	2,630	5,926
Ethanol (1,000 litres)	-	1,492	3,278
Biogas (1,000m^3)	133	409	687
Briquettes (Tonnes)	-	1,479	3,120

SDG 7 Scenario

This scenario is designed to achieve the SDG target of universal access to clean and modern cooking energy by 2028. It is built around the vision that economic growth will align with the economic blueprint Vision 2030, where the annual GDP growth rate is 10%, and the citizens have the resources to

transition to modern clean cooking solutions across the county. It seeks to achieve a complete phase-out of unsustainable solid biomass in combination with traditional cookstoves and kerosene cookstoves by 2028. Modern energy cooking solutions, such as the use of LPG, bio-ethanol, electricity, and biogas, will be adopted across all sectors of the county as the primary mode of cooking.

Table 50: Technology Adoption Urban and Rural (SDG Scenario)

Technology	Urban			Rural		
	2023 (%)	2028 (%)	2033 (%)	2023 (%)	2028 (%)	2033 (%)
TSOF	33	-	-	72	-	-
Wood ICS	16	-	-	21	-	-
Metallic Charcoal	35	-	-	31	-	-
Charcoal ICS	34	-	-	29	-	-
LPG Meko	44	57	70	10	33	55
LPG Stove	7	18.5	30	8	17	25
Kerosene	4	-	-	5	-	-
EPC	-	5	10	-	3	5
Electric (coil/induction)	-	2.5	5	-	3	5
Bio-ethanol	-	12.5	25	-	10	20
Biogas	-	-	-	1	2	4.0
Gasifier Stove	-	-	-	-	-	-

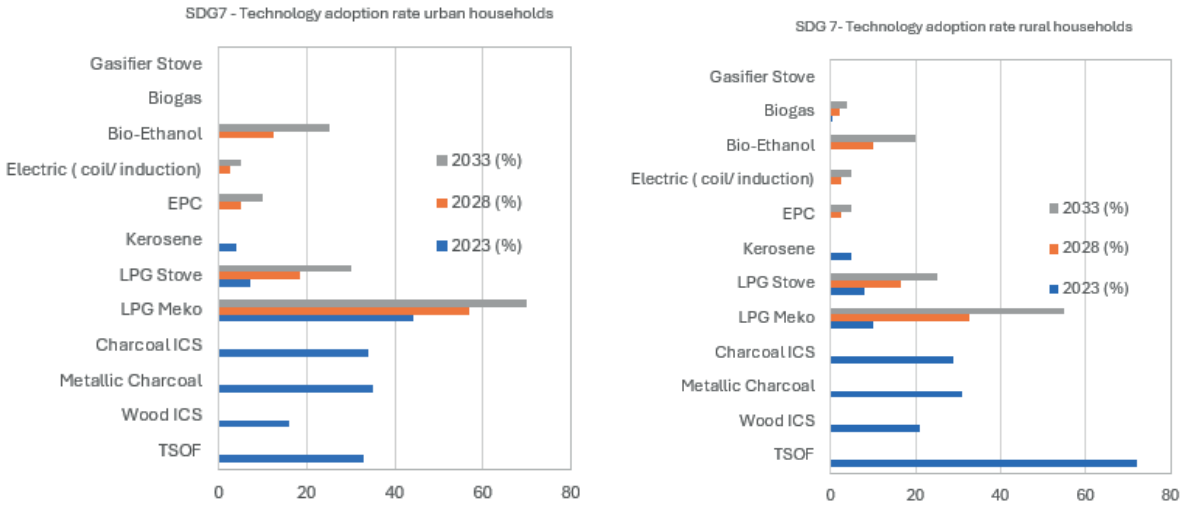


Figure 21: Technology Adoption Rates Urban and Rural Households

The demand for cooking energy under the SDG 7 scenario will be as per Figure 22, and the breakdown of fuel demand is given in Table 50.

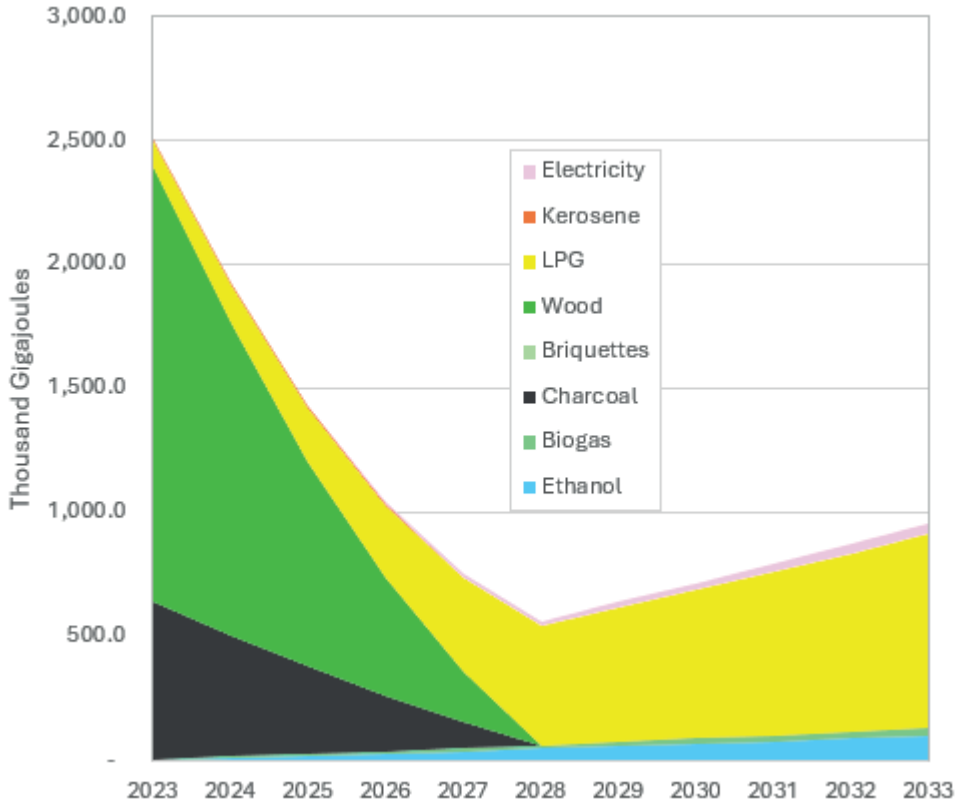


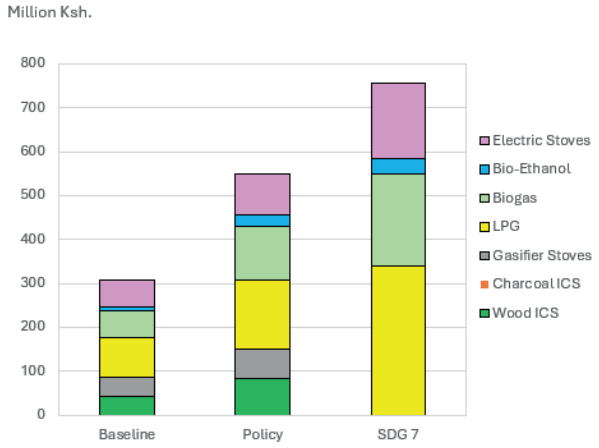
Figure 22: Energy Demand under the SDG Scenario (2023–2033)

Table 51: Summary of Fuel Demand under SDG Scenario

Fuel	2023	2028	2033
Firewood (Tonnes)	112,912	-	-
Charcoal (Tonnes)	22,114	-	-
LPG (Tonnes)	2,224	10,135	16,601
Kerosene (1,000 litres)	104	-	-
Electricity (MWh)	-	5,242	11,571
Ethanol (1,000 litres)	-	1,936	4,242
Biogas (1,000m^3)	133	681	1,221
Briquettes (Tonnes)	-	1,479	-

Synthesis of the Three Scenarios

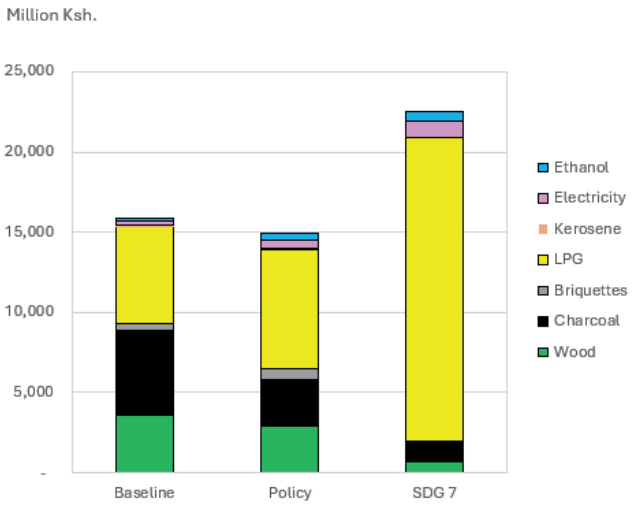
To compare the scenarios, the investments for each technology have been calculated year by year and consolidated as a net present value at a discount rate of 4%. The discount rate may reflect the cost of capital or the returns available on alternative investments of comparable risk. A low discount rate is selected due to the social dimension of the cooking sector, prioritising a more long-term strategy (longer period of return on investment).



Technology	Cost Million (Ksh.)		
	Baseline	Policy	SDG 7
Wood ICS	43	83	-
Charcoal ICS	-	-	-
LPG	91	158	338
Biogas	61	121	211
Bio-Ethanol	11	27	36
Electric Stoves	59	93	171
Gasifier Stoves	42	67	0
Total (Kshs)	306	550	756
Total (USD)	2	4	5

Figure 23: NPV of the Technology Investments in the Three Scenarios

Cooking Fuel Expenses Analysis



Fuel	Cost Million (Ksh.)		
	Baseline	Policy	SDG 7
Wood	3,615	2,889	656
Charcoal	5,244	2,902	1,315
LPG	6,048	7,420	18,928
Kerosene	71	71	33
Electricity	289	508	997
Ethanol	174	428	555
Briquettes	428	696	-
Biogas			
	15,867	14,913	22,483

Figure 24: Discounted Fuel Expenses for 2024–2033

Implementing the policy scenario in the county will generate savings of approximately KES 1 billion in fuel costs compared with the reference scenario. However, it requires KES 244 million more than the reference scenario for the technology investment. The policy scenario is thus recommended.

Table 52: Number of Clean Cooking Solutions to be Disseminated between 2024 and 2033

Technology	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
ICS	4,752	4,848	4,940	5,030	5,115	5,199	5,278	5,354	5,427	5,496	51,439
Gasifier	940	964	987	1,009	1,031	1,053	1,074	1,094	1,114	1,133	10,399
LPG—Meko	3,232	3,315	3,397	3,478	3,559	3,638	3,716	3,793	3,870	3,945	35,943
LPG—13 kg	735	764	794	824	854	885	916	948	980	1,013	8,713
Bio-ethanol stoves	1856	1933	2011	2089	2169	2248	2328	2407	2489	2571	22,101
EPC	406	426	444	464	483	503	523	543	563	584	4,939
Electric induction cookers	406	426	444	464	483	503	523	543	563	584	4,939
Biogas stoves	154	155	156	157	158	158	158	158	158	157	1,569

As can be seen from the tables above, a capital expenditure (capex) totalling USD 4 million is required to implement the solutions over the designated duration. The delivery of these solutions is expected to be facilitated through a combination of market-based and non-market-based interventions. Resources for implementation will be mobilised from various sources, including county internal funds, national government allocations, interventions from development partners, and private sector initiatives. Market-based interventions will be spearheaded by the private sector, with support from the county government through the creation of a conducive operating environment and partnerships that may include subsidies and result-based grants. Non-market-based delivery will focus on providing solutions to the most vulnerable households in need. Implementation will be overseen by the county government, in collaboration with the national government, development partners, and the private sector, reflecting a concerted effort to address cooking energy access challenges comprehensively and inclusively.

Recognising the effectiveness and sustainability of private sector-led initiatives, the county government will embark on an awareness creation campaign to educate households about the significance of adopting cleaner cooking methods. This campaign aims to raise awareness about the health, environmental, and economic benefits associated with cleaner cooking technologies while also strengthening supply through capacity building for local stove artisans and businesses. The costing of these market stimulation initiatives is shown in the table below.

Table 53: Costing of Market Activation Interventions—Clean Cooking Solutions

Activity	Unit	Unit cost (KES)	No. of units	Cost (KES)
Offering market activation support through; • Demonstration & product promotion events • Training workshops (local artisans, businesses etc.) • Capacity building (local artisans, businesses etc.) • Monitoring & evaluation	Lump sum			10,000,000
Total				**10,000,000**

3.2.2.2 Education institutions (ECDEs, primary schools, secondary schools and tertiary institutions)

ECDEs (pre-primary 1 and pre-primary 2)

There are a total of 318 ECDEs in the county. All of them are exclusively cooking with firewood, which is usually sourced from local markets. Of these 318, 264 are exclusively cooking with traditional three-stone open fires, while 54 are exclusively cooking with improved stoves. The improved stoves include the rocket stove (8) and the improved institutional stove (46). In all ECDEs, cooking is done in temporary kitchens. The average monthly expenditure on firewood per ECDE is KES 4,823, with an average student population of 34. The lowest enrolment is 3 students, while the highest enrolment is 148 students. Meals cooked include ten o'clock porridge and occasionally boiled maize and beans for lunch.

Table 54: ECDEs and the cooking methods

Sub-County	Number of ECDEs	Exclusive primary fuel	Type of primary stove used & kitchen type			Type of primary stove used & kitchen			Average monthly fuel expenditure (KES)	Average student population
			3-stone open fire	Modern kitchen	Temporary kitchen	Improved institution stove	Modern kitchen	Temporary kitchen		
Wundanyi	64	Firewood	18		18	46		46	8,677	29
Voi	92	Firewood	92		92				4,120	41
Mwatate	84	Firewood	84		84				4,000	30
Taveta	78	Firewood	70		70	8		8	2,493	37
Total/ average	**318**		**264**		**264**	**54**		**54**	**4,823**	**34**

(Source: County Department of ECDEs)

It is proposed to install improved institutional cookstoves (one Bellerive model per ECDE in 264 ECDEs) and to modernise the kitchens in all 318 ECDEs.

Rationale for recommending improved cookstoves for institutions

According to Baldwin (1988), the energy delivered to the pot is a function of the quantity of fuel burnt (kg), its calorific value (k), and the thermal efficiency of the stove used to combust the fuel (%). Therefore:

kg * k * % = Q ..... (i)

Since the calorific value (k) is constant, rearranging equation (i) above by holding fuel quantity constant (kg), the amount of heat energy delivered to the pot (Q) becomes directly proportional to the thermal efficiency of the stove used to combust the fuel (%).

$kg * k * \% = Q$

$(kg * k) * \% = Q$

$\% \propto Q$ ..... (ii)

Similarly, rearranging equation (i) above by holding the heat energy delivered to the pot (Q) constant, the stove's thermal efficiency (%) becomes inversely proportional to the fuel quantity consumed (kg).

$kg * k * \% = Q$

$$\% = \frac{Q}{(kg * k)}$$

$$\% \propto \frac{1}{kg} \text{.....(iii)}$$

Equations (ii) and (iii) prove that deploying stoves with higher thermal efficiency will automatically bring about a reduction in fuel consumption and therefore a saving on the fuel budget. In addition to improved cookstoves (those with higher thermal efficiency), cooking technologies such as solar, electricity, biogas, LPG, natural gas, and alcohol-based liquid fuels are recommended since they are cleaner at the point of use—devoid of noxious emissions responsible for household air pollution—and, in most cases, cheaper than firewood and charcoal (WHO 2022). Let us demonstrate the above concept by looking at potential fuel savings realised through replacing three-stone open fires with the Bellerive institutional stoves at the ECDEs. The former has an average thermal efficiency of 13%, while the latter's efficiency is about 39% (Ehrensperger et al. 2016).

Table 55: Cooking energy needs at ECDEs under the status quo scenario—justification for transitioning institutions to improved cookstoves

No. of stoves	Average monthly fuel expenditure / ECDE (KES)	Average cost of firewood/ Kg (KES/ kg)	Average monthly firewood consumption (kg) (a)	Three-stone open fire efficiency (%) (b)	Average calorific value of firewood (MJ/kg) (c)	Average cooking energy requirement/ ECDE/ month (MJ/month) (a*b*c)
264	4,823	5	964.9	13	18	2,257.9

Table 56: Cooking energy needs at ECDEs after switching to Bellerive stoves—justification for transitioning institutions to improved cookstoves

Average cooking energy requirement/ ECDE/ month (MJ/month) (a)	Bellerive stove thermal efficiency (%) (d)	Average calorific value of firewood (MJ/kg) (c)	Average monthly firewood consumption (kg) =	Average cost of firewood/ Kg (KES/ kg)	Average monthly fuel expenditure / ECDE (KES)
2,257.9	39	18	322	5	1,608

Table 57: Fuel and money savings after transitioning (per ECDE)—justification for transitioning institutions to improved cookstoves

Status quo		After transition		Monthly savings		Annual savings (9 months/ year)	
Monthly firewood use in kg	Monthly firewood cost in KES	Monthly firewood use in kg	Monthly firewood cost in KES	Firewood in kg	Cost in KES	Firewood in kg	Cost in KES
964.9	4,823	322	1,608	624.9	3,215	5,624.64	28,935

Therefore, deploying stoves with higher thermal efficiency will automatically bring about a reduction in fuel consumption and a saving on the fuel budget. In the case of the ECDEs, switching from a three-stone open fire to the Bellerive stove results in a reduction of 5,624.64 kg of firewood per ECDE per annum, which translates to 1,484.9 tonnes per year for all the 264 ECDEs cooking with three-stone open fires. This is equivalent to approximately 2,270 five-year-old trees (~654 kg as per GIZ, 2021). Note that in addition to improved stoves, it is also proposed to modernise kitchens in all the 318 ECDEs since the improved stoves are best housed in modern kitchens. The list of these ECDEs is contained in the annex.

Table 58: Capex cost of clean cooking solutions for ECDEs

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Bellerive institutional stoves	100 litress (150–200 students)	200,000	264	52,800,000
Modern kitchens	(Cost based on previous experience in implementing similar projects in the county)	5,000,000	318	1,590,000,000
Total				**1,642,800,000**

Public Primary Schools

There are a total of 223 public primary schools. All of them exclusively cook with firewood using 'old boilers' in temporary kitchens. The old boilers refer to ancient and dilapidated improved institutional cookstoves (Bellerive model), which are worn out beyond repair. It is therefore recommended to install modern improved cookstoves in all 223 schools and simultaneously construct modern kitchens, as temporary kitchens are not suitable for improved stoves. Based on enrolment, there are also good candidates for institutional biogas systems.

Table 59: Primary schools and the cooking methods

Sub-County	Number of primary schools	Exclusive primary fuel	Type of primary stove used & kitchen type			Enrolment			Average monthly fuel expenditure (KES)	Source
			Old boiler	Modern kitchen	Temporary kitchen	Min.	Average	Max.		
Taita	50	Firewood	50		50	37	188	702	18,888	Local markets
Voi	66	Firewood	66		66	24	298	1770	29,834	Local markets
Mwatate	64	Firewood	64		64	64	235	970	23,445	Local markets
Taveta	43	Firewood	43		43	21	369	1382	36,907	Local markets
Total/ average	**223**		**223**		**223**					

(Source: County Directorate of Education—National Government)

To enhance cooking energy efficiency, it is recommended to install improved cookstoves (Bellerive models) in the 223 schools using the old boiler stoves, and human waste biogas systems in 12 schools with enrolments above 700. Additionally, modern kitchens should be built in all 223 schools. A list of these institutions, disaggregated per proposed solution, is included in the annex.

Table 60: Capex cost of clean cooking solutions for primary schools—institutional stoves

Enrolment band	No. of schools	Institutional stove specifications	Unit cost (KES)	Total cost (KES)
21–100	32	100 litres	300,000	9,600,000.00
101–200	83	100 litres	300,000	24,900,000.00
201–350	63	200 litres	350,000	22,050,000.00
351–700	33	350 litres	400,000	13,200,000.00
701–800	4	400 litres	450,000	1,800,000.00
801–1,000	5	500 litres	500,000	2,500,000.00
Above 1,000	3	800 litres	600,000	1,800,000.00
Total	**223**			**75,850,000.00**

Table 61: Capex cost of clean cooking solutions for primary schools—human waste biogas systems and modern kitchens

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Human waste biogas system	Capacity 72 cubic metres	4,000,000	12	48,000,000.00
Modern kitchens	(Cost based on previous experience in implementing similar projects in the county)	5,000,000	223	1,115,000,000.00
Total				**1,163,000,000.00**

Public Secondary Schools

There are 91 public secondary schools. Of these, 60 are primarily cooking with old boilers (ancient institutional cookstoves, some repairable), 28 have modern institutional stoves, and 3 are cooking with a three-stone open fire. In terms of fuel, 84 schools use firewood exclusively, 5 use firewood with biogas from human waste as a secondary fuel, and 2 use firewood with charcoal as the secondary fuel. The following table summarises the information.

Table 62: Secondary schools and the cooking methods

Sub-County	Number of secondary schools	Firewood as the primary fuel			Secondary fuel		Type of kitchen		Average monthly fuel expenditure (KES)
		Old boiler	Improved institutional cookstove	3-stone open fire	Biogas from human waste	Charcoal	Permanent	Temporary	
Taita	20	20	-	-	3	-	20	-	148,824
Voi	27	-	27	-	-	-	27	-	33,785
Mwatate	29	25	1	3	2	2	7	22	66,750
Taveta	15	15	-	-	-	-	-	15	73,267
Total	**91**	**60**	**28**	**3**	**5**	**2**	**54**	**37**	

(Source: County Directorate of Education—National Government)

To enhance cooking energy efficiency, it is prudent to install Bellerive institutional stoves at the three public secondary schools currently using 3-stone open fires. Additionally, it is also advisable to rehabilitate and replace all old boilers. For costing purposes, it is assumed that out of the 60 schools, 30 will need repairs while the other 30 will require replacements. The average enrolment is 400 students. It is also recommended to install human waste biogas systems in eight secondary schools with enrolments of 700 and above. These institutions are currently exclusively using firewood. Finally, the kitchens at 37 institutions should be modernised. A list of these institutions, disaggregated by the proposed solution, is contained in the annex.

Table 63: Capex cost of clean cooking solutions for secondary schools

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Bellerive institutional stoves in 3 schools with 3-stone fire	100 litres	300,000	3	900,000.00
Rehabilitation of old boilers		150,000	30	4,500,000.00
Replacement of old boilers with new institutional stoves	350 litres	400,000	30	12,000,000.00
Human waste biogas system	Capacity 72 cubic metres	4,000,000	8	32,000,000.00
Modern kitchens	Standard size	5,000,000	37	185,000,000.00
Total				**234,400,000.00**

Tertiary Institutions (Universities, TTIs and VTCs)

There are four universities in the county. Out of these four, only two are using LPG for cooking. There are four TTIs, of which only two are cooking with firewood, burnt on improved institutional stoves. There are a total of 31 VTCs—16 do cook while 15 do not. Out of the 16 that cook, one has an improved cookstove, one is using biogas from human waste, and three have rocket stoves. The remaining 11 cook with 3-stone open fires. In terms of cooking environments, two have modern kitchens, seven have temporary kitchens, and seven do not have kitchens at all. A list of the VTCs is contained in the annex.

To enhance cooking energy efficiency, it is prudent to install Bellerive institutional stoves at 11 VTCs currently cooking with 3-stone open fires and to modernise kitchens at 14 VTCs. Based on enrolment, there are two additional VTCs with potential for human waste biogas systems.

Table 64: Capex cost of clean cooking solutions for VTCs

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Bellerive institutional stoves in VTCs using 3-stone fire	200 litres	350,000	11	3,850,000.00
Human waste biogas system	Capacity 72 cubic metres	4,000,000	2	8,000,000.00
Modern kitchens	Standard size	5,000,000	14	70,000,000.00
Total				**81,850,000.00**

3.2.2.3 Health Facilities

All Level 2 and 3 facilities exclusively cook with LPG, spending an average of KES 1,500 per month. This amount is ostensibly incurred in refilling a 6 kg LPG cylinder, implying that cooking is done on a small scale. Three Level 4 hospitals cook with both LPG and charcoal, while one facility cooks with only LPG. The data on these facilities' cooking methods is summarised below.

Table 65: Level 4 hospitals and cooking methods

Facility	Primary fuel	Average monthly cost (KES)	Secondary fuel	Average monthly cost (KES)
Taveta Sub-County hospital	Charcoal	50,000	LPG	12,000
Moi county referral hospital	LPG	1,500	Charcoal	15,000
Mwatate Sub-County hospital	LPG	30,000	None	
Wesu Sub-County hospital	LPG	50,000	Charcoal	12,000

(Source: County Department of Health)

The charcoal consumed at Taveta, Moi, and Wesu Sub-County Hospitals is substantial, given the monthly expenditure. During solutions validation, it was also indicated that all four facilities are good candidates for biogas systems, which can be fed by a mixture of human and kitchen waste. The biogas could help displace charcoal use at these three facilities.

Table 66: Capex cost of clean cooking solutions for Level 4 hospitals

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Human waste biogas system	Capacity 72 cubic metres	4,000,000	4	16,000,000.00
Total				**16,000,000.00**

3.2.2.4 Mining Sites

Miners at all sites primarily cook with firewood on 3-stone open fires. Charcoal is the secondary fuel, burnt on Kenya Ceramic Jikos (KCJ) and metallic stoves. The average cost of cooking energy per mine owner per month is estimated at KES 6,000. About 1,500 clean cooking solutions are needed (one device per four workers). Unfortunately, previous clean cooking interventions in the county have not included the mining community. It is therefore proposed to introduce clean cooking solutions through a market-based delivery approach. Initially, improved firewood and charcoal stoves will be prioritised. Later on,

cleaner options such as LPG will also be considered. These interventions will be implemented alongside those targeting households. The capital expenditure (capex) cost of these solutions is shown in the table below.

Table 67: Capex cost of clean cooking solutions for mining sites

Cost component	Specifications	Unit cost (KES)	Units	Cost (KES)
Clean cookstoves	At least Tier 2 as per IWA framework	3000	1500	4,500,000
Total				**4,500,000**

3.2.2.5 Barriers to Achieving Universal Access and Mitigation Measures

Securing sufficient financial resources for clean cooking initiatives presents a significant challenge, especially considering the substantial budgets required. Currently, a considerable portion of these funds is allocated to the modernisation of institutional kitchens, which, although non-energy related, is crucial for supporting energy intervention efforts. To address this challenge, proactive strategies and strategic partnerships will be essential for effective resource mobilisation.

Non-prioritisation of clean cooking projects by the national government, county government, and development partners: Clean cooking issues have yet to receive the attention and prioritisation they deserve. It is envisioned that this document will provide the much-needed springboard for placing clean cooking issues at the centre of the county's development agenda.

Nomadism: Some rural communities continue to practise nomadism. As such, the cooking solutions proposed must be compatible with this lifestyle. Therefore, the clean cooking stoves disseminated in affected areas should be portable.

Freely available firewood: A significant proportion of households collect firewood freely from their farms, reducing the incentive to purchase modern cooking devices. However, through awareness creation, communities can be educated on the health, socio-economic, and environmental benefits of modern solutions and encouraged to switch to cleaner options.

Affordability: As indicated by the poverty level, the majority of households have low disposable incomes. The rural and urban poor are particularly affected.

Beliefs and negative attitudes towards technology: Unfounded beliefs and attitudes might hinder the adoption and uptake of modern cooking solutions. For example, during community engagement forums, it was mentioned that some people consider meals prepared over a three-stone open fire tastier. Others believe that smoky kitchens impart a certain desirable flavour to food. To counter such beliefs, the proposed solutions should not deviate significantly from the technologies currently in use. This will reduce inertia, as the new devices will be seen as slight improvements on the past. Additionally, information dissemination will play a key role in dispelling these retrogressive myths.

Chapter 4: ENERGY EFFICIENCY AND CONSERVATION

4.1 Introduction

Energy efficiency involves the deployment of appliances and devices that consume less energy while producing a similar or higher output compared to devices that consume larger quantities of energy. Energy conservation, on the other hand, refers to the adoption of behaviours, habits, and practices that enable the consumption of lower amounts of energy. The implementation of EE&C measures yields many benefits, both at generation and consumption levels. At points of generation, EE&C helps minimise costs incurred during power generation. Additionally, EE&C reduces the overall demand on the grid, leading to manageable peak loads and, therefore, a more stable and reliable grid network. At the points of energy use, EE&C leads to lower energy bills. From an environmental perspective, there are also significant benefits since energy generation and consumption are associated with carbon emissions into the atmosphere. In this regard, there is compelling justification to promote EE&C across all sectors of the economy that consume energy services and products (Munene, Odongo & Nyambane 2019).

The Energy Act of 2019, Sections 193, 194, 195, and 196, gives county governments a broad mandate in promoting EE&C matters. Section 193 mandates county governments to take all necessary measures to promote the efficient use of energy and its conservation in buildings, industries, and households. Section 194 instructs county governments to establish a fund to promote the efficient use of energy and its conservation within the county. Sections 195 and 196 empower county governments to enforce compliance with EE&C measures, including ensuring compliance with energy audits for designated facilities (facilities consuming more than 180,000 kWh per annum) and compliance with Minimum Energy Performance Standards (MEPS) for appliances specified under the Energy (Appliances' Energy Performance and Labelling) Regulations 2016. Similarly, the Fifth Schedule under the 'Functions of the County Governments', Section 2(h), mandates county governments to 'customise national codes for energy efficiency and conservation in buildings to local conditions', while Section 3(i) mandates county governments to 'undertake energy efficiency and conservation measures within the county'. The Taita Taveta Climate Change Policy (refer to Section 1.5.2 on county energy policies and regulations) also proposes a raft of measures aimed at ensuring energy efficiency and conservation within the county.

As outlined in the INEP framework, the county energy plan plays a critical role in identifying and implementing measures and interventions to promote EE&C across various sectors within the county. This comprehensive approach encompasses households, buildings, industries, and transportation, recognising the interconnectedness of energy use and its impact on socio-economic development and environmental sustainability. The county energy plan aims to develop tailored strategies and initiatives to improve energy efficiency and promote conservation practices in households through public awareness and behaviour change communication campaigns. Similarly, for buildings, the plan focuses on implementing energy-efficient building codes, promoting green building practices, and enforcing energy audits to reduce energy consumption and carbon emissions. In industries, the plan emphasises enforcing the 4-year audit cycle requirement for all designated facilities in the county. This will stimulate the adoption of energy management systems, technology upgrades, and capacity-building initiatives to enhance energy efficiency, reduce production costs, and improve competitiveness. Finally, in transportation, the plan

seeks to promote the use of fuel-efficient vehicles, incentivise the proliferation of electric mobility, and encourage non-motorised transport methods. By integrating these measures and interventions into the county energy plan, county governments can catalyse a transition towards a more sustainable and resilient energy system, contributing to economic prosperity, environmental protection, and an improved quality of life for residents.

4.2 Households

The promotion of EE&C measures in households will primarily focus on disseminating information regarding the most energy-efficient appliances available. This approach recognises the pivotal role of consumer awareness and informed decision-making in driving the adoption of energy-saving technologies. Through targeted educational campaigns, households will be provided with comprehensive information on the energy efficiency ratings, features, and benefits of adopting energy-efficient appliances. Additionally, the dissemination efforts will highlight the long-term cost savings, environmental benefits, and potential rebates or incentives associated with choosing energy-efficient appliances. By empowering households with knowledge and resources to make informed choices, the promotion of energy-efficient appliances aims to facilitate the widespread adoption of EE&C practices, leading to reduced energy consumption, lower utility bills, and a more sustainable energy future.

To create awareness of the most energy-efficient appliances, it is proposed to implement an awareness and behaviour change campaign in the county to disseminate information on EE&C practices and behaviours. This campaign will be anchored mainly on the Energy (Appliances' Energy Performance and Labelling) Regulations 2016, which prescribe Minimum Energy Performance Standards (MEPS) for lamps (CFLs), fridges, motors, and air conditioners. The regulations are presently under review to add LED bulbs, TVs, computers, and cookers. The standards provide a framework for testing and labelling the appliances.

For appliance labelling, a 5-star labelling scheme is employed, whereby the most efficient appliances carry 5 stars while the least efficient have only 1 star. Based on this labelling scheme, end-users can identify the most efficient appliances available in the market. The labelling scheme, therefore, when coupled with proper awareness, can provide a useful guide for consumers to make informed purchasing decisions. Consumers will appreciate the fact that the energy efficiency of an appliance has a direct impact on the amount of energy (both electric and non-electric) consumed and, consequently, the cost of energy incurred.

This awareness creation project will entail:

1. Development of applicable awareness creation content, anchored on the regulations described above.
2. Producing this content.
3. Disseminating the content through talk shows, county energy days, social media awareness campaigns, public barazas, theatre/skits, school-based programmes, sporting events, and publicity materials.
4. Implementing an M&E framework for assessing outcomes.

Costing

Project: Awareness creation and behaviour change campaign to promote Energy Efficiency & Conservation in Households

Table 68: Costing—Awareness creation and behaviour change campaign to promote Energy Efficiency and Conservation in Households

	Activity	Cost in KES
1	Development of applicable awareness creation content	2,000,000.00
2	Content production	2,000,000.00
3	Content dissemination:	5,000,000.00
4	Monitoring & Evaluation	1,000,000.00
	Total	**10,000,000.00**

4.3 Buildings

According to the Kenya National Efficiency and Conservation Strategy (KNECCS) of 2020, the design and construction of buildings in Kenya are regulated by the Planning and Building Regulations of 2009 and the Building Code of 2006. The strategy acknowledges that these regulatory documents do not comprehensively address the aspect of EE&C in buildings.

In this regard, the strategy proposes the following measures, which are expected to be in place by 2025:

1. Develop and gazette Minimum Energy Performance Standards (MEPS) for buildings.
2. Improve the energy performance of new buildings in Kenya by ensuring that at least 10% of newly built floor area complies with energy efficiency requirements in the total building stock. Adopt the American Society of Heating, Refrigerating and Air-Conditioning Engineers' building energy conservation standards, or an equivalent, for public and commercial buildings.
3. Improve lighting energy efficiency in existing public buildings by at least 50%.
4. Promote new green public buildings—ensure at least 25% of buildings under affordable housing schemes are green buildings.

On its part, the Energy Act of 2019 provides that 'a county government with the authority of EPRA may amend the energy conservation building codes to suit local climatic conditions and may, by rules made by it, specify and notify energy efficiency and conservation building codes with respect to the use of energy in buildings in that county.' Additionally, as previously mentioned, the Fifth Schedule, Section 2(h), mandates county governments to 'customise national codes for energy efficiency and conservation in buildings to local conditions.'

To promote energy efficiency and conservation in buildings, it is proposed to customise County Building Codes and incorporate EE&C measures. After the enactment of the new codes, EE&C measures will be added to the list of parameters considered before the approval of structural and architectural plans, as well as before the issuance of Certificates of Occupancy. However, in so doing, the county government should leverage ongoing work under KNECCS.

The proposed measures, generated through the input of Technical Working Group Members, are as follows:

1. Domesticating/assimilating into the County Building Codes, the DRAFT ENERGY (SOLAR WATER HEATING) REGULATIONS, 2022.

   Section 18: All premises shall have in their design a provision for solar water heating system installation.

   Section 19:

   i. County Governments shall, as necessary, develop legislation on the minimum annual contribution of solar water heating systems to premises' hot water demand.

   ii. County legislation made under this sub-regulation shall exempt from the requirements premises:

      a. with technical limitations;

      b. incapable of incorporating solar water heating systems due to their special circumstances;

      c. supplied with hot water from a cogeneration plant in or proximate to the premises; or

      d. utilising electricity generated from renewable energy, where the excess is used to heat water as a dump load (waste heat recovery).

   iii. The daily hot water demand shall be calculated using the specific hot water demand values specified in Part A of the Seventh Schedule.

2. Utilising solar energy for outdoor lighting.
3. Allowing a reasonable allowance of at least 3 metres between the building perimeter and the plot boundary to facilitate the use of natural lighting inside the buildings. This consideration is mainly necessary in urban areas with high building density.
4. Utilising efficient lighting methods in the building's interior, including at least 3-star light bulbs (as per the MEPS labelling scheme), dimmer switches, and motion sensor bulbs for walkways and verandahs.
5. Deploying solar water pumps and wind pumps for water pumping.
6. Using energy-efficient lifts (as per MEPS standards for motors, at least 3 stars as per the MEPS labelling scheme).
7. Using efficient cooling technologies (as per MEPS standards for air conditioners, at least 3 stars as per the MEPS labelling scheme).
8. Ensuring buildings are well-oriented for maximum sunshine exposure. Ideally, most windows, where possible, should face eastwards.
9. Ensuring, to the extent possible, that buildings benefit from natural ventilation. This will be achieved by prescribing the number, size, and orientation of windows.
10. Embracing translucent roofs where applicable to enhance natural lighting.

In light of the above, a project dubbed 'Reviewing County Building Codes and Incorporating EE&C Measures' is proposed. The project will entail the customisation of County Building Codes to incorporate the EE&C measures outlined above.

The ‘Reviewing County Building Codes and Incorporating EE&C Measures’ project aims to enhance energy efficiency and conservation practices in the construction sector by revising existing county building codes to incorporate EE&C standards and requirements. Recognising the significant impact of buildings on energy consumption, this project seeks to promote sustainable building practices, reduce energy costs, and mitigate environmental impacts.

Activities

Review Existing Building Codes: Conduct a comprehensive review of the current county building codes and regulations to identify gaps, deficiencies, and opportunities for integrating EE&C measures.

Stakeholder Consultation: Engage key stakeholders, including government agencies, industry experts, architects, engineers, builders, and environmental organisations, in a consultative process to gather input, feedback, and recommendations for enhancing building codes with EE&C provisions.

Development of EE&C Guidelines: Develop detailed guidelines, standards, and specifications for incorporating EE&C measures into building design, construction, renovation, and maintenance practices, aligning with the EE&C measures outlined above.

Capacity Building: Provide training, workshops, and educational programmes to building professionals, contractors, and regulatory authorities on the importance of EE&C measures, compliance with updated building codes, and implementation of energy-efficient building practices.

Pilot Projects: Identify pilot projects within the county to demonstrate the feasibility and effectiveness of implementing EE&C measures in real-world construction projects. Monitor and evaluate the performance of these projects to assess energy savings, cost-effectiveness, and environmental benefits.

Public Awareness and Outreach: Launch a public awareness campaign to educate residents, property owners, and developers about the importance of energy efficiency in buildings, the benefits of EE&C measures, and the role of updated building codes in promoting sustainable development.

Policy Advocacy: Advocate for the adoption and enforcement of updated building codes with EE&C provisions through policy dialogues, stakeholder engagements, and collaboration with relevant government agencies and the county assembly.

The project will be implemented by the County Directorate of Public Works and Housing, supported by the County Directorate of Energy.

Costing

Table 69: Costing measures for promoting EE&C in buildings

	Activity	Cost in KES
1	Review Existing Building Codes	2,000,000.00
2	Stakeholder Consultation	2,000,000.00
3	Development of EE&C Guidelines	2,000,000.00
4	Capacity Building	2,000,000.00
5	Public Awareness and Outreach	2,000,000.00
6	Policy Advocacy	2,000,000.00
	Total	**12,000,000.00**

4.4 Industries

As per the Energy Act of 2019, Part VIII, County Governments are mandated to:

- Direct, if necessary, designated facilities (industries, factories, or complexes) consuming more than 180,000 kWh per annum, to have energy audits conducted. Designated facilities are required to carry out energy audits every four years.
- Direct any designated consumer to furnish the EPRA, in such form and manner, and within such period as may be specified by rules made by it, with information regarding the energy consumed by such consumer.
- Train personnel and specialists in techniques for the efficient use of energy and its conservation.
- Specify the matters to be included for inspection purposes.
- Appoint as many inspecting officers as necessary for enforcing energy efficiency and conservation measures.

Due to several limitations, the exact number of industries in Taita Taveta County was not established. However, according to Kenya Power, there are 22 industrial and commercial customers, implying that there are several industries in the county.

To promote EE&C in industries, the county government can begin by mapping all designated industries. It can then support EPRA in enforcing the energy audit requirement by appointing and building the capacity of inspection officers, with the target of ensuring universal compliance.

Project: Promoting EE&C in designated industries by enforcing compliance with energy audit requirements.

Costing

Table 70: Promoting EE&C in designated industries by enforcing compliance with energy audit requirements

	Activity	Cost (KES)
1	*Mapping all designated industries*	2,000,000.00
2	*Enforcing compliance with energy audit requirements*	3,000,000.00
	Total	**5,000,000.00**

4.5 Transport

As a basis for promoting EE&C in the transport sector, the INEP framework prescribes a template for collecting baseline data from the transport sector. This data is supposed to be provided by the National Transport and Safety Authority (NTSA) and the county government. The template is as shown below:

ENERGY EFFICIENCY AND CONSERVATION			
No	**Item**	**Unit**	**Quantity**
1	No. of electric 2 wheelers operating within the county	No.	
2	No. of electric 3 wheelers operating within the county	No.	
3	No. of electric 4 wheelers operating within the county	No.	
4	No. of vehicles operating within the county	No	
5	No. of vehicles owned by residents & operating within the county	No.	
6	Proportion of people using NMT (Non-Motorized Transport)	%	
7	No. of vehicles inspected per annum	No.	
8	No. of motorcycles registered in the county	No.	
9	No. of electric mobile charging facilities	No.	

However, despite efforts to obtain data from relevant departments, these efforts did not bear fruit. As such, it is currently impossible to propose specific measures for promoting EE&C in the transport sector. Nevertheless, the county government should continue to cultivate the right environment for attracting investments in green transport (e-mobility). It should also implement measures to encourage Non-Motorised Transport (NMT). NMT can be promoted by developing dedicated infrastructure for non-motorised transport, including bicycle lanes, pedestrian walkways, and shared pathways, providing safe and convenient routes for cyclists and pedestrians. There should also be proper signage, markings, and lighting to enhance visibility and safety for non-motorised users. Hopefully, in subsequent reviews of the CEP document, it will be possible to obtain this data and propose specific interventions to promote EE&C in the transport sector at the county level.

4.6 Barriers, Risks and Mitigation Measures

Energy efficiency improvement projects are often hindered by several barriers, both internal and external to organisations. Although operational interventions required to address efficiency issues are relatively simple from a technical perspective, factors such as lack of awareness, technical capacity, organisational structure, and financial constraints can impede their implementation. Barriers can be categorised in various ways.

These include principal-agent problems, lack of information, transaction costs, or organisational structure issues. Industry barriers may arise at various points in the decision-making process, as well as in the implementation and management of measures to improve energy efficiency. These barriers are influenced by the business environment and may include decision-making processes, energy prices, lack of information, lack of confidence in available information, or high transaction costs for obtaining reliable information. Limited capital availability is another common barrier.

Other barriers include the "invisibility" of energy efficiency measures, the difficulty of quantifying impacts, and the slow diffusion of innovative technologies into markets. The absence of a corporate energy policy, lack of awareness of energy efficiency strategies, insufficient skills and knowledge, competing corporate priorities, and limited financial resources to fund energy efficiency measures are also significant challenges. Decision-making processes in firms are shaped by their rules of procedure, business climate, corporate culture, managers' personalities, and perceptions of the firm's energy efficiency needs.

It is hoped that implementing this plan will help overcome these barriers and prioritise EE&C issues within the county.

Chapter 5: BIO-ENERGY RESOURCES

5.1 Biogas for Households

A biogas project targeting the 19,016 households identified as having the potential to adopt the technology, as profiled **in section 2.3**, is proposed. This project is envisioned to herald a new era of sustainable energy provision in Taita Taveta County. The plant digesters will be between 8 and 12 cubic metres, which are typical sizes for households. While the estimated unit cost of KES 300,000 per plant represents a substantial financial investment, totalling KES 5,704,800,000.00 for the construction of 19,016 units, the county government remains undeterred. Through strategic partnerships forged with various stakeholders—national government, development partners, and the private sector—the mobilisation of these resources is within reach, epitomising a collective commitment to realising this ambitious vision by 2030. Spearheaded by the collaborative efforts of the Energy Directorate and the Department of Livestock, this initiative not only promises to revolutionise energy access but also underscores the county's unwavering dedication to the eventual elimination of wood fuel.

Activities

The biogas project targeting 19,016 households will encompass a series of coordinated activities aimed at successful implementation and long-term sustainability. These activities include:

Partnerships and Resource Mobilisation: Strengthening partnerships with relevant stakeholders, including government agencies, NGOs, and private sector entities, to mobilise the financial and technical resources necessary for the project's success.

Community Sensitisation and Engagement: Organising awareness campaigns and community meetings to educate residents about the benefits of biogas technology, garner support, and ensure active participation in the project. Under this activity, a number of demo units will be constructed at selected households to demonstrate the technology's efficacy and functionality.

Technical Design and Procurement: Collaborating with experts to design biogas plant digesters tailored to household needs, followed by the procurement of necessary materials for construction.

Construction and Installation: Overseeing the construction and installation of biogas plant digesters at selected households, ensuring adherence to technical specifications and safety standards.

Training and Capacity Building: Providing comprehensive training to households on biogas system operation, maintenance, and safety protocols to ensure effective utilisation and longevity of the infrastructure. Arrangements will also be made to build the capacity of local artisans with construction and maintenance skills.

Sustainability Planning: Developing strategies for the sustainable management and maintenance of biogas systems, including mechanisms for ongoing support, repair, and replacement as needed.

Knowledge Sharing and Replication: Documenting project experiences and lessons learned to facilitate knowledge sharing with other communities and encourage the replication of similar initiatives in the county.

Monitoring and Evaluation: Establishing monitoring mechanisms to track project progress, measure impact, and address any challenges encountered during implementation, with periodic evaluations informing adjustments and improvements.

Costing

Table 71: Costing—biogas project for households

Cost component	Unit	Unit cost (KES) in 2024	No. of units	Discounted Cost (KES)
Capital investment	No. of biogas digesters	300,000	19,016	5,704,800,000.00
Partnerships and Resource Mobilisation, Community Sensitisation and Engagement, Training and Capacity Building, and M&E	Lump sum			10,000,000.00
Total				**5,714,800,000.00**

5.2 Biogas for Institutions from Human Waste

Biogas generation from human waste is still a relatively nascent technology in Kenya. However, in other parts of the world like China, Nepal, and India, this technology is well established. The technology is thus well proven and functional (Mugambi 2014). In Kenya, and specifically in Taita Taveta, there are institutions already generating biogas from a blend of human, kitchen, and animal waste (a good example is St. Mary High School). Overall, the uptake of human waste-fed biogas systems in Kenya will be driven by a combination of energy access needs, environmental considerations, health benefits, government support, and awareness creation. As awareness grows and technological advancements continue, biogas from human waste is expected to play an increasingly important role in meeting institutions' cooking energy requirements.

As previously mentioned in this document, there are 12 primary schools, 8 secondary schools, and 2 Vocational Training Centres (VTCs) in the county with substantial enrolment levels capable of generating adequate human and kitchen waste to sustain biogas plants. Additionally, all Level 4 hospitals have been identified as suitable candidates for this technology. With a proactive approach and strategic partnerships involving the national government, development partners, and the private sector, the county government is confident that biogas systems can be successfully installed at these institutions. This intervention is expected to serve as a catalyst for expanding the adoption of this technology across more institutions in the county.

5.3 Landfill Gas from Municipal Solid Waste

As highlighted in section 2.4, the county generates substantial amounts of municipal solid waste. This waste is accumulated at Chakaleri and Riata dumpsites. The waste comprises organic matter (>55%), plastics, paper and cardboard, glass, and metals. According to Mutz et al. (2017), there are five main technological options available for converting waste into energy. These technologies are briefly discussed below:

Anaerobic Digestion (AD) for Biogas Production: Anaerobic (without oxygen) decomposition of biodegradable organic waste into biogas. The waste is fed into an anaerobic digester, where micro-organisms digest/convert organic matter into biogas and a solid-liquid residue called digestate/slurry. Methane gas is the main energy carrier in biogas, and its proportion is 50–75%, depending on the type of waste and operational conditions. AD is suited for homogenous organic waste. Source-separated household waste, market and garden waste are good sources of AD feedstock. To increase feedstock availability, co-digestion with wastewater sludge, agricultural residue, etc., is also a feasible option. Biogas can be used directly to generate heat or to produce heat and electricity in a combined heat and power (CHP) plant. This is suited for annual waste quantities of >10,000 metric tonnes.

Landfill Gas Capture (LFGC): Sanitary landfilling (SLF) is a widely adopted and accepted method of treating waste. In most developing countries, it is usually the only available method of aggregating and treating waste in a controlled manner. Though more advanced and preferable compared to open dumping, SLF is still associated with negative environmental impacts. LFG capture is incorporated into SLFs to harness methane and mitigate the risk of environmental pollution. LFGC projects require a high content of reactive organic waste. LFG consists of 45–55% methane, with the rest being mainly CO2. LFG is suitable as a fuel for heat or power generation and is suited for annual waste quantities of >10,000 metric tonnes.

Incineration: This is the burning of waste in a controlled process, which reduces the waste's mass by about 75% and its volume by about 90%. Through incineration, the waste is rendered chemically inert, and heat is liberated in a self-sustaining combustion process. The heat energy can be harnessed to produce steam for electricity generation, heating/cooling, or for industrial processes. It is suited for mixed and untreated waste with a minimum lower calorific value (LCV) of 7 MJ/kg and for annual waste quantities of >150,000 metric tonnes.

Co-processing: This refers to the utilisation of material wastes from industrial processes to substitute mineral resources (material recycling) or to substitute traditional fuel materials such as coal and fossil fuels in generating heat energy (energy recovery). It requires fairly homogenous waste and is suited for annual waste quantities of >10,000 metric tonnes.

Alternative Technologies: Pyrolysis and Gasification: These involve the thermal degradation of waste in an oxygen-controlled environment, leading to the formation of pyrolysis gas and solid carbon. The process comprises four steps: smouldering, pyrolysis, gasification, and incineration. These technologies are suitable for specific waste streams, such as industrial waste, but are not suitable for municipal solid waste (MSW) due to the high cost of the technology, the high skills requirement, and the fact that the technology is still in its early stages. These are suited for annual waste quantities of >10,000 metric tonnes.

Table 72: Assessing the Feasible W2E Technology for MSW

Parameter	Taita Taveta MSW	Technology Options				
		Anaerobic Digestion	Landfill Gas Capture	Incineration	Co-processing	Pyrolysis & gasification
1. Overall level of waste management	Systematic collection & disposal exists. Recycling unsystematic/ absent					
2. Waste composition	Organic & non-organic wastes mixed					
3. Calorific value	Unknown; assumed it's <7 MJ/kg with moderate content of inorganic fractions					
4. Suitable annual waste quantities	Chakaleri—51,120 tonnes					
	Riata—19,080 tonnes					
5. Proximity to energy users	Feasibility of energy evacuation to evaluated					
6. Financing of W2E facility	CIDP allocations/ PPP arrangements?					

The Feasible W2E Technology

Interpreting the decision-making matrix

Color code	Implication
	Technology most suitable
	More information is need for complete suitability assessment
	Technology unsuitable

Based on the six parameters, Landfill Gas Capture at Chakaleri and Riata is the most feasible technology, subject to further evaluation of parameters 3, 5, and 6.

Estimating the Landfill Gas (LFG) Potential (Tsunatu et al., 2015)

In bio-chemical conversions, it's only the biodegradable component of organic matter that contributes to energy generation.

Total Waste = W tonness

Total Organic/Volatile Solids: VS = 50% (typical)

Organic bio-degradable proportion = 55% (county directorate of environment)

Total biodegradable organic matter = 0.5 * 0.58 * W = 0.29W tonnes

Digestion efficiency = 60% (typical)

Typical gas yield in m^3 = 0.8 m^3/ kg of organic matter digested; (0.29 W * 1,000) kg * 0.8 m^3/ kg * 0.6 = 139.2W

Calorific value of LFG = 5,000 kcal/m^3 (typical) = 5.81 kWh/ m^3 (1kWh = 860 kcal)

Hence, total energy recovery potential in kWh = 139.2W * 5.81 = 808.75W

Landfill Gas Potential (LFGP) at the Two Dumpsites

Table 73: Landfill Gas Potential (LFGP) at the Chakaleri and Riata Dumpsites

Parameter	Chakaleri	Riata
Total Annual Waste (W) tonnes	51,120.00	19,080.00
Adjust the annual waste for collection efficiency of 70%	35,784.00	13,356.00
Typical annual gas yield potential in m^3 (139.2W)	4,981,132.80	1,859,155.20
Typical daily gas yield potential in m^3 (139.2W/ (12*30)	13,836.48	5,164.32
Total annual energy recovery potential in kWh (808.75W)	28,940,310.00	10,801,665.00
Actual annual recovery potential in kWh at a typical conversion efficiency of 30% (242.63W)	8,682,271.92	3,240,566.28
Net power generation potential in kW (plant size) = (242.63 W/ (12*30*24) = 10.11W (12*30*24)	1,004.93	375.08

Subject to further quantification of waste quantities to determine the total amount of waste accumulated at the dumpsites, the above preliminary analysis indicates good potential for investing in Landfill Sanitary Facilities at the Chakaleri and Riata dumpsites, from which LFG can be harvested and distributed to nearby households, institutions, and SMEs.

According to Palacio et al. (2019), the applicable costs for the construction of Sanitary Landfills for Landfill Gas Capture at Chakaleri and Riata dumpsites are as shown in the table below.

Table 74: Capex and Opex Costs for Sanitary Landfills for Landfill Gas Capture at Chakaleri and Riata Dumpsites

Dumpsite	Annual waste outputs (tonnes) per annum	Cost component ($) per tonne of waste per year					
		Capital investment $		O & M $		Total $	
		min	max	min	max	min	max
		10	30	1	3	11	31
Chakaleri	35,784	357,840	1,073,520	35,784	107,352	393,624	1,109,304
Riata	13,356	133,560	400,680	13,356	40,068	146,916	414,036
Total	**49,140**	**491,400**	**1,474,200**	**49,140**	**147,420**	**540,540**	**1,523,340**

To support the implementation of the above project for landfill gas capture, the county government should consider domestication of the Sustainable Waste Management Act of 2022, which prescribes the following measures:

Section 14:

1. Each county government shall establish a materials recovery facility (MRF).
2. An MRF shall be used for final sorting, segregation, composting, and recycling of waste generated or transported to the county, and the residual waste shall be transported to a long-term storage or disposal facility landfill. Ideally, the MRFs should be located near or around the two county dumpsites, which will host the sanitary landfills. The county government has already allocated a budget of KES 40 million for an MRF in CIDP 3.

Section 11:

1. County governments shall, in consultation with relevant national government agencies, the public, and other stakeholders, develop county legislation within two years of the Act coming into effect.
2. Notwithstanding the generality of subsection (1), county governments may also make regulations prescribing
    a. the use of land within their jurisdiction for waste management; and
    b. investment in sustainable waste management, including waste collection, separation, treatment, processing, recovery, and sanitary final disposal of waste.

Section 9:

County governments shall:

1. Be responsible for implementing the devolved function of waste management and establishing the financial and operational conditions for the effective performance of this function.
2. Ensure that county waste management legislation is in conformity with this Act within one year of the Act's commencement.
3. Ensure that waste generated within the county is disposed of within the county's boundaries, unless there is an agreed framework for inter-county transportation and disposal of waste.
4. Provide central collection centres for recyclable materials.
5. Establish waste management infrastructure to promote source segregation, collection, reuse, and set up for materials recovery.
6. Maintain data on waste management activities and share the information with the relevant authority.
7. Mainstream waste management into county planning and budgeting.
8. Develop, manage, and maintain designated disposal sites and landfills.
9. Maintain a register of all waste service providers operating within their boundaries.

5.4 Bio-ethanol

As previously highlighted in this document, bio-ethanol presents a promising alternative to traditional cooking fuels such as firewood and charcoal, as it can effectively fulfil cooking tasks like boiling that require sustained heat. Furthermore, companies like KOKO Networks have introduced innovative delivery models which allow users to conveniently purchase bio-ethanol in small quantities on a daily basis.

Considering the significant number of households currently relying on charcoal and firewood, there is a considerable market opportunity for bio-ethanol. It is anticipated that the market activation measures outlined in the section on 'pathways for transitioning households to clean cooking solutions' will act as a catalyst to support bio-ethanol companies entering the Taita Taveta market. By implementing strategies such as awareness campaigns, subsidies, and incentives, these initiatives can help create demand for cleaner cooking alternatives like bio-ethanol, thereby facilitating the expansion of bio-ethanol suppliers into these untapped markets.

As envisioned, it is hoped that by the year 2033, at least 22,000 households will have transitioned from charcoal and firewood to bio-ethanol.

5.5 Barriers, Risks, and Mitigation Measures

High CAPEX costs for biogas digesters inhibiting affordability: This can be addressed through leveraging strategic partnerships and using innovative delivery models. For example, the county government has already signed a memorandum of understanding with SNV for the implementation of the African Biodigester Component. The county government will continue to seek further opportunities and partnerships.

Beliefs and myths: There are misconceptions that biogas from human waste can contaminate food. To address this, it is crucial to provide education and awareness about the scientific process behind biogas production and emphasise the safety measures involved in its use. Highlighting successful examples of similar systems implemented in other institutions in the county can also help dispel myths and build confidence in the technology's reliability and safety.

High capital expenditure for LFG projects: The county government will leverage Public-Private Partnership (PPP) opportunities to address the high CAPEX associated with the Landfill Gas (LFG) project. This approach involves collaborating with private sector entities to share the financial burden and risks of implementing the project. Through PPP arrangements, the county can access private sector expertise, technology, and funding, reducing the financial strain on public resources.

Chapter 6: ENERGY PROGRAMS AND PROJECTS

6.1 Projects and Programs to be Implemented by National Government

Project 1: Ensuring universal access to electricity in primary schools through solar PV connection and rehabilitation of faulty PV systems. The project will be implemented by the Directorate of Education in the national government, supported by the County Directorate of Energy.

Project 2: Equipping county water pans and small earth dams with solar water pumping infrastructure. This is a collaborative initiative between the county government, national government agencies, and development partners. Its implementation will be spearheaded by the County Department of Water Access.

Project 3: Enhancing universal access to clean cooking solutions at primary and secondary schools. This is a collaborative initiative between the national government's County Directorate of Education and the County Department of Energy and partners.

6.1.2 Summary

Table 75: Projects and Programs to be Implemented by National Government

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)-Inflation discounted cost	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
1.	To connect primary schools to electricity	Enhancing universal access to electricity in all learning centers	2024–2028	Site assessment, planning & design Installation and commissioning	Directorate of education backstopped by the county directorate of energy	4,400,000	National government through its various agencies.	5 primary schools	New
2.	To install solar powered water pumping infrastructure at water pans and small earth dams in the conservancies in the county.	Equipping county water pans and small earth dams with solar water pumping infrastructure.	2024–2028	Site assessment, planning & design Stakeholder engagement Pumping system installation and commissioning Training and Capacity Building	County department of Water Access, backstopped by the county directorate of energy	181,200,000.00	National government through its various agencies; conservancies, KWS etc.	Approximately 151 water pans & small earth dams in the county	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)-Inflation discounted cost	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
3.	To phase out 3-stone open fires, replace/ rehabilitate institutional stoves, modernise kitchens, and construct human waste biogas systems	Enhancing universal access to clean cooking solutions at primary and secondary schools	2024–2028	Site assessment, planning & design Installation and commissioning Training and Capacity Building	County directorate of education (national government), county department of energy and partners	1,473,250,000.00	National government & partners	223 public primary schools & 91second-ary schools	New

6.2 Projects and Programs to be Implemented by County Government

6.2.1 Description

Project 1: Facilitating universal electricity access in Taita Taveta households by 2030. The project will be spearheaded by the County Directorate of Energy in close collaboration with the relevant national government agencies (Kenya Power, REREC, KETRACO), development partners (e.g. the KOSAP project), and the private sector (private mini-grid developers).

Project 2: Ensuring universal access to electricity in ECDEs and VTCs through grid and solar PV connections, and upgrading to three-phase electricity supply in VTCs. The project will be implemented by the County Department of Education, supported by the County Directorate of Energy.

Project 3: Ensuring universal access to sustainable and reliable electricity and water heating in health facilities. The project will be implemented by the County Department of Health, supported by the County Directorate of Energy.

Project 4: Enhancing electricity supply at hatcheries in the county. The project will be implemented by the County Department of Livestock, backstopped by the County Department of Energy.

Project 5: Enhancing dairy value chains through electrifying milk processing plants and collection centres, and installation of dual-powered bulk milk chillers for sustainable production. The project will be implemented by the County Department of Livestock, with the County Directorate of Energy offering the necessary technical backstopping.

Project 6: Electrifying fish aggregation and marketing centres. The project will be implemented by the County Department of Fisheries, with the County Directorate of Energy offering the necessary technical backstopping.

Project 7: Retrofitting cold rooms for vaccine storage to make provision for dual powering/acquisition of solar-powered fridges. The project will be implemented by the County Department of Livestock, with the County Directorate of Energy offering the necessary technical backstopping.

Project 8: Strengthening power supply at the Tsavo honey processing plant. The project will be implemented by the County Department of Livestock, with the County Directorate of Energy offering the necessary technical backstopping.

Project 9: Electrification of slaughterhouses in the county—new grid connections and provision of solar PV backup systems. The project will be implemented by the County Department of Livestock, with the County Directorate of Energy offering the necessary technical backstopping.

Project 10: Market-based dissemination of solar-powered water pumps to farmers. A private sector-led initiative with the objective of completely displacing fuel pumps or significantly reducing their usage.

Project 11: Equipping county boreholes with solar water pumping infrastructure. A collaborative initiative between the county government, national government agencies, and development partners. Its implementation will be spearheaded by the County Department of Water Access.

Project 12: Equipping county water pans and small earth dams with solar water pumping infrastructure. A collaborative initiative between the county government, national government agencies, and development partners. Its implementation will be spearheaded by the County Department of Water Access.

Project 13: Replacing battery flashlights with solar lanterns and improving outdoor lighting at mining sites. The project will be implemented by the County Department of Mining, with the County Directorate of Energy offering the necessary technical backstopping.

Project 14: Transitioning all households to cleaner cooking methods by 2033. The project will entail spearheading households' uptake of cleaner cooking solutions comprising improved firewood and charcoal stoves, LPG gas, EPC, bio-ethanol, and biogas. The goal is to completely phase out the inefficient and wasteful traditional three-stone open fire and the metallic charcoal stoves by 2033 while also stimulating the uptake of LPG, bio-ethanol, and biogas. Implementation will be led by the County Directorate of Energy, working in collaboration with the national government, development partners, and the private sector.

Project 15: Enhancing universal access to clean cooking solutions at ECDEs and VTCs. The project will be implemented by the County Departments of ECDEs and VTCs, with the County Directorate of Energy offering the necessary technical backstopping.

Project 16: Displacing charcoal at Level 4 hospitals. The project will be implemented by the County Departments of Health, with the County Directorate of Energy offering the necessary technical backstopping.

Project 17: Promoting clean cooking methods at mining sites in the county. The project will be implemented by the County Department of Mining, with support from the County Department of Energy.

Project 18: Awareness creation and behaviour change campaign to promote energy efficiency and conservation in households. The project will be led by the Department of Communication, working in conjunction with the Department of Energy.

Project 19: Reviewing county building codes and incorporating energy efficiency and conservation measures. The project will be implemented by the County Directorate of Public Works and Housing, supported by the County Department of Energy.

Project 20: Promoting energy efficiency and conservation in designated industries by enforcing compliance with energy audit requirements. The project will be spearheaded by the Department of Energy, working in conjunction with the County Department of Trade and Industrialisation.

Project 21: Promoting biogas uptake by livestock farmers in the county. An ambitious biogas project targeting 1,569 farmers, though there is a potential for 19,016 households profiled as having the potential to adopt the technology. The project will be led by the Energy Directorate, with support from the County Department of Livestock.

Project 22: Construction of sanitary landfills for landfill gas capture at Chakaleri and Riata dumpsites. A public-private partnership project, which will be led by the Energy Directorate, with support from the County Department of Environment.

6.2.2 Summary

Table 76: Projects and Programs to be Implemented by County Government

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
1	To ensure all households will have access to electricity by 2030	Facilitating universal electricity access in Taita Taveta Households by 2030.	2024–2030	Resource mobilization, Infrastructure development, delivery of electrification solutions	County govt. of Taita Taveta in collaboration with: Kenya Power, REREC, KETRACO, KOSAP, Development partners, Private sector	Cost dependent of supply option selected	County govt, National govt., Development partners, Private sector	44,000 households	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
2	To connect ECDEs and VTCs to electricity	Enhancing universal access to electricity in all learning	2024–2028	Site assessment, planning & design Installation and commissioning	Departments of education backstopped by the county directorate of energy	93,400,000	County government & partners	268 ECDEs connected to the grid, 9 ECDEs connected to solar PV, 3 VTCs connected to 3-phase, 5 VTCs upgraded to 3-phase supply	New
3	To connect health facilities with grid power, to upgrade supply from single phase to 3-phase, to install solar water heating systems, to install PV and genset backup, and to rehabilitate faulty PV systems	Ensuring universal access to sustainable & reliable electricity and water heating in health facilities	2024–2028	Site assessment, planning & design Installation and commissioning	Department of health backstopped by the county directorate of energy	391,100,000	County government & partners	4 level 4 facilities, 10 level 3 facilities, and 56 level 2 facilities	New
4	To upgrade grid power supply from single phase to 3-phase and to provide dual-powered incubators	Enhancing electricity supply at the hatcheries in the county	2024–2028	Site assessment, planning & design Installation and commissioning	Department of livestock backstopped by the county directorate of energy	29,500,000	County government and partners	12 hatcheries	New
5	To upgrade grid power supply from single phase to 3-phase and to provide dual-powered chillers	Enhancing dairy value chains through electrifying milk processing plants & collection centres and installation of dual-powered bulk milk chillers	2024–2028	Site assessment, planning & design Installation and commissioning	Department of livestock backstopped by the county directorate of energy	65,500,000	County government and partners	9 milk cooling plants	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
6	To provide solar-powered flake ice-making machines	Electrifying fish aggre-gation and marketing centers.	2024–2028	Site assessment, planning & design Installation and commissioning	Department of fisheries backstopped by the county directorate of energy	15,000,000	County government and partners	3 landing sites without power	New
7	To retrofit vaccine cold rooms to make provision for dual powering or provide solar-powered fridges in order to make power supply reliable & sustainable	Retrofitting cold rooms for vaccine storage/ acquisition of solar powered fridges	2024–2028	Site assessment, planning & design Installation and commissioning	Department of livestock backstopped by the county directorate of energy	4,000,000	County government and partners	4 vaccine centers	New
8	To upgrade supply to 3-phase and to provide a diesel generator	Strengthen-ing power supply at Tsavo honey processing plant	2024–2028	Site assessment, planning & design Installation and commissioning	Department of livestock backstopped by the county directorate of energy	2,000,000	County government and partners	Tsavo honey processing plant	New
9	New grid connection and provision of light PV back-ups	Electrifi-cation of slaughter houses in the county	2024–2028	Site assessment, planning & design Installation and commissioning	Department of livestock backstopped by the county directorate of energy	5,800,000	County government and partners	11 public abattoirs	New
10	To promote uptake and adoption of solar-powered pumps by farmers practising farming using river water and water from canals	Market based dissemina-tion of solar powered water pumps.	2024–2028	Demonstration & product promotion events, Farmer field days, Technology showcases, Monitoring & evaluation	County directorate of crops, supported by county directorate of energy	6,000,000	County government & partners	Approxi-mately 6200 farmers in the county	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
11	To install solar powered water pumping infrastructure in unequipped boreholes and those pumping with gensets.	Equipping county boreholes with solar water pumping infrastructure.	2024–2028	Site assessment, planning & design Stakeholder engagement Pumping system installation and commissioning Training and Capacity Building	County department of Water Access, backstopped by the county directorate of energy	105,000,000.00	County government & partners, as mentioned in this document, KOSAP has preliminarily earmarked 19 boreholes for solarisation.	15 boreholes	New
12	To install solar powered water pumping infrastructure at water pans and small earth dams in the county.	Equipping county water pans and small earth dams with solar water pumping infrastructure.	2024–2028	Site assessment, planning & design Stakeholder engagement Pumping system installation and commissioning Training and Capacity Building	County department of Water Access, backstopped by the county directorate of energy	20,400,000.00	County government & partners	Approximately 17 water pans & small earth dams under the county government	New
13	To displace battery flashlights with portable solar lanterns; To install high mast flood lights	Replacing battery flashlights with solar lanterns and improving the outdoor lighting at the mining sites.	2024–2028	Demonstration & product promotion events Site assessment, planning & design	County department of Mining Access, backstopped by the county directorate of energy	222,900,000.00	County government & partners; Portable lanterns will be disseminated through market-based models	19 main mining sites	New
14	To phase out traditional 3-stone open fires and metallic charcoal stoves while also stimulating uptake of LPG, bioethanol and biogas	Transitioning all households to cleaner cooking methods by 2028	2024–2033	Lobbying & creation of strategic partnerships, market activation, awareness creation & training workshops, demonstration & showcasing of technology, M&E	County directorate of Energy in collaboration with the national government, Development partners & the private sector	Market strengthening support (10,000,000) Capex cost (USD 4 million)	County govt, National govt., Development partners, Private sector	All households in the county	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
15	To phase out 3-stone open fire stoves and to modernise the kitchens	Enhancing universal access to clean cooking solutions at ECDEs and VTCs.	**2024–2028**	Site assessment, planning & design Installation and commissioning Training and Capacity Building	County Departments of ECDES and VTCs with the County Directorate of Energy	1,724,650,000.00	County government & partners	318 ECDEs and 16 VTCs	New
16	To install biogas systems	Displacing charcoal at level 4 hospitals	2024–2028	Site assessment, planning & design Installation and commissioning Training and Capacity Building	County department of health	16,000,000.00	County government & partners	4 level hospitals	New
17	To displace 3-stone open stoves with more efficient ones.	Promoting clean cooking methods at the mining sites in the county.	2024–2028	Demonstration & product promotion events	County department of Mining Access, backstopped by the county directorate of energy	4,500,000 (capex cost)	County government & partners	19 main mining sites	New
18	To implement an awareness and behavior change campaign in the county to disseminate information on EE&C practices and behaviors.	Awareness creation and behavior change campaign to promote Energy Efficiency & Conservation in Households.	2024–2028	Development of applicable awareness creation content – anchored on MEPS regulations, Producing this content, Disseminating the content through talk shows, county energy days, social media awareness campaigns, public *barazas*, theatre/kits, school-based programs, sporting events and publicity materials, Implementing an M&E framework for assessing outcomes.	County department of Communication, backstopped by the county directorate of energy	10,000,000.00	County government & partners	Households	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
19	To enhance energy efficiency and conservation practices in the construction sector by revising existing county building codes to incorporate EE&C standards and requirements.	Reviewing County Building Codes and Incorporating EE&C Measures.	2024–2028	Review Existing Building Codes Stakeholder Consultation Development of EE&C Guidelines Capacity Building Public Awareness and Outreach Policy Advocacy	County directorate of Public Works & Housing	12,000,000.00	County government & partners	The building sector	New
20	To ensure designated facilities in the county are complying with the 4-year audit cycle requirement	Promoting EE&C in designated industries by enforcing compliance of energy audit requirements.	2024–2028	Mapping all designated industries Enforcing compliance with energy audit requirement	County directorate of Energy	5,000,000.00	County government & partners	The industrial sector	New
21	To promote biogas uptake by households.	Promoting biogas uptake by livestock farmers in the county.	2024–2033	Partnerships and Resource Mobilization, Community Sensitization and Engagement, Technical Design and Procurement, Construction and Installation, Training and Capacity Building, Sustainability Planning, Knowledge Sharing and Replication	County department of energy in conjunction with the department of livestock	Capex—KES 5,704,800,000.00 Market activation—10,000,000.00	County government, national government, development partners and private sector. As mentioned previously in the document, GIZ & SNV are implementing the ABC project in the county. The project will contribute towards realization of these targets.	More than 1,569 households, the potential is estimated at 19,016 households	New

S/No.	Objective	Project/ Programme	Timelines	Specific Activities	Implementing Agency	Project Cost (KES)	Source of Fund	Targeted Beneficiaries	Status (New/ Ongoing)
22	To harvest landfill gas from sanitary landfills	Construc-tion of Sanitary Landfills for Landfill Gas Capture at Chakaleri and Riata dumpsites	2024–2028	Feasibility studies, Site assessment, planning & design Installation and commissioning Training and Capacity Building	County department of energy in conjunction with the department environment	Between USD 540,540 and 1,523,340	County government through a PPP	2 dumpsites	New

6.3 Projects and Programs to be Implemented by Development Partners and the Private Sector

6.3.1 Description

Note that the county government is counting on support from development partners to implement all the above projects listed under the 'county government'. However, the projects listed below are those in which development partners and private sector players are expected to take a prominent role in their implementation. The objectives, targets, timelines, costs, and beneficiaries are as listed in the above table on 'projects and programs to be implemented by the county government'.

Project 1: Dissemination of clean cooking solutions and off-grid lighting solutions in households, SMEs, institutions, and mining sites.

Project 2: Promoting biogas uptake by livestock farmers and institutions in the county. For example, the county government has already signed a memorandum of understanding with SNV for the implementation of the ABC project, which aims at installing household biogas systems in the county.

Project 3: Market-based dissemination of solar-powered water pumps to farmers with the objective of completely displacing fuel pumps or significantly reducing their usage.

Chapter 7: IMPLEMENTATION, COORDINATION, MONITORING AND EVALUATION

7.1 Projects and Programs to be Implemented by National Government

Table 77: M&E Framework—Projects and Programs to be Implemented by National Government

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection responsibility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
1	Enhancing universal access to electricity in all learning centers	No. of primary schools connected to solar PV systems	0	2024	1				1	Directorate of education (national government)	County directorate of energy
		No. of primary schools with solar PV rehabilitated	0	2024	2	2			4		
2	Equipping county water pans and small earth dams with solar water pumping infrastructure.	No. of waterpans & small earth dams equipped with solar powered pumping infrastructure	0	2024	30	30	30	61	151	County directorate of water access	County directorate of energy
3	Enhancing universal access to clean cooking solutions at primary and secondary schools	No. of institutional stoves installed at public primary schools	0	2024	50	50	50	73	223	Directorate of education (national government)	County directorate of energy
		No. of kitchens at public primary schools modernized	0	2024	50	50	50	73	223		
		No. of biogas systems installed at primary schools	0	2024	3	3	3	3	12		

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection responsibility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
3	(Continued) Enhancing universal access to clean cooking solutions at primary and secondary schools	No. of institutional stoves installed at public secondary schools	0	2024	3	10	10	10	33	Directorate of education (national government)	County directorate of energy
		No. of institutional stoves repaired at public secondary schools	0	2024		10	10	10	30		
		No. of kitchens at public secondary schools modernized	0	2024	7	10	10	10	37		
		No. of biogas systems installed at secondary schools	0	2024	2	2	2	2	8		

7.2 Projects and Programs to be Implemented by County Government

Table 78: M&E Framework—Projects and Programs to be Implemented by County Government

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsi-bility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
1	Facilitating universal elec-tricity access in Taita Taveta Households by 2030	No. of households connected to electricity	67,000	2023	6300	6300	6300	6300 2028–2029-6300 2029–2030-6300 2030–2031-6300	44,000 HHs by **2030**	County directorate of energy	County directorate of energy
2	Enhancing universal access to electricity in all learning centers	No. of ECDEs connected to grid	0	2024	60	60	60	88	268	County directorate of education	County directorate of energy
		No. of ECDEs connected to PV systems	0	2024	3	3	3		9		

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsi-bility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
2	(Continued) Enhancing universal access to electricity in all learning centers	No. of VTCs connected to 3-phase supply	0	2024	1	1	1		3	County directorate of education	County directorate of energy
		No. of VTCs upgraded to 3-phase supply	0	2024	1	1	1	2	5		
3	Ensuring universal access to sustainable & reliable electricity and water heating in health facilities	No. of Level 4 hospitals equipped with Solar water heating systems	0	2024	1	1	1	1	4	County department of health	County directorate of energy
		No. of Level 4 hospitals equipped with grid comple-mentary PV systems	0	2024	1	1	1	1	4		
		No. of Level 3 hospitals equipped with Solar water heating systems	0	2024	2	2	2	4	10		
		No. of Level 3 hospitals equipped with grid comple-mentary PV systems	0	2024	2	2	2	4	10		
		No. of Level 3 hospitals equipped with diesel gensets	0	2024	2	2	2	2	8		
		No. of Level 3 hospitals connected to 3 phase supply	0	2024	2	2	2	2	8		
		No. of Level 2 hospitals equipped with Solar water heating systems	0	2024	2	2	2	2	8		
		No. of Level 2 hospitals connected to grid power	0	2024	2	2	2	3	9		
		No. of Level 2 hospitals with back up PV systems	0	2024	5	5	5	7	22		
		No. of faulty PV systems rehabilitated at level 2 facilities	0	2024	1	2	2	2	7		

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsi-bility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
4	Enhancing electricity supply at the hatcheries in the county	No. of hatcheries connected to 3-phase supply	0	2024	2	3	3	3	11	County department of livestock	County directorate of energy
		No. of hatcheries fitted with dual powered incubators	0	2024	3	3	3	3	12		
5	Enhancing Dairy Value Chains through Electrifying Milk Processing plants & collection centers and installation of Dual Powered Bulk Milk Chillers.	No. of milk chilling plants connected to 3-phase supply	0	2024	1	1	1	2	5	County department of livestock	County directorate of energy
		No. of chillers fitted with dual powered chillers	0	2024	2	2	2	3	9		
6	Electrifying fish aggregation and marketing centers.	No. of landing sites equipped with solar flake ice machines	0	2024		1	1	1	3	County department of fisheries	County directorate of energy
7	Retrofitting cold rooms for vaccine storage to make provision for dual power/ acquisition of solar powered fridges	No. of vaccine centers	0	2024	1	1	1	1	4	County department of livestock	County directorate of energy
8	Strengthening power supply at Tsavo honey processing plant	No. of connections to 3-phase	0	2024			1		1	County department of livestock	County directorate of energy
		No. of diesel back-up gensets procured	0	2024			1		1		
9	Electrification of slaughter houses in the county	No. of new grid connections	0	2024	1				1	County department of livestock	County directorate of energy
		No. of back-up PV systems installed	0	2024	2	3	3	3	11		
10	To promote uptake & adoption of solar powered pumps by farmers	No. of solar powered water pumps disseminated	0	2024	1500	1500	1500	1700	6200	County directorate of crops	County directorate of energy

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsi-bility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
11	Equipping county boreholes with solar water pumping infra-structure	No. of boreholes equipped with solar powered pumping infrastructure	0	2024	3	3	4	5	15	County directorate of water access	County directorate of energy
12	Equipping county water pans and small earth dams with solar water pumping infrastructure.	No. of water-pans & small earth dams equipped with solar powered pumping infrastructure	0	2024	5	5	5	7	17	County directorate of water access	County directorate of energy
13	Replacing battery flashlights with solar lanterns and improving the outdoor lighting at the mining sites.	No. of portable solar lanterns disseminated	0	2024	2000	2000	2000	2700	8700	County directorate of mining	County directorate of energy
		No. of high mast flood lights installed	0	2024	9	9	9	9	36		
14	To phase out traditional 3-stone open fire and metallic charcoal stoves while also stimulating uptake of LPG, bio-ethanol, EPCs and biogas	No. of ICS disseminated	0	2024	4,752	4,848	4,940	5,030	28–29= 5115 29–30= 5199 30–31= 5278 31–32= 5354 32–33= 5427 33–34= 5496 51,439 by 2033	County directorate of energy	County directorate of energy
		No. of gasifiers disseminated	0	2024	940	964	987	1,009	28–29= 1031 29–30= 1053 30–31= 1074 31–32= 1094 32–33= 1114 33–34= 1133 10,399 by 2033		

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsi-bility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
14	(Continued) To phase out traditional 3-stone open fire and metallic charcoal stoves while also stimulating uptake of LPG, bio-ethanol, EPCs and biogas	No. of LPG *mekos* disseminated	0	2024	3,232	3,315	3,397	3,478	28–29= 3559 29–30= 3638 30–31=3 716 31–32= 3793 32–33= 3870 33–34= 3945 35943 by 2033	County directorate of energy	County directorate of energy
		No. of 13 kg LPG cylinders disseminated	0	2024	735	764	794	824	28–29= 854 29–30= 885 30–31= 916 31–32= 948 32–33= 980 33–34= 1013 8713 by 2033		
		No. of bio-ethanol stoves disseminated	0	2024	1856	1933	2011	2089	28–29= 2169 29–30= 2248 30–31= 2328 31–32= 2407 32–33= 2489 33–34= 2571 22101 by 2033		

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsi-bility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
14	(Continued) To phase out traditional 3-stone open fire and metallic charcoal stoves while also stimulating uptake of LPG, bio-ethanol, EPCs and biogas	No. of EPC disseminated	0	2024	406	426	444	464	28–29= 483 29–30= 503 30–31= 523 31–32= 543 32–33= 563 33–34= 584 4939 by 2033	County directorate of energy	County directorate of energy
		No. of induction cookers disseminated	0	2024	406	426	444	464	28–29= 483 29–30= 503 30–31= 523 31–32= 543 32–33= 563 33–34= 584 4939 by 2033		
		No. of biogas disseminated	0	2024	154	155	156	157	28–29= 158 29–30= 158 30–31= 158 31–32= 158 32–33= 158 33–34= 157 1569 by 2033		
15	Enhancing universal access to clean cooking solutions at ECDEs and VTCs.	No. of Bellerive institutional stoves installed at ECDEs	0	2024	60	60	60	84	264	County department of ECDEs	County directorate of energy
		No. of modern kitchens constructed ECDEs	0	2024	60	60	60	138	318		

S/ No.	Project/ Programme	Outcome indicators	Baseline		Annual targets				Total target by 2028	Data collection Responsibility	Reporting entity
			Value	Year	2024–2025	2025–2026	2026–2027	2027–2028			
15	(Continued) Enhancing universal access to clean cooking solutions at ECDEs and VTCs.	No. of Bellerive institutional stoves installed at VTCs	0	2024	2	3	3	3	11	County department of VTCs	County directorate of energy
		No. of modern kitchens constructed VTCs	0	2024	3	3	3	5	14		
		No. of biogas systems installed VTCs	0	2024			1	1	2		
16	Displacing charcoal at level 4 hospitals	No. of biogas systems installed	0	2024	1	1	1	1	4	County department of health	County directorate of energy
17	Promoting clean cooking methods at the mining sites in the county.	No. of clean cookstoves disseminated	0	2024	300	300	300	600	1500	County department of mining	County directorate of energy
18	Awareness creation and behavior change campaign to promote Energy Efficiency & Conservation in Households.	No. of behavior change communication & awareness creation campaigns rolled out	0	2024		1			1	County department of communication	County directorate of energy
19	Reviewing County Building Codes and Incorporating EE&C Measures.	No. of county building codes reviewed	0	2024				1	1	County department of Public Works & Housing	County directorate of energy
20	Promoting EE&C in designated industries by enforcing compliance of energy audit requirements.	No. of designated facilities complying with the 4 year audit requirement	0	2024	5	5	5	5	20	County department of Trade and Industrialization	County directorate of energy
21	Construction of Sanitary Landfills for Landfill Gas Capture at Chakaleri and Riata dumpsites	No. of sanitary landfills with provision for LFG capture	0	2024			1	1	2	County directorate of energy	County directorate of energy

Chapter 8: CONCLUSIONS

This CEP represents a significant milestone in Taita Taveta County's journey towards achieving sustainable energy access and fostering inclusive development. Through comprehensive stakeholder engagement, rigorous data analysis, and strategic planning, the CEP has emerged as a dynamic and responsive framework tailored to the county's unique energy landscape. By identifying key challenges, proposing appropriate solutions, and fostering collaboration among diverse stakeholders, the CEP lays the foundation for transformative change, unlocking opportunities for economic growth, environmental sustainability, and improved livelihoods for all residents. Moving forward, the successful implementation of the CEP will require continued commitment, coordination, and innovation from all stakeholders, as we work together towards a future powered by adequate, clean, reliable, and inclusive energy for generations to come.

It is acknowledged that not all the energy needs have been captured in this plan. This is on account of the dynamic and evolving nature of energy access challenges within the county. While the plan strives to comprehensively address existing gaps and barriers, it recognises the possibility of emerging energy needs and unforeseen developments over time. However, this recognition does not signal defeat or inadequacy; rather, it signifies a proactive approach towards adaptability and continuous improvement. By incorporating a built-in mechanism for periodic review and evaluation, the CEP demonstrates a commitment to staying responsive and relevant in the face of changing circumstances. The scheduled review after three years offers a valuable opportunity to assess progress, identify new priorities, and incorporate lessons learned, ensuring that the energy plan remains effective, equitable, and reflective of the evolving needs and aspirations of the community. This iterative process not only enhances the resilience and flexibility of the CEP but also reinforces a culture of ongoing learning, innovation, and collaboration in addressing energy challenges.

Successfully implementing the plan hinges on the county government's ability to prioritise resource mobilisation, recognising the multifaceted nature of funding requirements and the diverse array of potential sources. Internal county departmental budgets represent a foundational source of funding, requiring strategic allocation and prioritisation to ensure sufficient financial support for energy initiatives outlined in the plan. Additionally, tapping into national government resources provides another avenue for funding, necessitating effective advocacy and collaboration with the national government to secure necessary allocations and grants. Development partners offer valuable financial and technical support, but accessing these resources requires proactive engagement, relationship-building, and alignment with partner objectives and priorities. Furthermore, leveraging private sector-led market-based interventions can unlock innovative financing mechanisms and attract investment capital, fostering sustainable energy solutions while stimulating economic growth. To effectively mobilise these resources, the county government must adopt a proactive approach, engaging in strategic lobbying efforts, forging partnerships, and networking with stakeholders across sectors. By leveraging a combination of internal budgetary allocations, strategic partnerships, and networking opportunities, the county government can harness the necessary resources to drive forward the implementation of the CEP, realising its vision of sustainable energy access and inclusive development for all residents.

For coordinated implementation and in line with INEP requirements, the county government should expedite the operationalisation of the CEPC. The CEPC will be responsible for coordinating and overseeing CEP implementation. The committee will be chaired by the County Executive Committee (CEC) member responsible for energy. The mandate of CEPC will include:

i. Provide strategic leadership and governance oversight towards the realisation of energy sector objectives.

ii. Deliberate and approve the recommendations submitted by the Technical Committee.

iii. Prepare the CEP for approval at the County Assembly.

iv. Set out the county energy planning objectives and ensure they are aligned with the national energy planning objectives.

v. Review periodic progress reports on the implementation of agreed targets in the CEP.

vi. Resource mobilisation, with allocation and distribution of mobilised resources.

vii. Promote coordinated technical support and policy dialogue on strategic energy issues with the national government, other county governments, development partners, faith-based organisations, non-governmental organisations (NGOs), civil society, and private sector partners.

viii. Ensure effective oversight through receiving and reviewing regular reports from the Technical Committee.

The membership of the CEPC shall constitute the following:

Table 79: Membership of the County Energy Planning Committee (CEPC)

No.	Organization	Position
1.	The County Executive Committee Member responsible for Energy	Chairperson
2.	Chief Officer responsible for energy	Member
3.	The Director responsible for Energy	Secretary
4.	One (1) representative of the County Commissioner	Member
5.	The County Executive Committee Member responsible for Finance and Planning	Member
6.	The Chief Officer responsible for Economic Planning	Member
7.	The County Executive Committee Member responsible for Lands, Housing, Physical Planning and Urban development	Member
8.	The County Executive Committee Member(s) responsible for Water, Environment and Natural Resources	Member
9.	One (1) representative from Kenya Power and Lighting Company	Member
10.	One (1) representative from Rural Electrification and Renewable Energy Corporation	Member
11.	One (1) representative from Kenya Forest Service County Representative	Member
12.	Technical County Officer(s) responsible for either Coal, Renewable Energy and Electricity	Member
13.	A representative from Non-Governmental Organization	Member
14.	A representative from private sector	Member
15.	Not more than (5) Co-opted member from both State and Non-State Actors	Co-opted member

The necessity to bolster the manpower capacity within the Energy Directorate is paramount to the successful implementation of the CEP and the realisation of its objectives. Presently, the Energy Directorate operates with limited human resources, comprising only one director overseeing the energy docket. This staffing configuration poses significant challenges in effectively executing the mandates and initiatives outlined in the CEP, particularly given the expansive scope of energy-related activities across the county. To address this shortfall, urgent measures are required to strengthen the organisational structure of this docket. Furthermore, there is an urgent need to augment the workforce by recruiting additional energy officers, ensuring adequate coverage and representation across all four sub-counties: Voi, Taita, Mwatate, and Wundanyi. This decentralised staffing approach will facilitate closer engagement with local communities, enhance coordination, and streamline the implementation of energy projects and initiatives at the grassroots level.

Additionally, the development of a comprehensive policy framework is imperative to provide a robust regulatory foundation for anchoring the implementation of the CEP. This policy should delineate clear guidelines, mandates, and mechanisms for advancing energy access, promoting sustainability, and fostering innovation within the county.

Moreover, capacity-building initiatives are essential to equip officers within the energy department with the requisite skills, knowledge, and expertise in energy technologies (wind, solar, hydro, biogas, cookstoves, biomass, biofuels) and the use of GIS mapping in the development of energy interventions. By investing in human capital development, the county can build a cadre of skilled professionals capable of driving forward the ambitious agenda outlined in the CEP, ensuring its effective implementation and long-term success in advancing energy access and sustainability goals.

Finally, there are numerous opportunities in this document which the private sector can tap into. These include the dissemination of solar home systems under the LCEP, dissemination of domestic and institutional clean cooking solutions, installation of domestic and institutional biogas systems, dissemination of solar water pumps to smallholder farmers, construction of sanitary landfills for LGF capture, and indeed many other opportunities. To this end, and in the coming days, the department of energy, in collaboration with the department of trade and other stakeholders, will prepare an energy investment prospectus that will showcase and elaborate these opportunities.

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Chapter 10: ANNEXES

10.1 ECDEs in Off-Grid Areas and in Need of Electrification

Sub-County	Name of ECDEs
TAVETA	LOTIMA A
TAVETA	LOTIMA B
TAVETA	LOTIMA HILL
TAVETA	NGUTINI
TAVETA	LOTIMA A. B
TAVETA	ST. NOBERT TANGINI
TAVETA	NJORO SPRINGS
TAVETA	GRIGAN
TAVETA	KIMONDIA

10.2 ECDEs in On-Grid Areas and in Need of Electrification

SUB-COUNTY	NAME OF ECDES	SUB-COUNTY	NAME OF ECDES	SUB-COUNTY	NAME OF ECDES
TAVETA		TAITA	MLILO	VOI	MANYANI ECDE
TAVETA	ABORI	TAITA	NGONGONDINYI	VOI	MWAMBITI ECDE
TAVETA	NJORO	TAITA	MWAKILEMBA	VOI	TALIO ECDE
TAVETA	LAMBO	TAITA	KISHUSHE	VOI	MCHANG'A ECDE
TAVETA	MRABANI	TAITA	DAKU	VOI	MLONDO ECDE
TAVETA	KITOBO	TAITA	STAR KISHUSHE	VOI	KIZUMANZI ECDE
TAVETA	KAMBUGU	TAITA	MWAN'GORUA	VOI	WRAY ECDE
TAVETA	MARODO	TAITA	MKANYATTA	VOI	KAJIRE ECDE
TAVETA	RIATA NDOGO	TAITA	MAKUTANO	VOI	SAGALLA ECDE
TAVETA	RIATA	TAITA	MTUNGUNYI	VOI	KANYANGA ECDE
TAVETA	MADARASANI	TAITA	MCHUNGUNYI	VOI	KIRUMBI ECDE
TAVETA	MASEGHETENI	TAITA	MSANGARINYI	VOI	KAVINGONI ECDE
TAVETA	ELDORO	TAITA	STAR SUNGULULU	VOI	MARIE ECDE
TAVETA	KIWALWA	TAITA	SUNGULULU	VOI	ZONGWANI ECDE
TAVETA	MWARUSA	TAITA	NYAMBU	VOI	MWACHOKI ECDE
TAVETA	KITOGHOTO A	TAITA	BOMA	VOI	G. SOWA ECDE
TAVETA	KITOGHOTO B	TAITA	KIDULE	VOI	G. MOSI ECDE
TAVETA	NEEMA	TAITA	MAYNARD	VOI	KILEVA
TAVETA	NDILIDAU	TAITA	FIGHINYI	VOI	KIRONGWE ECDE
TAVETA	KASAANI	TAITA	MWAILENGO.	VOI	MKAMENYI ECDE

SUB-COUNTY	NAME OF ECDES	SUB-COUNTY	NAME OF ECDES	SUB-COUNTY	NAME OF ECDES
TAVETA	SALAITA	TAITA	CHOKE	VOI	BUGUTA ECDE
TAVETA	MKUYUNI	TAITA	SIRIENYI	VOI	MAJENGO ECDE
TAVETA	BUSTANI	TAITA	MWAROMBO	VOI	MSHARINYI ECDE
TAVETA	BAHATI	TAITA	SHIGHARO	VOI	BARAKA ECDE
TAVETA	KIMALA	TAITA	CHOME	VOI	JORA ECDE
TAVETA	LIDIMO	TAITA	MLAWA	VOI	BIRIKANI ECDE
TAVETA	REKEKE	TAITA	SHINNING ANGELS [PRISON]	VOI	KITEGHE ECDE
TAVETA	ST. PETERS	TAITA	NGURARU	VOI	ZUNGULUKANI ECDE
TAITA	IYALE	TAITA	N'GONDA	VOI	MATANGINI ECDE
TAITA	LUSHANGONYI	TAITA	MBAURO	VOI	MAGHANGA ECDE
TAITA	ST. JOHNS	TAITA	WESU	VOI	KULIKILA ECDE
TAITA	ST. JAMES	TAITA	MASUMBENYI	VOI	GWIRAVINDI ECDE
TAITA	MWANGEA	VOI	MWAKINGALI ECDE	VOI	SASENYI ECDE
TAITA	MWANDA	VOI	VOI ECDE	VOI	RUKANGA ECDE
TAITA	MLAMBA	VOI	MWAMUNGA ECDE	VOI	KIKONGORINYI ECDE
TAITA	NDUMBINYI	VOI	IMANI ECDE	VOI	ITINYI ECDE
TAITA	MARUNGU	VOI	PRISCILLA ECDE	VOI	KISIMENYI ECDE
TAITA	ST. PETERS IKUMINYI	VOI	SALAUDIN ECDE	VOI	NGAMBENI ECDE
TAITA	MWAROKO	VOI	GAZA ECDE	VOI	MBELE ECDE
TAITA	SANGENYI	VOI	KALELA ECDE	VOI	MWAMBANI ECDE
TAITA	MWAKISHIMBA	VOI	MAJENGO ECDE	VOI	MIASENYI ECDE
TAITA	NGULU	VOI	KALAMBE ECDE	VOI	BUNGULE ECDE
TAITA	MDUNDONYI	VOI	MNAONI ECDE	VOI	MARASI ECDE
TAITA	KIPOTONYI	VOI	GIMBA ECDE	VOI	MARUNGU ECDE
TAITA	WERUGHA	VOI	MWANYAMBO ECDE	VOI	BONDENI ECDE
TAITA	MSANGARINYI	VOI	BOMANI ECDE	VOI	HIDAYA ECDE
TAITA	MAGHIMBINYI	VOI	BONA ECDE	VOI	MAKWASINYI ECDE
TAITA	KIMANGACHUGHU	VOI	BIRIKANI ECDE	VOI	KALE
TAITA	KIRIRWA	VOI	TAUSA ECDE	VOI	MWANANGAO
TAITA	MGHAMBONYI	VOI	GORA ECDE	VOI	WANGALA
TAITA	MWANYALO	VOI	MARINGO ECDE	MWATATE	MWAWACHE
TAITA	NYACHE	VOI	NDILE ECDE	MWATATE	MAZOLA
TAITA	SHAGHA	VOI	NDOME ECDE	MWATATE	MRURU
TAITA	WUMINGU	VOI	MLUNDINYI ECDE	MWATATE	MWAKITUTU
TAITA	MMBONUNYI	VOI	NDII ECDE	MWATATE	SECHU
TAITA	WALA	VOI	GHAZI ECDE	MWATATE	WUMARI
TAITA	KITUMBI	VOI	MWAKAJO ECDE	MWATATE	BOMTONYI
TAITA	NGOLIA	VOI	ORE ECDE	MWATATE	DIGHAI

SUB-COUNTY	NAME OF ECDES	SUB-COUNTY	NAME OF ECDES	SUB-COUNTY	NAME OF ECDES
TAITA	NGILINYI	VOI	MOLE ECDE	MWATATE	CHUNGA-UNGA
TAITA	PARANGA	VOI	MWAMBOLEMBOLE ECDE	MWATATE	KITUMA
MWATATE	MWEMBA	MWATATE	LOWER KIDAYA	MWATATE	MAKTAU
MWATATE	HURUMA	MWATATE	CHONGONYI	MWATATE	MSORONGO
MWATATE	MKUKI	MWATATE	MWACHAWAZA	MWATATE	MNENGWA
MWATATE	ST. JOSEPHS	MWATATE	KISHAMBA	MWATATE	GODOMA
MWATATE	KUNGU	MWATATE	FURUSINYI	MWATATE	KONGONI
MWATATE	MWANDUKA	MWATATE	MWAVUNYU	MWATATE	MWASHOTI
MWATATE	VICHWALA	MWATATE	MRUGHUA	MWATATE	LATIKA
MWATATE	KWAMONE	MWATATE	MNAMU	MWATATE	MWASHUMA
MWATATE	KIDAYA SIGHAIGHU	MWATATE	BURA	MWATATE	MLUGHI
MWATATE	JOSA	MWATATE	KILULUNYI	MWATATE	ZARE
MWATATE	DEMBWA	MWATATE	BARAWA	MWATATE	MBAGHA
MWATATE	WUSI	MWATATE	NYOLO	MWATATE	MWATATE
MWATATE	MLAMBENYI	MWATATE	MWAKINYUNGU	MWATATE	KIPUSI
MWATATE	MWATUNGE	MWATATE	RAHAI	MWATATE	KISHAU
MWATATE	MZWANENYI	MWATATE	MARUMBENYI	MWATATE	RONG'E
MWATATE	MSISINENYI	MWATATE	KIGHOMBO	MWATATE	MAMBURA
MWATATE	MWANDALA	MWATATE	MWANGA	MWATATE	MANGANGA
MWATATE	MWANDISHA	MWATATE	MWAMBOTA	MWATATE	MENGO
MWATATE	MAILIKUMI	MWATATE	MWAKALERI	MWATATE	KIGHANGACHINYI
MWATATE	MGENO	MWATATE	KIRONGE	MWATATE	MWEMBA
MWATATE	MWATUNGE ANEX	MWATATE	MRABENYI	MWATATE	HURUMA
MWATATE	SHELEMBA	MWATATE	BAGHAU	MWATATE	MKUKI
MWATATE	MARIWENYI	MWATATE	EBENEZER	MWATATE	ST. JOSEPHS
MWATATE	KIGHONONYI				

10.3 List of Level 2 Facilities to Be Connected to the Grid

1	Kachero dispensary
2	Madera dispensary
3	Mbulia dispensary
4	Bamako dispensary
5	Zungulukani dispensary
6	Manoa dispensary
7	Mwachawaza dispensary
8	Vighombonyi dispensary
9	George faraji dispensary

10.4 List of Level 2 Facilities with Defective PV Systems

1	Mata Dispensary
2	Ndilidau dispensary
3	Rekeke health centre
4	Chala dispensary
5	Vighombonyi dispensary
6	Kishushe dispensary
7	Sangeroko dispensary

10.5 List of Level 2 Facilities to Be Prioritised for SHW Systems

The county department of health will validate and provide this list (8 facilities) during implementation.

10.6 List of Level 2 Facilities to Be Equipped with Backup PV Systems

The county department of health will validate and provide this list (22 facilities) during implementation.

10.7 List of 11 Public Abattoirs to Be Equipped with Backup PV Systems

	Name	Sub-County	Location / ward
1	Maungu Slaughter Slab	Voi	Maungu Town
2	Canaan S/Slab	Voi	Canaan Centre
3	Kasighau S/Slab	Voi	Rukanga
4	Taveta Town Slaughterhouse	Taveta	Taveta Town
5	Chumvini S/slab	Taveta	Chumvini
6	Challa S/slab	Taveta	Challa town
7	Wundanyi Slaughterhouse	Taita	Wundanyi Town
8	Werugha Slaughterhouse	Taita	Kese Town
9	Mgange Nyika S/Slab	Taita	Mgange Nyika
10	Mwatate Slaughterhouse	Mwatate	Mwatate Municipality
11	Bura Slaughterhouse	Mwatate	Bura Town

10.8 List of 15 Irrigation Schemes in Taveta Sub-County

S/No.	Scheme	Village-Ward	Source of Water
1	Njukini Scheme	Chala/Njukini	Njukini river
2	Chumvini	Chala/Njukini	Lumi river
3	Tsaramvo	Chala/Njukini	Sainte springs
4	Sir Ramson	Chala/Njukini	Njoro springs
5	Challa	Chala/Njukini	Lumi river
6	Kasokoni	Mahoo	Little Lumi river
7	Kimala A and B	Mata	Lumi river
8	Lumi Farmers Project	Mata	Lumi river
9	Lesuyai	Mata	Maloja river
10	Marodo	Mboghoni	Lumi river
11	Kimorigo	Mboghoni	Lumi river
12	Kamleza	Mboghoni	Njoro Kubwa canal
13	Kitobo	Mboghoni	Njoro Kubwa canal
14	Mrabani	Mboghoni	Njoro Kubwa canal
15	Majengo	Mboghoni	Majengo springs

10.9 List of 6 Boreholes without a Source of Pumping Power

Sub-County	Name	On-grid/ Off-grid	Daily water demand (litres)	Yield (litres/ hour)	Daily Pumping duration (hours)	Desired pump capacity (kW)	Desired capacity of elevated tank in litres	Management
Taveta	Njukini borehole	Off-grid	90,000	N/A		7.5	20,000	Community
	Chumvini	Off-grid	90,000	12,000	7.5	7.5	20,000	Community
	Mahandakini	Off-grid	80,000	30,000	26.7?	7.5	10,000	Community
	Sir Rampson	On-grid	80,000	N/A		7.5	N/A	Community
Wundanyi	Kishushe wumingu	Off-grid	60,000	5,000	12	5.5	5,000	Community
Mwatate	Singila	On-grid	120,000	10,000	12	7.5	N/A	Community

10.10 List of 9 Boreholes Pumping with Gensets

Sub-County	Name	On-grid/ Off-grid	Daily water demand (litres)	Yield (litres/ hour)	Daily Pumping duration (hours)	Pump capacity (kW)	Monthly fuel costs (KES)	Management
Taveta	Eldoro	Off-grid	150,000	10,000	15	7.5	30,000	Tavevo
Voi	Birikani-kisimenyi	Off-grid	60,000	5,000	12	5.5	20,000	Tavevo
Voi	Talio nyika	Off-grid	180,000	10,000	18	11	50,000	Tavevo
Voi	Kisimenyi	Off-grid	60,000	3,000	20	7.5	30,000	Community
Mwatate	Kighombo	Off-grid	300,000	24,000	12.5	11	50,000	Community/Tavevo
Mwatate	Msau polytechnic	Off-grid	120,000	5,000	60?	7.5	30,000	Community
Taveta	Rekeke booster pump	Off-grid	120,000			7.5	40,000	Tavevo
Mwatate	Modambogho	Off-grid	80,000	5,000	16	4.4	20,000	Tavevo
Mwatate	Mvita	On-grid	120,000	20,000	6	11	45,000	Tavevo

10.11 List of 8 Boreholes Pumping with Grid

Sub-County	Name	Pump type	Daily water demand (litres)	Yield (litres/ hour)	Pumping duration (hours)	Pump capacity (kW)	Monthly fuel costs (KES)	Management
Voi	Jora	Submersible	80,000	4,000	20	5.5	25,000	Community
Mwatate	Mwasinenyi 2	Submersible	500,000	45,000	11	30	300,000	Tavevo
Mwatate	Mwasinenyi 1	Submersible	240,000	30,000	8	22	250,000	Tavevo
Mwatate	Dighai	Submersible	150,000	10,000	15	11	80,000	Tavevo
Mwatate	Manoa	Submersible	150,000	8,000	18.75	7.5	60,000	Tavevo
Wundanyi	Wanyumba	Submersible	40,000	4,000	10	5.5	20,000	Tavevo
Taveta	Lutheran	Submersible	100,000	10,000	10	4	40,000	Tavevo
Taveta	Lessesia	Submersible	200,000	20,000	10	11	100,000	Tavevo

10.12 List of 17 Water Pans and Small Earth Dams under the County Government

Item No	County	Sub-County	Ward	Name of the Water Source
1	Taita Taveta	Voi	Kasighau	Gae
2	Taita Taveta	Voi	Kasighau	Mkamenyi
3	Taita Taveta	Voi	Kasighau	Bafwe
4	Taita Taveta	Voi	Mbololo	Kambito
5	Taita Taveta	Voi	Sagala	Mwambisi
6	Taita Taveta	Mwatate	Chawia	Marbongonyi
7	Taita Taveta	Mwatate	Chawia	Manoa
8	Taita Taveta	Mwatate	Chawia	Iriwenyi
9	Taita Taveta	Mwatate	Chawia	Ngulu

Item No	County	Sub-County	Ward	Name of the Water Source
10	Taita Taveta	Mwatate	Mwatate	Ziwani
11	Taita Taveta	Mwatate	Chawia	Ngerenyi DAM
12	Taita Taveta	Mwatate	Mwatate	Mwatate Sisal
13	Taita Taveta	Mwatate	Mwatate	Mwatate dam
14	Taita Taveta	Mwatate	Ronge	Kighombo dam
15	Taita Taveta	Mwatate	Wusi/Kishamba	Mambisi dam
16	Taita Taveta	Wundanyi	Werugha	Kishenyi dam
17	Taita Taveta	Wundanyi	Wumingu/Kishushe	Mukuru dam

10.13 List of Water Pans and Small Earth Dams inside the Conservancies

Ranch	Water Pans	Names
Mgeno	7	Ziwa la Simba, Ziwa la Vumbi, Panda 1, Panda 2, Malembo, Shambenyi, Zaghatisa
Maungu	7	Biadhi, Bulabula, Gosa, Ikonge, Kitololo
Kasigau	7	Kiwanjani, Katana, Chete, Nzea, Mangare, Jerumani, Kisugunua,
Lualenyi	4	Pua na Mdomo, Lion Rock, Kwa Msabaa, Moshi, Boma Simba
Lumo	7	
Choke	4	
Kutima	5	
Mbale	10	Ziwa la Ruma Ngombe, Mwakilanga Pan, Ziwa Mwabolo, Ziwa Walowe, Ziwa Loghofa, Ziwa la Nyati, Kasarani Pan, Ziwa Mwaranginyi, Tugwe Pan, Ziwa Woresha
Wushumbu	4	
Marungu Hill	4	
Kambanga	5	Boma ya Mwaroko, Ziwa A & B, Block 1 & 2
Dawida	6	
Mbulia	5	
Lake Jipe	5	Kwa Nyati, A, B, C, Kwa Ndege
Chalongo	0	
Taita Ranch	20	Tank 1, Tank 5, Pika Pika, Kizima, Shita, Mwamba, Simba, Bunduki, Matopeni, Tank 7 & 8, Simeon, Sagana
Taita Hills	5	Majimachafu Waterpan, 26d, 39, 37, 14b
Shumba Valley	8	
Bura	20	
Sagalla	1	
Amaka	10	
Dokata		
Wangala		
Teri B	4	

Ranch	Water Pans	Names
Mramba		
Oza		
Bachuma	2	
Izera		
Kamungi	1 Earthdam	
Shirango	0	

10.14 Lighting and Cooking Data for the Main Mining Sites

Sub-County	Area	No. of mine owners	Average no. of workers per mine owner	Average total no. of mine workers	Average hours spent inside mine tunnels during the day	Average hours spent inside mine tunnels during the night	Main source of lighting the tunnels	Average monthly cost of lighting energy per mine owner (KES)	Main source of cooking fuel	Main type of cooking device	No. of flood lights needed
Voi	Mangare	6	12	72	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	2
	Mghughonyi	5	15	75	8	6	Battery flashlights	7,200	Firewood/ charcoal	3-stone fire	3
Mwatate	Mkuki	49	20	980	8	6	Battery torches	7,200	Firewood/ charcoal	3-stone fire	3
	Mwananchi	18	20	360	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	2
	Kutima and Choke	4	15	60	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	2
	Kituma	10	6	60	8	N/A	Battery flashlights		Firewood/ charcoal	3-stone fire	1
	Kamtonga	10	16	160	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	1
	Dighai	8	15	120	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	1

Sub-County	Area	No. of mine owners	Average no. of workers per mine owner	Average total no. of mine workers	Average hours spent inside mine tunnels during the day	Average hours spent inside mine tunnels during the night	Main source of lighting the tunnels	Average monthly cost of lighting energy per mine owner (KES)	Main source of cooking fuel	Main type of cooking device	No. of flood lights needed
(Continued) **Mwatate**	Chunga Unga	10	15	150	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	2
	Kambanga	25	20	500	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	2
	Mariwenyi	4	15	60	8	N/A	Battery flashlights		Firewood/ charcoal	3-stone fire	3
	Mgama	15	15	225	8	6	Battery flashlights		Firewood/ charcoal	3-stone fire	4
	Alia	7	15	105	8	6	Battery torches	7,200	Firewood/ charcoal	3-stone fire	2
Taita	Sangenyi	3	10	300	8	N/A	N/A		Firewood/ charcoal	3-stone fire	1
	Kishushe	5	50	250	8	N/A	N/A	6,200,000*	Firewood/ charcoal	3-stone fire	3
Taveta	Rukinga	2	20	40	8	N/A	N/A	1,500	Firewood/ charcoal	3-stone fire	1
	Lessesia	12	25	300	8	N/A	N/A		Firewood/ charcoal	3-stone fire	1
	Lukungu	8	25	200	8	N/A	N/A		Firewood/ charcoal	3-stone fire	1
	Lerukenge	15	20	300	8	N/A	N/A		Firewood/ charcoal	3-stone fire	1
Total		**216**	**349**	**4317**							**36**

(Source: County Department of Mining)

10.15 ECDEs in Need of Improved Cookstoves

Taita	Voi		Mwatate		Taveta Sub-County	
Wala	Mwakingali Ecde	Kizumanzi Ecde	Mwawache	Maktau	Bahati	Madarasani*
Kitumbi	Voi Ecde	Wray Ecde	Mazola	Msorongo	Bustani	Marodo
Ngolia	Mwamunga Ecde	Kajire Ecde	Mruru	Mnengwa	Nomiya	Mokine*
Nyache	Imani Ecde	Sagalla Ecde	Mwakitutu	Godoma	St. Peters*	Mrabani
Ngilinyi	Priscilla Ecde	Kanyanga Ecde	Sechu	Kongoni	Vikwatani	Mrabani Kambugu
Paranga	Salaudin Ecde	Kirumbi Ecde	Wumari	Mwashoti	Mkuyuni	Mwarusa
Shagha	Gaza Ecde	Kavingoni Ecde	Bomtonyi	Latika	Msengoni	Neema
Mlilo	Kalela Ecde	Marie Ecde	Dighai	Mwashuma	Luidimo	Python Hill
Daku	Majengo Ecde	Zongwani Ecde	Chunga-Unga	Mlughi	Grigan	Riata
Mtungunyi	Kalambe Ecde	Mwachoki Ecde	Mungama	Zare	Jipe	Riata Ndogo.
Mchungunyi	Mnaoni Ecde	G. Sowa Ecde	Alia	Mbagha	Kimala	Masekheteni
Ngongondinyi	Gimba Ecde	G. Mosi Ecde	Kamtonga	Mwatate	Kimundia	A.B.C Chokaa
Mwakilemba	Bomani Ecde	Kileva	Mkengerenyi “A”	Kipusi	Njoro Mata	Challa Chini
Kishushe	Bona Ecde	Kirongwe Ecde	Mkengerenyi “B”	Mwatunge	Orkung,U*	Chokaa
Star Kishushe	Birikani Ecde	Mkamenyi Ecde	Mwachabo	Mzwanenyi	Rekeke	Irrigation
Mwan’gorua	Tausa Ecde	Buguta Ecde	Kitivo	Msisinenyi	St. Norbert*	Kalambani
Mkanyatta	Gora Ecde	Majengo Ecde	Manoa	Mwandala	Kasaani	Kidong’u
Wanjala [Makutano]	Maringo Ecde	Msharinyi Ecde	Mwemba	Mwandisha	Khadija Muna	Kikwatani
	Ndile Ecde	Baraka Ecde	Huruma	Mailikumi	Ndilidau	Kivukoni
	Ndome Ecde	Jora Ecde	Mkuki	Mgeno	Salaita	Lepolos
	Mlundinyi Ecde	Birikani Ecde	St. Josephs	Mwatunge Annex	Njoro	Machungwani
	Ndii Ecde	Kiteghe Ecde	Kungu	Shelemba	Mshegheshesheni	Majengo
	Ghazi Ecde	Zungulukani Ecde	Mwanduka	Mariwenyi	Abori	Muusini

Taita	Voi		Mwatate		Taveta Sub-County	
	Mwakajo Ecde	Matangini Ecde	Vichwala	Kighononyi	Ahsante	Sir Ramson
	Ore Ecde	Maghanga Ecde	Kwamone	Mwakinyungu	Eldoro	Ulawani
	Mole Ecde	Kulikila Ecde	Kidaya Sighaighu	Rahai	Eldoro C. (Baraka)	Uthiani
	Mwambolembole Ecde	Gwiravindi Ecde	Josa	Marumbenyi	Kitobo.*	Wololo
	Mwakiki Ecde	Sasenyi Ecde	Dembwa	Kighombo	Kitoghoto A	Ziwani
	Kulele Ecde	Rukanga Ecde	Wusi	Mwanga	Kitoghoto B	Kirimeri
	Kirindinyi Ecde	Kikongorinyi Ecde	Mlambenyi	Mwambota	Kiwalwa	Kitondoni
	Mzwanenyi Ecde	Itinyi Ecde	Lower Kidaya	Mwakaleri	Lambo	Mahoo
	Mrangi Ecde	Kisimenyi Ecde	Chongonyi	Kironge	Lotima (Ngutini)	Malukiloriti
	Mwakuni Ecde	Ngambeni Ecde	Mwachawaza	Mrabenyi	Lotima A	Nakruto
	Mbulia Ecde	Mbele Ecde	Kishamba	Baghau	Lotima AB	Njukini
	Wongonyi Ecde	Mwambani Ecde	Furusinyi	Ebenezer	Lotima B	Lessesia A
	Magogo Ecde	Miasenyi Ecde	Mwavunyu	Kishau	Lotima Hill	
	Kirutai Ecde	Bungule Ecde	Mrughua	Rong'e		
	Ikanga Ecde	Marasi Ecde	Mnamu	Mambura		
	Mkwachunyi Ecde	Marungu Ecde	Bura	Manganga		
	B/Mghanga Ecde	Bondeni Ecde	Kilulunyi	Mengo		
	Kambito Ecde	Hidaya Ecde	Barawa	Mengo		
	Manyani Ecde	Makwasinyi Ecde	Nyolo	Kighangachinyi		
	Mwambiti Ecde	Kale	Kituma			
	Talio Ecde	Mwanangao				
	Mchang'a Ecde	Wangala				
	Mlondo Ecde					

10.16 Public Primary Schools in Need of Improved Cookstoves and Modern Kitchens

Taveta	Mwatate	Voi	Taita
Abori	Mwavunyu	Mkamenyi	Choke
Chala	Bura	Jora	Chome
Chokaa	Baghau	Itinyi	Fighinyi
Eldoro	Chungaunga	Kizumanzi	Iyale
Jipe	Dembwa	Kileva East Field	Kidule
Kidongu	Dighai	Kajire	Kimangachughu
Kitobo	Godoma	Marasi	Kishushe
Kitoghoto	Josa Pri	Manyani	Kitumbi
Kiwalwa	Kamtonga	Mwambiti	Lushangonyi
Lessesia	Kidaya Saghaighu	Ikanga	Maghimbinyi
Lotima	Kighombo	Ore	Marugu
Lumi	Kighononyi	Mwakajo	Maynard
Machungwani	Kilulunyi	Kalela	Mbauro
Madarasani	Kipusi	Birikani	Mchungunyi
Mahandakini	Kironge	Kale	Mdundonyi
Mahoo Day And Boarding	Kishamba	Kirindinyi	Mghambonyi
Majengo	Kishau	G.Sowa	Mkanyatta
Malukiloriti	Kitivo	Gimba	Mlamba
Mata	Kongoni	Wongonyi	Mlawa
Mrabani	Kungu	Mole	Mlechi
Mshekesheni	Mailikumi	Kambito	Mlilo
Nakruto	Mambura	Wray	Msangarinyi
Njoro	Manoa	Mwanyambo	Mwakishimba
Njukini	Mariwenyi	Rukanga	Mwanda
Orkung'u	Mazola	Miasenyi	Mwangea
Rekeke	Mbagha Pri	Zungulukani	Mwanyalo
Riata	Mengo Pri	Mchang'a	Mwaroko
Salaita	Mgeno	Kirumbi	Mwarombo
Sir Ramson	Mlughi Pri	Imani	Ndumbinyi
Sowene	Mnamu	Mwamunga	Ngonda
St. Josephs Kivukoni	Mnengwa	Ndile	Ngilinyi
St. Norbert Tangini	Mngama	Wangala	Ngolia
St. Patricks Kimala	Mrabenyi Primary	Talio	Ngongodinyi

Taveta	Mwatate	Voi	Taita
Taveta	Mrughua	Mkwachunyi	Ngulukiweto
Timbila	Mruru	Mlondo	Nyache
Ulawani	Msisinenyi	Ghazi	Nyambu
Ziwani	Msorongo Pri	Ngambeni	Paranga
Taveta Special School	Mwachabo	Mwakiki	Sangenyi
Timbila Special School	Mwachawaza	Sasenyi	Shagha
Khadija Muna Memorial	Mwakaleri Pri.	Mlundinyi	Shigharo
Grigan	Mwakinyungu	Mwakuni	Sirienyi
Patani Hill	Mwakitau	Kirutai	St. Ingatious Nguraru
Njoro Springs	Mwakitutu	Msharinyi	St. James
	Mwambota	Ndome	St. Johns
	Mwandala	Mwambolembole	St. Laurent Daku
	Mwandisha	Mwakingali	St. Peters Ikuminyi
	Mwashoti	Bungule	Sungululu
	Mwashuma	Mbulia	Vuria
	Mwatate Primary	Makwasinyi	Werugha
	Mwatunge	Marungu	Wumingu
	Mwawache Pri	Buguta	
	Mwemba	B.Mganga	
	Mzwanenyi	Voi	
	Nyolo Pri	Sagala	
	Rahai	G.Mosi	
	Rong'e Pri	Mrangi	
	Sechu	Mbele	
	Shelemba	Mwanyambo Sne	
	Sino Girls	Priscillah	
	St. Joseph's	Kisimenyi	
	Vichwala	Kiteghe	
	Wumari	Marie	
	Wusi Primary	Kalambe	
	Zare	Tausa	
		Ndii	
		Mwambani	

10.17 Public Primary Schools with Potential for Human Waste-Fed Biogas Systems

Name	Sub-County	Student Population
Sowene	Taveta	1382
Taveta	Taveta	782
Timbila	Taveta	729
Mrughua	Mwatate	970
Marasi	Voi	797
Kalela	Voi	999
Mwanyambo	Voi	1770
Mwamunga	Voi	1461
Mwakingali	Voi	890
Buguta	Voi	823
Voi	Voi	940
St. Ingatious Nguraru	Taita	702

10.18 Public Secondary Schools Cooking with 3-Stone Open Fire

Name	Sub-County
Elija Mzae Secondary	Mwatate
Mwanga Secondary	Mwatate
Zare Secondary	Mwatate

10.19 Public Secondary Schools Cooking with Old Boilers in Need of Replacement/Rehabilitation

Name	Sub-County	Name	Sub-County	Name	Sub-County
Dalmas Moka Secondary	Taita	Bura Girls	Mwatate	Timbila High	Taveta
St. Johns Secondary	Taita	Chawia High	Mwatate	Mahoo High	Taveta
Dr. Aggrey High	Taita	David Kitawi Secondary	Mwatate	Eldoro Girls	Taveta
St. Mary's High	Taita	Kenyatta High	Mwatate	Njoro Secondary	Taveta
St. Agatha Ngoloki High	Taita	Kituma Secondary	Mwatate	Mahandakini Secondary	Taveta
Mdundonyi Secondary	Taita	Kombolio High	Mwatate	Soweni Secondary	Taveta
Canon Kituri High	Taita	Manoa Secondary	Mwatate	Chala Secondary	Taveta
Shimbo Secondary	Taita	Mlamba High	Mwatate	Mata Secondary	Taveta
Ngangao Secondary	Taita	MRABENYI SEC	Mwatate		
Kitumbi High	Taita	Mshimba Secondary	Mwatate		
Mghambonyi Secondary	Taita	Munda Secondary	Mwatate		
PJ Mwangola Secondary	Taita	Murray Girls	Mwatate		
Mghalu High	Taita	Mwafuga Secondary	Mwatate		
Paranga Secondary	Taita	Mwakaleri Secondary	Mwatate		
Mbela High	Taita	Mwakitau Secondary	Mwatate		
Kiwinda Secondary	Taita	Mwambonu Secondary	Mwatate		
Senior Mwangeka High	Taita	Mwandango Secondary	Mwatate		
Kajungunyi Secondary	Taita	Mwangoji High	Mwatate		
Funju Secondary	Taita	Mwanyambo Secondary	Mwatate		
Mwakiwiwi Secondary	Taita	Mwasere Girls	Mwatate		

10.20 Public Secondary Schools Cooking with Potential for Human Waste-Fed Biogas Systems

Institution	Enrollment	Institution	Enrollment
Dr. Aggrey High	1178	Soweni Secondary	770
Bura Girls	1207	Mwakitawa Secondary	814
Kenyatta High	1248	Mwangea Secondary	1025
Murray Girls	1482	Voi Boys' Secondary	1150

10.21 Public Secondary Schools in Need of Modern Kitchens

Name	Sub-County	Name	Sub-County
Chawia High	Mwatate	Timbila High	Taveta
David Kitawi Secondary	Mwatate	Mahoo High	Taveta
Kombolio High	Mwatate	Eldoro Girls	Taveta
Manoa Secondary	Mwatate	Njoro Secondary	Taveta
Mlamba High	Mwatate	Mahandakini Secondary	Taveta
MRABENYI Secondary	Mwatate	Soweni Secondary	Taveta
Mshimba Secondary	Mwatate	Chala Secondary	Taveta
Munda Secondary	Mwatate	Mata Secondary	Taveta
Mwafuga Secondary	Mwatate	Kitobo Secondary	Taveta
Mwakaleri Secondary	Mwatate	Kiwalwa Secondary	Taveta
Mwakitau Secondary	Mwatate	Njukini Secondary	Taveta
Mwambonu Secondary	Mwatate	Bishop Njenga Secondary	Taveta
Mwandango Secondary	Mwatate	Ngutiini Secondary	Taveta
Mwangoji High	Mwatate	Makiloriti Secondary	Taveta
Mwasere Girls	Mwatate	Lumi Secondary	Taveta
Ngami Secondary	Mwatate		
St. John's Mwema Secondary	Mwatate		
Elija mzae Secondary	Mwatate		
Mwanga Secondary	Mwatate		
Ngangu Secondary	Mwatate		
St. Joseph Secondary	Mwatate		
Zare Secondary	Mwatate		

10.22 List of VTCs in the County

The department will provide the names of the institutions to benefit from various interventions outlined under the access to clean cooking services section of this document.

TAITA SUB-COUNTY						
		1st Years		*2nd Years*		**Total**
S/No.	**VTC Name**	***M***	***F***	***M***	***F***	
1	Mwagafwa	18	21	49	26	**114**
2	Mbale	16	12	15	9	**52**
3	Werugha	13	14	16	13	**56**
4	Nyache	52	30			**82**
5	Mwarungu	35	6	49	9	**99**
6	Kishushe	11	10	10	12	**43**
7	Mwanda	34	18		0	**52**
8	Kiloghwa	111	94	37	24	**266**
	Total	**290**	**205**	**176**	**93**	**764**
VOI SUB-COUNTY						
		1st Years		*2nd Years*		**Total**
S/No.	**VTC Name**	***M***	***F***	***M***	***F***	
9	Voi	103	106	48	41	**298**
10	Mraru	10	10	17	6	**43**
11	Tausa	40	6	18	8	**72**
12	Ndome	31	27	0	0	**58**
13	Ghazi	19	6	6	15	**46**
14	Wongonyi	13	6	4	1	**24**
15	Mwambiti	15	6	23	10	**54**
16	Sagalla	15	10	0	6	**31**
17	Bungule	21	6	7	4	**38**
18	Marungu	24	16	0	3	**43**
	Total	**291**	**199**	**123**	**94**	**707**

MWATATE SUB-COUNTY						
		1st Years		*2nd Years*		**Total**
S/No.	**VTC Name**	***M***	***F***	***M***	***F***	
19	Mselia	8	2	7	3	**20**
20	Mnamu	6	2	4	8	**20**
21	Mwachawaza	**23**	**16**	**19**	**10**	**68**
22	Kidaya Ngerenyi	25	16	26	19	**86**
23	Mlambenyi	31	13	4	2	**50**
24	Mwanjila	113	79	67	26	**285**
25	Rong'e Juu	37	14	0	0	**51**
26	Msau	17	12	20	11	**60**
27	Kighombo	15	7	10	4	**36**
	Total	**275**	**161**	**157**	**83**	**676**
TAVETA SUB-COUNTY						
		1st Years		*2nd Years*		**Total**
S/No.	**VTC Name**	***M***	***F***	***M***	***F***	
28	Taveta	39	4	46	18	**108**
29	Kambugu	11	4	5	0	**20**
30	Chumvini	53	28	11	17	**109**
31	Chala	29	18	5	3	**55**
	Total	**126**	**54**	**66**	**33**	**278**
	Grand Total	**982**	**619**	**522**	**303**	**2426**

10.23 List of TTIs in the County

NAME OF FACILITY
VOI TSAVO NATIONAL POLYTECHNIC
MWATATE TECHINCAL AND VOCATIONAL COLLEGE
WUMINGU TECHINCAL AND VOCATIONAL COLLEGE
TAVETA TECHINCAL AND VOCATIONAL COLLEGE

10.24 List of Universities in the County

NAME OF FACILITY
KMTC VOI CAMPUS
KMTC TAVETA CAMPUS
TAITA TAVETA UNIVERSITY
TAITA TAVETA UNIVERSITY NGERENYI CAMPUS.

10.25 Types and Costing for Clean Cooking Solutions for Households

Firewood ICS Investment Analysis (Policy Scenario)

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Households (Thousands HH)	110	112	114	116	118	120	122	124	126	128	130
Urban HH	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HH	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural HH ICS Penetration	15,913	19,726	23,566	27,427	31,304	35,191	39,084	42,976	46,863	50,740	54,600
Annual Increment		3,813	3,840	3,861	3,877	3,887	3,893	3,893	3,887	3,876	3,860
Cost of ICS/Stove (KES)	2,000										
Cost of ICS KES. Million/Year (Rural)		8	8	8	8	8	8	8	8	8	8
Urban HH ICS Penetration	5,447	6,386	7,394	8,474	9,627	10,855	12,161	13,546	15,013	16,564	18,200
Annual Increment		939	1,008	1,079	1,153	1,228	1,306	1,385	1,467	1,551	1,636
Cost of ICS KES. Million/Year (Urban)		2	2	2	2	2	3	3	3	3	3
Total Costs	**NPV 83**	**10**	**10**	**10**	**10**	**10**	**10**	**11**	**11**	**11**	**11**

Gasifier Investment (Policy Scenario)

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Total	110	112	114	116	118	120	122	124	126	128	130
Urban HH	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HH	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural Gasifier Penetration	-	762	1,530	2,305	3,084	3,867	4,653	5,440	6,228	7,015	7,800
Annual Increment		762	769	775	779	783	786	787	788	787	785
Cost of Gasifier (KES)	8,000										
Cost of Gasifier KES. Million/Year (Rural)		6	6	6	6	6	6	6	6	6	6
Urban HH Gasifier Penetration	-	178	373	586	816	1,064	1,331	1,618	1,925	2,252	2,600
Annual Increment		178	195	212	230	248	267	287	307	327	348
Cost of Gasifier KES. Million/Year (Urban)		1	2	2	2	2	2	2	2	3	3
Total No. of Gasifier Stoves		940	964	987	1,009	1,031	1,053	1,074	1,094	1,114	1,133
Total Costs (KES. Million)/Year	**NPV 67**	**8**	**8**	**8**	**8**	**8**	**8**	**9**	**9**	**9**	**9**

LPG Investment Analysis

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Total Households (Thousands)	110	112	114	116	118	120	122	124	126	128	130
Urban HH	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HH	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural HH Meko Penetration	7,578	9,520	11,477	13,445	15,421	17,402	19,387	21,372	23,354	25,331	27,300
Annual Increment		1,943	1,956	1,968	1,976	1,982	1,985	1,985	1,982	1,977	1,969
Rural 13Kg Penetration	6,062	6,398	6,733	7,068	7,402	7,734	8,065	8,393	8,719	9,041	9,360
Annual Increment		336	335	335	334	332	331	328	326	322	319
Cost of LPG (KES)											
6KG Cylinder + Gas	3,390										
13KG Cylinder + Gas + 2 Burner Stove	8,580										
Meko Investment KES. Million/Year		7	7	7	7	7	7	7	7	7	7
13KG Investment KES. Million/Year		3	3	3	3	3	3	3	3	3	3
Total (Rural)	**Total**	**9**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**9**	**9**

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Urban HH Meko Penetration	14,980	16,269	17,627	19,057	20,559	22,136	23,789	25,520	27,331	29,224	31,200
No. of new cylinder		1,289	1,358	1,429	1,502	1,577	1,653	1,731	1,811	1,893	1,976
Urban HH 13KG Penetration	2,383	2,783	3,212	3,671	4,161	4,683	5,237	5,825	6,448	7,106	7,800
No. of new cylinder		400	429	459	490	522	555	588	623	658	694
Meko Investment KES. Million/Year		4	5	5	5	5	6	6	6	6	7
13KG Investment KES. Million/Year		3	4	4	4	4	5	5	5	6	6
Total (Urban)	**Total**	**8**	**8**	**9**	**9**	**10**	**10**	**11**	**11**	**12**	**13**
Total No. of New Cylinders (Meko)		3,232	3,315	3,397	3,478	3,559	3,638	3,716	3,793	3,870	3,945
Total No. of New Cylinders (13KG)		735	764	794	824	854	885	916	948	980	1,013
Total Investment Cost KES. Million/Year (Meko)		11	11	12	12	12	12	13	13	13	13
Total Investment Cost KES. Million/ Year (13KG Cylinder + Stove)			6	7	7	7	7	8	8	8	8
Total Investment Cost KES. Million/Year	**NPV 158**	**17**	**18**	**18**	**19**	**19**	**20**	**20**	**21**	**22**	**22**

Bio-Ethanol Investment Analysis

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Thousand Households	110	112	114	116	118	120	122	124	126	128	130
Urban HH	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HH	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural HH Bio-Ethanol Penetration	-	1,142	2,295	3,457	4,626	5,801	6,979	8,160	9,342	10,522	11,700
Annual Increment		1,142	1,153	1,162	1,169	1,175	1,179	1,181	1,181	1,181	1,178
Cost of Bio-Ethanol Stove (KES)	1,550										
Cost of Bio-Ethanol Stove KES. Million/ Year (Rural)		2	2	2	2	2	2	2	2	2	2
Urban HH Bio-Ethanol Penetration	-	714	1,494	2,343	3,263	4,257	5,326	6,473	7,699	9,007	10,400
Annual Increment		714	780	849	920	994	1,069	1,147	1,226	1,308	1,393
Cost of Bio-Ethanol Stove KES. Million/ Year (Urban)		1	1	1	1	2	2	2	2	2	2
Total Costs (KES. Million)/Year	**NPV 27**	**3**	**3**	**3**	**3**	**3**	**3**	**4**	**4**	**4**	**4**

EPC Investment Analysis

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Thousand Households	110	112	114	116	118	120	122	124	126	128	130
Urban HHs	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HHs	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural HH EPC Penetration	-	228	459	691	925	1,160	1,396	1,632	1,868	2,104	2,340
Annual Increment		228	231	232	234	235	236	236	236	236	236
Cost of EPC (KES)	13,500										
Cost of EPC (KES. Million)/Year (Rural)		3	3	3	3	3	3	3	3	3	3
Urban HH EPC Penetration	-	178	373	586	816	1,064	1,331	1,618	1,925	2,252	2,600
Annual Increment		178	195	212	230	248	267	287	307	327	348
Cost of EPC (KES. Million)/Year (Urban)		2	3	3	3	3	4	4	4	4	5
Total Costs (KES. Million)/Year	**NPV 53**	**5**	**6**	**6**	**6**	**7**	**7**	**7**	**7**	**8**	**8**

Electric Stove (Coil/Induction)

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Thousand Households	110	112	114	116	118	120	122	124	126	128	130
Urban HHs	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HHs	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural HH EPC Penetration	-	228	459	691	925	1,160	1,396	1,632	1,868	2,104	2,340
Annual Increment		228	231	232	234	235	236	236	236	236	236
Cost of Electric Stove (KES)	10,000										
Cost of Electric Stove (KES. Million)/Year (Rural)		2	2	2	2	2	2	2	2	2	2
Urban HH Electric Stove Penetration	-	178	373	586	816	1,064	1,331	1,618	1,925	2,252	2,600
Annual Increment		178	195	212	230	248	267	287	307	327	348
Cost of Electric Stove (KES. Million)/Year (Urban)		2	2	2	2	2	3	3	3	3	3
Total Costs (KES. Million)/Year	**NPV 40**	**4**	**4**	**4**	**5**	**5**	**5**	**5**	**5**	**6**	**6**

Biogas Investment Analysis

Branch	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Thousand Households	110	112	114	116	118	120	122	124	126	128	130
Urban HHs	34,045	35,677	37,346	39,050	40,791	42,569	44,382	46,232	48,118	50,041	52,000
Rural HHs	75,778	76,164	76,513	76,826	77,103	77,343	77,547	77,715	77,846	77,941	78,000
Rural HH Biogas Penetration	379	533	689	845	1,002	1,160	1,318	1,477	1,635	1,793	1,950
Annual Increment		154	155	156	157	158	158	158	158	158	157
Cost of 8M3 domestic biogas system (KES)	95,000										
Cost of Biogas System KES. Million/Year	**NPV 121**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**

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