COUNTY GOVERNMENT OF NYANDARUA

Department Of Roads, Transport, Energy & Public Works

COUNTY ENERGY PLAN

2024 - 2028

Funded by the European Union

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Technical Support

SETA
Sustainable Energy Technical Assistance

Contract Number: 2020/007 KENYAEUTA

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List of Abbreviations

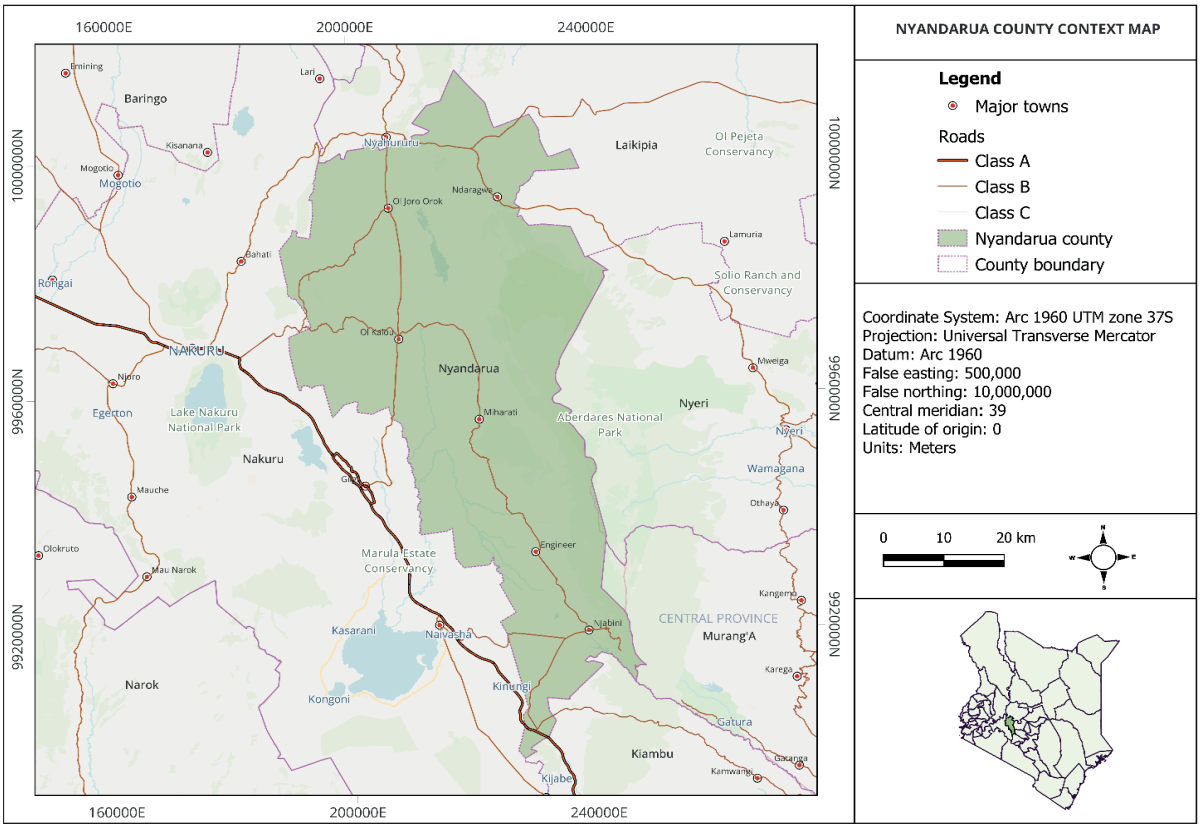
ABPL	Africa Bioenergy Program Limited
ADALYs	Averted Disability Adjusted Life Years
AECID	Spanish Agency for International Development Cooperation
AFD	French Development Agency
APR	Annual Progress Report
BAU	Business as Usual
BMZ	German Federal Ministry of Economic Cooperation and Development
CAPEX	Capital Expenditure
CAPI	Computer-Aided Personal Interview
CCAK	Clean Cooking Association of Kenya
CCF	Clean Cooking Fund
CDM	Clean Development Mechanism
CEC	County Executive Committee
CEP	County Energy Plan
CEPC	County Energy Planning Committee
CeREB	Central Region Economic Block
CGN	County Government of Nakuru
CIDP	County Integrated Development Plan
CIMES	County Integrated Monitoring Evaluation System
COM-SSA	Covenant of Mayors in Sub-Sahara Africa
CRA	Commission on Revenue Allocation
ECDE	Early Childhood Development and Education

ECD	Early childhood development
EDGE	Excellence in Design for Greater Efficiencies
EE	Energy Efficiency
EE&C	Energy Efficiency and Conservation
EER	Energy Efficiency Ratio
EC	Energy Conservation
EPC	Electric pressure cooker
EPRA	Energy and Petroleum Regulatory Authority
EUI	Energy use index
FPO	Focal Point Office(r)
GBP	Green Business Partnerships
GCP	Gross County Product
GDC	Geothermal Development Company
GDP	Gross Domestic Product
GEOSIM	Geospatial Simulation Model
GFW	Global Forest Watch
GHG	Greenhouse Gas
GHI	Global Horizontal Irradiation
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GJ	gigajoule
HAP	Household air pollution
H. E.	His Excellency
HH	Household
HVAC	Heating, ventilation, and air conditioning systems
ICF	Inner City Fund International
ICT	Information Communication Technology
ICS	Improved Cookstove
IEA	International Energy Agency
IEBC	Independent Electoral and Boundaries Commission
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
INEP	Integrated National Energy Planning
INFORSE	International Network for Sustainable Energy
IRENA	International Renewable Energy Agency

IRR	Internal rate of return
KDHS	Kenya Demographic and Health Survey
KEBS	Kenya Bureau of Standards
KenGen	Kenya Electricity Generating Company
KEREA	Kenya Renewable Energy Association
KES	Kenya Shillings
KETRACO	Kenya Electricity Transmission Company
kHA	Kilohectares
KII	Key Informant Interview
kJ	kilojoule
KNBS	Kenya National Bureau of Statistics
KNEECS	Kenya National Energy Efficiency and Conservation Strategy
KNES	Kenya National Electrification Strategy
KPLC	Kenya Power and Lighting Company
kWh	kilowatt-hour
kWp	kilowatt peak
LCEP	Least Cost Electrification Plan
LCOE	Levelized Cost of Electricity
LCPDP	Least Cost Power Development Plan
LEAP	Low Emissions and Analysis Platform
LED	Light Emitting Diode
LMCP	Last Mile Connectivity Program
LPG	Liquified Petroleum Gas
M&E	Monitoring and Evaluation
MECS	Modern Energy Cooking Services
MEPS	Minimum Energy Performance Standards
MJ	megajoule
MoE	Ministry of Energy
MoEP	Ministry of Energy and Petroleum
MoU	Memorandum of Understanding
MT/Mton	Megatonne
MTP	Medium Term Plan
MTR	Mid-term Review
MW	Megawatt
MWh	megawatt-hour

NCBI	National Center for Biotechnology Information
NGOs	Non-Governmental Organizations
NMT	Non-motorized Transport
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
ODK	Open Data Kit
PAYG	pay-as-you-go
PDD	Project Design Document
PGMs	Programmes
PPP	Public-private partnership
PUE	Productive use of Energy
PV	Photovoltaic
PVOUT	Potential photovoltaic electricity production
RBF	Results-Based Financing
REREC	Rural Electrification and Renewable Energy Corporation
RF	Recovery Factor
RPR	Residue-to-Product Ratio
SACCO	Savings and Credit Cooperative Organisation
SCODE	Sustainable Community Development Services
SDG	Sustainable Development Goal
SEACAP	Sustainable Energy Access and Climate Action Plan
SEforAll	Sustainable Energy for All
SEI	Stockholm Environment Institute
SEP	Slum Electrification Project
SETA	Sustainable Energy Technical Assistance
SHS	Solar Home System
SMEs	Small and Medium-sized Enterprises
SWH	Solar Water Heating
TBD	To be determined
TSOF	Three-Stone Open Fire
TVET	Technical and Vocational Education and Training
USD	United States Dollar
VTC	Vocational and Technical College
Wp	Watt peak

VISION AND MISSION



County Vision

A prosperous, transformed, and equitable county that provides a high quality of life to its citizens.

County Mission

To transform Nyandarua through a practical, realistic, and measurable economic, political, and social transformation strategy that includes every citizen in building a greater county and ensures equal distribution of resources and opportunities.

FOREWORD

Fellow Nyandarua residents, energy investors, regulators, partners, and all stakeholders in the sustainable development and energy sectors, I am proud to present the first Nyandarua County Energy Plan (CEP).

Throughout the history of devolution in Kenya, governments at all levels have embarked on developing sustainable energy solutions as a means to drive local and national economic growth, with varying degrees of success. While Kenya is a leading proponent of clean energy on the continent and indeed globally, achieving over 80% of our energy mix from renewable resources, we must also recognise that many renewable resource pools across our counties remain underutilised. Meanwhile, people in rural areas continue to face challenges due to reliance on unrefined cooking and heating fuels and practices, despite the availability of affordable equipment and methods to enable the clean use of local resources. Additionally, only about half of our rural population has access to electricity, compared to close to 80% at the national level.

In Nyandarua County, we are among the counties with the highest usable biomass per capita yet lack refined methods to effectively utilise and commercialise this resource to boost our socio-economic status. We have an abundance of forests and other vegetation, livestock and farm waste, and vast stretches of land with viable wind speeds suitable for harnessing wind power. Furthermore, our county has a better-than-average potential for developing solar plants at micro, small, and medium scales.

In my 2023–2027 manifesto, I laid out a robust framework to accelerate sustainable development in Nyandarua and support national growth through local and regional partnerships, including those in the energy sector.

This energy plan is a deliberate strategy to increase the proportion of our local population and institutions—particularly those offering critical services—with access to electricity; to profile and scale up our local energy resources to attract commercial investment; to develop methods and resources that enable the widespread, clean use of local resources, particularly biomass, for cooking and heating in all households; to explore and develop our local wind and solar resources through investment partnerships; and to work broadly in collaboration with stakeholders across both government and private sectors to contribute positively to the national energy framework and climate action agenda.

In this regard, I proudly invite you to partner with Nyandarua County in this bold and ambitious step towards improved livelihoods, sustainable living, and a future of shared prosperity through the responsible and efficient use of our energy resources.

H. E. MOSES NDIRANGU BADILISHA KIARIE
Governor
Nyandarua County

PREFACE

The development of the CEP has been necessitated by the requirements of the Energy Act (2019) and the Constitution of Kenya (2010). The promulgation of the Constitution of Kenya on 27th August 2010 made it essential to devolve energy functions, including energy development, energy planning, and energy licensing and regulation, from the national government to counties. Given the variance in energy resources and development capacities among counties, local and regional level planning is imperative. The County Government of Nyandarua is therefore gratified to have achieved this significant milestone in developing a County Energy Plan—a comprehensive framework for meeting the county's energy needs and a strategic roadmap for implementing all energy functions.

As we embark on this transformative journey outlined in our visionary County Energy Plan for the Department of Public Works, Roads, Transport, Housing, and Energy, we do so with a profound commitment. Contained within these pages is the blueprint for our collective journey towards a future characterised by clean and affordable energy for all.

This County Energy Plan represents the culmination of extensive research, consultation, and collaboration with experts, community leaders, and government agencies. In essence, this energy plan serves as an invitation—a call to action for stakeholders, policymakers, and the wider community. It is a pledge to collaborate, innovate tirelessly, and uphold the principles of sustainability in every facet of our energy projects. Together, let us embark on this transformative expedition, where each objective achieved propels us closer to the 2030 Agenda of the UN Sustainable Development Goal (SDG 7): Affordable and Clean Energy.

HON. CECILIA KIRIRA
County Executive Committee (CEC)—Roads, Transport, Energy and Public Works
Nyandarua County

ACKNOWLEDGEMENTS

The formulation of the County Energy Plan took into account Articles 201 and 232 of the Constitution of Kenya, which provide for public participation and stakeholder engagement. The task force on the implementation of the 2019 Energy Act led the development process for the county energy plan, under the capable leadership and guidance of our Governor, H. E. Moses Ndiragu Badilisha.

The development of this framework would not have been possible without the support and involvement of the County Executive Committee (CEC) for Roads, Transport, Energy and Public Works;Hon Cecilia Kirira; the Chief Officer for Roads Transport, Energy and Public Works: Eng Peter Karanja. The task force further acknowledges the collaboration among various county departments and the staff of the Directorate of Energy, led by the CEP focal person, Eng Josphat Ngure.

We also acknowledge the significant strategic partnerships with the Sustainable Energy Technical Assistance (SETA) project funded by the EU. Special thanks go to the core team—namely, Jean-Paul Laude (SETA Team Leader), Jechoniah Kitala (Key Expert), Emma Nyabicha (Liaison Officer), as well as the Sustainable Community Development Services (SCODE) team, including John Maina, Anastacia Kamau, and Daniel Wanjohi (funded by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to support the SETA team)—who have tirelessly facilitated the completion of the CEP development process. We extend our gratitude to sector agencies, including Kenya Power, the Rural Electrification and Renewable Energy Corporation (REREC), and the Mirangine Energy Centre, among others, for their steadfast support in all energy matters.

Finally, I would like to express my appreciation to the citizens of the County Government of Nyandarua. Their dedication and active participation have enabled us to gather real and substantive data, providing an accurate picture of our county's energy access, resources, and development.

The commitment, dedication, sacrifice, and determination of all involved can only be rewarded by the Almighty Lord. Together, we will implement effective measures to ensure the successful delivery of our County Energy Plan.

ENG. PETER M. KARANJA
Chief Officer—Roads, Transport, Energy and Public Works
Nyandarua County

EXECUTIVE SUMMARY

Introduction

Under the Energy Act of 2019, county governments in Kenya are responsible for i) county energy planning, ii) county energy regulation, and iii) county energy operations and development. They must also develop affordable and sustainable energy plans in alignment with national energy policies and the Integrated National Energy Planning Framework 2020 (INEP).

The CEP aims to provide affordable, sustainable, and reliable energy for residential, institutional, and commercial users in Nyandarua County. It covers mechanical, thermal, and electric applications across all sectors and social services. The following objectives of the CEP support this goal:

a. Establish a medium-term planning framework to advance the provision of affordable, sustainable, and reliable energy within the county.

b. Ensure proactive compliance with the energy planning and administration provisions of the National Constitution (2010) and the Energy Act (2019).

c. Address challenges and highlight opportunities in the energy sector at the county level.

Electricity Access Rates

Access to Grid Electricity: Access to grid electricity has increased: according to the 2019 census data, 41.3% of households in Nyandarua had access to grid electricity. By the 2022 baseline survey, connectivity had increased to 77%. The highest percentages of households using grid electricity for lighting are in Nyandarua Central (52.4%), Kinangop (51%), and Nyandarua West (48.7%), while Kipipiri has the lowest proportion of households connected to the grid at 27%.

Alternatives to Grid Electricity: Following grid electricity, the most common alternatives in Kipipiri are kerosene lamps and solar PV systems. Many households in Kipipiri use solar PV (37.3%) and kerosene lamps (27%). With the rising cost of kerosene (approximately KES 178 per litre in 2023 from KES 65 in 2019) and the high initial cost of connecting to the grid, most households without grid connection are likely to switch to solar PV systems.

Health Facilities: Approximately 78% of healthcare facilities in Nyandarua County are connected to the grid, while 12% use solar home systems, and 10% have no access to electricity.

Enterprises: Most industries in Nyandarua County use the national grid as their primary energy source. In addition, 13% of these industries have incorporated solar power as a secondary source, and 26.6% rely on generators for backup.

Clean Cooking Access Rates

Primary Cooking Fuel: Firewood is the predominant primary cooking fuel used by households in Nyandarua County, with 70% of households relying on it, followed by charcoal (15.6%) and Liquefied Petroleum Gas (LPG) (12.5%).

Stove and Fuel Stacking: Households frequently use multiple cooking methods, a practice referred to as stacking. Approximately 77% of households practise stacking, while 23% do not stack (i.e., they use only one stove/fuel type for cooking). Charcoal is the top secondary cooking fuel, used by about 53.5% of households, followed by firewood (12.5%) and LPG (11%). Around 30.5% of households use LPG, 8% use firewood, 4.5% use charcoal, and 57% do not have a tertiary cooking solution.

Targets and Priority Areas

The county government must prioritise access to clean cooking solutions and electricity for lighting and productive activities. Ensuring access to clean cooking fuels and technologies for everyone is essential to reduce deforestation and minimise health issues caused by household air pollution (HAP). Additionally, increasing electricity consumption among households, institutions, and enterprises is crucial for economic growth. Currently, most households connected to the grid or off-grid solar solutions primarily use electricity for lighting. Promoting the productive use of electricity—for example, for irrigation, cooling, and powering equipment—will enhance economic productivity and improve overall social well-being.

The County Energy Plan

This County Energy Plan identifies four core challenges: i) lack of an overarching energy planning framework, ii) low access to clean cooking solutions, iii) moderate access to electricity for lighting, powering, and productive use, and iv) underutilisation of energy resources (wind, hydro, solar, and farm waste). To address these, the CEP adopts a programmatic approach delivered through three interrelated components:

1. Accelerating access to energy for clean cooking and heating,
2. Enhancing access to electricity, and
3. Addressing and implementing cross-cutting issues and initiatives.

The CEP aims to achieve universal access to sustainable, affordable, and reliable energy for households, commercial users, and institutions, as illustrated in Figure 1. The CEP components are divided into nine programmes (PGMs) with an estimated implementation budget of KES 1.837 billion over five years, detailed in Chapters 5 and 6. This budget includes investments from the private sector, contributions from national and sub-national governments, support from development agencies, and climate finance in both in-kind and cash forms. Creating an environment that attracts private sector investments and fosters collaboration between development agencies and the county government is essential for mobilising these resources.

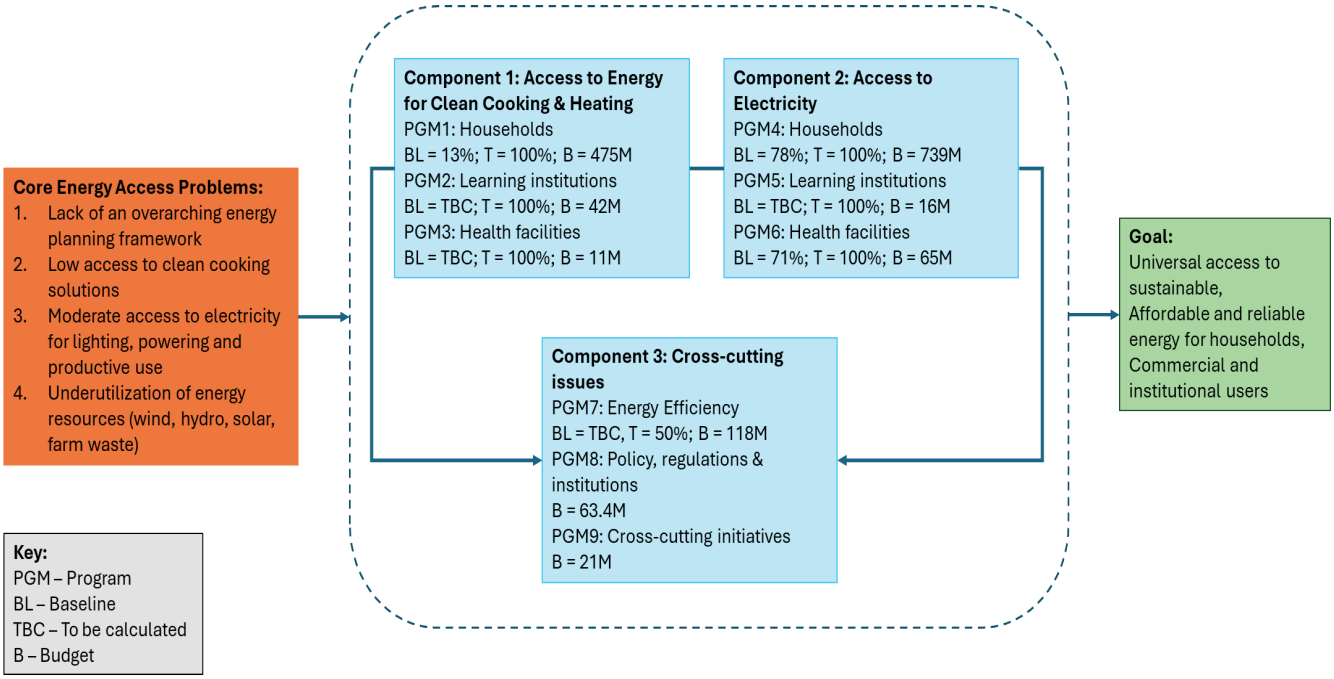
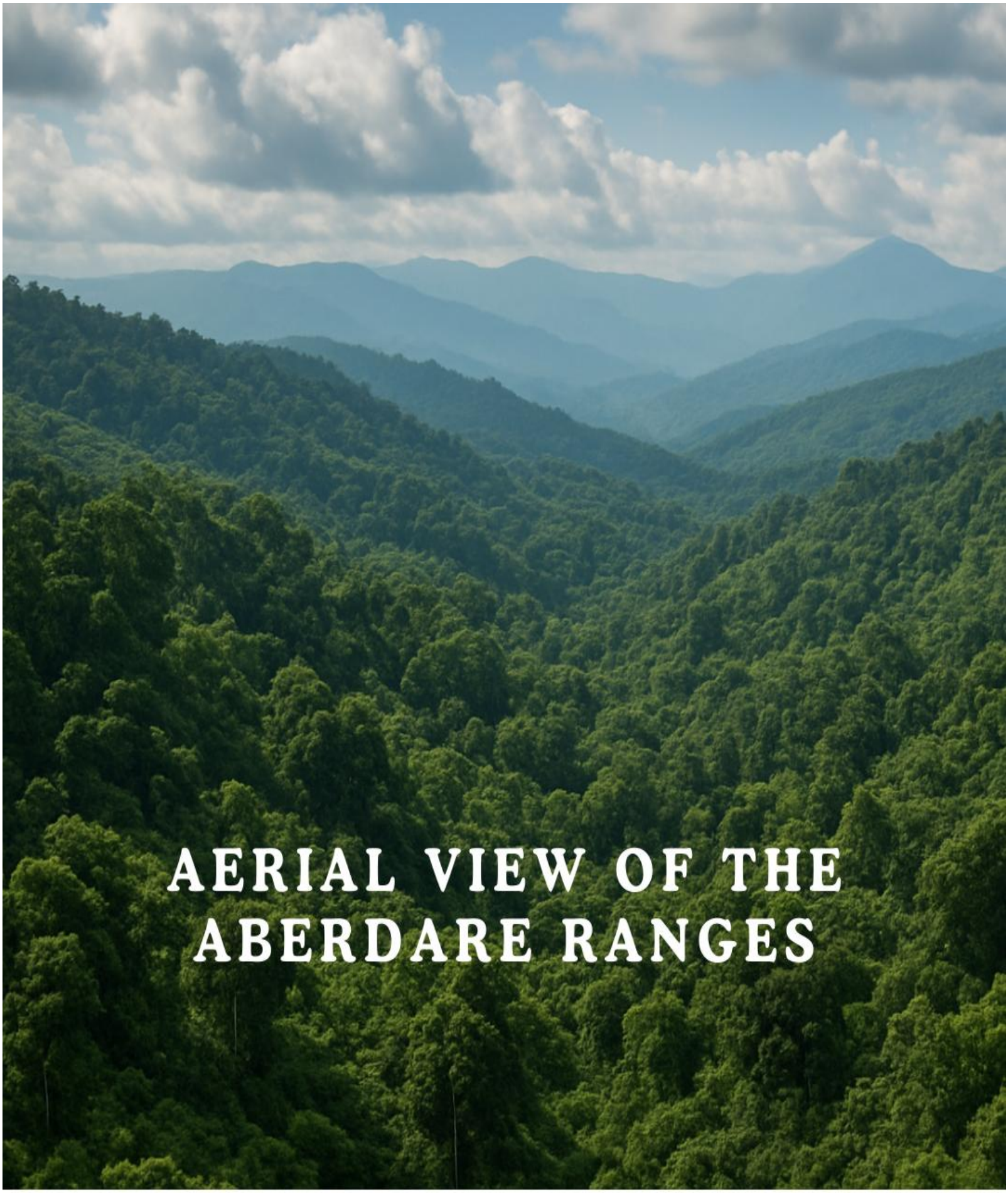


Figure 1: A Summary of the Nyandarua County Energy Plan (CEP)



AERIAL VIEW OF THE ABERDARE RANGES

Chapter 1: INTRODUCTION

1.1 Background

1.1.1 Rationale

The 2010 Constitution of Kenya established 47 counties and introduced a decentralised system that delegates energy planning and administrative responsibilities to the sub-national level for the first time. This system aims to promote fairer distribution of resources, enhance local involvement in energy planning, and focus investments on previously underserved areas. Chapter 11 and the Fourth Schedule of the Constitution list the functions devolved to county governments. The Energy Act (2019) builds on these constitutional provisions, detailing the new framework in sections 5, 193, 194, 196, 199, 222, and the Fifth Schedule. Specifically, Section 5, Sub-section 3 mandates that each county government must develop and submit a local energy plan to the Cabinet Secretary based on its energy needs. The national government is responsible for collaborating with county governments to ensure the provision of sustainable, affordable, and reliable energy services that meet the needs of all citizens. In addition to developing the CEP, county governments oversee the development and utilisation of renewable energy resources. Their role includes strategising and planning to deliver energy services efficiently to domestic, institutional, commercial, and industrial users. It is in line with these legislative and institutional changes that the County Government of Nyandarua, with support from the Sustainable Energy Technical Assistance (SETA)[1] project, has developed this CEP.

Nyandarua County, part of the Mt. Kenya and Aberdare Regional Economic Bloc, is predominantly rural, with 90% (Table 1 below) of its population residing in rural areas, primarily engaged in agriculture and livestock production. The county boasts a human development index of 0.53 and a low poverty headcount rate (32%), which is slightly above the national average (Table 1). The County Government of Nyandarua has outlined ambitious socio-economic development plans in the County Integrated Development Plan for 2023–2027 (CIDP). The CIDP identifies low (41.6%) electricity access and underdeveloped alternative energy sources as key challenges hindering universal access to sustainable energy[2]. On-grid and off-grid electricity are the primary lighting sources, while firewood (70% of households) and charcoal (16% of households) are predominantly used for thermal applications such as cooking and space heating. This CEP outlines the county's goals and role within the national energy planning framework and highlights investment opportunities in the energy sector.

Table 1 shows the critical socio-economic indicators for Nyandarua County.

[1] The Sustainable Energy Technical Assistance (SETA) project, funded by the EU and operated by Kenya's Ministry of Energy and Petroleum, enhances institutional capacity within the sustainable energy sector. It supports the identification, planning, and implementation of projects focused on renewable energy, energy access, and energy efficiency in Kenya.

[2] County Government of Nyandarua. (2023). Nyandarua County Integrated Development Plan III 2023-2027. https://www.nyandarua.go.ke/23b/wp-content/uploads/2023/07/Nyandarua-County-Integrated-Development-Plan-III-2023-2027-Popular-Version.pdf

Table 1: Nyandarua County fact sheet

#	Indicator	Value	Description
1	Demographic data[3]		
	Total population (2019)	638,289	Ranks 33 nationally
	Rural population	571,754	90% of total population
	Urban population	66,535	10% of the total population
	Total households	179,686	Ranked 29th nationally
	Average household size, 2019	3.5	
2	Human Development Index (2015)[4]	0.53	3% higher than the national average of 0.52
3	Gross County Product 2020 (KES million)[5]	150,062	Contributing 1.5% to the national GDP
4	Poverty headcount rate (%)[6]	32	Below the National average of 38.6%
5	Households with access to electricity 2019 (%)[7]	41.6%	Lower than the national average of 75%
6	Access to clean cooking[8]	13%	70% of households use firewood as their primary cooking fuel 16% use charcoal as their primary cooking fuel LPG is the predominant clean cooking solution for 12.5% of households as a primary fuel

1.1.2 Objectives

The primary objective of this CEP is to facilitate the provision of affordable, sustainable, and reliable energy for residential, institutional, and commercial users in Nyandarua County. In this plan, 'energy' encompasses mechanical, thermal, and electric applications across all productive sectors and social services. The following CEP objectives support this goal:

a. Establish a medium-term planning framework to advance the provision of affordable, sustainable, and reliable energy within the county.

b. Ensure proactive compliance with the energy planning and administrative provisions of the National Constitution (2010) and the Energy Act (2019).

c. Address challenges and highlight opportunities in the energy sector at the county level.

The development of this CEP involved comprehensive consultations and included an assessment of the county's energy resources, an analysis of current and future energy demands, an evaluation of existing energy efficiency and conservation measures, and the proposal of an implementation and financing plan aligned with the draft INEP framework.

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[3] Kenya National Bureau of Statistics. (2019). 2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County. https://www.knbs.or.ke/2019-kenya-population-and-housing-census-reports/

[4] OCHA. (2015). Kenya Human Development Index per county. https://data.humdata.org/dataset/kenya-human-development-index-per-county?force_layout=desktop

[5] Kenya National Bureau of Statistics. (2023a). Nyandarua County Statistical Abstract 2022. https://www.knbs.or.ke/wp-content/uploads/2023/07/Nyandarua-County-Statistical-Abstract-2022.pdf

[6] Kenya National Bureau of Statistics. (2023). The Kenya Poverty Report: Based on the 2021 Kenya Continuous Household Survey. Kenya National Bureau of Statistics. https://www.knbs.or.ke/download/the-kenya-poverty-report-2021/

[7] Commission on Revenue Allocation. (2022). Kenya County Fact Sheets. CRA. https://cra.go.ke/wp-content/uploads/2022/06/Kenya-County-fact-sheets-Report-Final-Res.pdf

[8] KNBS, & ICF. (2023). Kenya demographic and health survey 2022. https://www.knbs.or.ke/kenya-demographic-and-health-survey-kdhs-2022/

This CEP is organised into six chapters as described below:

Chapter 1 Introduction—An overview of Nyandarua County's geographic and demographic details and the methodology used in developing the energy plan.

Chapter 2 Provides an inventory of available energy resources in the county and an analysis of their exploitability.

Chapter 3 Quantifies current energy use by households, institutions, and businesses, including fuel (biomass and fossil fuel) consumption, the number of electrified and non-electrified households and institutions, and productive uses of energy. It also describes projected energy growth and demand under various scenarios. For Nyandarua, we considered three scenarios: i) business as usual, ii) SDG 7, and iii) high economic growth.

Chapter 4 Energy Efficiency.

Chapter 5 Details programmes and projects to be implemented.

Chapter 6 Implementation, Coordination, Monitoring, and Evaluation.

1.2 County Overview

1.2.1 Geographic Description

Nyandarua County covers approximately 3,245.1 square kilometres, part of which is occupied by the Aberdare Ranges, lying between latitude 0°8' North and 0°50' South and between longitude 35°13' East and 36°42' West. It is bordered by Kiambu to the south, Murang'a to the southeast, Nyeri to the east, Laikipia to the north, and Nakuru to the west[9]. Nyandarua County encompasses five administrative sub-counties under its jurisdiction: Kinangop, Kipipiri, Ol Kalou, Ol Joro Orok, and Ndaragwa, as presented in Table 2 below.

Table 2: Nyandarua County Administrative Units (CIDP, 2023)

Sub-County	Area (km²)	No of Locations	No of Sub-Locations
Aberdares	717	6	13
Kipipiri	456	12	32
Wanjohi		*	*
Miranginee	246	11	21
Kinangop	294	7	36
Nyandarua Central	347	9	27
Nyandarua North	528	8	23
Nyandarua West	385	7	14
Gathanji		8	17
Nyandarua South	314	*	*
Total	**3286**	**68**	**183**

*Unavailable data

[9] County Government of Nyandarua. (2023). Nyandarua County Integrated Development Plan III 2023-2027. https://www.nyandarua.go.ke/23b/wp-content/uploads/2023/07/Nyandarua-County-Integrated-Development-Plan-III-2023-2027-Popular-Version.pdf

Table 3: Political Units

Constituency	No. of Wards	Wards
Kinangop	8	Engineer, Gathara, North Kinangop, Murungaru, Njambini/Kiburu, Nyakio, Githabai, Magumu
Kipipiri	4	Wanjohi, Kipipiri, Geta, Githioro
Ol Kalou	5	Karau, Kanjuiri Ridge, Mirangine, Kaimbaga, Rurii
Ol Joro Orok	4	Gathanji, Gatimu, Weru, Charagita
Ndaragwa	4	Leshau Pondo, Kiriita, Central, Shamata

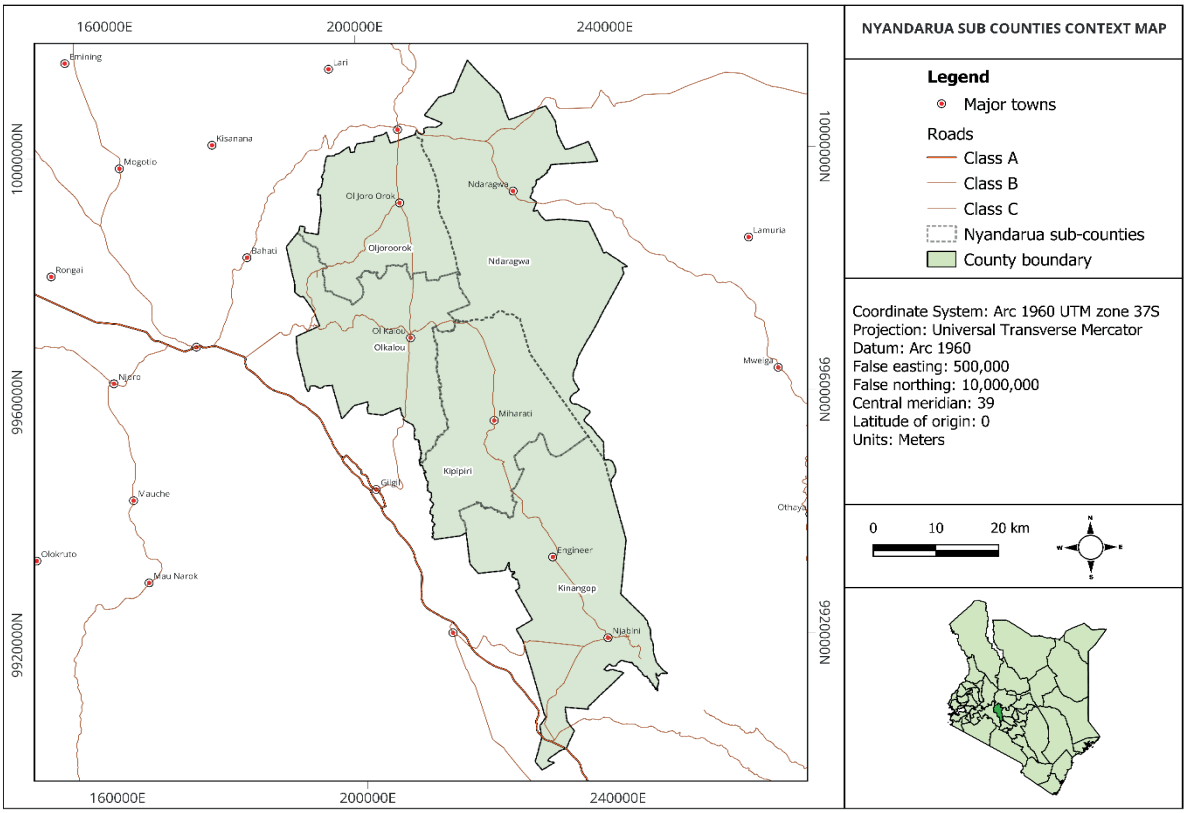


Figure 2: Nyandarua County Constituencies and Wards

Nyandarua County has a cool, temperate climate with consistent, well-distributed rainfall throughout the year. The county experiences two rainy seasons: the long rains from March to May, reaching up to 1,600 mm, and the short rains from September to December, with up to 700 mm. The county's average annual rainfall is 1,500 mm. It has moderate temperatures, which are lower than the national average. The warmest period occurs between December and March, while July is the coolest month. The highest average temperature is around 21.5°C in December, and the lowest is approximately 7.1°C in July. The county is divided into seven ecological zones, as shown in Table 4.

Table 4: Ecological Zones of Nyandarua County

Sub-County	Zone	Crop Enterprises
Upper Highland 1	North and South Kinangop	Receives relatively high rainfall
Upper Highland 2	North Kinangop	Falls in the high rainfall zone
Upper Highland 3	Ol Kalou, Kinangop	
Upper Highland 4	Ol Joro Orok, Kipipiri	
Lower Highlands 3	Ol Kalou	Receives a moderate amount of rainfall
Lower Highlands 4	Ndaragwa, Kipipiri	Dry, ranching zone
Lower Highlands 5	Ndaragwa	Largely dry

1.2.2 Demographic and Socio-Economic Outlook

Nyandarua County had a population of 638,289 in 2019, with males comprising 49.3% (315,022) and females 50.6% (323,247)[10]. The county had 179,686 households, an average household size of 3.5 persons, and a population density of 194/km². Population projections estimate growth to 721,112 by 2025 and 746,009 by 2027[11]. In 2019, Kinangop Sub-County had the highest number of households, with a population of 205,280, accounting for 32.16% of the county's total population. By contrast, Ol Joro Orok had the smallest population, at 97,965, representing 15.34%. Population projections for 2027 are detailed in Table 5, segregated by sex and adjusted for demographic factors such as fertility, mortality, birth rates, and immigration. The average annual growth rate is 2.2%.

Table 5: Population Projections (Source: Nyandarua CIDP, 2023)

County/ Sub-County	2019			2027		
	Male	Female	Total	Male	Female	Total
Nyandarua	315,022	323,247	638,289	365,883	380,126	746,009
Kinangop	100,884	104,387	205,280	117,172	122,755	239,924
Kipipiri	46,113	47,740	93,855	53,558	56,140	109,694
Ol Kalou	70,776	71,697	142,476	82,203	84,313	166,521
Ol Joro Orok	48,752	49,697	97,965	56,623	57,868	114,498
Ndaragwa	48,497	50,214	98,713		59,050	115,372

Nyandarua is a member of the Central Region Economic Bloc (CeREB), which comprises ten counties. The county's socio-economic activities primarily include farming, agroforestry, tourism, and trade[12]. Its Gross County Product (GCP) in 2020 was KES 150.062 billion, with agriculture, forestry, and fishing contributing 71%[13]. In 2019, Nyandarua ranked as the fifth contributor to the national GDP, accounting

[10] Kenya National Bureau of Statistics. (2019). 2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County. https://www.knbs.or.ke/2019-kenya-population-and-housing-census-reports/

[11] County Government of Nyandarua. (2023). Nyandarua County Integrated Development Plan III 2023-2027. https://www.nyandarua.go.ke/23b/wp-content/uploads/2023/07/Nyandarua-County-Integrated-Development-Plan-III-2023-2027-Popular-Version.pdf

[12] *Nyandarua County Government. About Nyandarua County.* www.nyandarua.go.ke

[13] Kenya National Bureau of Statistics. (2023a). Nyandarua County Statistical Abstract 2022. https://www.knbs.or.ke/wp-content/uploads/2023/07/Nyandarua-County-Statistical-Abstract-2022.pdf

for 1.52%[14] of the total. The main agricultural products are Irish potatoes and maize, while dairy farming is a significant livestock activity[15]. Approximately 27% of households rely on casual employment, and 17% run small enterprises. The primary economic activities contributing to the GCP are detailed in Table 6 below.

Table 6: Nyandarua's Socio-Economic Activities and GCP Contribution[16]

Economic Activity	Percentage Contribution to GCP
Agriculture, Forestry, and Fishing	71.42%
Mining and Quarrying	0.56%
Manufacturing	1.45%
Electricity Supply	0.20%
Water Supply; Waste Collection	0.27%
Construction	0.51%
Wholesale and Retail Trade; Repair of Motor Vehicles	1.32%
Transport and Storage	5.02%
Accommodation and Food Service Activities	0.64%
Information and Communication	0.82%
Financial and Insurance Activities	0.79%
Real Estate Activities	3.25%
Professional, Technical, and Support Services	1.29%
Public Administration and Defense	7.11%
Education	3.37%
Human Health and Social Work Activities	0.95%
Other Service Activities	1.33%
Financial Services Indirectly Measured	-0.29%
Total	**100.00%**

[14] *Daily Nation. (2022); Nyandarua County Tops in Wealth Creation.* www.nation.africa

[15] *Wairimu K. (2022), Best Crops in Nyandarua County with High Profit.* www.farmworx.co.ke

[16] Kenya National Bureau of Statistics. (2023a). Nyandarua County Statistical Abstract 2022. https://www.knbs.or.ke/wp-content/uploads/2023/07/Nyandarua-County-Statistical-Abstract-2022.pdf

1.3 Methodology

1.3.1 Primary Data Collection

In August 2022, a baseline survey was conducted over five days by a team of 10 enumerators and three supervisors across the five sub-counties of Nyandarua County. One representative ward from each of the 25 wards was selected for the survey, targeting 40 households per day. Both qualitative and quantitative methods were employed, utilising an online household questionnaire via the Open Data Kit (ODK Collect) application, ensuring real-time data collection and secure storage. Participation in the survey was voluntary, with households required to sign an informed consent form to ensure data confidentiality.

The team received an introduction letter from the County Commissioner, which was deposited at the ward administrators' offices. They also wore task-specific badges for easy identification.

The household baseline survey aimed to survey 40 households in each of the five wards of Nyandarua County, as shown in Table 7 below. Random sampling was used to ensure impartial data collection. Enumerators randomly approached households without any pre-selection. Households had the right to decline participation; in such cases, the enumerator thanked the household and moved on to the next one.

The pre-selection criteria for target wards included geographical coverage, weather patterns, population density, urban or rural classification, and economic activities. The county's major economic activities are farming, quarrying, and trade.

Table 7: Sample Size Stratification

#	Sub-County	Ward	Sample Size (Households)
1	Ndaragwa	Leshau Pondo	40
2	Ol Joro Orok	Gatimu	40
3	Ol kalou	Karau	40
4	Kipipiri	Wanjohi	40
5	Kinangop	Magumu	40
Total			**200**

1.3.2 Review of Secondary Data

The CEP development process involved an in-depth review of national and sub-national policies, laws, plans, national census data, county-level databases, and geospatial resources. Additionally, current energy planning benchmarks in other countries and counties were examined to understand national and international best practices. Table 8 details some of the policy documents and legislation reviewed in preparing this plan.

Table 8: List of Some of the Reviewed Documents

No.	Document	Functions
1	Kenya Constitution and Vision 2030	The Kenya Vision 2030 identifies energy as one of the infrastructure enablers of its social economic pillar.
2	The County Governments Act, 2012	Requires the county to protect and develop natural resources in alignment with national and county government policies.
3	The Energy Act No. 1, 2019	Consolidates the laws relating to energy and provides for national and county government functions in relation to energy.
4	National Environment Management and Coordination Act, Chapter 387	Provides the legal and institutional framework for environmental management, addressing related and incidental matters.
5	Nyandarua County Integrated Development Plan 2023–2028	Outlines the county's vision, goals, and strategies for sustainable development. Aligned with Kenya Vision 2030, the fourth Medium-Term Plan (2023–2028), the 17 Sustainable Development Goals (SDGs), and Africa's Agenda 2063, and other national, regional, and international economic development frameworks, this plan encapsulates our commitment to positive transformation.
6	Nyandarua County Climate Change Act, 2021	Aims to address climate change through local actions that mitigate and adapt to its effects. Establishes frameworks for sustainable development by incorporating climate resilience into county plans and projects, reducing vulnerability, and promoting low-carbon development.
7	Nyandarua County Statistical Abstract, 2022	Provides a comprehensive report on key economic, social, and demographic indicators for the county.
8	The Kenya Poverty Report Based on the 2021 Kenya Continuous Household Survey	Offers the latest data on household demographics, education, consumption, labour force, housing conditions, and amenities based on 2021 monthly data collection.
9	Kenya Demographic and Health Survey, 2022	Details county-level cooking fuel usage rates disaggregated by fuel type (e.g., charcoal, wood, LPG, electricity, bioethanol, biogas, and farm residue).
10	Kenya County Fact Sheets, 3rd Edition	It also has data sets synthesised by the Commission on Revenue Allocation notably: county revenues and expenditures, counties' contribution to Gross Domestic Product, counties' Intra-regional bloc contribution to the Gross Domestic Product, and data on the dominant economic activities by county.
11	Sustainable Energy for All (SEforAll)	Outlines Kenya's pathway to achieving universal access to modern energy services, increasing energy efficiency, and raising the renewable energy share in the energy mix to 80% by 2030.
12	Kenya National Electrification Strategy (KNES)	Recognises the role of off-grid options, mini-grids, and stand-alone solar systems in complementing grid extension and intensification.
13	The Climate Change Act, 2016	Provides a legal and institutional framework for climate change mitigation and adaptation; to facilitate and enhance response to climate change; and provides guidance and measures for achieving low carbon climate-resilient development.
14	Kenya National Bureau of Statistics (KNBS)	Establishes baseline data for household electricity access, population figures, and growth rates.

1.3.3 Spatial Modelling

Electrification Modelling

Electrification modelling was conducted using the Levelized Cost of Electricity (LCOE) model. The electrification analysis for Nyandarua County was carried out using a Geographic Information System (GIS) developed specifically for the electrification plan. To ensure high accuracy, 793 population clusters were delineated based on a continuous raster surface depicting the county's population density. These clusters were categorised as rural or urban and validated against the 2019 census data. The electrification status of each cluster was determined by proximity to step-down transformers, using a GIS layer from Kenya Power and Lighting Company (KPLC) and verified with Google Earth. Clusters located within or partially within a 600m buffer around transformers were classified as 'electrified', while those outside this buffer were considered unelectrified. Using these defined clusters, the geospatial electrification tool GEOSIM calculated the investment and operational costs for electrification projects, exploring various supply options to achieve universal access:

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

ii. **Grid intensification**—to electrify housing clusters within a perimeter of between 601 to 1,600 metres from an existing transformer.

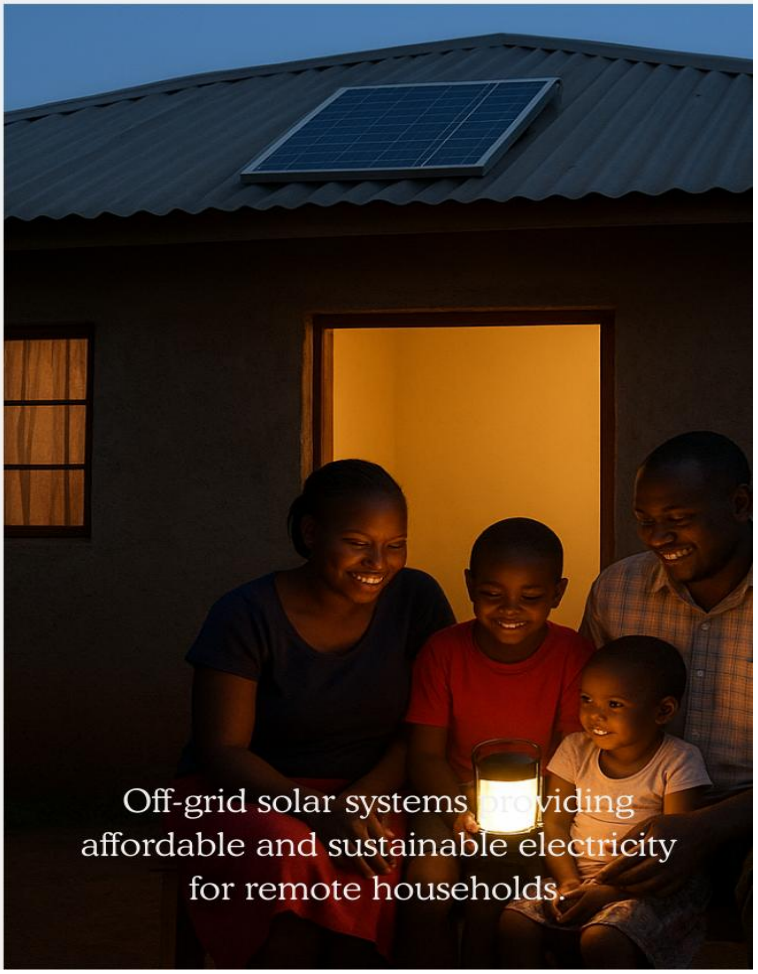
iii. **Solar home systems (SHS)**—standalone systems to reach households in densification/ intensification areas where the cost of an SHS becomes lower than a grid connection for an equivalent level of consumption. This tends to apply with lower levels of consumption.

iv. **Grid extension and mini-grid development**—these were not studied, as the furthest localities from the current network are within the intensification area.

Cooking Modelling

This CEP employed the Low Emissions and Analysis Platform (LEAP), an integrated modelling tool developed by the Stockholm Environment Institute (SEI). The analysis used scenarios—conceptualised storylines of potential energy system developments—to create and evaluate alternative future outcomes. This approach prepares county leadership for extreme outcomes and guides them on measures needed to achieve desired outcomes.

Rural households in Nyandarua gaining access to reliable electricity through grid extension and densification.



Chapter 2: ENERGY RESOURCES ASSESSMENT

2.1 Solar Energy

2.1.1 Solar Technology Options

The sun is the ultimate primary energy source, emitting energy that exceeds the world's needs by more than 8,000 times[17]. On average, Kenya experiences around 6.5 hours of sunshine per day, and 70% of its land area has the potential to receive more than 5 kWh/m²/day of solar energy[18]. Solar photovoltaic (PV) technology has notably helped Kenyans harness solar power for lighting and other productive uses. In 2018, nearly 1.8 million people used small (11–50W) solar home systems (SHS), and 14,000 used larger (>50W) SHS[19]. In Nyandarua County, Kipipiri (37.3%), Nyandarua North (36.3%), and Nyandarua South (34%) are the leading sub-counties in primary use of solar PV for lighting, as shown in Figure 3 below.

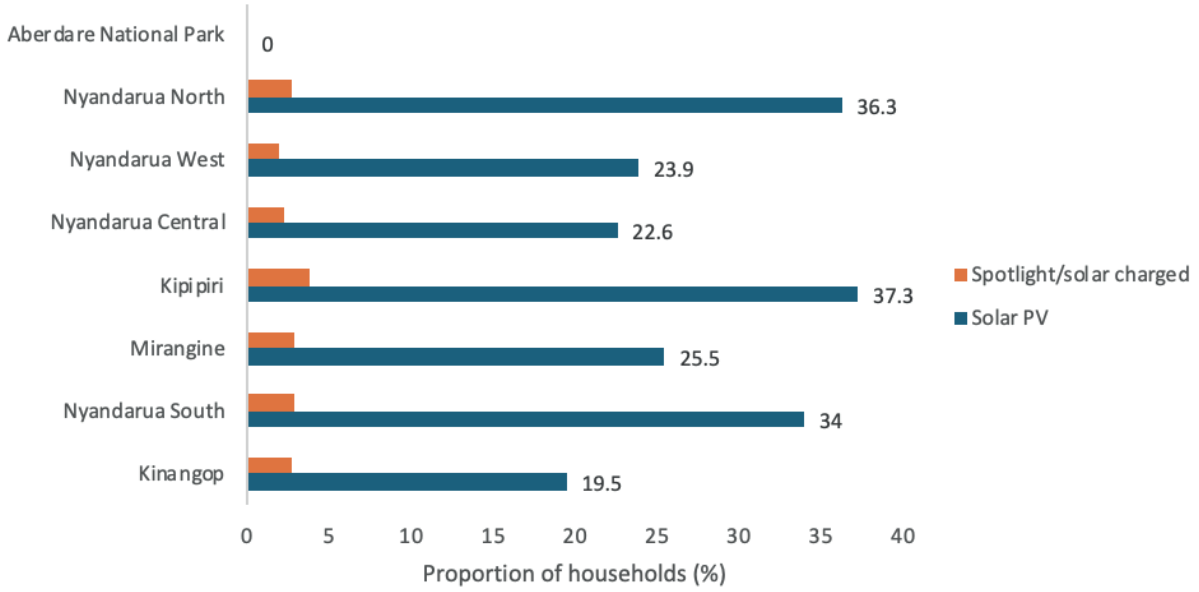


Figure 3: Solar PV Usage in Nyandarua County

2.1.2 Solar Resource Assessment

According to the Global Solar Atlas[20], the solar potential in Nyandarua is significant, particularly in the northern parts of the county. Figure 4 shows the long-term average Global Horizontal Irradiation (GHI)

[17] Wald, L. (2018). Basics in solar radiation at Earth surface.

[18] Oloo, F. O., Olang, L., & Strobl, J. (2015). Spatial modelling of solar energy potential in Kenya. International Journal of Sustainable Energy Planning and Management, 6, 17–30.

[19] Kamar, L. (2023). Number of people using Solar Home Systems (SHS) in Kenya from 2011 to 2018. Energy and Environment. https://www.statista.com/statistics/1279982/number-of-people-using-solar-home-systems-in-kenya/

[20] 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.

in Nyandarua County, with the average GHI being approximately 1,996 kWh/m²/year, indicating a high potential for photovoltaic electricity production (Plate B).

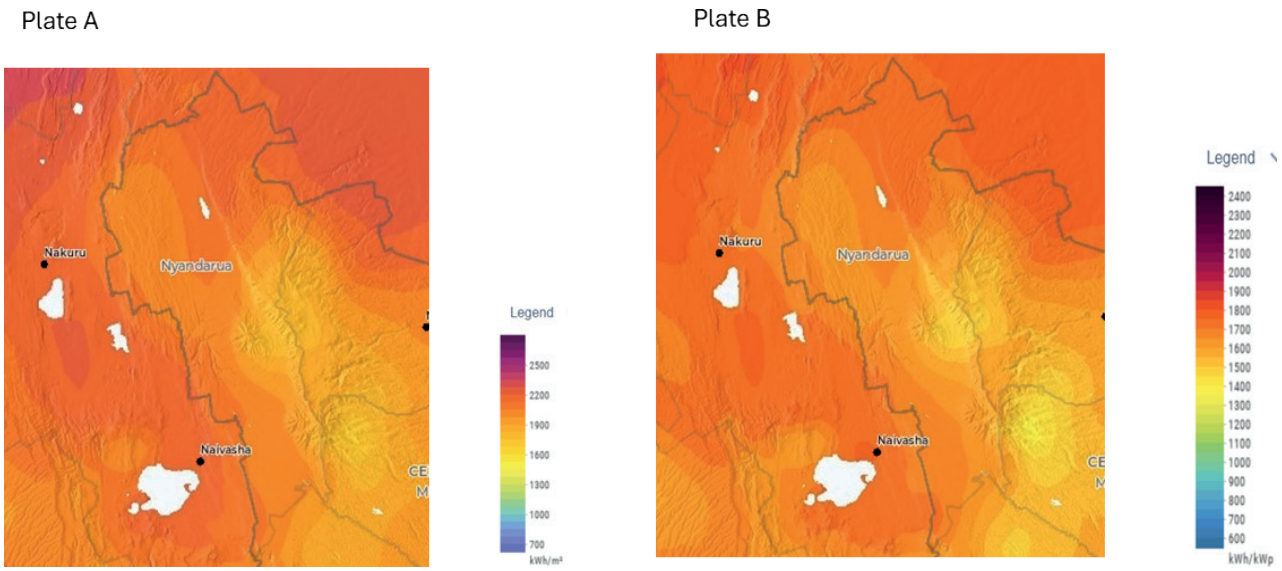


Figure 4: Global Horizontal Irradiation in kWh/m²/day (Plate A) and PV Output in kWh/kWp/year (Plate B)

In terms of solar irradiation, the best resources are in the north and south of the county (primarily in Nyandarua North), where the GHI is close to 6 kWh/m²/day. The less-endowed areas in terms of solar resources are in the eastern parts of Nyandarua, including a southern sub-county with a GHI of 5.05 kWh/m²/day (mountain area). The PV power output represents the electricity generated by PV panels, with the southern zone ranging from 4.28–4.72 kWh/kWp, the central zone from 4.05–4.57 kWh/kWp, and the northern zone from 4.47–4.72 kWh/kWp. These estimates do not account for system losses, which vary by PV technology application type. Generally, losses range from 10% to 14% for grid-connected systems and more than 20% for solar mini-grids supported by battery storage.

2.1.3 Solar PV Powering for Small Residential Settlements

Small residential PV systems vary in capacity (from 100 Wp to 1 kWp) depending on their intended use. A typical small solar system of 0.1 kWp can generate around 13 kWh of electricity per month, enough to power basic home appliances such as a refrigerator, TV, light bulbs, and a fan (depending on the energy usage of each appliance)[21]. Investment costs for smaller systems remain high, in the range of 10–12 USD/Wp installed. A 50 Wp system typically costs 60 to 70 USD or KES 80,000 to 100,000, with an expected battery pack replacement after 5 to 8 years, costing approximately KES 40,000 to 50,000.

[21] EcoWatch (2023). Will a 3 kW Solar Panel System Work for Your Home? – Retrieved from: https://www.ecowatch.com/solar/3-kw-solar-systems#:~:text=A%203kW%20solar%20system%20will,much%20energy%20your%20unit%20uses). Date: 8/9/2023

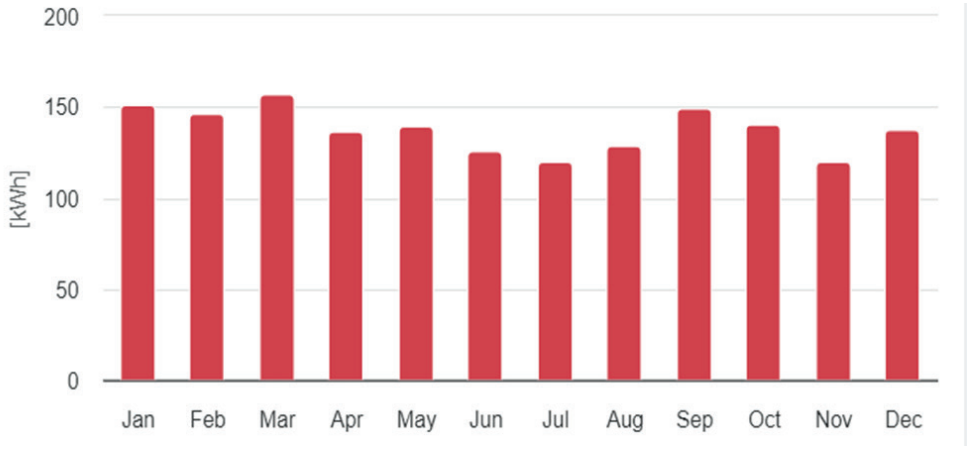


Figure 5: Monthly Production Averages for 1000 Wp Installed in Nyandarua

PV production is relatively constant throughout the year, with April, June, and November showing slightly lower-than-average production levels.

2.1.4 Solar Plants for Enterprises

The high average solar resource and its consistent availability throughout the year make solar power economically attractive for larger Small and Medium-sized Enterprises (SMEs) and factories with significant annual electricity demand, such as tea factories, dairies, and cooling facilities. Over the past decade, total investment costs for utility-scale solar PV capacity have dramatically decreased[22]. In 2022, the cost of mainstream PV panels was around 0.307 USD/Wp, while highly efficient panels cost around 0.407 USD/Wp.

The low cost of panels has significantly reduced the global capacity-weighted average total installed cost for utility-scale projects commissioned in 2022 to

- USD 876/kW, which is 4% lower than in 2021 and 83% lower than in 2010, with a range from USD 569/kW to USD 1,878/kW for projects within the 5th and 95th percentiles.
- A utility-scale PV project in South Africa costs approximately 1,257 USD/kWp installed.

It would be reasonable to assume that the investment costs for a solar power plant in Kenya for industrial uses, with an installed capacity ranging from a few MW to 10 MW, could range from 1,200 to 1,400 USD/kWp (for a system without storage, synchronised with Kenya Power's supply). With a capacity factor of 17.5% and overall system efficiency of 90%, the Levelised Cost of Electricity (LCOE) for a 20-year investment could range from 17.0 to 19.8 KES/kWh[23] compared to the current tariff of 23 KES/kWh paid to Kenya Power.

The internal rate of return (IRR) on this investment would be between 11% and 13%, with a payback period of approximately 7 to 8 years.

[22] IRENA (2023), Renewable power generation costs in 2022, International Renewable Energy Agency, Abu Dhabi

[23] SETA economist own assessment

2.1.5 Solar Potential for Thermal Applications

With an average GHI of 20.5 MJ/m²/day, one square metre of a solar water heater (SWH) could heat 60 litres of water from 10°C to 60°C with an efficiency of 60%, or up to 80 litres with an efficiency of around 80% (calculated as 20.5 MJ/m² x 1,000 (MJ→kJ) x 60% efficiency / (4.18 kJ/l/°C x Δ50°C)). For an SWH system to heat 1 m³ of water from 10°C to 60°C, the required area would range from 14 m² for highly efficient equipment to 17 m² for standard equipment (60% efficiency). Heating 1 m³ of water to 60°C using an electric water heater would consume approximately 232 GJ (calculated as 1,000 l x 4.18 kJ/l/°C x 50°C / 90% efficiency), or 64 kWh.

Healthcare Facilities

In healthcare facilities, SWHs can provide:

- Sanitary hot water for patients and staff (for showers)
- Hot water for kitchens
- Hot water for laundry services

The number of beds per 1,000 people in Kenya is reported to be 1.4[24]. With a projected 2023 population of 696,000 in Nyandarua, the estimated number of hospital beds is approximately 974. Based on the repealed 2012 SWH regulations, each bed requires an estimated 50 litres of hot water daily, bringing the total daily requirement to 49,000 litres. If SWH systems with 20 m² collectors per 1,000-litre capacity were installed across healthcare facilities, around 49 units would be required, with a total collector area of 974 m².

Assuming an equipment cost of €1,130 (KES 200,000) for a 350-litre SWH, the installed cost in Nyandarua, including transport and installation, is estimated to be 135% of the equipment price (€1,590 or KES 270,000). Such equipment could save approximately 22 kWh per day, or roughly 7,000 to 8,000 kWh annually, leading to a return on investment period of 1.5 to 1.7 years, or about 2 years based on levelised cost estimates. Given Nyandarua's solar potential, institutional solar water heater installations would be a valuable investment for the county's health sector. To meet the overall estimated demand of 974 m² of SWH capacity and 49 m³ of hot water daily, an investment of KES 37.6 million could yield annual savings of one million kWh or KES 23.5 million.

Education Facilities

Consideration has been given to all educational facilities, including pre-schools, primary and secondary schools, public universities, Vocational Training Centres, Technical and Vocational Education and Training (TVET) centres, and teacher training colleges. The hot water requirements were determined by multiplying the number of enrolled students by the 5-litre daily requirement per student stipulated in the SWH regulations. The number of students is summarised in the table below based on data from Nyandarua's County Integrated Development Plan (CIDP) 2023–2027, along with the total SWH units required to meet daily demand.

[24] World Bank. Hospital Beds per 1000 people, Kenya. Retrieved from: https://data.worldbank.org/indicator/SH.MED.BEDS.ZS?locations=KE. Date: 8/9/2023

Table 9: Swh Units Required for Educational Institutions in Nyandarua County

Education Institution	Enrolled Students	Litres of Hot Water Required (5 litres/student/day)	SWH Units Required (20 m²/1,000 litres)
Pre-School	31,844	371,000	7,426
Primary School	188,308	941,540	18,831
Secondary School	96,646	375,240	7,505
Vocational and Technical Colleges (VTCs)	2,414		
Technical, Vocational Education and Training (TVETs) Centres	3,924		
Totals	**323,136**	**1,688,080**	**33,762**

To meet the estimated demand of 1,688 m³ of hot water per day, an investment of KES 1.3 billion would be required to install 33,762 m² of SWH units, potentially saving 30.7 million kWh per year, or KES 706.6 million.

2.2 Wind Energy

Data from the Global Wind Atlas[25] was used to visualise the mean annual wind speed and wind power capacity factor of Nyandarua County, as shown below. The capacity factor is defined as the average power generated divided by the rated peak power (i.e., the amount of energy produced by a wind turbine compared to the energy it would produce if it ran at its rated power over a given period). This metric is used to compare the potential for wind power generation at different sites.

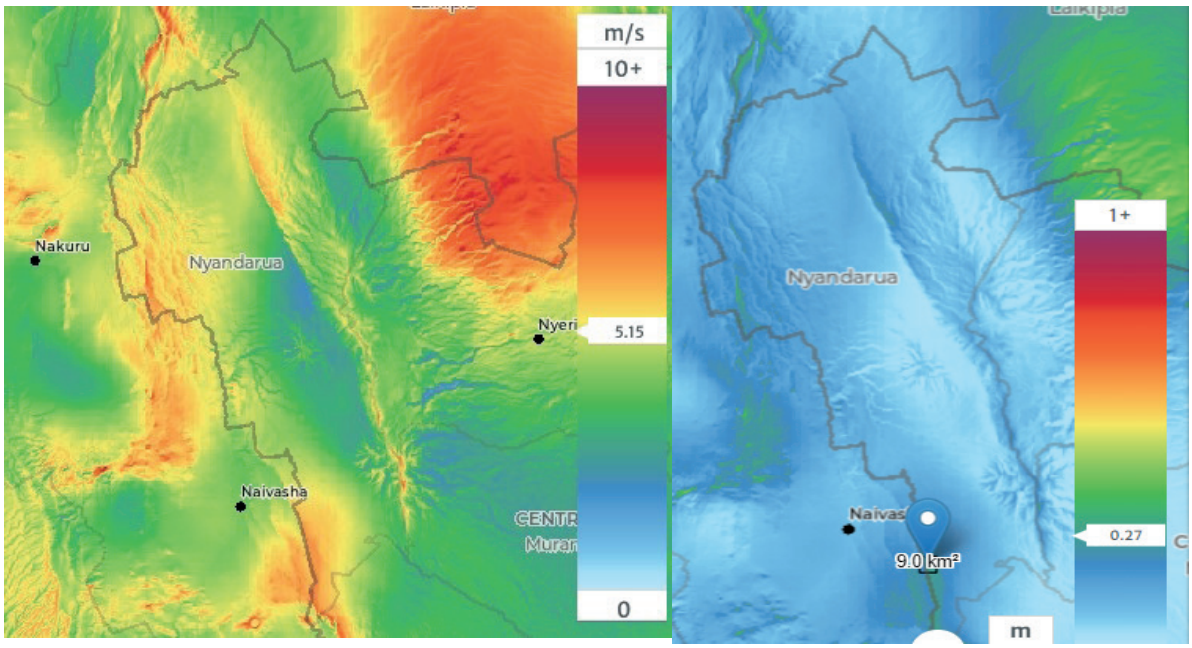


Figure 6: Mean annual wind speed at 100 metres and corresponding capacity factor—IEC Class I for Nyandarua County

[25] 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 Nyandarua County, higher wind speeds above 7 m/s at a height of 100 m are found in the sub-county of Nyandarua South and the northern part of Nyandarua North Sub-County. The brown to dark brown areas on the map indicate wind speeds between 7 and 9 m/s along the crests.

In terms of energy potential, the capacity factor map highlights areas with the most favourable conditions for wind energy production. Feasibility studies undertaken in the Kinangop area revealed adequate wind speeds averaging 8 m/s, which led to the conceptualisation and launch of the Kinangop Wind Power project in 2004[26]. The project site (labelled as "site" on Figure 7 below) is located on the Kinangop Plateau at an elevation of approximately 2,600 metres above sea level. The Kinangop Wind Park site coordinates are 0°49'41.22" S and 36°33'19.27" E. Unfortunately, this project was not implemented.

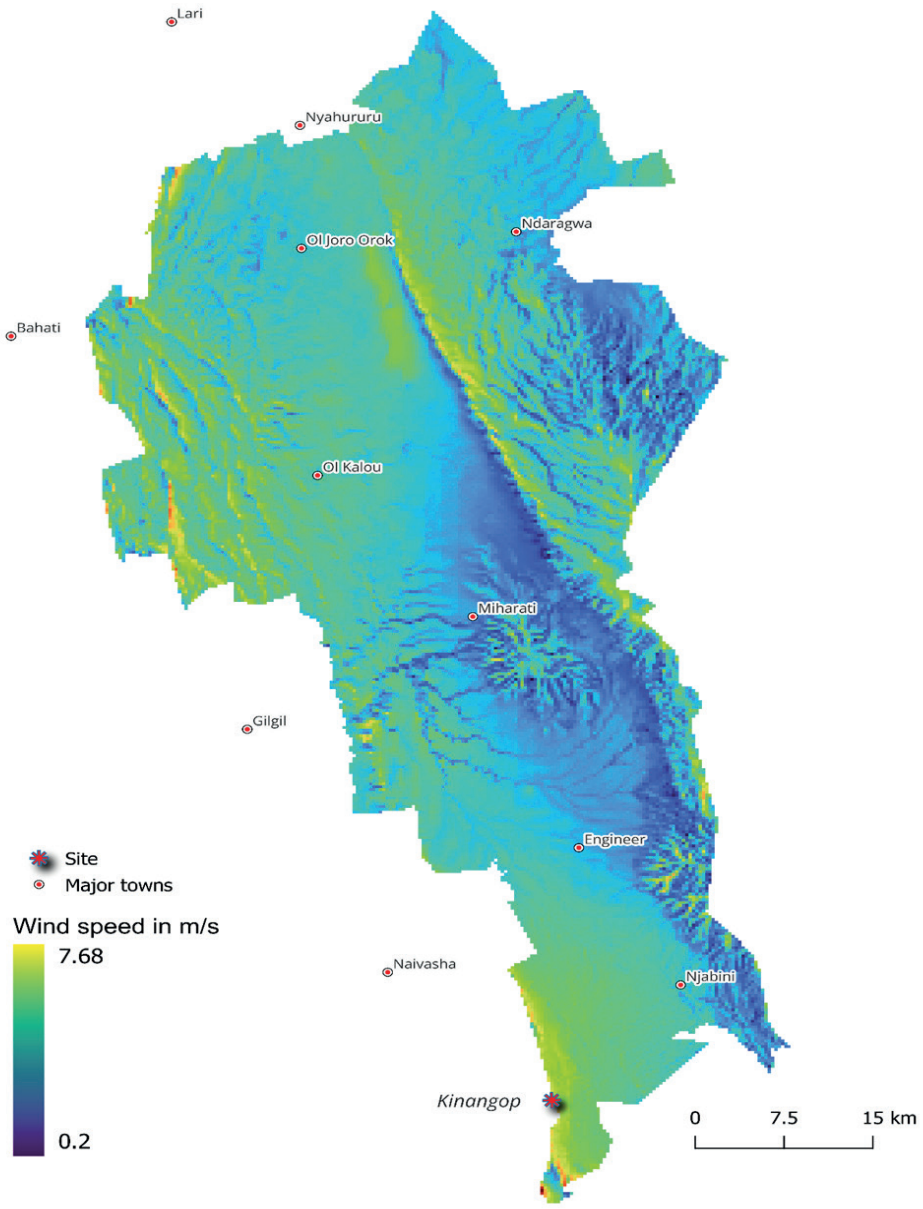


Figure 7: Nyandarua County wind resource map

[26] Clean Development Mechanism-Executive Board. (2012). Project Design Document Form (CDM PDD): 60 MW Kinangop Wind Park Project. https://cdm.unfccc.int/UserManagement/FileStorage/GVM9IOHK8EF6S5D2CUWYNL3ABZX017

2.3 Hydro Energy

Hydropower was one of Kenya's earliest recognised national resources, with exploration beginning in the early 1920s. In addition to large hydropower plants, the private sector established several isolated micro-hydro schemes, largely for tea estates, sawmills, and missionary operations. For instance, the Mujwa Catholic Mission near Nkubu in Tana River County set up a 60 kW micro-hydro plant in 1927, which operated successfully until the late 1990s. The assessed optimised potential[27] assessed in Nyandarua County (run-of-the-river) is about 38.7 MWa[28], for hydropower in Nyandarua County (run-of-the-river) is approximately 38.7 MWa, making it one of the lowest in the country. However, the county does have several potential sites for hydro projects ranging from 0.1 to 3 MW. Apart from the Ndiara area, most of these are located in the Ol Kalou watershed.

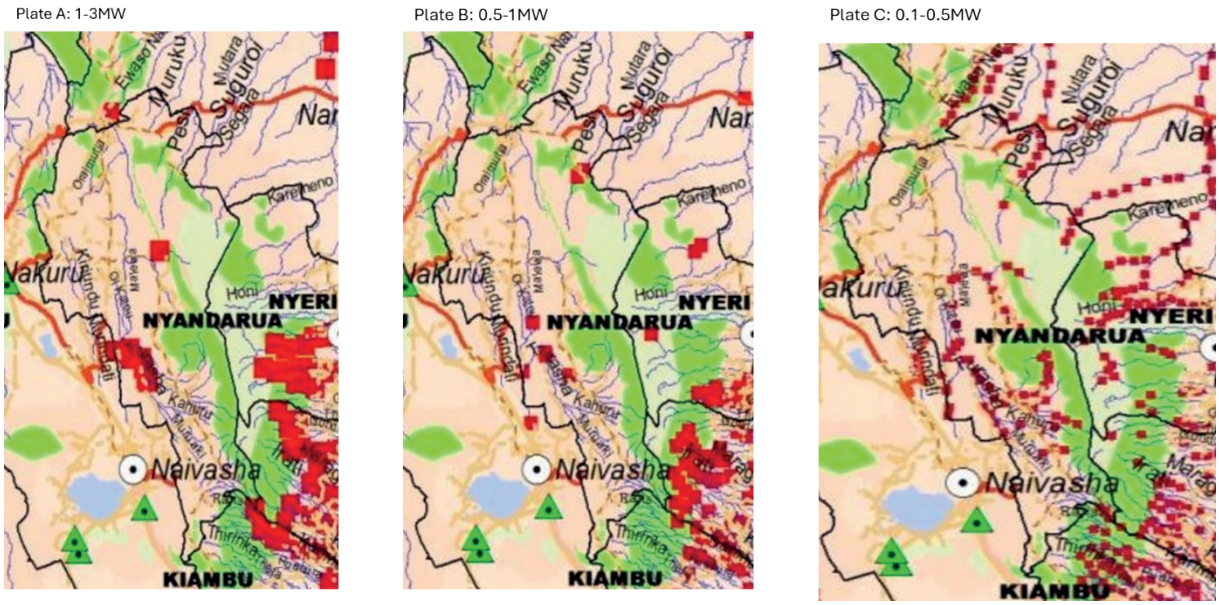


Figure 8: Nyandarua County hydro-electric power resources

2.4 Bioenergy

2.4.1 Overview

Bioenergy is renewable organic material derived from crops, trees, wood chips, aquatic plants, manure, and municipal waste. Bioenergy can be categorised into three forms: (i) solid biomass such as fuelwood, charcoal, pellets, and briquettes; (ii) liquid biofuels, including bioethanol and biodiesel; and (iii) gaseous biofuels like biogas, biomethane, and syngas[29]. These can be used in their natural state or further processed, as shown in Figure 9.

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[27] The potential can be optimised using weirs and damming effect to raise the available head by between 2% and 10 % of the head evaluated.

[28] MWa being power potential available in megawatts. *Source: Hydropower Resources Atlas of Kenya with Emphasis on Small Hydropower Resources, MoE/ONT/36/2011-2012, June 2015.*

[29] Ministry of Energy and Petroleum. (2020). Bioenergy strategy 2020-2027. MoEP. https://repository.kippra.or.ke/bitstream/handle/123456789/3017/Bioenergy-strategy%202020-2027.pdf?sequence=1&isAllowed=y

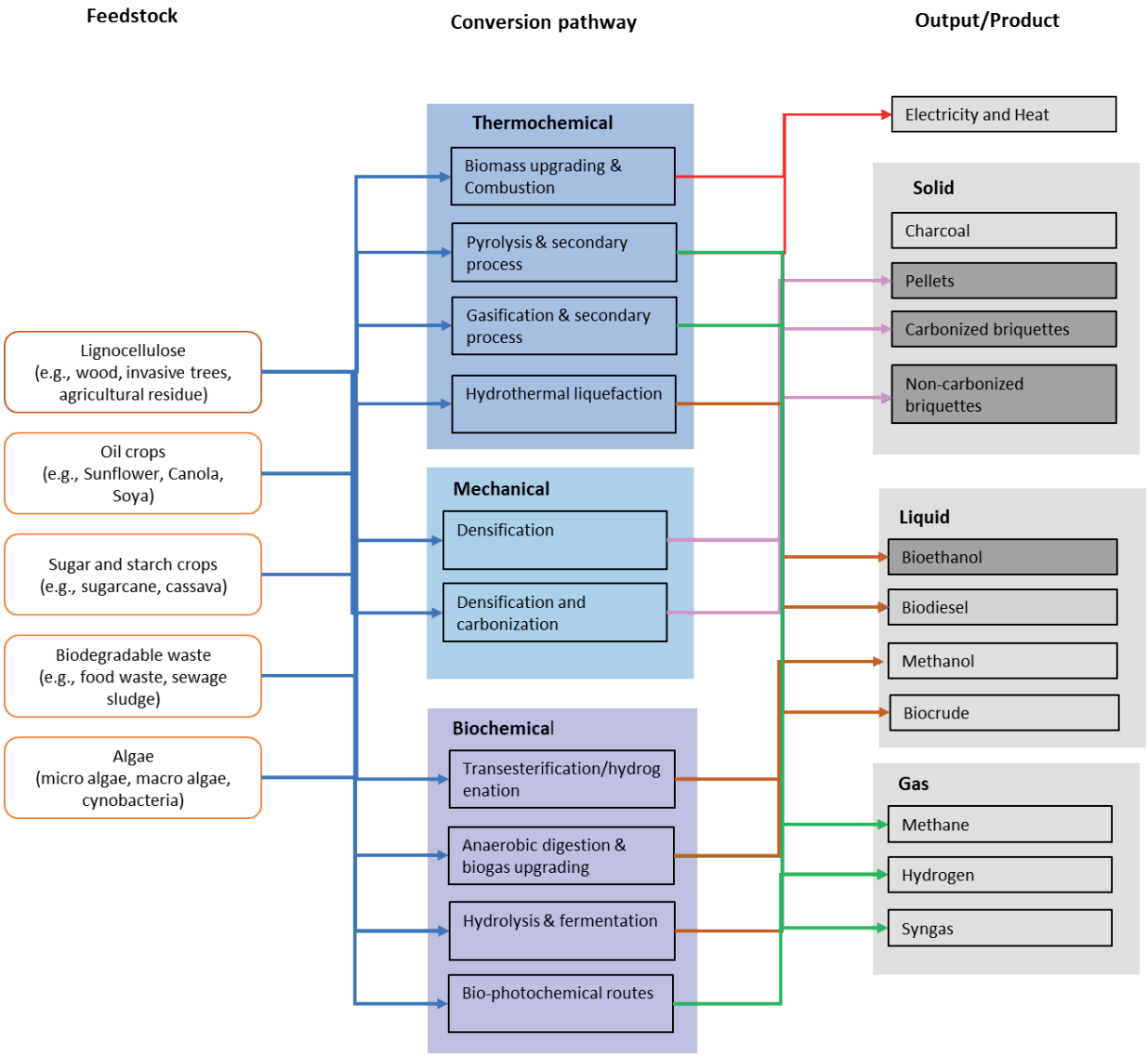


Figure 9: Feedstock and conversion pathways for different biofuels (adapted with alterations from Puscoli et al., 2021)[30]

2.4.2 Wood Fuel

Nyandarua is a net wood-producing county, with wood supply exceeding demand, enabling it to export surplus wood to other counties[31]. However, it has a negative net charcoal balance of 46,454 m³, indicating reliance on other regions for supply (Table 10).

[30] Pascoli, D. U., Aui, A., Frank, J., Therasme, O., Dixon, K., Gustafson, R., Kelly, B., Volk, T. A., & Wright, M. M. (2022). The US bioeconomy at the intersection of technology, policy, and education. Biofuels, Bioproducts and Biorefining, 16(1), 9–26. https://doi.org/10.1002/bbb.230

[31] Ministry of Environment, Water and Natural Resources. (2013). Analysis of demand and supply of wood products in Kenya. https://www.scribd.com/document/411278222/Analysis-of-Demand-and-Supply-of-Wood-Products-in-Kenya

Table 10: Nyandarua County net wood fuel balance (Data Source: Ministry of Environment, Water and Natural Resources, 2013)

Category	Timber (m^3)	Poles (m^3)	Wood fuel (m^3)			Total (m^3)
			Firewood	Charcoal	Total (m^3)	
Supply potential	244,151	80,878	381,960	205,671	587,631	1,500,291
Demand	81,272	21,767	288,832	252,125	540,957	1,184,953
Net Balance	162,879	59,111	93,128	(46,454)	46,674	315,338

Nyandarua County has twelve forests: Geta, Dundori, Ndaragwa, Ragia, North Kinangop, Laikipia, Aberdare, and One Forest, as well as Marmanet, Rumuruti, Ewaso Narok, and Lariak Forest. Together, these forests cover about 52,715 hectares, of which 52,621 hectares are gazetted and 94 hectares are non-gazetted. The distribution of forest areas by sub-county is shown in Table 11.

Table 11: Category and size of forests

Sub-County	Category	Area (Hectare)
Kinangop	Gazetted	13,471.9
	Non-Gazetted	0
Ol Kalou	Gazetted	0
	Non-Gazetted	94.04
Ol Joro Orok	Gazetted	3,326
	Non-Gazetted	0
Kipipiri	Gazetted	0
	Non-Gazetted	21,644.4
Ndaragwa	Gazetted	14,179.1
	Non-Gazetted	0
Total	**Gazetted**	**52,621**
	Non-gazetted	**94**

These forests, along with government conservancies and reserves, are the main sources of wood fuel in the county. Some households cut home-grown trees, while others collect wood from nearby natural bushland. Survey data indicated that 79% of households use firewood for cooking, with 76.5% relying on it as their primary cooking fuel.

2.4.3 Agricultural Residue

Agricultural residues are organic materials left from harvesting or processing crops. These residues can be either field residues, like maize stalks, left in the field after harvest, or process residues, such as sugarcane bagasse, produced during crop processing[32]. The agricultural activities in Nyandarua County

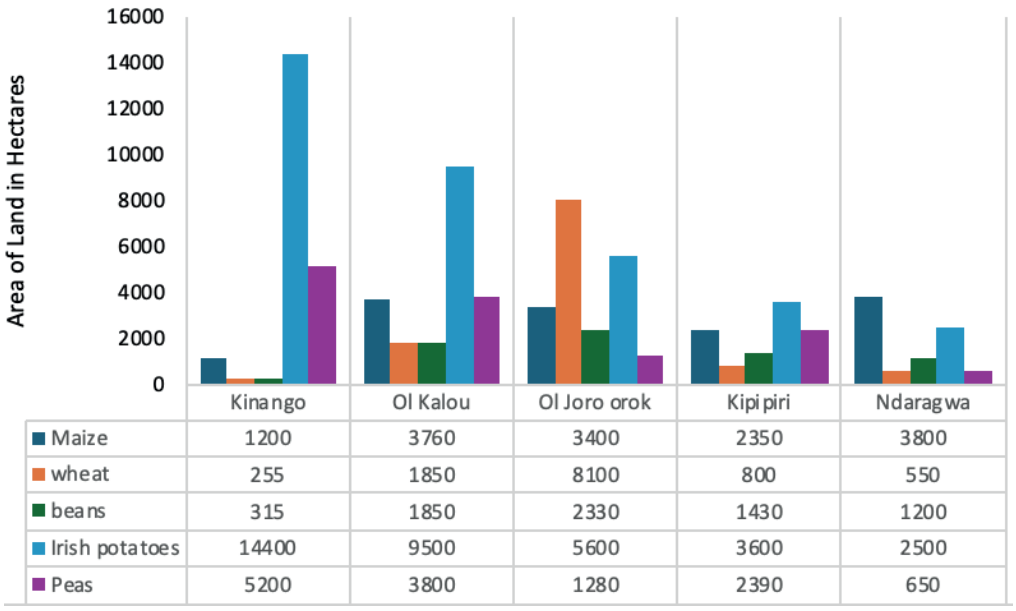
[32] Wekesa, A. N. (2013). Using GIS to assess the potential of crop residues for energy generation in Kenya. http://ir.canterbury.ac.nz/handle/10092/7838

are influenced by the area's ecological zones, which determine the types of crops grown and livestock raised. Table 12 lists the principal crops and livestock practices across the sub-counties.

Table 12: Main crops grown in Nyandarua County sub-counties[33]

Sub-County	Crop Enterprises
Kinangop	Potatoes, maize, garden peas, wheat, pyrethrum, dairy
Ol Kalou	Potatoes, maize, garden peas, wheat, pyrethrum, dairy
Ol Joro Orok	Potatoes, maize, garden peas, wheat, pyrethrum, dairy
Kipipiri	Potatoes, maize, garden peas, wheat, pyrethrum, dairy
Ndaragwa	Potatoes, maize, garden peas, wheat, pyrethrum, dairy

According to survey data, 79% of households practice farming, equating to approximately 141,952 households capable of producing agricultural waste for energy. Of these households, 61.5% grow maize. Secondary data shows that Irish potatoes are the dominant crop, followed by maize, wheat, pyrethrum, and peas. Most households cultivate small plots. Figure 10 below shows the hectares used for crop production in the county in 2021.



	Kinango	Ol Kalou	Ol Joro orok	Kipipiri	Ndaragwa
Maize	1200	3760	3400	2350	3800
wheat	255	1850	8100	800	550
beans	315	1850	2330	1430	1200
Irish potatoes	14400	9500	5600	3600	2500
Peas	5200	3800	1280	2390	650

Figure 10: Area of land used for crop production (Data Source: KNBS, 2022)[34]

The annual potential for crop residue from maize, wheat, potatoes, beans, and peas in Nyandarua County is approximately 428,719 tonnes, as shown in Table 13. The primary source of this residue is Irish potatoes, primarily in the form of peels and pulp. However, as some of the crop is sold to other counties, not all residue remains available for reuse in Nyandarua.

[33] Kenya National Bureau of Statistics. (2023). Nyandarua County statistical abstract 2022. https://www.knbs.or.ke/wp-content/uploads/2023/07/Nyandarua-County-Statistical-Abstract-2022.pdf

[34] Kenya National Bureau of Statistics. (2023). Nyandarua County statistical abstract 2022. https://www.knbs.or.ke/wp-content/uploads/2023/07/Nyandarua-County-Statistical-Abstract-2022.pdf

Challenges to using crop residue for energy production include (i) competition with other uses, such as animal feed and compost, which replenishes soil fertility, and (ii) seasonality, making residues an unreliable energy source. For instance, most smallholder farmers heavily rely on tropical pastures and crop residues as primary dry season feed[35]. A biodigester offers a practical solution by anaerobically decomposing residue to produce biogas for cooking and biofertiliser. However, for efficient operation, a household biodigester requires at least two zero-grazed cattle or a sufficient number of poultry (chickens and pigs) to supply a consistent feedstock[36]. While potatoes and peas are usually consumed in small quantities by households, they could also serve as biodigester feedstock for biogas and biofertiliser production.

Table 13: Approximate potential for crop residue in Nyandarua

Residue-producing crops	2020 Production (tonnes)[37]	Residues component	Residue-to-Product Ratio (RPR)[38]	Residue Recovery Factor (RF)
Maize	14,148	Stalks	13%	80%
		Husks	20%	100%
		Cobs	25%	100%
Wheat	11,812	Wheat stalks	14%	80%
Beans	7,588	Beans straws	1.9	
Irish potatoes	351,380	Peels	27%	94872.60
		Pulps		
Peas	43,791	Pods	30–67%[39]	21238.64
Total (tonnes)	**428,719**			

2.4.4 Animal Waste

Upgrading animal manure to cleaner and more efficient energy carriers, such as biogas from anaerobic digestion, offers significant potential to provide reliable energy while safeguarding the environment[40]. Nyandarua County has about 1,633,500[41] livestock, which can provide adequate feedstock for biogas and biofertiliser production. Approximately 140,854 households in Nyandarua practice livestock farming. Table 14 shows the distribution of livestock across the county. A dairy cow produces roughly 10 kg of dung per day[42]; with 245,278 dairy cows in 2021[43], Nyandarua's livestock could produce around 2,452,780 kg of dung, enough to generate 98,111.2 m³ of biogas.

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[35] Lanyasunya, T. P., Wang, H. R., Mukisira, E. A., Abdulrazak, S. A., & Ayako, W. O. (2006). Effect of seasonality on feed availability, quality and herd performance on smallholder farms in Ol-Joro-Orok Location/Nyandarua District, Kenya. Tropical and Subtropical Agroecosystems, 6(2), 87–93. https://www.redalyc.org/pdf/939/93960206.pdf

[36] International Network for Sustainable Energy (INFORSE). (2008). Manual on Sustainable Energy Solutions to Reduce Poverty in Asia. https://inforse.org/asia/M_III_biogas.htm

[37] *KNBS & Nyandarua County Government (2022); County St*atistics Abstract

[38] *New Science Pg (2015), International Journal for energy & Power Engineering.* www.article.sciencepg.net

[39] *NCBI (2021)Chemical Composition of Green Pea(Pisum Sativum L.) Pods.* www.ncbi.nlm.gov

[40] Surendra, K. C., Takara, D., Hashimoto, A. G., & Khanal, S. K. (2014). Biogas as a sustainable energy source for developing countries: Opportunities and challenges. Renewable and Sustainable Energy Reviews, 31, 846–859. https://www.sciencedirect.com/science/article/pii/S1364032113008290

[41] *KNBS & Nyandarua County Government (2022); County Statistics Abstract*

[42] *Renewable Energy Sources.* www.ecourseonline.iasri.in

[43] *KNBS & Nyandarua County Government (2022), County Statistics Abstract*

Table 14: Animal Distribution by Sub-County[44]

Sub-County	Cows	Sheep	Poultry	Goats	Others	Total
Kinangop	58,325	10,010	6,050	51,330	2565	128,280
Njabini	51,897	64,801	5,115	52,790	220	174,823
Ol Kalou	72,820	79,940	3,945	111,510	8620	276,835
Mirangine	37,592	42,889	1,631	55,079	3292	140,483
Ol Joro Orok	48,100	81,340	3,950	130,280	6420	270,090
Kipipiri	61,420	39,300	71,460	5,050	4,695	181,925
Ndaragwa	103,155	72,853	161,260	64,231	6,895	408,394
Total	**433,309**	**391,133**	**253,411**	**470,270**	**32,707**	**1,580,830**

[44] *KNBS & Nyandarua County Government (2022); County Statistics Abstract*

Chapter 3: STATUS OF ENERGY ACCESS

3.1 Overview of Energy Access

This chapter summarises energy access in Nyandarua County, drawing from a 2022 baseline survey, the 2022 Kenya Demographic and Health Survey (KDHS), and 2019 census data. The survey samples included 200 households, 22 educational institutions, 76 health centres, and 52 enterprises.

3.2 Electricity Access: Households

3.2.1 Electric Energy

The 2019 census data indicated that 41.3% of households in Nyandarua had grid electricity. The 2022 baseline survey showed an increase in connectivity to 77%. Figure 10 illustrates that the highest percentages of households using grid electricity for lighting are in Nyandarua Central (52.4%), Kinangop (51%), and Nyandarua West (48.7%), whereas Kipipiri has the lowest percentage at 27%.

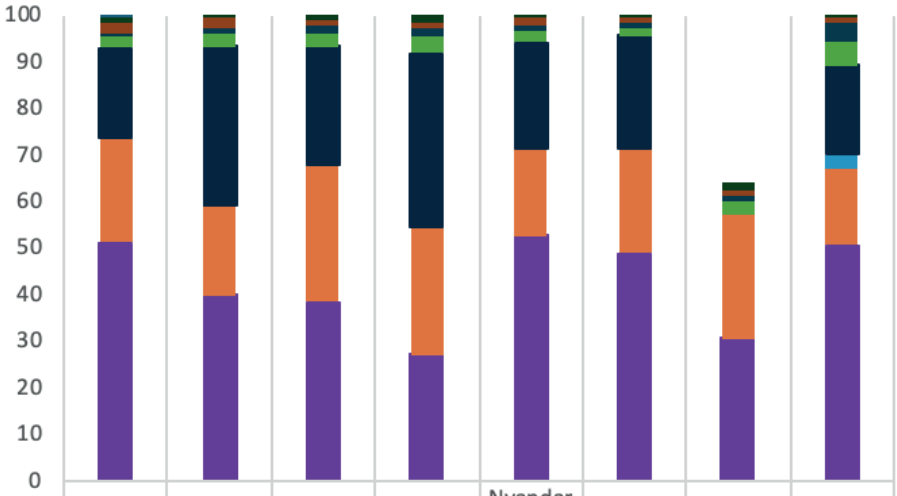
Kerosene lamps and solar PV systems were the most used alternatives after grid electricity, with Kipipiri reporting the highest percentage of households using solar PV (37.3%) and kerosene lamps (27%). With the increased cost of kerosene (≈KES178/L in 2023, up from ≈KES65 in 2019)[45][46] and the high upfront cost of grid connection, most households without grid connection would likely switch to solar PV systems. The pay-as-you-go (PAYG) financing model has significantly improved the affordability of standalone solar PV systems in Kenya, offering a viable solution to the high upfront costs associated with solar energy adoption[47]. The Nyandarua County government has partnered with REREC to enhance grid electricity access. The main obstacles identified in the CIDP include insufficient transformers, challenging terrain, low population density, and underutilisation of transformers[48].

[45] https://www.epra.go.ke/services/petroleum/petroleum-prices/

[46] Global Petrol Prices. (2024). Kenya Kerosene prices, 15-Apr-2024. https://www.globalpetrolprices.com/Kenya/kerosene_prices/#:~:text=We%20show%20kerosene%20price%20data%20for%20Kenya%20from,and%20a%20maximum%20of%20KES%20209.06%20on%202023-11-20.

[47] Waldron, D., & Siena, H. (2020). PAYGo Transformed Off-Grid Solar: Is Consumer Financing Next? https://www.cgap.org/blog/paygo-transformed-grid-solar-is-consumer-financing-next

[48] County Government of Nyandarua. (2023). Nyandarua County Integrated Development Plan III 2023-2027. https://www.nyandarua.go.ke/23b/wp-content/uploads/2023/07/Nyandarua-County-Integrated-Development-Plan-III-2023-2027-Popular-Version.pdf



	Kinangop	Nyandarua south	Mirangine	Kipipiri	Nyandarua Central	Nyandarua West	Nyandarua North	Kenya
Generator (Diesel/petrol)	0.1							0.1
Battery (car/charged)	1.3	0.9	1.2	1.6	0.7	0.5	1.5	0.4
Candle	2.2	1.9	1.3	1.2	1.9	1.3	1.1	1.3
Torch/spotlight dry cells	0.6	1.2	1.2	1.7	1.1	0.9	1.4	3.8
Torch/spotlight solar charged	2.7	2.9	2.9	3.8	2.3	1.9	2.7	5.2
Solar	19.5	34	25.5	37.3	22.6	23.9	0	19.3
Wood	0.1	0.1	0.2	0.2	0.1	0.1	0.2	2.8
Gas lamp		0.1		0.1		0.1		0.2
Kerosene lamps	22.2	19.4	29.4	27	18.9	22.6	26.4	16.5
Mains electricity	51	39.6	38.2	27	52.4	48.7	30.4	50.4

Figure 11: Distribution of households by the main type of lighting fuel and sub-county in 2019

3.2.2 Thermal Energy (Cooking and Space Heating)

The predominant cooking fuel used by households in Nyandarua County is firewood, with 70% of households reporting it as their primary cooking fuel, followed by charcoal (15.6%) and LPG (12.5%), as shown in Figure 12. The survey conducted for the CEP aligns with KDHS findings that 79% of households use firewood (mainly on a three-stone open fire stove), 19% use charcoal, and 2.5% use LPG as a primary cooking fuel.

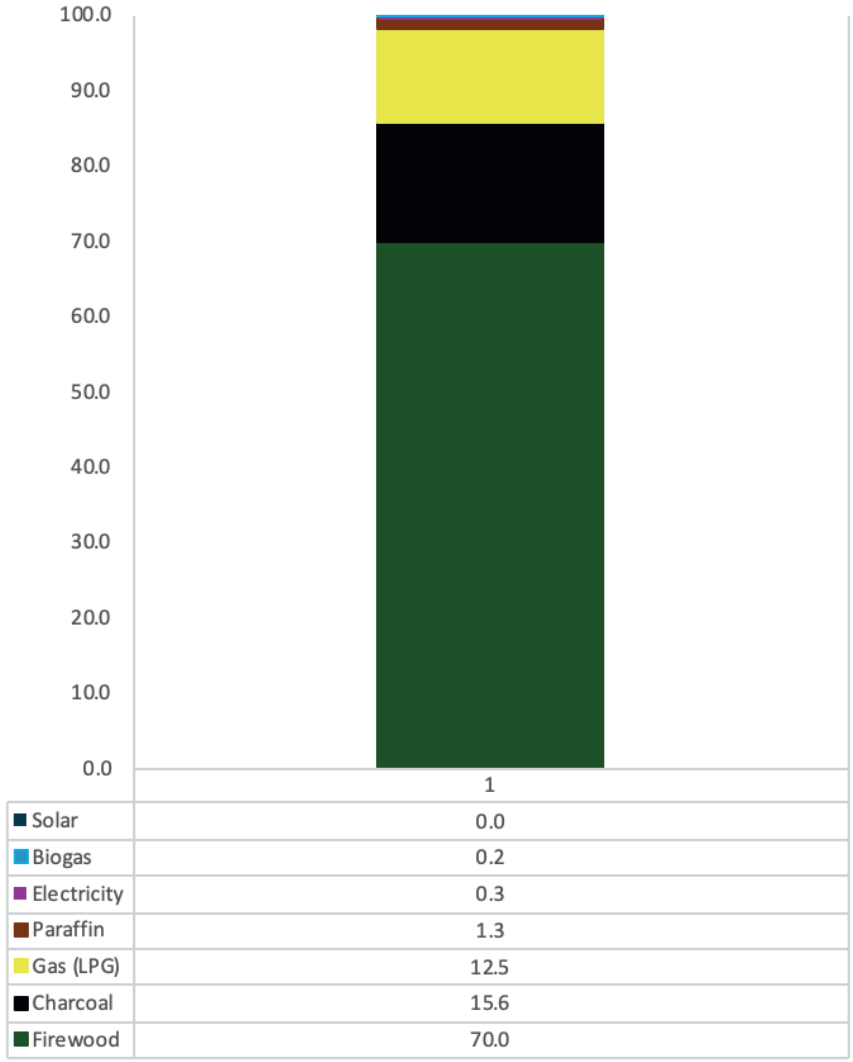


Figure 12: Primary cooking fuel for Nyandarua households (KDHS, 2022)

Households often use multiple cooking methods, a practice referred to as stacking. Respondents were also asked to describe their secondary cooking stoves where relevant. In this regard, 77% of households practice stacking, while 23% do not stack (i.e., they use only one stove/fuel for cooking). Charcoal is the top secondary cooking fuel, used by about 53.5% of households, followed by firewood (12.5%) and LPG (11%), as shown in Figure 13.

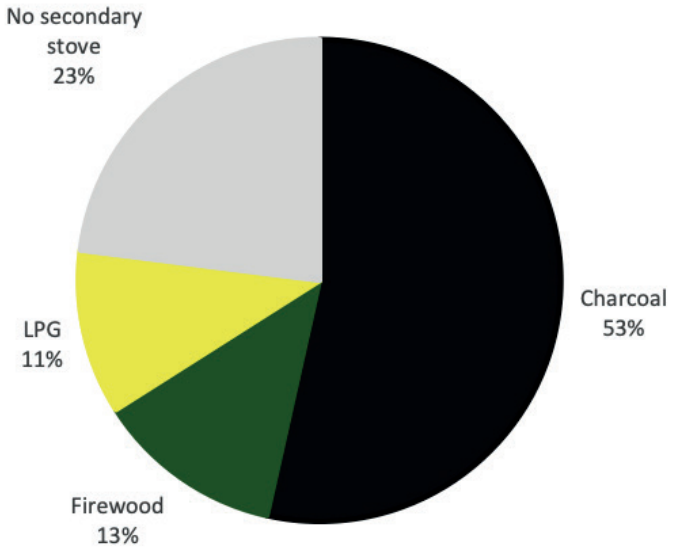


Figure 13: Household's secondary cookstove/fuel

Approximately 30.5% of households use LPG as a tertiary cooking solution, 8% use firewood, 4.5% use charcoal, and 57% do not have a tertiary cooking solution, as shown in Figure 14 below.

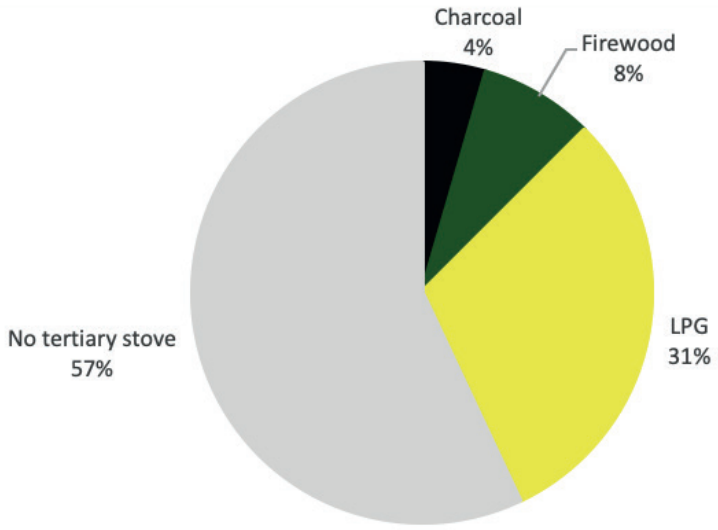


Figure 14: Household's tertiary cookstove/fuel

Stacking is a crucial part of the transition to cleaner cookstoves and fuels. Households that practise stacking are on a path to cleaner cooking energy—a positive development. Stacking allows households to experiment with different cookstoves and fuels, leading to customised strategies and user-driven innovation[49]. Drivers of cooking fuel and stove stacking include affordability challenges, technical

[49] Ochieng, C. A., Zhang, Y., Nyabwa, J. K., Otieno, D. I., & Spillane, C. (2020). Household perspectives on cookstove and fuel stacking: A qualitative study in urban and rural Kenya. Energy for Sustainable Development, 59, 151–159.

characteristics of stoves, availability of fuel and stoves, personal or food preferences, and low levels of women's empowerment[50].

Despite Nyandarua County's strengths in livestock rearing and a favourable environment for biogas technology, animal waste utilisation for biogas production remains low. As of 2021, the number of biodigesters in the county was minimal, and only a small number of households used biogas for cooking, as shown in Table 14 below.

Table 15: Distribution of households using biogas technology

Sub-County	Households (HHs)	Biogas users (%)[51]	HHs using biogas technology
Kinangop	30,847	0.3%	93
Nyandarua South	25,650	0.2%	51
Mirangine	17,880	0.2%	36
Kipipiri	25,077	0.2%	50
Nyandarua Central	21,852	0.2%	44
Nyandarua West	29,003	0.2%	58
Nyandarua North	27,906	0.3%	84
Total Biogas users			**416**

The prevalent use of wood fuel is attributed to its affordability and availability, with 97% of households reporting easy access to their primary fuel through collection, purchase, or harvesting from their own farms, among other methods. Woodfuel's widespread availability and affordability present significant challenges to adopting cleaner energy solutions, especially given the high inflation rates and rising costs of LPG and other petroleum products. Moreover, it is estimated that a typical household in Kenya cuts down approximately one tree annually to produce around four bags of charcoal or firewood for cooking[52]. This results in the loss of about 174,660 trees each year in Nyandarua County alone, contributing to approximately 2,187.5 tonnes of carbon dioxide remaining in the atmosphere due to the reduction in carbon sinks.

3.3 Electricity Access: Educational Institutions

The survey, sourced from 15 county ward administrators, reports that there are 643 Early Childhood Development and Education (ECDE) centres, 489 primary schools, 208 secondary schools, 21 TVETs, and 69 adult education centres. Connectivity levels in the wards for each type of institution were categorised into five groups based on grid connection: 0–25%, 25–50%, 50–75%, 75–100%, and missing data. Figure 14 below illustrates the grid connectivity of different educational institutions.

[50] Perros, T., Allison, A. L., Tomei, J., & Parikh, P. (2022). Behavioural factors that drive stacking with traditional cooking fuels using the COM-B model. Nature Energy, 7(9), 886–898.

[51] *KNBS & Nyandarua County Government (2022),* County Statistics Abstract

[52] Awuor, O. R., Olajide, O. A., & Evans, B. (2022). Analysis of household use of traditional fuels and possible contribution to deforestation in Kisii County, Kenya. Open Journal of Ecology, 12(11), 756–772. https://www.scirp.org/journal/paperinformation?paperid=121382

Most wards reported that 75% to 100% of primary schools, secondary schools, TVETs, colleges, and special schools were connected to the grid. Notably, 83% of wards indicated that colleges in their areas had grid connections, while no data was available for 17% of the remaining wards, as shown in Figure 15 below.

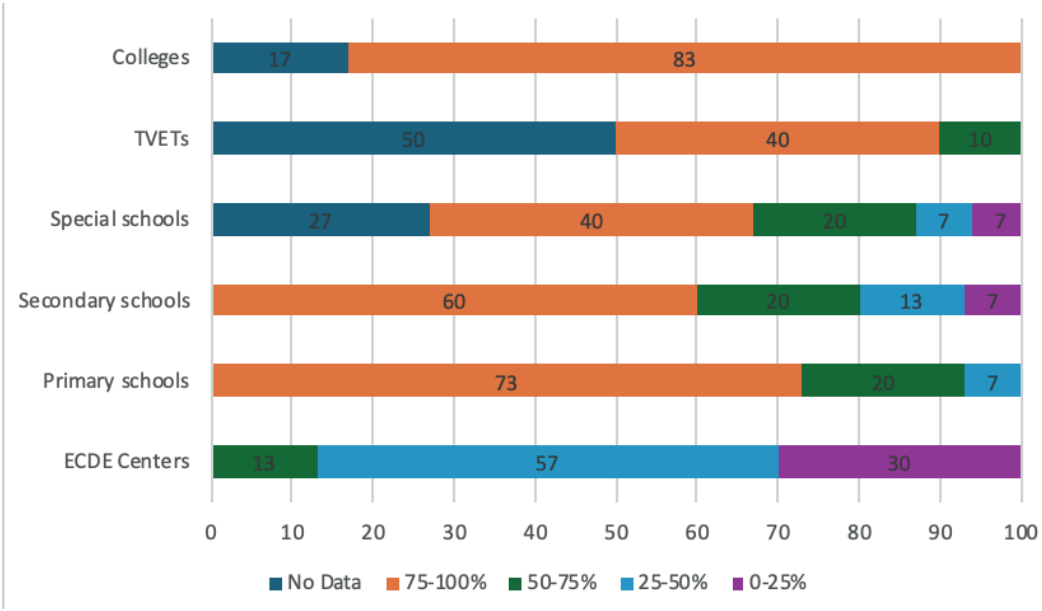


Figure 15: Educational institutions' connection to the grid in wards

3.4 Electricity Access: Health Facilities

In 2021, Nyandarua County had 171 health facilities[53], classified as government, faith-based, private, and non-governmental organisation (NGO) health facilities. According to LabFlow, however, the county has 193 health facilities, a variation of about 12%. These include 7.3%, 44.6%, 47.7%, and 0.5% of facilities as faith-based, Ministry of Health, private, and NGOs, respectively. The total of 193 represents just 1.3% of Kenya's health facilities. Their distribution across sub-counties is shown in Table 16 below[54].

Table 16: Distribution of health facilities in Nyandarua County

Sub-County	Number of health facilities	Proportion in County	Percentage Connected
Kinangop	62	32%	
Kipipiri	26	13%	
Ol Kalou	41	21%	
Ol Joro Orok	31	16%	
Ndaragwa	33	17%	
Total	**193**	**100%**	

[53] KNBS & Nyandarua County Government

[54] LabFlow(2022) Health Facilities in Nyandarua County. www.labflow.org

Generally, about 78% of all healthcare facilities in Nyandarua County are connected to the grid, while 12% use solar home systems and 10% have no access to any form of electricity, as shown in Figure 16 below. Access to reliable electricity is critical to improving healthcare, especially in rural areas grappling with poor infrastructure. For instance, if the cold chain fails upon the arrival of supplies, essential items like vaccines and medicines could spoil. Moreover, if a clinic lacks lighting, patients needing care at night could miss out on crucial services.

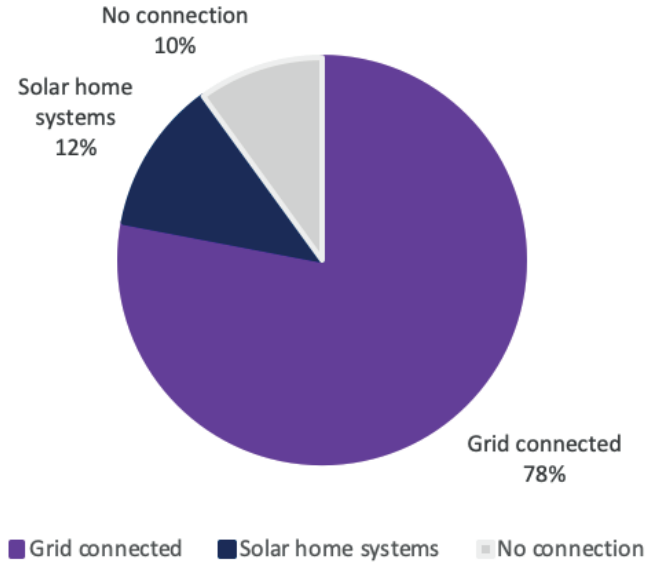


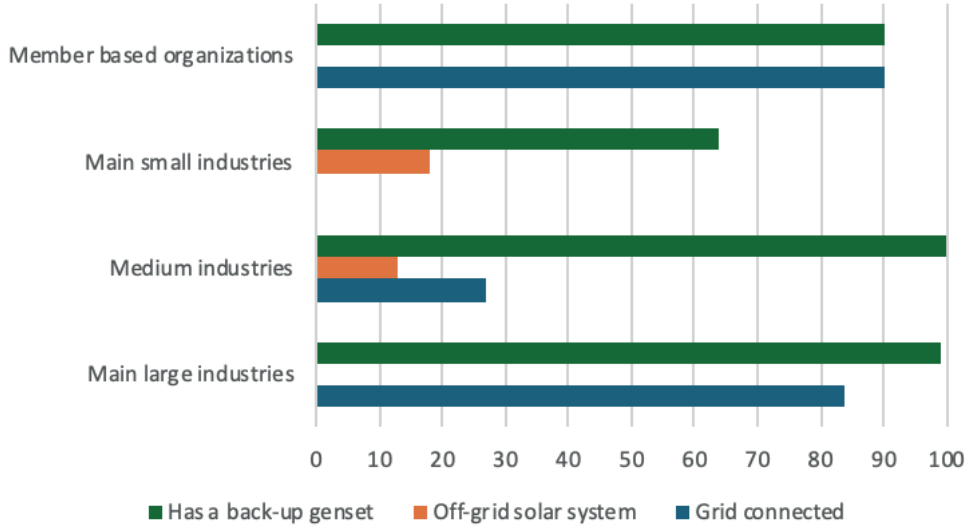
Figure 16: Health facilities' access to electricity

3.5 Electricity Access: Enterprises

As of 2019, Nyandarua County was home to 20,846 SMEs. During a survey, these enterprises were categorised into main large industries, medium industries, small industries, and member-based organisations. Connectivity to the national grid as a primary energy source varied among these categories, with 99% of the main large industries surveyed being connected. These industries included milk processing companies, coffee factories, hotels and tourism centres, manufacturers and fabricators, wildlife conservancies, and horticultural and flower farms. Among these, 84% had a backup energy system, with 52% utilising generators.

All main medium industries in Nyandarua County use the national grid as their primary energy source, with 13% also using solar power as a secondary source. For backup, 26.6% rely on generators. Main small industries, including millers, bakeries, construction stone mining, hotels, honey harvesting, livestock marketing, juakali (informal sector), general shops, and welding and fabrication shops, primarily depend on the national grid, with 64% connected. Additionally, 17.8% utilise solar power, and 21% use it as a secondary source. For backup energy, 21% use diesel generators, and 14.2% use firewood.

In Nyandarua County, member-based organisations include dairy cooperatives, sand harvesting groups, livestock marketing cooperatives, cereal producers, juakali SACCOs, transport SACCOs (matatu), and millers' associations. At least 90% of these organisations are connected to the national grid.



3.6 Productive Use of Energy

Nyandarua County's primary socio-economic activities are agriculture and livestock production. Integrating renewable energy into the county's agricultural sector can significantly enhance productivity, sustainability, and resilience to climate change. By leveraging solar, wind, biogas, and hydro energy, farmers can improve irrigation, reduce post-harvest losses, and increase the overall efficiency of agricultural operations. Two critical intervention areas are:

Irrigation: Solar-powered irrigation systems can ensure a consistent water supply, improving crop yields and reducing reliance on rain-fed agriculture. Several off-grid solar companies are distributing solar pumps in Nyandarua to smallholder farmers. However, the high upfront costs of these systems impede mass uptake.

Cold Storage: Solar energy can power cold storage facilities, helping farmers reduce post-harvest losses by preserving perishable produce. In this regard, Danida Green Business Partnerships (GBP) initiated a cold storage chain project in Nyandarua. Expected outcomes include significant reductions in post-harvest losses through cooling technology as a climate change adaptation measure in both private and public sectors. The project also aims to foster business and technological innovation, encouraging more investment in sustainable cooling solutions[55]. The County government could leverage this ongoing initiative to expand its knowledge base and establish partnerships, ensuring that all sub-counties have cold storage systems to facilitate the commercialisation of agriculture. The county government has also announced a partnership with the National Government to install 35 milk coolers. This investment aims to increase milk production and ensure safe storage and transportation for farmers[56].

[55] Danida Green Business Partnerships. (2023). Reducing food loss and waste through green cold chain solutions for farmers and traders in Kenya. https://danida-business-partnerships.dk/projects/reducing-food-loss-and-waste-through-green-cold-chain-solutions-for-farmers-and-traders-in-kenya/

[56] Mkulima Today. (2023). Nyandarua county's plan to construct 35 milk coolers. https://mkulimatoday.com/nyandarua-county-to-build-35-milk-coolers/

3.7 Modelling Energy Demand and Growth

3.7.1 Context

Under the INEP, County Energy Planning seeks to identify the most cost-effective electrification strategies to achieve universal access in Nyandarua County by 2030. By the end of 2023, 77.8% of households in the county were connected to the national grid[57]. According to the Least Cost Electrification Plan (LCEP) analysis, nearly 43,000 households in Nyandarua County remain without electricity, although 96% are within the government-defined connection distance of 600 metres from an existing transformer. Contributing factors likely include affordability issues, connection challenges, and low electricity demand among many low-income households.

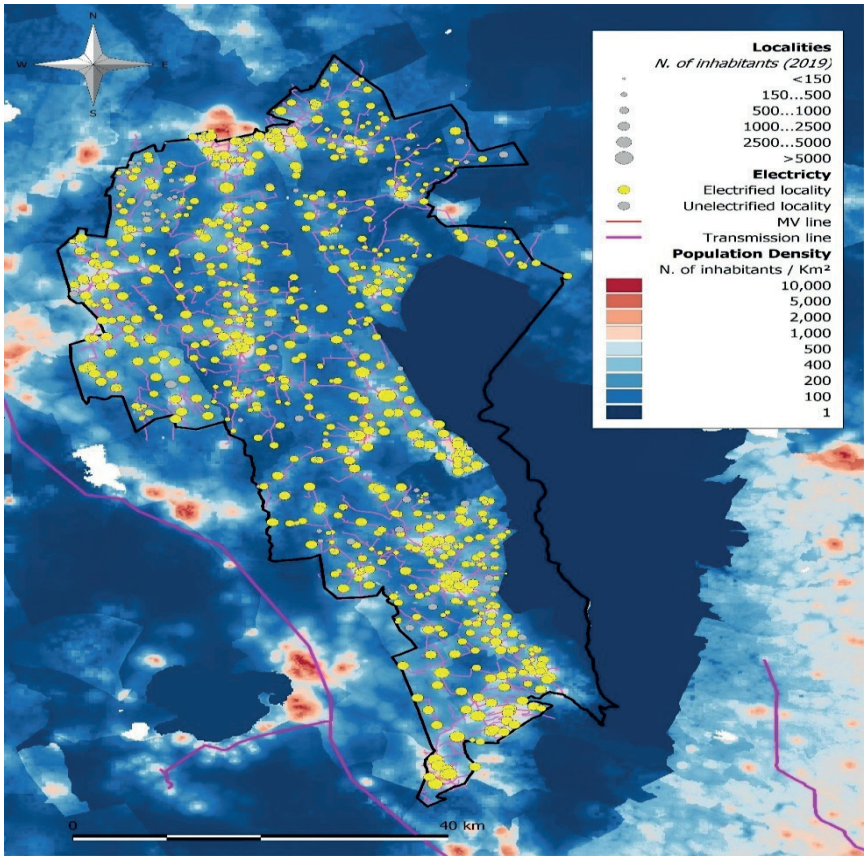


Figure 17: Electrification status of population clusters in Nyandarua County

Three consumption levels (Tiers) were analysed for rural and urban areas to estimate investment needs and identify the optimal electrification option for each community. The county's population was segmented into small units called 'clusters'. Of these, 29% contained fewer than 500 inhabitants, 42% had between 50 and 500 inhabitants, and the remaining 29% had up to 5,500 inhabitants.

As shown in Figure 18, electricity consumption levels vary from Tier 1+ (supporting basic tasks like lighting, phone charging, or powering a radio) to Tier 5 (accommodating medium to high-load appliances

[57] KPLC registered 150,199 clients and the number of households in the County is estimated at 193,093 for 2023.

such as laptops, refrigerators, rice cookers, washing machines, irons, hair dryers, toasters, microwaves, and air coolers, as well as enabling small business operations, referred to as productive energy use).

Table 17: Energy consumption scenarios explored for Nyandarua's least-cost electrification planning

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

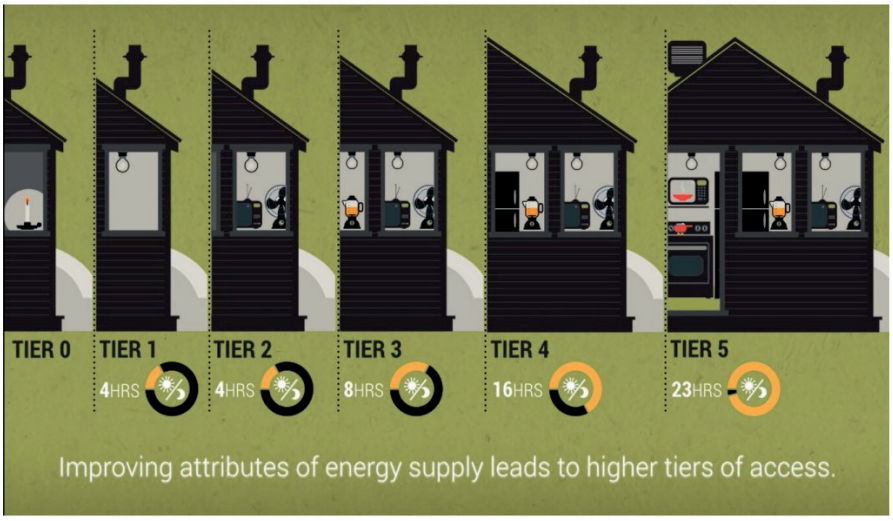


Figure 18: The multi-tier access definition (SE4ALL)

3.7.2 Least-Cost Electrification Results for Nyandarua County

Considering the 150,000 households already electrified and the 222,000 households expected by 2030, around 72,000 households will need to be electrified to achieve universal access. As shown in Figure 19 below, the total investment required for this objective varies significantly across scenarios, depending on the level of expected consumption.

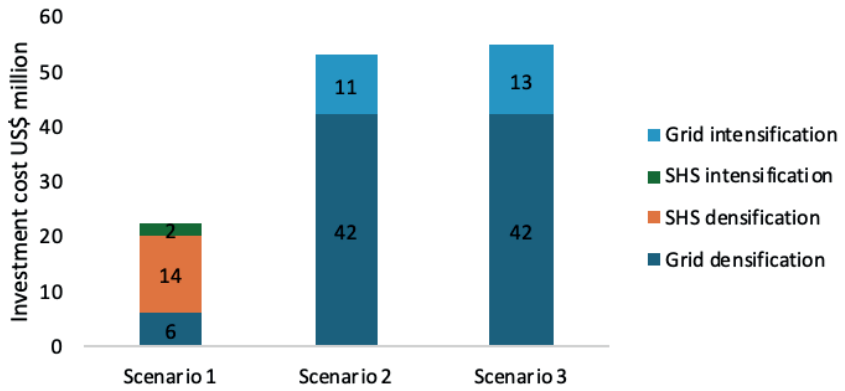


Figure 19: Summary of investments by scenario for universal access in the county

In the higher consumption scenarios (Scenario 2 & Scenario 3), electrification would occur exclusively through the expansion of the existing network. In this scenario, 87% of households would be electrified by grid densification and 13% via grid intensification. Scenario 2 would imply an investment of USD 53 million, and Scenario 3, USD 55 million. The slight difference between these two scenarios is due only to the higher capacity and cost of transformers in Scenario 3.

Table 18: Investment by scenario and supply option

Supply option	Scenario 1	Scenario 2	Scenario 3
Grid densification	6,136,032	42,153,888	42,153,888
SHS densification	14,096,274		-
SHS intensification	2,397,245		
Grid intensification		10,938,000	12,779,230
Total	**22,629,551**	**53,091,888**	**54,933,118**

The structure of the county's electrification plan changes significantly for Scenario 1 compared to the higher scenarios. In this scenario, only urban households in the densification area would be electrified via the national grid due to their expected high level of consumption (Tier 5). All other households (87%) would be electrified using SHS due to their very low demand (Tier 1+). For this reason, the investment required for electrification in Scenario 1 is 2.3 times lower than for Scenario 2, amounting to USD 22.6 million.

Table 19: Number of new connections by supply option and scenario

Supply option	Scenario 1	Scenario 2	Scenario 3
Grid densification	9,131	62,729	62,729
Sharing (%)	13	87	87
SHS densification	53,598	-	-
Sharing (%)	75	-	-
Grid intensification	-	9,115	9,115
Sharing (%)		13	13
SHS intensification	9,115		
Sharing (%)	12		
Total	**71,844**	**71,844**	**71,844**

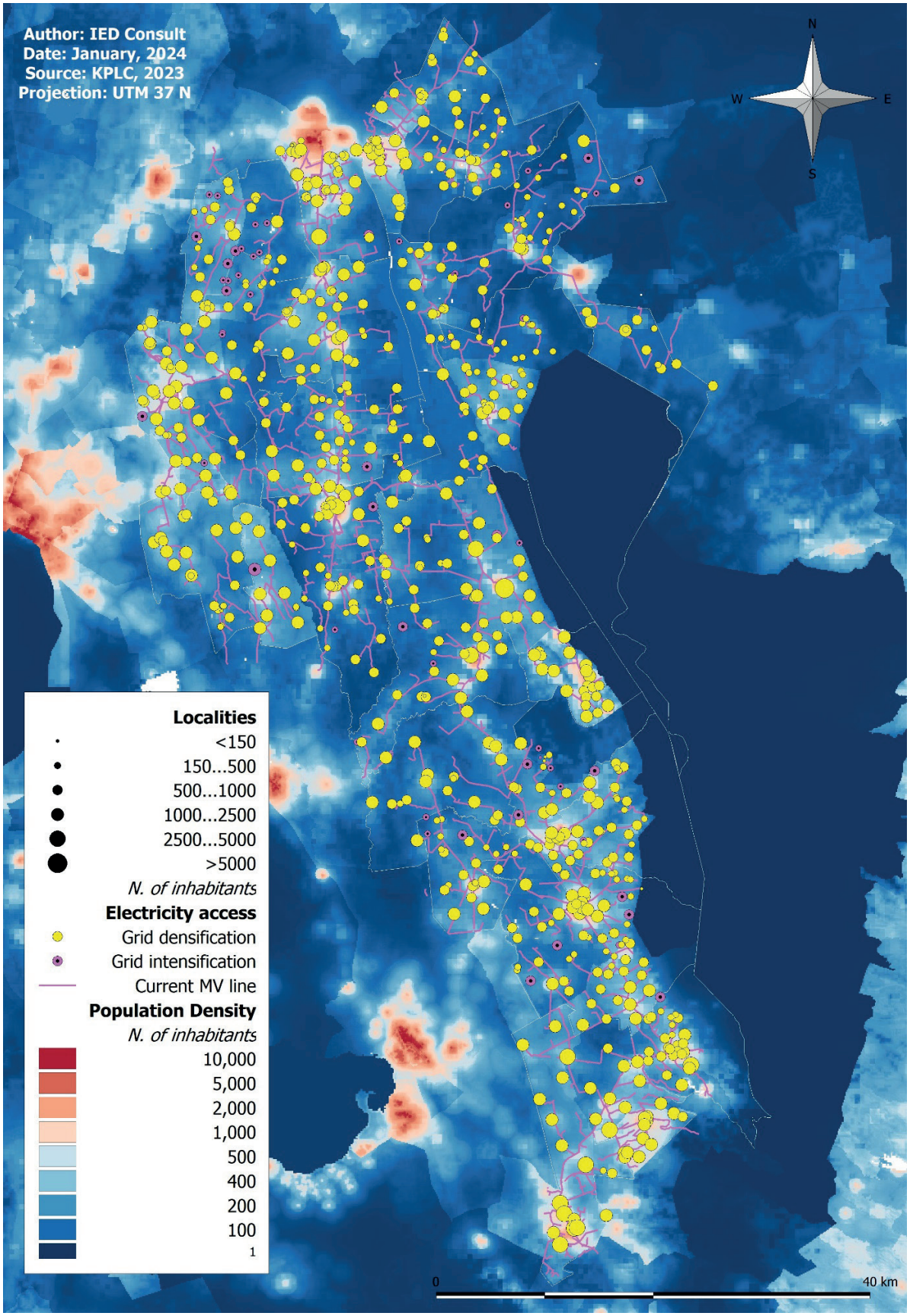


Figure 20: Map 2—Electrification planning of the County—Scenario 2

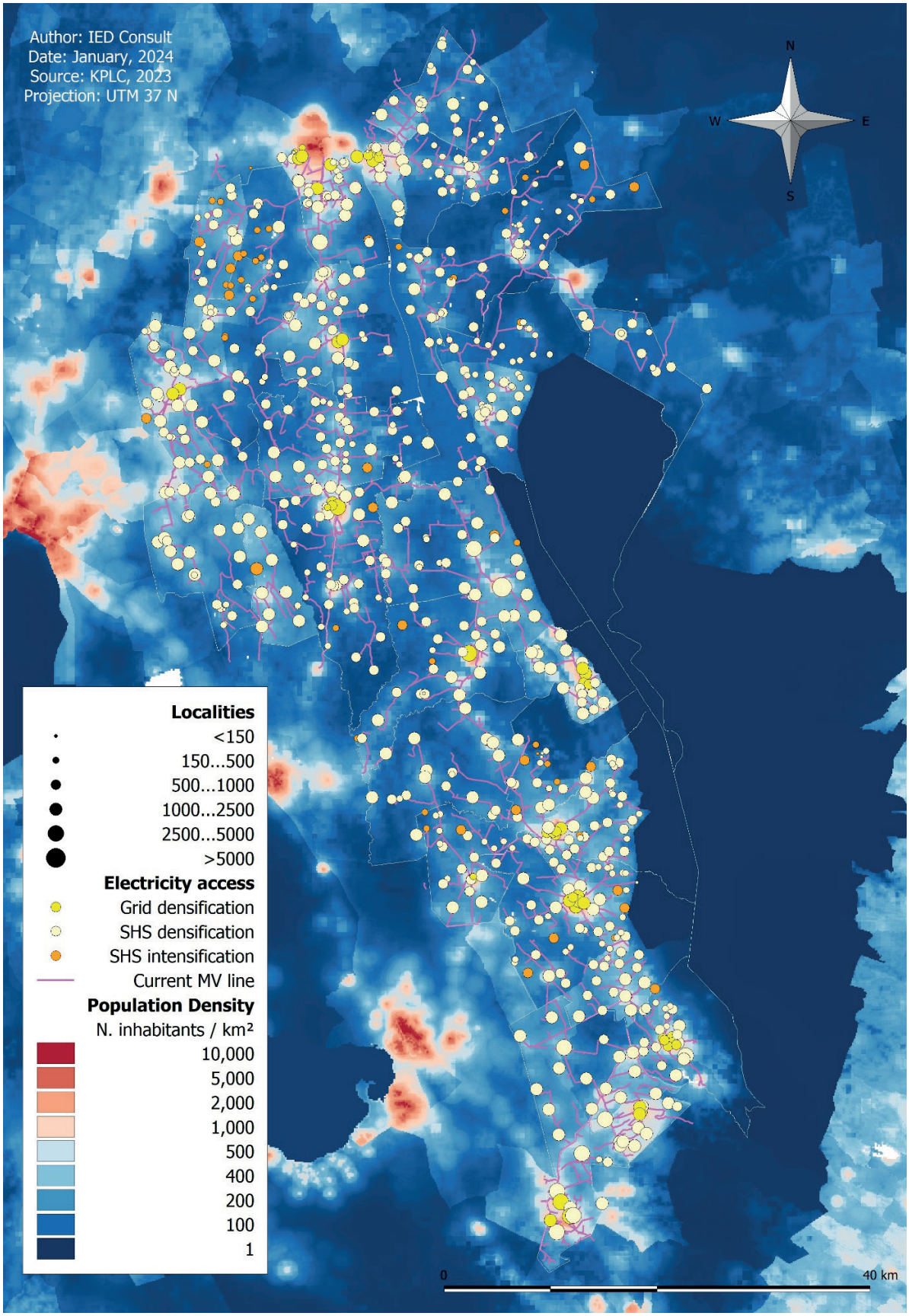


Figure 21: Map 3—Electrification planning of the County—Scenario 1

3.7.3 Health Facilities

According to county authorities, there are 86 public health facilities from levels 2 to 5, and 69 are connected to the national grid. Of the 65 facilities georeferenced by the Ministry of Health, 35 of the 41 dispensaries are connected, 20 of the 22 health centres are connected, and there is one district and one sub-district hospital. The list of non-connected facilities (public and private) is available in the annexes.

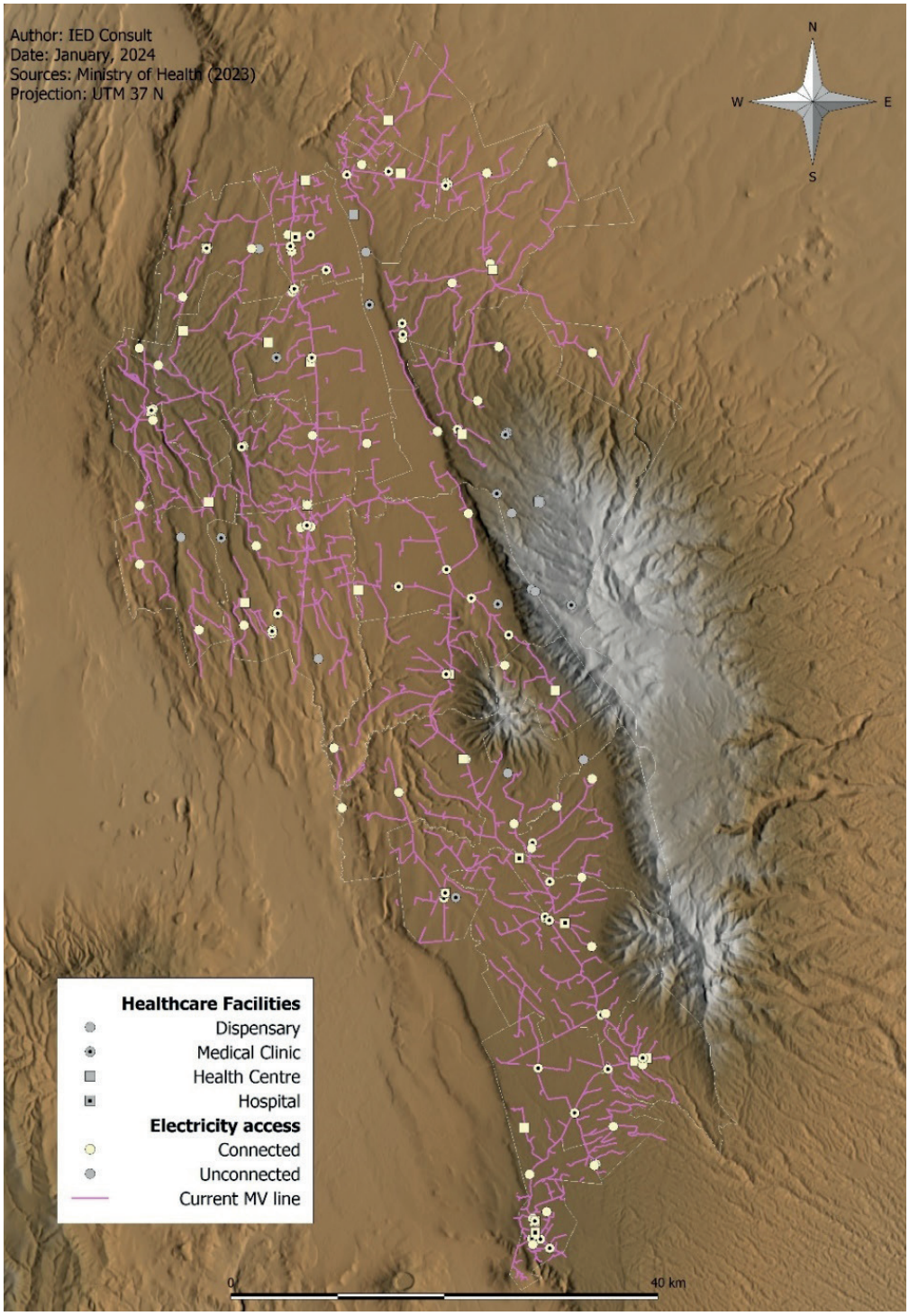


Figure 22: Electrification status of health facilities (public and private)

3.7.4 Education Facilities

Regarding education facilities, county authorities have identified 501 ECDE centres not connected to the grid, while 351 primary schools, 178 secondary schools, and 16 VTCs are connected. In the absence of geolocation data for these facilities, the list from the Ministry of Education was used. This list identified 193 ECDE centres, 59 primary schools, 13 secondary schools, and 2 VTCs located beyond the reach of a transformer. The detailed list is available in Annex 2: Education facilities outside the scope of a transformer.

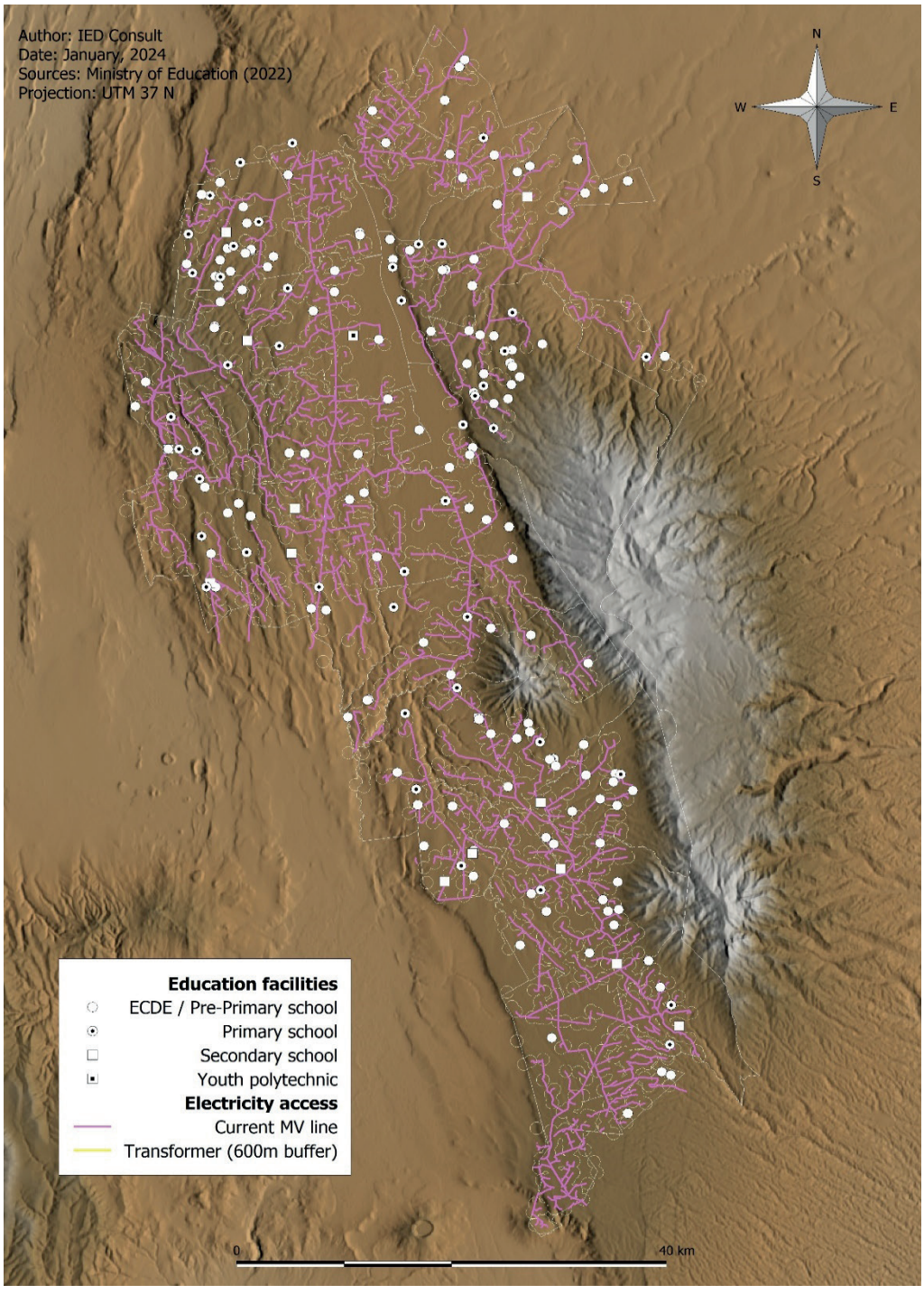


Figure 23: Electrification status of educational institutions.

3.7.5 Clean Cooking

3.7.5.1 Demographic Projections

As more households transition to modern cooking solutions, the cooking landscape is expected to change. In 2023, the urban population was estimated at 78,859, representing 11% of the total population, with urban households numbering 27,513 or 14% of all households, as illustrated in Figure 24. With an annual urbanisation growth rate of 3.5%, the urban population is projected to reach 110,857 (14%) by 2033, while urban households are expected to comprise 42,637 or 17% of total households.

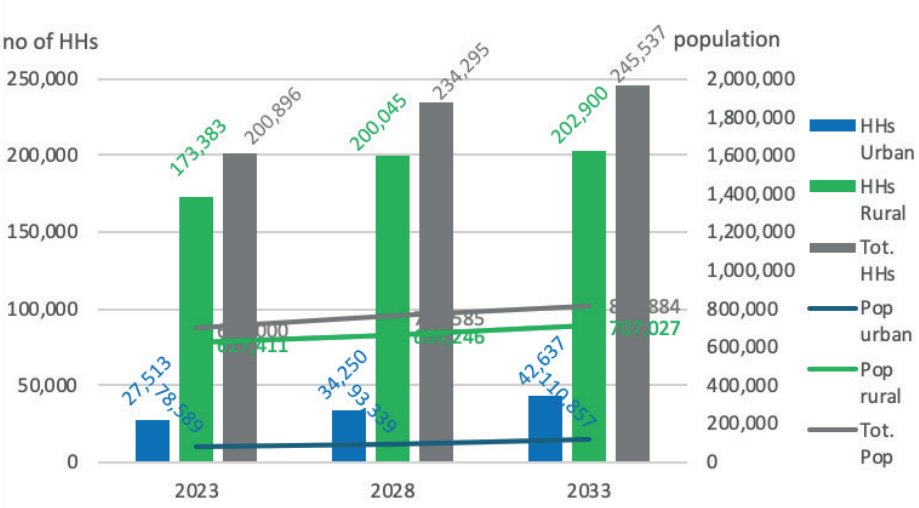


Figure 24: Demographic Projection for Nyandarua

3.7.5.2 Transition Pathways

Rural Households

- Livestock farming is prevalent in Nyandarua County, allowing households to adopt biogas technology. This transition can be facilitated through initiatives like the ongoing African Biogas Component (ABC) programme, which will install 20,000 small to medium-scale biogas plants and 250 institutional plants over the next five years. Efforts will also focus on raising awareness about the additional benefits of biogas technology, such as biofertiliser production.
- The adoption of firewood and charcoal Improved Cookstoves (ICS) should be tied to promoting the sustainable use of natural resources and awareness of the hazards of charcoal production and use. Charcoal production requires approximately 6–7 tonnes of firewood to produce 1 tonne of charcoal, depending on carbonisation efficiency, which ranges from 15% to 18%.
- Adoption of LPG stoves
- Adoption of briquettes and gasifier stoves.

Urban Households

- Aiming to phase out charcoal use in urban areas by 2028, the county plans to encourage transitions to eCooking, LPG, and bioethanol stoves.
- The adoption of briquettes and gasifier stoves will be promoted.

With 85.6% of Nyandarua County's energy needs (70% wood and 15.6% charcoal) met by woodfuel, the county will need to partner with the national government to enhance and secure woody and forestry resources' sustainability during the transition period. The following measures are proposed to support this initiative:

- Awareness campaigns on sustainable use and management of woody resources and forests.
- Mapping of charcoal production areas and the development of a strategy to progressively offset this production.
- Promotion of woodlots and agroforestry (Rationale: A one-acre woodlot can sustainably produce approximately 1 tonne of firewood annually. Knowing that a household's cooking energy needs are about 4.5 GJ/HH/year, equating to roughly 1.8 tonnes of firewood annually on an ICS, a woodlot of 1 acre can make a substantial contribution to their cooking needs when complemented by LPG, bioethanol, or biogas).
- Enforcement of existing regulations mandating that 10% of farm area is covered by trees.

3.7.5.3 Total Energy Demand Comparison Under Different Scenarios

Three scenarios were developed to inform the county's cooking energy decisions:

- Baseline or business-as-usual—No intervention by the County government.
- Policy scenario—Based on full implementation of energy policies that impact cooking energy transitions.
- SDG7 scenario—Aims for universal access to clean cooking solutions by 2028.

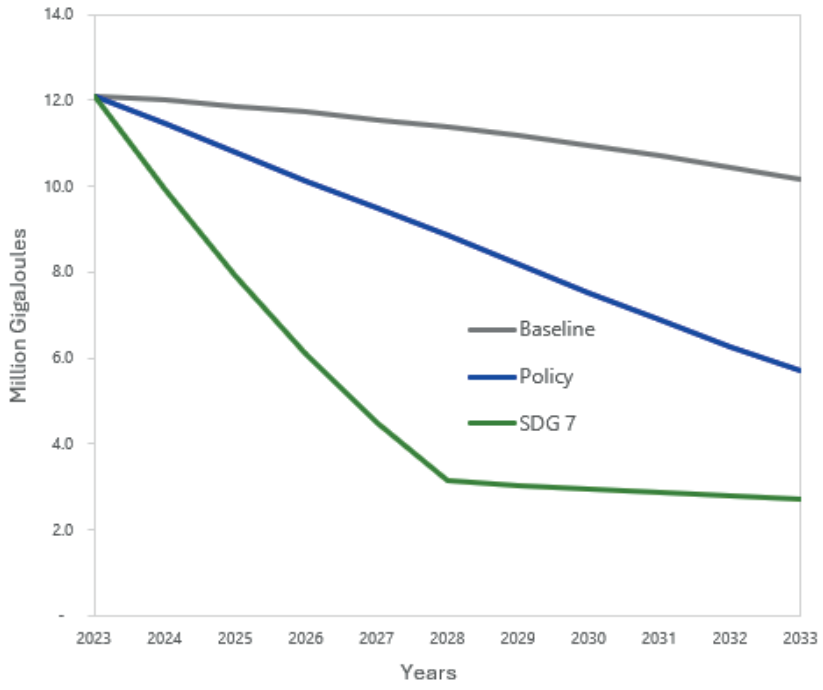


Figure 25: Energy Demand Comparison for All Scenarios

Table 20: Cooking Fuels Demand in GJ Across the Three Scenarios

Scenario	2023	2028	2033
Baseline (1,000,000 GJ)	12.1	11.4	10.2
Policy (1,000,000 GJ)	12.1	8.9	5.7
SDG 7 (1,000,000 GJ)	12.1	3.1	2.7

3.7.5.4 Baseline Scenario

In the baseline scenario, firewood and charcoal remain critical in the cooking landscape of Nyandarua. Current initiatives, such as zero-rating VAT on LPG and behavioural change campaigns, contribute to a shift towards ICS, resulting in reduced energy demand. LPG usage is on the rise, with bioethanol and electric pressure cookers (EPCs) also introduced in Nyandarua's urban households. An average of 30 biogas plants is projected to be built annually, increasing the number of domestic biogas plants to 815 by 2033, up from 537[58] in 2021.

Table 21: Technology Adoption Rate—Urban and Rural (Baseline Scenario)

Technology	Urban			Rural		
	2023 (%)	2028 (%)	2033 (%)	2023 (%)	2028 (%)	2033 (%)
TSOF	65	40	15	73	49	25
Wood ICS	7	18.5	30	11	31	50
Metallic Charcoal stove	50	37.5	25	29	22.0	15
Charcoal ICS	30	33	35	29	32	35
LPG Meko	50	55	60	38	42	45
LPG Stove	9	15	20	7	10	12
Kerosene	1	0.5	-	9	5	-
EPC	-	1.5	3	-	0.5	1
Electric Stove (coil/induction cookers)	2	3.5	5	-	1.0	2
Bioethanol	-	5	10	-	2.5	5
Biogas technology	-	-	-	0.3	0.4	0.4
Gasifier Stove	-	5.0	10	-	2.5	5

[58] ABPL 2021 data

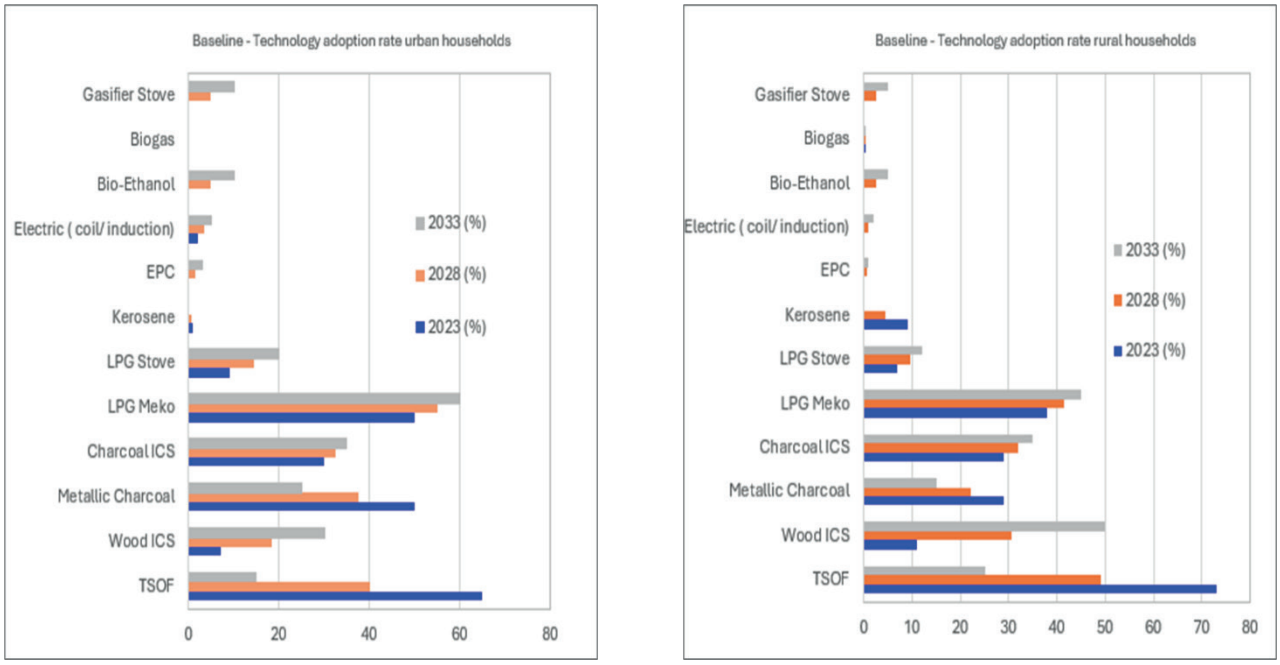


Figure 26: Technology Adoption Rate for Urban and Rural Households

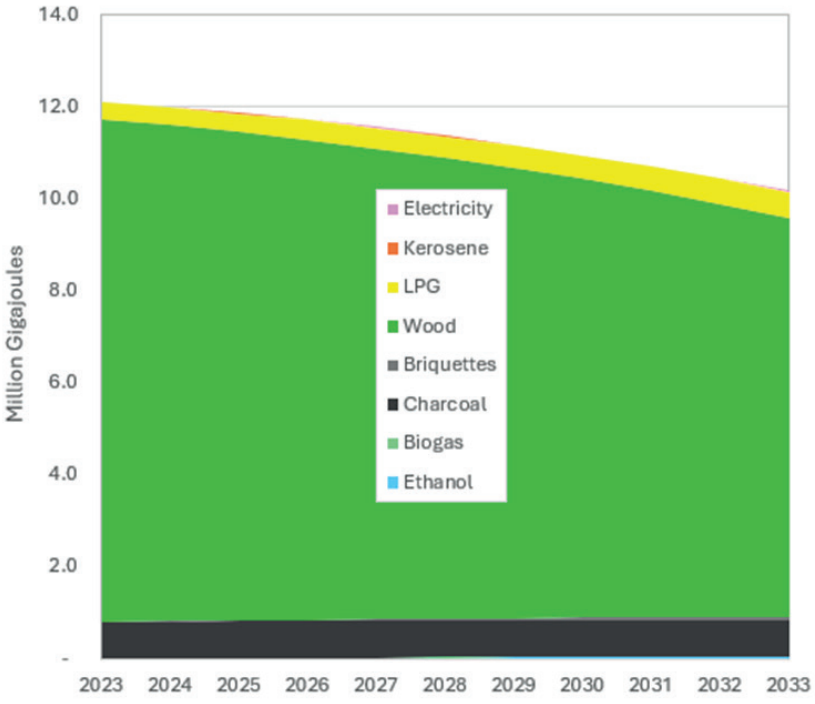


Figure 27: Energy Demand Under the Baseline Scenario

Despite demographic growth, the reference scenario indicates a stabilisation or marginal reduction in firewood and charcoal demand.

Table 22: Summary of Fuel Demand Under Baseline Scenario (2023–2033)

Fuel	2023	2028	2033
Firewood (Tonnes)	705,019	647,208	558,266
Charcoal (Tonnes)	27,750	27,894	27,439
LPG (Tonnes)	7,703	9,805	12,250
Kerosene (1,000 Litres)	395	217	-
Electricity (MWh)	343	1,946	4,005
Ethanol (1,000 Litres)	-	952	2,130
Biogas (1,000 m³)	183	234	287
Briquettes (Tonnes)	-	1,604	3,591

3.7.5.5 Policy Scenario

Under the policy scenario, Nyandarua County is making significant moves towards ICS, balancing biomass supply and demand through strategies that include mapping charcoal production areas, creating plans to gradually reduce charcoal production, and enforcing regulations for 10% tree cover on farms.

Adoption of clean cooking solutions (LPG, electric cooking, ethanol, and biogas) is increasing, leading to a reduction of 4.5 million GJ in energy consumption compared to the baseline. The number of biogas plants is set to increase, with 30 new plants yearly from 2023 to 2028 and 70 yearly from 2029 to 2033. This initiative aims to have 1,020 biogas plants by 2033, covering 0.5% of rural households.

Table 23: Technology Adoption Rate—Urban and Rural (Policy Scenario)

Technology	Urban			Rural		
	2023 (%)	2028 (%)	2033 (%)	2023 (%)	2028 (%)	2033 (%)
TSOF	65	25	-	73	30	5
Wood ICS	7	40.0	50	11	50	50
Metallic Charcoal stove	50	20.0	5	29	10.0	5
Charcoal ICS	30	25	20	29	35	40
LPG Meko	50	60	70	38	45	55
LPG Stove	9	15	25	7	10	12
Kerosene	1	2.0	-	9	4	0
EPC	-	4.0	6	-	1.0	2
Electric (coil/induction)	2	4.0	6	-	1.0	2
Bio-Ethanol	-	4	15	-	2.0	5
Biogas	-	-	-	0.3	0.4	0.5
Gasifier Stove	-	16.0	20	-	15.0	20

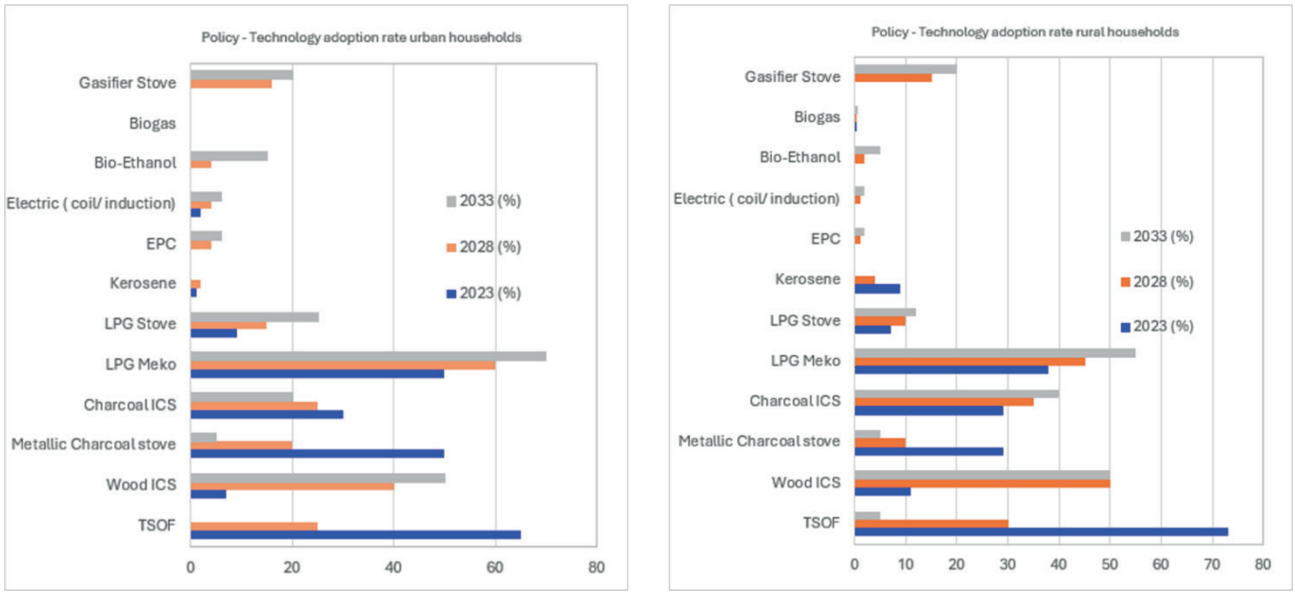


Figure 28: Technology Adoption Rates for Urban and Rural Households

In the policy scenario, it is projected that by 2033, the demand for wood (both firewood and charcoal feedstock) will decrease by approximately 500,000 tonnes. Conversely, LPG demand is expected to increase by 10,361 tonnes. There will also be a significant rise in electricity demand, reaching 5,700 MWh, and ethanol demand is anticipated to reach 2.5 million litres by 2033.

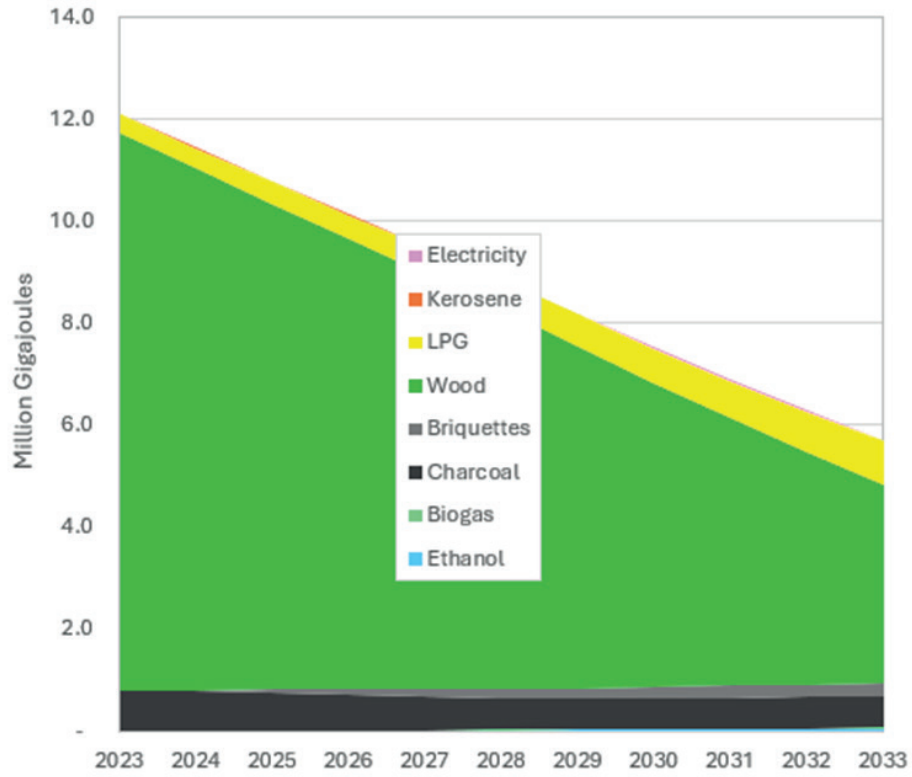


Figure 29: Energy Demand under Policy Scenario (2023–2033)

Table 24: Summary of Fuel Demand under Policy Scenario (2023–2033)

Fuel	2023	2028	2033
Firewood (Tonnes)	705,019	482,354	251,553
Charcoal (Tonnes)	27,750	21,373	21,043
LPG (Tonnes)	7,703	11,894	18,064
Kerosene (1,000 Litres)	395	224	-
Electricity (MWh)	343	2,846	5,700
Ethanol (1,000 Litres)	-	761	2,440
Biogas (1,000 m³)	183	234	359
Briquettes (Tonnes)	-	8,454	12,277

An analysis of the investment requirements to implement the policy scenario shows an average annual requirement of KES 120 million, as shown in Figure 30. The policy scenario assumes that no new investments will be made in kerosene stoves, leading to a gradual reduction in their use, with usage expected to reach zero by 2033. Consequently, this plan allocates no capital expenditure (CAPEX) for kerosene stoves.

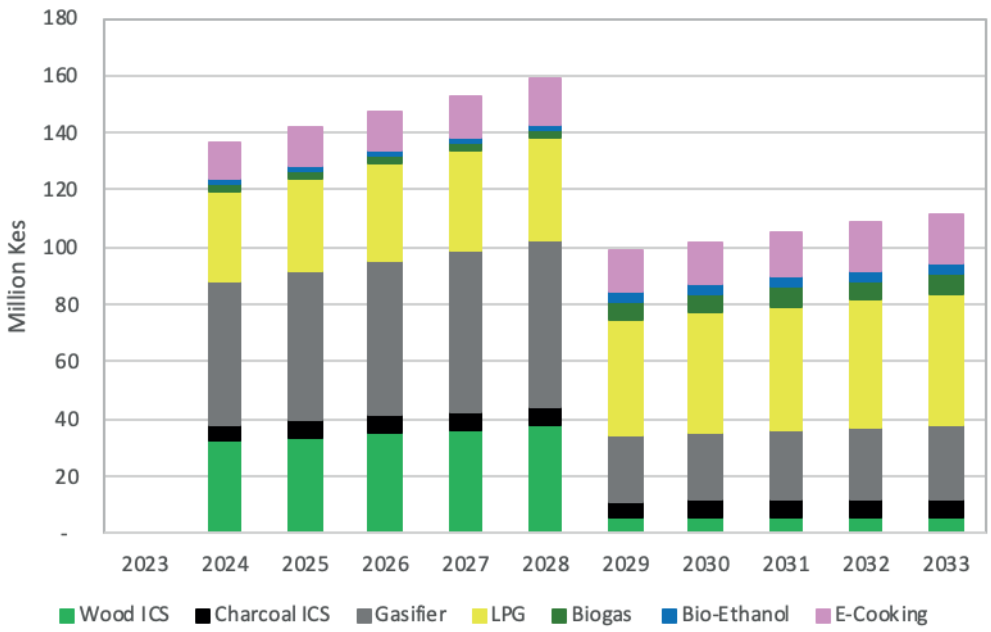


Figure 30: Level of Investment Required for Technology Acquisition

Transitioning to biogas and electric cooking (E-cooking) requires higher initial investments than their current roles in the cooking energy mix. However, the benefits of these technologies extend beyond just cooking and justify the additional costs. For example, investing in biogas technology supports cooking energy needs, produces biofertilisers, reduces carbon emissions from cooking, and positively impacts climate change by lowering methane emissions. Meanwhile, the primary benefit of E-cooking is its contribution to climate change mitigation; with 85% of Kenya's power generation being renewable, E-cooking is nearly climate-neutral.

3.7.5.6 SDG Scenario

This scenario targets universal access to clean and modern cooking energy by 2028, aiming to phase out unsustainable solid biomass and traditional and kerosene cookstoves. Due to Nyandarua's specific location and climate, households are expected to continue using firewood for space heating, managed sustainably through the use of gasifiers in urban households and a combination of ICS and gasifiers in rural households.

Table 25: Technology Adoption Rate—Urban and Rural (SDG Scenario)

Technology	Urban			Rural		
	2023 (%)	2028 (%)	2033 (%)	2023 (%)	2028 (%)	2033 (%)
TSOF	65	-	-	73	-	-
Wood ICS	7	-	-	11	30	25
Metallic Charcoal stove	50	-	-	29	-	-
Charcoal ICS	30	-	-	29	-	-
LPG Meko	50	60	50	38	70	60
LPG Stove	9	40	50	7	30	30
Kerosene	1	-	-	9	-	-
EPC	-	5	10	-	2.0	5
Electric (coil/induction)	2	5	10	-	2.0	5
Bio-Ethanol	-	20	25	-	5	10
Biogas	-	-	-	0.3	0.7	1.0
Gasifier Stove	-	25	50	-	40	50

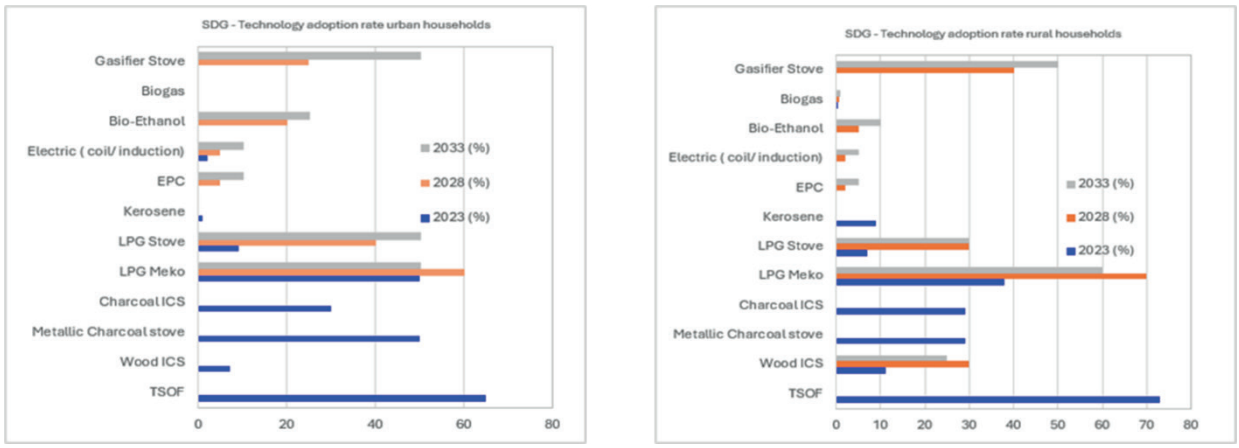


Figure 31: Technology Adoption Rates for Urban and Rural Households

A behavioural change campaign, implemented alongside measures to enhance affordability, accessibility, and reliability, will support the shift to clean cooking solutions as the primary cooking method. Households will be encouraged to transition to LPG equipped with a 13 kg cylinder, moving away from the smaller 6 kg Meko. Bioethanol usage is projected to increase to 25% in urban households and 10% in rural households. Adoption of electric cooking (E-cooking) is expected to rise to 10% in urban households

and 5% in rural households. Additionally, under the SDG scenario, 1,500 new biogas plants will be established, increasing the adoption rate to 1.0% among rural households.

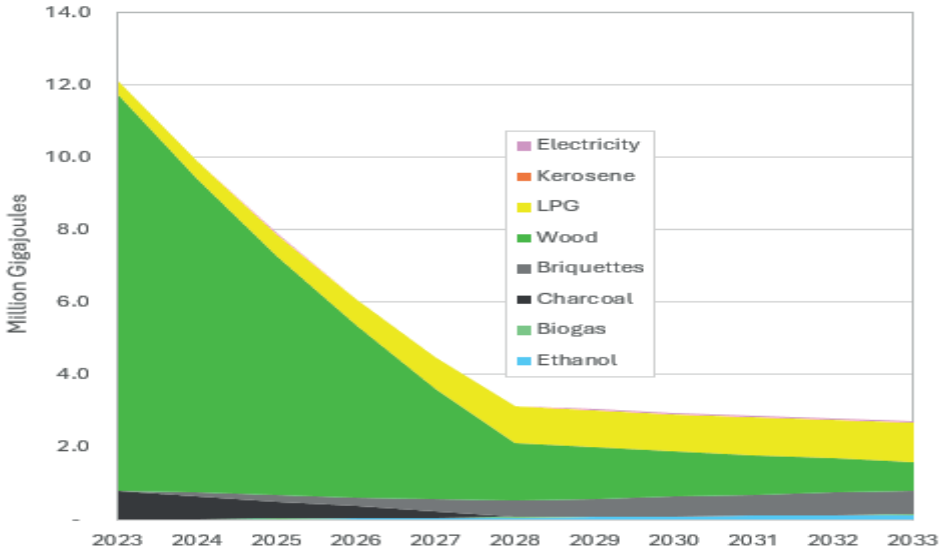


Figure 32: Energy Demand under the SDG Scenario (2023–2033)

Table 26: Summary of Fuel Demand under SDG Scenario (2023–2033)

Fuel	2023	2028	2033
Firewood (Tonnes)	705,019	102,456	50,949
Charcoal (Tonnes)	27,750	-	-
LPG (Tonnes)	7,703	21,500	22,530
Kerosene (1,000 Litres)	395	-	-
Electricity (MWh)	343	4,782	11,936
Ethanol (1,000 Litres)	-	2,433	5,484
Biogas (1,000 m³)	183	483	797
Briquettes (Tonnes)	-	21,066	30,692

Chapter 4: ENERGY EFFICIENCY AND CONSERVATION

4.1 Overview

Energy Efficiency (EE) means using less energy to perform the same task without compromising quality, through the adoption of efficient technologies and processes. Energy Conservation (EC) involves reducing energy consumption by preventing waste, such as turning off lights when not in use and using renewable energy sources. This chapter covers county public buildings, households, public institutions, and public health centres, as outlined in the INEP guidelines.

4.2 Energy Efficiency and Conservation Standards, Benchmarks and Guidelines

The energy efficiency assessments and proposals were guided by the Kenya National Energy Efficiency Strategy, which identifies critical sectors for improvement in Kenya. The Minimum Energy Performance Standards (MEPS) were used to recommend the efficiency of various appliances. The Excellence in Design for Greater Efficiencies (EDGE) tool informed measures for buildings, and guidelines from the Kenya Green Building Society provided additional recommendations to enhance building efficiency in the county.

4.2.1 Minimum Energy Performance Standards (MEPS)

The Energy (Appliances Energy Performance and Labelling) Regulations, 2016, established MEPS for various appliances, including motors, fluorescent lamps, domestic refrigerators, and air conditioners. MEPS are based on test procedures that determine the energy performance of appliances and provide guidelines for labelling their energy performance ratings. Appliances receive a star rating from 1 to 5, with 5 stars denoting the highest level of energy efficiency. The specific Kenya Bureau of Standards (KEBS) standards to consider when implementing recommendations include:

- **KS 2449-1: 2013 (Rotating Electrical Machines):** Sets the MEPS for induction electric motors rated from 0.73 kW to less than 185 kW, using a star rating system where one star denotes the least efficient motors, and three stars indicate the most efficient.
- **KS 2463: 2019 (Non-Ducted Air Conditioners):** Applies to single-package and split-system non-ducted air conditioners, measuring energy efficiency through the Energy Efficiency Ratio (EER), which is the ratio of cooling power output to power input. The EER corresponds to an energy performance class rating ranging from Star 1 (least efficient) to Star 5 (most efficient).
- **KS 2464-2: 2020 (Refrigerating Appliances):** Outlines the MEPS for household and commercial refrigerators, specifying class rating indices based on the appliance's annual energy consumption relative to a refrigerator class's standard yearly energy consumption, from Star 1 (least efficient) to Star 5 (most efficient).

4.2.2 Excellence in Design for Greater Efficiency (EDGE)

EDGE (2022) is an online green building certification tool that allows assessment of the most cost-effective ways to incorporate energy and water efficiency in buildings, such as offices, homes, hotels, hospitals, and retail spaces. Developed by the International Finance Corporation (IFC), the EDGE tool models building efficiency metrics, such as the Energy Use Index (EUI), which provides energy performance metrics for building energy use. It can benchmark a base case with minimal energy efficiency measures against an improved case with applied energy efficiency measures. The model inputs include building metrics like annual energy consumption (electricity and fuels) and indoor floor area. The output is EUI expressed as the total energy used within a building in a year (kWh) per gross floor area (m^2), customarily presented as $kWh/m^2/yr$.

4.2.3 Kenya Green Building Society Guidelines

Green building guidelines[59] provide specific parameters to adopt in building design, enhancing energy and water efficiency with a focus on effective passive design. This design incorporates solar thermal performance, water and energy conservation measures, building orientation, building envelope, and efficient appliances and fixtures to minimise heating and cooling requirements. It also promotes local renewable energy generation, solar water heating, and natural lighting during the day. The design includes efficient low-flow water appliances, wastewater harvesting, and recycling.

4.2.4 Energy Efficiency and Conservation Assessment

The Department of Public Works, Roads, Transport, Housing and Energy oversees Energy Efficiency and Conservation in Nyandarua County.[60] It supervises the uptake of energy-efficient infrastructure and appliances. Meetings with county officers and reviews of their records indicated that, while up-to-date information on energy access and renewable energy penetration is available, energy efficiency monitoring and documentation lags behind. A lack of a functional energy management team may contribute to this issue. Project-based ad hoc committees within the Department's energy section of the Department of Public Works, Roads, Transport, Housing and Energy and are appointed to address specific activities.

The training needs assessment shows that most County Officers (67%) are not fully aware of the prevailing energy policy requirements and provisions of various regulations governing energy efficiency, indicating a need for additional capacity building to mainstream energy efficiency and conservation. This was also observed in most commercial industries assessed, where staff possess the prerequisite skills but would benefit from policy and technical training in energy management.

In specific facilities, such as agricultural value addition plants, public and commercial buildings, and institutions like hospitals, operation and maintenance programmes are prioritised, while energy efficiency receives less attention. Opportunities for energy-efficient installations are primarily in new constructions, where modern technology is used, while older facilities continue using less efficient technologies.

[59] IFC. Sintali. (March 2020). EDGE Expert Training: Guidelines for Green Buildings. Nairobi: IFC

[60] County Government of Nyandarua – Pamoja Tujijenge

A key challenge in mainstreaming energy efficiency is the lack of a nationwide Energy Efficiency and Conservation (EE&C) building code with specific guidelines for county adoption. While the Kenya National Energy Efficiency and Conservation Strategy (KNEECS) 2020 indicates that a national building code will be available by 2025, intermediary measures, such as county-specific benchmarks and guidelines, could improve local energy efficiency.

In Nyandarua, as in many rural counties with low energy access, funding is directed towards enhancing energy access, leaving energy efficiency significantly underfunded. This makes mainstreaming EE&C activities challenging. Identifying quick wins and building the capacity of county officers could be a starting point for promoting energy efficiency.

4.3 Sub-sectors Energy Efficiency and Conservation

4.3.1 Households

Most people in the county rely on firewood and charcoal for cooking, using highly inefficient technologies like the Three-Stone Open Fire (TSOF) or non-standard artisanal improved stoves. Based on ISO 19867, stove performance standards use five parameters to measure efficiency, as shown in Figure 33 below. Under these standards, most stoves in use fall under Tier 1 and Tier 2.

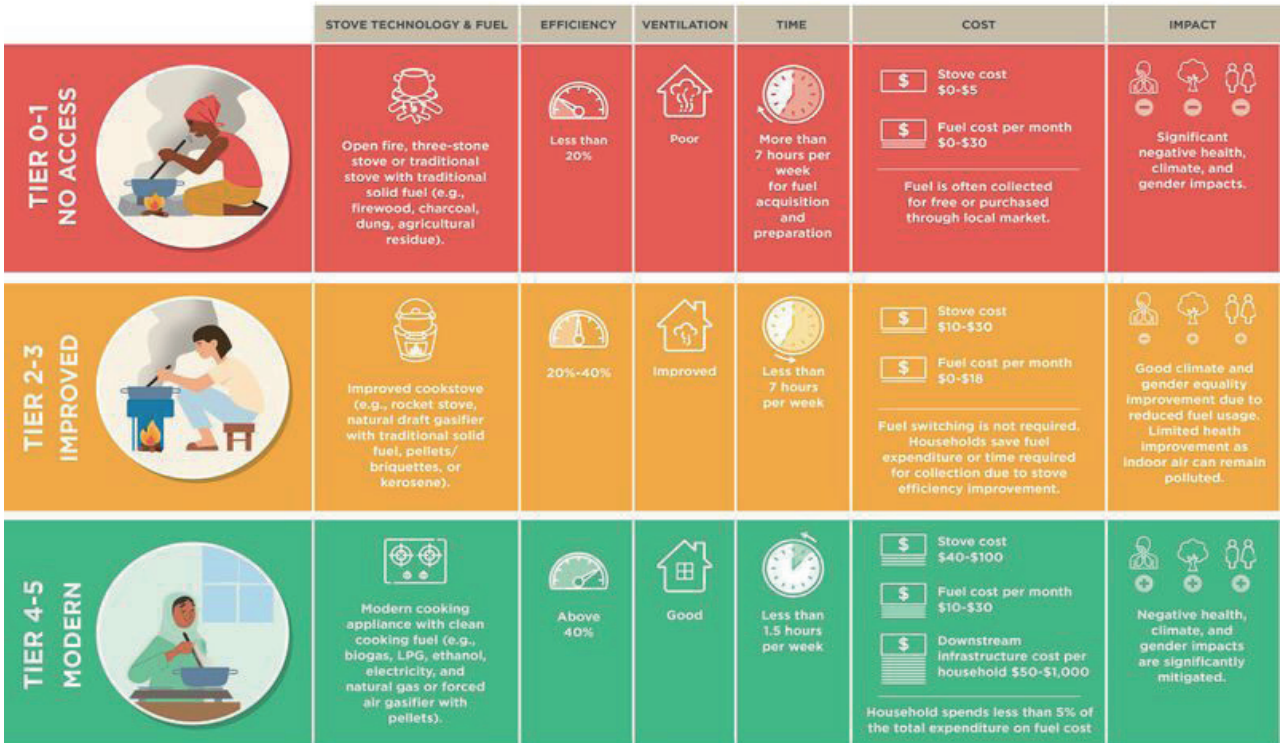


Figure 33: Stove Tiers and Associated Characteristics

In addition, charcoal production is primarily done using earthen kilns with a low efficiency of 10–15%. This leads to two levels of wastage: during production and stove burning, resulting in high overall energy wastage. The example below illustrates this:

Box 1: Case Example for Charcoal Production

Assuming Nyandarua County consumes 100 tonnes of charcoal monthly, how many trees need to be cut to produce 100 tonnes of charcoal annually, given that the kilns used have an efficiency of 12%? The average weight of a tree is 500 kg. If a new version of charcoal kilns were introduced with an efficiency of 30%, how many trees would be saved to produce the same amount of charcoal?

i. Annual charcoal consumption = 100 tonnes/month x 12 = 1,200 tonnes/year

ii. Total amount of wood required with the current efficiency.

- Total wood required = $\frac{\text{Annual charcoal consumption}}{\text{Efficiency of the Kiln}}$ = 1,200 tonnes/0.12 =10,000 tonnes

iii. Number of trees required (current efficiency) = $\frac{\text{Total wood required}}{\text{Weight of a tree}}$ = 20,000 trees

iv. Total wood required with new efficiency = 1,200 tonnes ÷ 0.30 = 4,000 tonnes

v. Number of trees required (new efficiency): Total wood (kg)/500 = 8,000 trees

Therefore, by adopting more efficient kilns, about 12,000 trees would be saved annually.

The following are the most common types of cooking solutions currently in use, which are highly inefficient and release high levels of emissions. The transition from traditional cooking appliances to modern ones has been incremental, leaving most people reliant on traditional methods. Hence, an ambitious plan is needed to transform how people cook.

Traditional metallic charcoal stove

Improved Charcoal stove -Kenya Ceramic Jiko

Three stone open fire

Improved firewood stove

Figure 34: Most Common Traditional Cookstoves

Producers and distributors offer more efficient cooking solutions, including firewood, charcoal, bioethanol, biogas, and electric cookers. These solutions are efficient and clean, and when tested against ISO 19867, they fall between Tier 3 and Tier 5 in efficiency and emissions. However, the main drawback of many of these solutions is the high upfront cost, making them unaffordable for end-users. Figure 35 below shows these types of technologies and their indicative prices.

Bioethanol stove (Kes 1500 – price subsidised

Charcoal stove (Kes 4000 -5000)

Electric Pressure Cooker (Kes 6000-15000)

Prefabricated biodigester (price depend on the size (From Kes 80,000 on ward

Induction Cooker (Kes 5000 -10,000)

Figure 35: Modern Cookstoves

Therefore, it is highly recommended that the county focus on energy efficiency in both fuel production and demand by promoting efficient cooking solutions. Initiatives could include providing consumer subsidies, microfinancing, and innovations to make these cooking solutions accessible and affordable for end users.

4.3.2 Educational Institutions

Educational institutions, from early childhood development (ECD) centres and primary schools to universities, have significant potential for energy efficiency improvements. These improvements can directly benefit the financial health of these institutions by reducing energy consumption and lowering carbon emissions. The following are opportunities for energy efficiencies:

- **Upgrading lighting systems:** Replacing incandescent and fluorescent lamps with LED lighting. LEDs consume up to 75% less energy than other options and last longer than incandescent bulbs.
- **Enhancing natural lighting:** It is highly recommended that classrooms have large windows to maximise the penetration of natural light during daylight hours. Existing buildings that do not meet this standard should be retrofitted, and all new buildings should adhere to this standard.
- **Installation of occupancy and motion light sensors:** Lighting should be automated by installing sensors that turn lights on and off based on occupancy.
- **Awareness and education:** Students, teaching, and non-teaching staff should be educated on energy conservation measures, from cooking to managing power appliances. Behavioural change is a continuous process, ensuring that sustainable behaviours and practices are mainstreamed within the institutions.
- **Cooking:** Not all schools offer cooking, but most that do, such as boarding schools, primarily use firewood. Over the years, campaigns have encouraged schools to adopt improved institutional stoves, but many schools within the county still use three-stone open fires, and others have not properly maintained their stoves, losing potential benefits. Improved institutional stoves have an efficiency range of 50–70% compared to open fires, which have an efficiency of about 15%. This has a significant impact on school budgets and the environment, as firewood is not sourced sustainably. **The following example illustrates the benefits of transitioning to efficient cookstoves.**

Box 2: Case Example for Cooking Technology

A secondary school in Nyandarua County uses open fires for cooking food and heating water for students. This method has an efficiency of 15%. Each day, the school uses 500 kg of firewood. A neighbouring school with the same number of students has adopted an improved institutional stove with an efficiency of 60%.

i. How many tonnes of firewood does each school use in three months?

ii. How much does each school spend on firewood per term (three months) if the cost of one tonne of firewood is KES 3,000?

Answers:

i. Over the course of three months, the school using open fire for cooking uses 45 tonnes of firewood, while the school with the improved stove uses 11.25 tonnes.

ii. In terms of expenses, the school using open fire spends KES 135,000 on firewood per term, while the school with the improved stove spends KES 33,750 over the same period.

This demonstrates the positive impact of improved cooking solutions on school budgets and the environment.

Additional Measures for Enhancing Energy Efficiency in Learning Institutions

Train kitchen staff in energy-saving cooking techniques. This should be done regularly, and practical measures should be instilled, such as:

- Keeping lids on pots and pans when cooking to increase pressure and temperature, making food cook faster.

- Regular maintenance and cleaning of cooking appliances to ensure optimal operation. For example, an institutional stove with intact insulation conserves energy.
- Using the right size of pots and pans to minimise heat loss.
- Ensuring only dry wood is used in kitchens that use firewood, with firewood stored in a dry place protected from rain or water.
- Mandatory energy usage recording and monitoring: For example, fuels can be weighed, and kitchen staff should maintain a journal to record fuel inflows and outflows.

Ensuring proper ventilation: Use energy-efficient ventilation systems as needed, turning them on only when required. Efficient kitchen hoods and exhaust systems can reduce air conditioning needs, saving energy.

4.3.3 Health Facilities

Health facilities, especially those at levels 4 to 6, are the most energy-intensive in the community. Operating 24/7, they consume large amounts of energy for heating, cooling, lighting, medical equipment, and other critical services, presenting significant opportunities for energy efficiency improvements. The following are some areas the County Government of Nyandarua can target:

- Energy-efficient building designs and retrofits:
  - Improve building insulation and sealing to reduce heating and cooling needs.
  - All new buildings should aim to meet green building certification standards, guiding the design or retrofit process towards higher energy efficiency.
- **Heating, ventilation, and air conditioning systems (HVAC):** HVAC systems are major energy consumers, regulating and moving heated and cooled air throughout a facility. Implementing energy-efficient HVACs can significantly reduce energy consumption, thus lowering monthly energy bills. Examples include high-efficiency boilers, chillers, and variable-speed drives on motors. Regular maintenance and upgrades ensure these systems operate at peak efficiency.
- **Lighting solutions:** Switching to energy-efficient lighting options like LEDs can drastically reduce energy consumption, as they consume around 75% less energy than incandescent bulbs. Additionally, installing lighting control sensors and timers would enhance the energy efficiency of health facilities.
- **Medical equipment efficiency:** Invest in energy-efficient equipment and ensure proper maintenance. Implement power management strategies for medical equipment, such as shutting down or using low-power modes when not in use.
- **Water heating:** Hot water is essential in hospitals for hygiene, infection control, patient care, laundry, food services, and cleaning. Various options should be adopted to meet these needs, including solarising water heating, upgrading to high-efficiency water heaters, recovering heat from HVACs, and installing low-flow fixtures in sinks, showers, and toilets to reduce hot water use.
- **Implement energy management systems:** Continuous monitoring of energy consumption to identify areas for improvement and verify the effectiveness of energy-saving measures.
- **Staff training and engagement:** Regularly train facility staff on best practices for energy conservation, including the proper use and maintenance of equipment. Identify and select energy champions within departments to help promote energy-saving behaviours among staff.

4.3.4 County Buildings

County government buildings, including offices, courthouses, and other public facilities, present a significant opportunity for energy efficiency improvements. These buildings vary widely in size and function, and many are old, operating with inefficient systems due to their age and the absence of concrete measures, plans, budgets, and awareness of the role of energy efficiency in optimising financial resource use. Upgrading these facilities saves energy, reduces costs, and sets standards for environmental stewardship in the community. Some opportunities the county can leverage include:

- **Lighting and photo-sensitive bulbs:** Replace all non-LED lighting with LED bulbs. Install motion sensors, daylight sensors, and timers to reduce lighting when areas are unoccupied or have adequate natural light. This will significantly reduce electricity consumption and result in cost savings.
- **Building envelope improvement:** Enhance insulation in walls, roofs, and floors to maintain indoor temperatures and reduce the demand for heating and cooling systems. Install appropriately sized windows to allow sufficient natural light during the day, drastically reducing the need for artificial lighting.
- **Energy efficiency training:** Conduct regular training and awareness programmes about energy-saving practices and the importance of reducing energy consumption. Place best practice messages on energy conservation in strategic locations to remind building users regularly. These messages should be in striking colours, visible, and have a simple, clear message, as illustrated in the figure below:

Figure 36: Alert message to remind you to turn off the lights

4.3.5 Street Lighting

Street lighting is a critical component of urban infrastructure and enhances safety and security for pedestrians, cyclists, and motorists. Within the county, street lights account for a significant portion of the county's energy bill. Hence, prioritising energy conservation and efficiency measures is essential. This will also enable the county to provide more street lighting to a larger population. The following are some measures the county can implement to realise further benefits in energy saving:

- **Repair and maintenance:** Establish a dedicated desk in charge of repairs and maintenance to ensure a swift response for maintenance or replacement. Additionally, this could be enhanced by utilising remote monitoring and management systems to identify non-functioning streetlights, thereby reducing downtime. For example, there have been cases where a timer malfunctions,

causing lights to be on during the day while remaining off at night. The response has not been swift, often taking several weeks or months to resolve.

- **Upgrading streetlights with LEDs:** Replace traditional lighting bulbs with LEDs. They are highly efficient, have a longer lifespan, and offer better light quality than traditional bulbs. Install timers to ensure the lights operate within a set schedule.
- **Solarising streetlights:** Adopting solar streetlights reduces dependency on grid electricity and lowers electricity bills. Since Nyandarua is well endowed with high solar insolation (GHI average of 2,244 kWh/m²/year), the county should take advantage of this resource.
- **Engaging the private sector through public-private partnerships (PPP):** To enhance the lighting of the county, the county government should collaborate with the private sector in the installation of streetlights. This could be achieved through a PPP where private entities adopt several streetlights (maintenance, bill payment, installation, etc.) in exchange for the opportunity to advertise on those masts or others within the county, ensuring that a larger part of the county is well lit.
- **Community awareness:** It has been noted that cases of streetlight vandalism are rampant within the county, particularly concerning solar streetlights, where solar panels or batteries are stolen. The community should be sensitised about the benefits of street lighting and their role in community development. This will ensure the community takes ownership of the lights and helps to protect them. It is noted that the vandals reside within the community and are known to locals.

Box 3: Case Example to Calculate the Savings from Replacing Halogen Streetlights with LED

The LED is rated at 50 watts and the halogen at 200 watts.

i) How many units of electricity does each consume per year?

ii) If one unit of electricity costs KES 30, what will be the amount saved if the county government replaces 500 halogen streetlights with LEDs?

Calculate the total energy consumption per day for both halogen and LED lights.

i. Halogen lights total electricity consumption per day:
   - 200 W × 500 lights = 100,000 W/h = 100 kW/hour
   - Daily consumption = 100 kW × 12 hours = 1,200 kWh

ii. LED lights total electricity consumption per day:
   - 50 W × 500 lights = 25,000 W = 25 kWh
   - Daily consumption = 25 kW × 12 hours = 300 kWh

iii. Calculate the annual electricity consumption for both halogen and LED lights:
   - Halogen: 1,200 kWh/day × 365 days = 438,000 kWh/year
   - LED: 300 kWh/day × 365 days = 109,500 kWh/year

iv. Calculate the annual cost for both halogen and LED lights:
   - Halogen lights annual cost = 438,000 kWh × KES 30/kWh = KES 13,140,000
   - LED lights annual cost = 109,500 kWh × KES 30/kWh = KES 3,285,000

v. Annual savings:
   - Cost of halogen lights per year – Cost of LED lights per year = Annual saving
   - KES (13,140,000 – 3,285,000) = **KES 9,855,000/year.**

Upgrading Street Lighting With Solar LEDs

Chapter 5: BIOENERGY

5.1 Overview

In Nyandarua County, biomass remains the predominant energy source for cooking, with firewood accounting for 53% of its usage, especially prevalent in rural areas. Charcoal is another significant biomass source, utilised by 13% of the population. The extensive reliance on these biomass fuels has led to considerable environmental degradation, including deforestation, as trees are frequently harvested unsustainably. Moreover, the collection of firewood demands a considerable time investment, disproportionately affecting women and children, who often spend extensive periods gathering it. This not only exacerbates drudgery and diminishes productivity but also restricts educational opportunities for these groups.

The environmental consequences of such biomass usage are profound. They encompass the depletion of local forest reserves, loss of biodiversity, and escalated soil erosion. Furthermore, the inefficient combustion of these materials in traditional cooking practices significantly contributes to indoor air pollution, posing serious health risks, particularly respiratory diseases, predominantly impacting women and children who are more frequently exposed to cooking smoke.

5.2 Bioenergy Opportunities in Nyandarua County

Nyandarua County, nestled within one of Kenya's crucial water towers, presents substantial yet largely untapped potential for bioenergy development, as discussed in Chapter 2. Despite its vast resources, the harvesting and utilisation of bioenergy have been conducted unsustainably and without the deserved priority, particularly in the energy sector, where it is predominantly seen merely as a source for cooking fuel. This perception places bioenergy low on the development agenda, undermining its potential to contribute to sustainable development.

5.3 The Untapped Potential of Bioenergy

Nyandarua's strategic position as part of Kenya's significant water towers mandates the protection and sustainable management of its natural resources. Bioenergy, if harnessed responsibly, can contribute to this goal. For instance, the county's robust agricultural sector produces substantial waste that could be converted into energy. Crop residues like potato peels and vegetable waste, which are abundant due to the county's high agricultural activities, can be utilised in biogas plants. Additionally, the livestock sector offers a plentiful supply of manure, another excellent substrate for biogas production.

Implementing sustainable harvesting techniques is imperative to leveraging bioenergy's full potential while preserving ecological balance. For example, introducing energy crops on degraded lands or as part of intercropping systems can provide biomass without competing with food production. Crops such as Napier grass and bamboo yield high biomass and help in soil conservation and rehabilitation.

5.3.1 Economic and Social Impacts

The development of a local bioenergy sector can have profound economic and social effects. Establishing biogas plants or biomass energy facilities can create jobs in the construction, operation, and maintenance phases. A study by the International Renewable Energy Agency (IRENA) suggests that, on average, every megawatt of biomass power generation capacity can create approximately ten full-time jobs in rural areas[61].

Moreover, bioenergy can provide a steady income stream for farmers through the sale of agricultural residues or energy crops. This is particularly impactful in Nyandarua, where agriculture forms the economic backbone of the community. Smallholder farmers can diversify their income sources, reducing poverty and boosting local economies.

5.3.2 Environmental Benefits

Sustainably managed bioenergy projects can significantly contribute to environmental restoration. By reducing reliance on wood fuel, which leads to deforestation, bioenergy can help preserve Nyandarua's forest cover. Furthermore, the use of biogas technology reduces greenhouse gas emissions compared to traditional wood and charcoal usage, contributing to climate change mitigation efforts.

5.3.3 Policy and Planning

For Nyandarua to realise the full potential of bioenergy, robust policy support and strategic planning are essential. The county government could collaborate with national and international energy agencies to draft policies incentivising renewable energy investments, particularly in bioenergy. Such policies could include subsidies for biogas installation, grants for research in energy crop cultivation, and favourable tariffs for bioenergy power.

5.3.4 Potential Bioenergy Pathways

The figure below illustrates various biomass feedstock types and their conversion pathways into different bioenergy products. Feedstocks like lignocellulose, oil crops, sugar and starch crops, biodegradable waste, and algae are processed via thermochemical, mechanical, or biochemical methods. Thermochemical processes, such as pyrolysis and gasification, produce electricity, heat, and solid, liquid, and gaseous fuels like charcoal, biogas, and bioethanol. Mechanical methods like densification yield solid biofuels, while biochemical methods like fermentation and anaerobic digestion produce biogas, biodiesel, and other liquid and gaseous fuels.

[61] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Solid_biomass_supply_2019.pdf

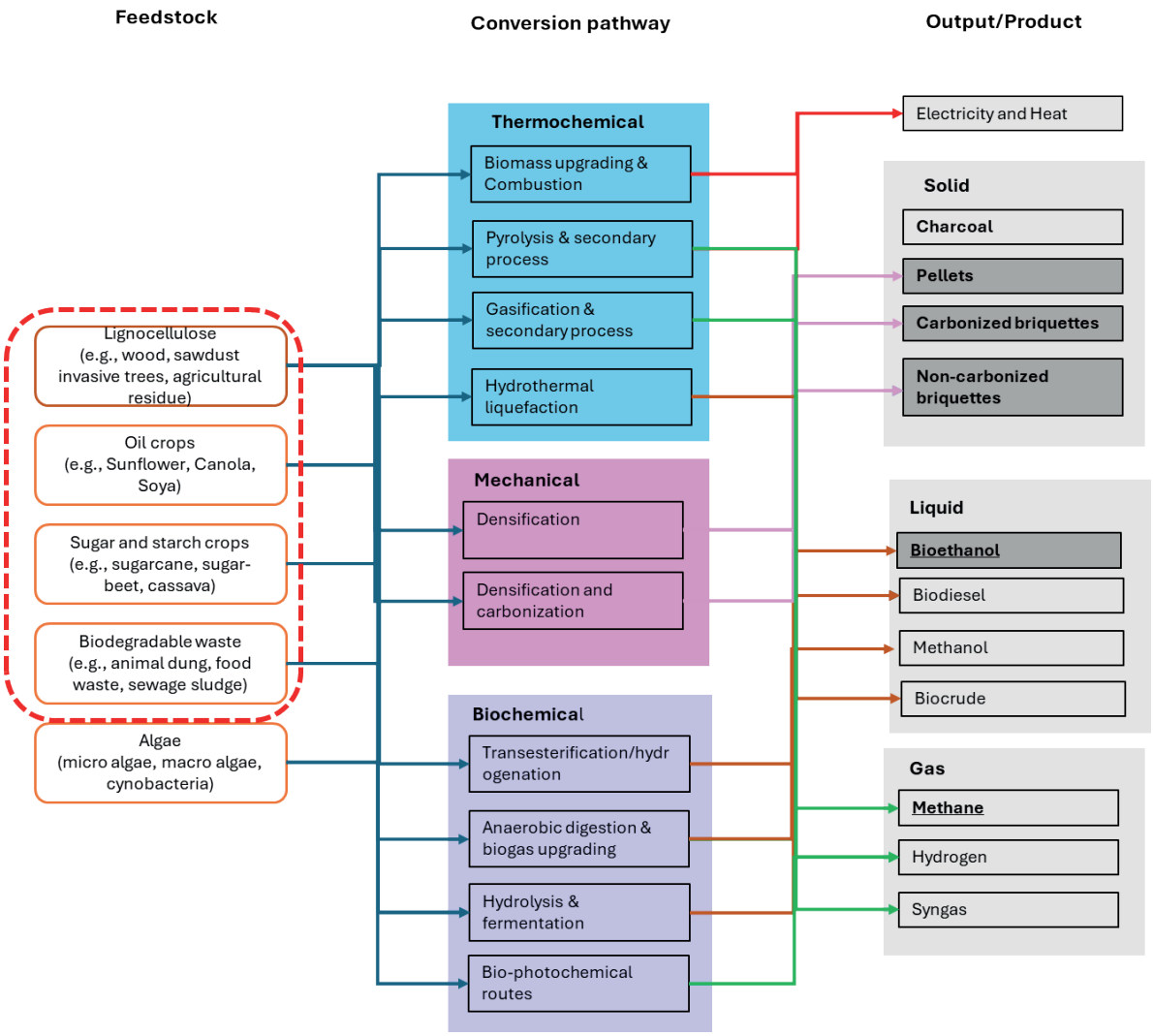


Figure 37: Bioenergy value chain pathways

However, not all pathways would be practically possible in Nyandarua. This section selects the feedstock and pathway with the highest potential in the county. This chapter should be read in conjunction with Chapter Two to avoid duplications. The selected feedstocks include pellets, sugar beets, and biogas; however, the list could be expanded as more evidence is gathered on the viability of various pathways. The chapter further discusses what needs to be done to ensure the sustainable exploitation of bioenergy resources in the county.

5.3.5 Pellets and Briquettes

Pellets and briquettes are made from biomass residues such as agricultural and forestry waste. Nyandarua County, with its diverse agricultural activities, offers a rich source of raw materials for this production.

- **Potential Sources of Biomass:** Nyandarua produces crops like maize, potatoes, and vegetables, which generate large amounts of agricultural residues (corn stalks, husks, potato vines). These residues can be converted into pellets and briquettes for fuel, providing an alternative to traditional wood and charcoal.

- **Forestry Residues:** The county has a timber industry, and the waste from sawmills, such as sawdust, wood chips, and forest thinning residues, offers a substantial amount of biomass. These can be processed into pellets or briquettes, especially as a means to manage forest resources sustainably.
- **Production Feasibility:** The establishment of local production units for processing biomass into pellets or briquettes would create employment opportunities and promote sustainable energy access. Additionally, the proximity to farming communities means raw materials would be abundant and transportation costs minimal.
- **Environmental Benefits:** Utilising agricultural and forestry waste would reduce open-air burning, help mitigate deforestation, and offer a cleaner-burning alternative to firewood and charcoal.

5.3.6 Sugar Beets

Sugar beets have the potential to be a significant biofuel feedstock due to their high sugar content, which can be fermented to produce bioethanol.

- **Agricultural Suitability:** Nyandarua's high-altitude climate and fertile soils are conducive to growing sugar beets. These crops can be cultivated alongside other major crops, providing farmers with diversification. With adequate extension services and the introduction of high-yielding varieties, sugar beet farming could thrive in the region.
- **Bioethanol Production:** Sugar beets are ideal for bioethanol production. This biofuel has gained high potential as an alternative energy source for cooking in Kenya, contributing to reduced carbon emissions. Developing small-scale or decentralised ethanol production units in Nyandarua could meet local fuel needs and create new revenue streams for farmers.
- **By-products:** Besides ethanol, sugar beet processing yields by-products like beet pulp and molasses, which can be used as animal feed or for further bioenergy production (such as biogas). This would create a circular economy around sugar beet farming and processing.

5.3.7 Biogas

Given its extensive dairy and farming activities, biogas production using organic waste and manure is highly viable in Nyandarua County.

- **Feedstock Availability:** The county has a high dairy cattle population, and animal manure is a primary feedstock for biogas production. Additionally, agricultural waste, household organic waste, and food processing residues could supplement the cattle dung.
- **Small-Scale and Community Biogas Systems:** Farmers can establish small-scale biogas digesters to meet their cooking and heating energy needs. Larger, community-based biogas plants could be developed to supply renewable energy to local institutions like schools, hospitals, and other community facilities.
- **Complementing Agriculture:** The by-product of biogas production, known as bio-slurry, is a nutrient-rich organic fertiliser. This can improve soil health and boost crop yields, promoting sustainable farming practices in the region.

- **Energy Security and Sustainability:** Biogas can reduce reliance on firewood, helping conserve local forests and reduce indoor air pollution from traditional biomass use. It also offers a clean, continuous energy supply for cooking and heating, reducing the demand for LPG or electricity in rural households.

5.4 Recommendations for Bioenergy Optimisation and Exploitation

The following recommendations have been proposed to ensure sustainability and optimise the exploitation of bioenergy resources in a manner that will have a socio-economic and environmental positive impact on the county:

i. Need for Proper Planning

Proper planning forms the foundation of sustainable bioenergy exploitation. Nyandarua County needs to undertake a detailed bioenergy strategy development process that outlines clear objectives, timelines, and responsibilities. This should involve stakeholder consultations to ensure all relevant sectors, including agriculture, energy, and the environment, are considered. Proper planning will also involve alignment with national energy policies and ensuring synergy with other county-level development plans to create a harmonised approach towards sustainable energy exploitation.

ii. Data for Understanding the Current Situation

Accurate and reliable data is crucial for identifying the current bioenergy landscape in Nyandarua. A comprehensive data collection process will map out the available bioenergy resources, assess energy consumption patterns, and identify energy gaps within the county. This includes conducting surveys, engaging with local communities, and leveraging satellite imagery for resource mapping. Data-driven insights will form the basis for decision-making, investment, and policy formulation.

iii. Mapping of Sub-Counties and Their Potential

Each sub-county within Nyandarua has unique potential for bioenergy development. A thorough mapping process should be conducted to evaluate resources such as agricultural waste, forest residues, and livestock waste and their respective energy potential. This process should also account for land-use patterns, existing infrastructure, and socio-economic conditions to ensure that sub-county-specific interventions are crafted. This targeted approach will help prioritise areas with the highest bioenergy potential and streamline investment.

iv. Bioenergy Resource Assessment

Conducting a detailed bioenergy resource assessment will provide insights into the seasonal availability and quantity of biomass in Nyandarua. This assessment must ensure that bioenergy production does not conflict with food security or lead to deforestation. The county should use this information to balance energy production with environmental conservation and agricultural productivity.

v. Creating a Policy and Regulatory Framework and Plan

For bioenergy to flourish in Nyandarua, there must be a conducive policy environment. The county can build on the existing national policies, such as the Energy Act of 2019 and the National Bioenergy Strategy 2020, which support renewable energy technologies. Additionally, advocacy for tailored bioenergy policies that address local challenges—such as high upfront costs, lack of awareness, and regulatory barriers—should be part of the strategy. The county government must work closely with the national government to harmonise policies that streamline the approval, licensing, and operational processes of bioenergy projects.

Nyandarua should develop a bioenergy development plan. The plan should outline the county's long-term strategy for exploiting bioenergy. This plan will prioritise bioenergy projects, identify funding mechanisms, and set clear targets for bioenergy adoption. The development plan should also include a monitoring and evaluation component to track progress and ensure continuous improvement in bioenergy initiatives.

vi. Capacity Building and Training

Building local capacity is essential for the sustainability of bioenergy projects. Training programmes should be established in partnership with technical institutions, universities, and other relevant bodies to equip the local workforce with the skills to operate, maintain, and expand bioenergy systems. Specialised training can also target farmers and SMEs on bioenergy resource management, energy-efficient technologies, and sustainable practices. In this way, local ownership of bioenergy projects will increase, contributing to job creation and long-term sustainability.

vii. Community Engagement and Education

Sustainable bioenergy projects cannot succeed without the involvement of local communities. Nyandarua should prioritise community engagement through consultations, town hall meetings, and partnerships with local leaders. Engaging communities ensures that bioenergy projects align with their needs, provide economic benefits, and promote social inclusion. This approach will also foster community ownership and long-term sustainability of bioenergy initiatives.

In addition, consumer education campaigns, workshops, and community outreach programmes can highlight how bioenergy contributes to energy security, environmental sustainability, and economic development.

viii. Promoting Private Sector Participation

Private sector involvement will be crucial to scaling bioenergy production, distribution, and marketing in Nyandarua. The county government can encourage private investment by creating favourable conditions such as tax incentives, low-interest loans, or public-private partnerships (PPPs). Establishing a framework that supports market-driven solutions will spur innovation, lower costs, and ensure the long-term success of bioenergy projects.

ix. Promotion of Efficient Biomass Stoves and Alternative Cooking Solutions

Efficient biomass stoves can significantly reduce the pressure on biomass resources. By promoting the use of these stoves, Nyandarua County can curb deforestation and promote a more efficient use of available resources. The county can partner with stove manufacturers and offer subsidies or financing to lower-income households to accelerate stove adoption.

In addition, Nyandarua should explore alternative cooking energy solutions, such as bioethanol, LPG, and solar cookers. The county could create pilot programmes to demonstrate the effectiveness of these technologies, especially in rural areas. Providing financial support and creating awareness of these alternatives will further reduce the demand for biomass.

x. Promoting the Production of Fast-Maturing Tree Species

Encouraging the cultivation of fast-growing tree species will help replenish biomass resources more rapidly. Nyandarua can support reforestation and afforestation programmes that involve the planting of tree species with a high energy yield. This could be integrated with agricultural activities, providing farmers with additional income while ensuring a sustainable supply of biomass for energy production.

xi. Upgrading Energy Centres

Existing energy centres in Nyandarua can be upgraded to serve as hubs for promoting bioenergy and other renewable energy technologies. These centres should provide training, demonstrations, and technical support to farmers, entrepreneurs, and communities interested in bioenergy. Upgrading these facilities will also help drive awareness and adoption of energy-efficient and sustainable practices across the county.

xii. Establishing a Bioenergy Technologies Database

A centralised database that records bioenergy technologies, suppliers, and project outcomes will help Nyandarua track progress and identify areas for improvement. This database will also serve as a valuable resource for local businesses, policymakers, and researchers interested in bioenergy.

Nyandarua County can create a comprehensive, sustainable bioenergy strategy that supports environmental conservation, economic development, and energy access by addressing these aspects. This holistic approach will attract investment and foster community involvement, driving the county towards a greener and more sustainable future.

Biogas Resource Center: Unlocking the Potential of Dairy Waste for Clean Energy Adoption

Chapter 6: PROGRAMMES AND PROJECTS

6.1 Overview of the CEP

Based on national laws, the Nyandarua County CEP establishes a framework for planning and implementation to enhance coordination among key stakeholders promoting energy access. These stakeholders include local and national governments, development agencies, and the private sector. Nyandarua County aims to achieve universal electricity access by 2027 through both on-grid and off-grid methods, and universal access to clean cooking solutions by 2028. The CEP's vision relies on strategic partnerships with the national government, the private sector, development partners, and bilateral and multilateral donors to create an investment-friendly operating environment.

The CEP identifies three main issues: poor coordination within the energy sector, the absence of a comprehensive energy planning framework, and limited access to clean, affordable, and reliable energy. It proposes a solution through a programmatic strategy encompassing four interconnected areas: access to energy for cooking and heating, electricity access, productive use of energy (PUE), and cross-cutting issues. This strategy consists of 12 programmes aiming to enhance energy access by 2030 with a budget of KES 1,837 billion over five years, as outlined in Chapter 8. This budget to implement the strategy is expected to come from contributions from the private sector, national and sub-national governments, development agencies, and climate finance, both in-kind and cash. Key to this strategy is creating a conducive environment for private sector investment and bolstering collaboration between development agencies and the county government to leverage these resources.

6.2 Components of the CEP

6.2.1 Component 1: Energy Access—Clean Cooking and Heating

Table 27: Programme 1—Accelerating Cleaner Cooking Solutions for Households

Programme 1: Intervention area—Accelerating clean and more efficient household cooking energy

Baseline: 13% of the County population has access to clean cooking solutions

Target:

A. 87% (currently without access to clean cooking) to have at least one clean cooking solution as part of their stack by 2030

B. Double the proportion of primary use of clean cooking solutions from 13% to at least 26% by 2030

C. All households using charcoal and firewood to burn it on a high-efficiency improved cookstove (ICS)

Outputs	Activities	Progress Indicators	Responsibility	Timeline (Indicative start-date)
Partnership established with cooking energy providers and development partners	Mapping of active cooking solution providers and development partners	A detailed list of clean cooking service providers active in Nyandarua and those planning to enter the County	Energy department	2024/2025—Q2
	Consultative forums on the County clean cooking vision and opportunities	Two consultative forums held	Energy department / Consultant	2024/2025—Q3
	MoU with partners on clean cooking solutions	At least five MoUs signed with partners	Energy department	2024/2025—Q4
Awareness creation on the benefits of improved cooking solutions undertaken	Desk survey on appropriate awareness creation approaches considering rural-urban dynamics and different socio-economic groups	Awareness creation campaign strategy	Energy department / Public Health department / Gender department / Consultant	2024/2025—Q4
	Recruit a marketing firm	Marketing firm identified and contracted		2025/2026—Q1
	Awareness creation roll-out	Series of campaigns rolled out in all the sub-counties		2025/2026—Q2, Q4 2025/2026—Q2, Q4
	Establish and mainstream Clean Cooking Energy Week annually	Gazettement of the energy week and annual roll-out	Energy department / Health department / Agriculture department / Service providers / Gender department / Development partners	2025/2026—Q4 2025/2026—Q4 2025/2026—Q4 2025/2026—Q4 2026/2027—Q4
A Clean Cooking Fund created (a - Residential needs)	Develop clean cooking fund strategy focusing on residential users	Guidelines and a strategy developed	Energy department / Gender department / Environment department / Economic Planning	2024/2025—Q4
	The County government allocates a budget for clean cooking	Nyandarua allocates a seed fund toward CCF	Energy department / Treasury / Planning department	2024/2025—Q1
	Mobilise finances to strengthen the CCF	Fund equivalent to the County allocation mobilised	Energy department / Health department / Gender department	2024/2025—Q4

Programme 1: Intervention area—Accelerating clean and more efficient household cooking energy

Baseline: 13% of the County population has access to clean cooking solutions

Target:

A. 87% (currently without access to clean cooking) to have at least one clean cooking solution as part of their stack by 2030

B. Double the proportion of primary use of clean cooking solutions from 13% to at least 26% by 2030

C. All households using charcoal and firewood to burn it on a high-efficiency improved cookstove (ICS)

Outputs	Activities	Progress Indicators	Responsibility	Timeline (Indicative start-date)
Dissemination of clean cooking energy solution mix accelerated—LPG, ethanol, biogas, pellets, efficient improved biomass stoves etc.	Design a consumer financing facility and Results-Based Financing (RBF)	A functional consumer financing and RBF facility ready for roll-out	Gender department / Energy department / Private sector / Financial institutions / Development partners	2024/2025—Q3 onward
	Roll-out consumer financing through—Merry-go-round, Saccos, pay-go, etc.	Increased uptake of clean cooking solutions through developed consumer finance	Gender department / Energy department / Private sector / Financial institutions / Development partners	2025/2026—Q3
	Roll-out RBF cookstoves facility to enhance the uptake of clean cooking solutions	New and innovative clean cooking solutions are readily available and accessible to consumers	Energy department / Private sector / Trade department / Development partners / Financial institutions	2025/2026—Q3
	Strengthen the role of the Clean Cooking Association of Kenya (CCAK) at the County level	CCAK County chapter activated through the signing of an MoU with the County	Energy department / Development partners / CCAK	2025/2026—Q3

Table 28: Programme 2—Accelerating Clean Cooking Energy for Learning Institutions

Programme 2: Intervention area—Accelerating clean cooking in learning institutions

Baseline: TBD—# of the County learning institutions have access to cleaner cooking solutions

Target: 80% access to cleaner cooking solutions by 2027 and 100% by the year 2030

Outputs	Activities	Progress Indicators	Responsibility	Timeline (indicative start date)
All schools without clean and efficient cooking solutions mapped out	Convene the County school heads forum	An annual head of schools event held	Education department / Energy department	2024/2025—Q4
	Commission a County-level audit of all public schools and determine those that do not have access to clean cooking solutions	All schools without access to improved institutional stoves mapped out		2024/2025—Q4
A Clean Cooking Fund created (b—Institutional needs)	Develop a clean cooking fund strategy focusing on institutional users	Roll-out of institutional stoves financing	Financial institutions / Education department / Energy department	2024/2025—Q2
	Develop or adopt guidelines for institutional stove providers	Institutional stove providers' guidelines developed	Energy department / Energy research institutions / Development partners	2024/2025—Q4
	Develop a register of certified institutional stove installers in the County	Online register of certified institutional stove installers developed	Energy department / Development partners	2024/2025—Q3 onward
	Roll-out institutional stove programme	Number of institutional stoves installed	Energy department / Development partners / Education department	2024/2025—Q3

Table 29: Programme 3—Accelerating Clean(er) Cooking Solutions for Health Facilities

Programme 3: Intervention area—Health facilities access to clean energy for cooking.

Baseline: TBD—# of the health facilities have access to cleaner cooking solutions

Target: 100% access to clean cooking solutions by 2027

Outputs	Activities	Progress indicators	Responsibility	Timeline (Indicative start date)
Public health institutions without clean cooking solutions mapped	Map out all health institutions without access to clean cooking solutions	Number of health facilities without access to clean energy for cooking mapped out	Health department / Energy department	2024/2025—Q4
	Undertake energy needs assessment	Needs assessment completed	Health department / Energy department	2024/2025—Q4
	Adapt the CCF to finance health institutions	CCF activated for health institutions	Energy department / Treasury / Development partners	2024/2025—Q1
All health institutions fitted with clean cooking solutions	Mobilise development partners for technical and financial support	Amount of funds mobilised	Energy department / Health department / Development partners	2024/2025—Q4
	Clean energy for cooking roll-out	Number of health facilities fitted with clean cooking solutions	Development partners / Treasury / Health department / Energy department	2024/2025—Q1

6.2.2 Component 2: Energy Access—Electricity

Table 30: Programme 4—Household lighting electricity access

Programme 4: Intervention Area—Household Energy for Lighting

Baseline: 78% of the County population has access to electricity

Target: 100% access to electricity by 2027

Outputs	Activities	Progress indicators	Responsibility	Timeline (Indicative start date)
All households in Nyandarua connected to electricity through grid for those near transformers and off-grid solutions for those in remote areas	Map areas planned for densification/intensification & grid extension over the next five years in liaison with KPLC	Grid densification, intensification & extension plan for the next five years shared with the County	KPLC/Energy Department REREC	2024/2025—Q2
	Last-mile connection activated	Number of households connected as per the agreed plan	KPLC/Energy Department	2024/2025—Q4
	Develop a database of certified solar PV products, service providers, and solar technicians	A functional online database of solar service providers and product sellers in place	KEREA/ Energy Department/ Consultant/ EPRA	2024/2025—Q2 onward
	Vet all solar products marketed in the County to ensure quality certification	Registration of solar products sellers and types in the County; Market surveillance & monitoring	Kenya Bureau of Standards/ Energy Department / Development Partners	2024/2025—Q3 onward
	Promote Solar Home Systems (SHS) and solar lanterns in areas outside the electrification zones marked by KPLC	60% of households targeted for off-grid solar connected by year 3, 40% connected in the next two years	Development Partners/ Service Providers/ Energy Department/ Financial Institutions	2024/2025—Q4 onward

Table 31: Programme 5—Institutional Appliances

Programme 5: Intervention Area—Institutions of Learning Energy for Lighting and Powering Appliances **Baseline: TBD—# of institutions of learning with access to electricity** Target: 100% access to electricity by 2027				
Outputs	**Activities**	**Progress indicators**	**Responsibility**	**Timeline (Indicative start date)**
All institutions of learning without power mapped out	Identify all institutions without power: location and proximity to grid	All learning institutions without electricity mapped out	Energy Department/ Development Partners/ Education Department	2024/2025—Q4
	KPLC shares its institutional electrification plans for the next five years	County on-grid extension plans by KPLC shared	KPLC/ Energy Department	2024/2025—Q4
All institutions connected to power—either grid power or off-grid solutions	Design a model for off-grid electrification	Off-grid electrification model designed	Energy Department/ Treasury/ Development Partners/ Financial Institutions	2024/2025—Q3
	Mobilise financial resources to support off-grid electrification solutions	Amount of funds mobilised against the target	Development Partners/ Treasury/ Energy Department	2024/2025—Q3
	Connect institutions with electricity	Number of institutions connected to electricity	Development Partners/ Energy Department/ Education Department	2024/2025—Q2 onward

Table 32: Programme 6—Health Facilities Appliances

Programme 6: Intervention Area—Health Facilities Energy for Lighting and Powering Appliances **Baseline: 71% access to electricity** Target: Enhance quality and uninterrupted access to energy for lighting and powering appliances by 2027				
Outputs	**Activities**	**Progress indicators**	**Responsibility**	**Timeline (Indicative start date)**
Energy need assessment undertaken	Identify main challenges for power supply interruption	Need assessment report	KPLC/Energy Department/ Health Department	2024/2025—Q4
	Develop tailor-made solutions for each facility	Tailor-made solutions roll-out	Energy Department/ Health Department/ Development Partners	2024/2025—Q2
Funds raised to support backup solutions setup	County government allocates budget to enhance power in health facilities	Amount of funds allocated	Health Department/ Energy Department/ Development Partners	2024/2025—Q3
	Mobilisation of financial resources from partners	Amount of funds mobilised	Development Partners/ Treasury/ Health Department/ Energy Department	2024/2025—Q2
Uninterrupted power supply	Install backup power solutions for facilities without backup	Backup power systems installed	Energy Department / Health Department / Development Partners	2024/2025—Q1

Table 33: Programme 7—Productive Uses of Energy

Programme 7: Intervention Area—Productive Use of Energy[62] **Baseline: To be determined (TBD)** Target: TBD				
Outputs	**Activities**	**Progress indicators**	**Responsibility**	**Timeline (Indicative start date)**
Milk coolers supplied with adequate power in all milk-producing sub-counties	Undertake energy need assessment for milk coolers in the County	Need assessment report	Agriculture Department/ Energy Department	2024/2025—Q2
	Install power and power backup systems for milk coolers	Number of milk coolers installed with power and backup system	Agriculture Department/ Trade Department/ Development Partners/ Financial Institutions	2024/2025—Q4
Horticulture cold chains established in all the relevant markets	Energy need assessment for horticulture cold rooms in the County	Need assessment report	Agriculture, Livestock and Fisheries Department	2024/2025—Q4
	Install cold chain storage rooms in key towns and lease to aggregators at attractive rates	Number of installed cold chain storage facilities. Number of aggregators leasing the installed cold storage facilities	Fisheries Department/ Agriculture Department/ Trade Department/ Development Partners	2025/2026—Q2
Scaled-up cold chain storage systems installed in partnership with ongoing initiatives (e.g., by Danida)[63]	Energy need assessment for potato cold chain	Need assessment report	Agriculture Department	2025/2026—Q2
	Identify and develop strategic partnerships with private sector to develop cold chains and processing	Strategic technology partners (e.g., Inspira Farms and Dafford) and financing partners (e.g., Danida and CLASP) identified	Agriculture Department/ Energy Department	2025/2026—Q2
	Set up cold storage facilities in sub-counties	Cold storage facilities in sub-counties	Agriculture Department/ Trade Department/ Private Sector/ Development Partners	2025/2026—Q2

[62] A baseline was not undertaken during the field survey and it is expected that upon the setting up of the coordinating secretariat, the office in conjunction with the relevant departments will be able to agree on the baseline and targets when the need assessment will be happening. This applies to all the intervention areas that did not have a baseline.

[63] Danida Green Business Partnerships. (2023). Reducing food loss and waste through green cold chain solutions for farmers and traders in Kenya. https://danida-business-partnerships.dk/projects/reducing-food-loss-and-waste-through-green-cold-chain-solutions-for-farmers-and-traders-in-kenya/

6.2.3 Component 3: Cross-cutting Issues

Table 34: Programme 9—Energy Efficiency

Programme 8: Intervention Area—Enhancing Energy Efficiency in the County **Baseline: TBD** Target: 50% reduction in streetlight energy bills from existing infrastructure				
Outputs	**Activities**	**Progress indicators**	**Responsibility**	**Timeline (Indicative start date)**
50% of all streetlights retrofitted with solar power	Map streetlights needing solar retrofitting and identify areas requiring additional lighting in the County	Need assessment report	Energy Department/ Roads Department/ Transport Department	2024/2025—Q2 onward
	Installation of solar street lighting	Number of streetlights retrofitted Number of new streetlights installed	Energy Department/ Roads Department/ Transport Department	2024/2025—Q2 onward
All grid-connected streetlights retrofitted with LED lights	Replace conventional streetlights with LED lights	Number of streetlights replaced with LED	Energy Department/ Roads Department/ Transport Department/ KPLC	2024/2025—Q2
A streetlight rapid response desk established	Establish a rapid response desk for streetlight maintenance	Response time to streetlight maintenance reduced by half	Energy Department	2024/2025—Q1
	Automate lighting in public places	Number of public places with automated lighting systems	Energy Department/ Roads Department/ KPLC	2024/2025—Q4
All public buildings adopt energy efficiency measures	Sensitize and educate government staff on energy efficiency practices	% Change in electricity bills for public buildings	Energy Department/ Public Works Department	2024/2025—Q2 onward
All new public buildings adopt green-building guidelines	Gazette the green-building guidelines	Green building guidelines gazetted	Physical Planning Department/ Construction Department	2024/2025—Q2 onwards
	Train the physical planning team on green building best practices	Number of public buildings adopting green-building guidelines	Physical Planning Department	2024/2025—Q2 onward

Table 35: Programme 10—Policy and Regulation

Programme 9: Intervention Area—Policy, Regulations, and Institutions **Baseline: 0**				
Outputs	**Activities**	**Progress indicators**	**Responsibility**	**Timeline (Indicative start date)**
County energy biomass policy developed	Hold consultative forums	Number of consultative forums held	Energy Department/ Climate Change Department/ Environment Department/ Development Partners/ Private Sector/ Forest Department	2024/2025—Q1
	Establish thematic working groups (charcoal, biogas, pellets, briquettes)	Number of functional working groups in place		2024/2025—Q1 onwards
	Develop the County biomass policy	County biomass energy policy developed		2024/2025—Q4
3 energy centres and innovation hubs established	Identify sites for energy centres	Land and paperwork for energy centre establishment finalised	Energy Department/ ICT Department/ Research Institutions/ Development Partners	2024/2025—Q1
	Develop operational plans for energy centres	Operational plan developed		2024/2025—Q2
	Gazette the energy centres	Energy centers gazetted by the County	Energy Department	2024/2025—Q4
	Identify and engage strategic partners to co-run the centres	At least three MoUs signed with strategic partners	Energy Department	2025/2026—Q1
	Equip the energy centres	All requisite equipment purchased	Energy Department/ Development Partners/ Private Sector	2025/2026—Q2 onward
County Energy Planning Committee (CEPC) established	Hold consultation forums for members per energy regulations	Members identified and co-opted to the CEPC	Energy Department	2024/2025—Q2
	Gazette the CEPC	CEPC gazetted	Energy Department	2024/2025—Q2
CEP secretariat established	Publish functions of the CEP	Operational guidelines of the CEP completed	Energy Department	2024/2025—Q2
	Gazette the CEP	CEP gazetted	Energy Department	2024/2025—Q2
	Recruit the CEP secretariat core team	CEP secretariat operational	Energy Department	2024/2025—Q3

Table 36: Programme 10—Cross-Cutting Initiatives

Programme 10: Intervention Area—Cross-Cutting Initiatives in the CEP

Baseline: TBD

Target: Integrate gender into all CEP programmes, initiate waste-to-energy projects, foster wind energy investments, and maximise GHG abatement potential and health benefits (e.g., averted Disability-Adjusted Life Years (ADALYs) and time savings)

Outputs	Activities	Progress indicators	Responsibility	Timeline (Indicative start date)
Gender integrated into CEP implementation	Undertake a gender need assessment	• Needs assessment report	Energy Department/ Gender Department	2024/2025—Q1
	Customise the national gender policy in energy for local context	• County gender white paper in energy developed		2024/2025—Q2
	Integrate gender into CEP through training and increased women's involvement in implementation	• More women involved in decision-making, especially in clean cooking energy	Energy Department/ Gender Department	2024/2025—Q2 onward
Waste-to-energy initiatives	Install waste-to-energy conversion systems (e.g., biodigesters) at all market centres	• Number of waste-to-energy plants installed; • Number of plants operational annually	Civil Works, Energy, and Environment Departments	2024/2025—Q2 onward
	Train energy and environment personnel in sub-counties on waste-to-energy Train county staff to train/sensitize traders on waste-to-energy practices	• Number of staff trainedin all sub-counties; • Number of trainings held by trained personnel at market centres	Civil Works, Energy, and Environment Departments	2024/2025—Q2 onward
	Promote waste-to-energy initiatives on farms (e.g., horticultural, dairy)	• Number of waste-to-energy systems installed on farms	Civil Works, Energy, and Environment Departments	2024/2025—Q2 onward
Wind energy investments	Review challenges that led to the Kinangop Wind Power Plant construction project's collapse	• Comprehensive report documenting the Kinangop Wind Power plant challenges; • Action plan on how to tackle the challenges developed	Land, Energy, and Environment Departments	2024/2025
	Hold public consultations on plans to revive wind power development at potential sites	• Minutes of public consultation meetings held	Land, Energy, and Environment Departments	2024/2025—Q2 onward
	Develop action plan to address identified challenges	• Action plan developed	Land, Energy, and Environment Departments	2024/2025—Q2onward
	Consult the Ministry of Energy and Petroleum (MoEP) and REREC on potential investors for a wind power plant in Kinangop	• Minutes of meetings with MOEP; • Investors identified and consulted; • Wind project(s) • MW of wind power connected to grid	Land, Energy, and Environment Departments	2024/2025—Q2onward
Leveraging GHG abatement potential of interventions	Mainstream GHG abatement estimates in all energy sector initiatives	• tCO_2 avoided/reduced; • Number of carbon projects developed • Amount of carbon finance leverage	Energy Department/ Gender Department	2024/2025—Q2 onward

Programme 10: Intervention Area—Cross-Cutting Initiatives in the CEP

Baseline: TBD

Target: Integrate gender into all CEP programmes, initiate waste-to-energy projects, foster wind energy investments, and maximise GHG abatement potential and health benefits (e.g., averted Disability-Adjusted Life Years (ADALYs) and time savings)

Outputs	Activities	Progress indicators	Responsibility	Timeline (Indicative start date)
Leveraging Clean Impact Bonds[64] from health co-benefits of clean cooking access	Estimation and aggregation of clean cooking health and time saving benefits from cooking sector interventions in the County (e.g., biogas technology, and higher tier improved cookstoves)	• Enterprises and project implementers sensitised on Clean Impact Bonds; • Averted Disability Adjusted Life Years (ADALYs) • Number of Clean Impact Bonds aggregated and traded. • Revenue generated from Clean Impact Bonds	Energy Department	2024/2025—Q2 onward

[64] International Finance Corporation. (2023). Clean Impact Bond: Mobilizing Finance for Clean Cooking. IFC. https://www.ifc.org/content/dam/ifc/doc/2023-delta/ifc-clean-impact-bond-052023.pdf

Chapter 7: IMPLEMENTATION, COORDINATION, MONITORING, AND EVALUATION

7.1 Implementation: Institutional Setting

The practical implementation of the CEP relies on strong partnerships with key stakeholders, including government and non-government organisations. To facilitate this, Nyandarua County must foster robust relationships with private sector partners, international development agencies, the national government, and various energy organisations, while enhancing the environment supporting these collaborations to achieve the CEP's objectives.

A proposed implementation framework for the CEP involves establishing a coordinating secretariat led by a Focal Point Officer (FPO) and supported by core staff. This secretariat will focus on the daily management of the CEP, ensuring consistent attention to its execution within the County. As recommended by the draft INEP framework, a legal framework will provide the necessary institutional support for the secretariat[65].

The formation of a County Energy Planning Committee (CEPC) will offer policy and strategic guidance. This committee will include high-level county officials and key representatives from national energy and environmental agencies. Chaired by the County Executive Committee Member for Energy, the CEPC will convene at least three times a year to review progress, endorse work plans and budgets, and provide strategic direction. The proposed structure of the CEP secretariat is detailed below, illustrating its integration within the broader Nyandarua County Government framework.

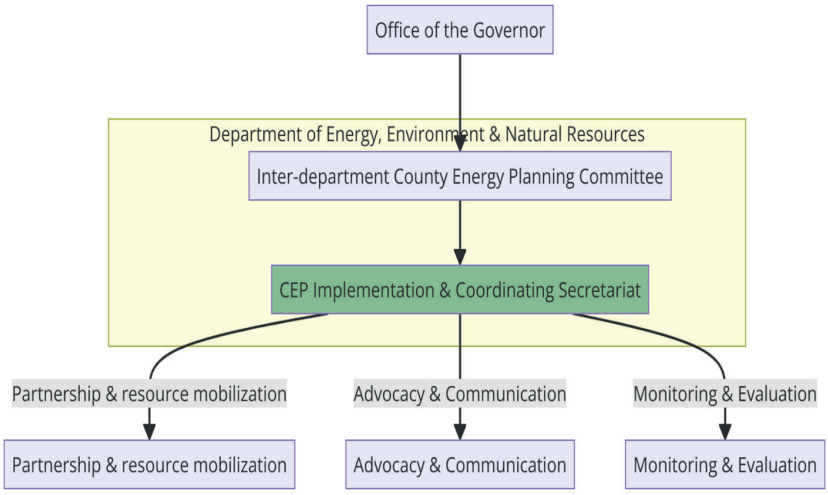


Figure 38: Implementation and Coordination Structure

[65] Ministry of Energy. (2021). Draft Energy (Integrated National Energy Plan) Regulations. Government of Kenya

7.1.1 Focal Point Office (FPO)

The functions of the FPO will include:

- Overseeing the implementation of the CEP as per the approved plans
- Identifying opportunities within the CEP and coordinating with the national government, affiliate institutions, County departments, and non-governmental entities, including the private sector, development partners, and NGOs
- Managing resource mobilisation, partnerships, and monitoring and evaluation
- Acting as a link between the CEPC and the CEP
- Three interlinked offices will support the FPO in effectively discharging its mandate: partnership and resource mobilisation, advocacy and communications, and monitoring and evaluation.

7.1.2 Partnership & Resource Mobilisation Office

The Partnership and Resource Mobilisation Office will be responsible for:

- Strengthening County partnerships with the private sector, donors, and national government departments; arranging and holding partnership meetings; delivering administrative aspects of partnership plans; reviewing and appraising partnerships; and working with partners to deliver effective processes, such as information sharing, assessment, and referral processes
- Sourcing information from partners and providing reciprocal information from the County
- Monitoring existing partnerships and preparing regular and ad-hoc reports for both internal and external circulation, ensuring continuous improvement of internal monitoring and evaluation systems for partnerships to identify and address any potential issues at an early stage
- Acting as a link between the CEP team and other departments to ensure that all departments are kept informed of CEP interventions and any departmental involvement or issues
- Networking, updating, and liaising with key in-country and international donors
- Advising programme and programme quality teams, finance, and working groups on relevant donor requirements/compliance, potential funding opportunities, changes in donor priorities, and ensuring quality grant management for all CEP-funded projects
- Identifying opportunities for meaningful collaboration within and across the County
- Securing partner buy-in and discussing parameters to ensure maximum benefit from all partnerships

7.1.3 Advocacy and Communications Office

- Due to the devolved nature of the energy sector between the national government and the County, an officer will be needed to advocate Nyandarua CEP issues to the national government, partners, and donors.
- The Advocacy Officer will lead the CEP's advocacy agenda for national government intervention, such as in rural electrification.
- Communicate the strategic objectives of the CEP to other departments, partners, and the national government.

- Maintain thorough knowledge of the CEP's needs and potential opportunities, as well as an understanding of how it impacts other sectors in the County and at the national level

7.1.4 Monitoring and Evaluation Office

The Monitoring and Evaluation (M&E) Office will:

- Develop and manage the project's monitoring and evaluation framework, including assessments and a Performance Monitoring Plan with appropriate data collection mechanisms
- Regularly update the Project Work Plan to align with project milestones and timelines
- Evaluate the current data quality, collection methods, and adequacy for impact assessment
- Establish baseline data for each project aspect and for any indicators currently lacking this information
- Systematically gather data to track progress against performance indicators
- Work with partners to align their monitoring systems and practices where feasible
- Assist in project reporting, including mid-term and final evaluations
- Determine partners' needs for technical support and provide targeted M&E training
- Oversee the M&E database and synthesise the data collected
- Extract insights and compile case studies to document the qualitative impact of the project
- Offer recommendations for enhancing project execution based on M&E insights.

7.2 Detailed Work plan

Table 37: Detailed work plan of programs and initiatives

		From Financial Year 2024/2025 to 2027/2028																			
		Yr 1				Yr 2				Yr 3				Yr 4				Yr 5			
Output	**Activities**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 5**	**Q 6**	**Q 7**	**Q 8**	**Q 9**	**Q 10**	**Q 11**	**Q 12**	**Q 13**	**Q 14**	**Q 15**	**Q 16**	**Q 17**	**Q 18**	**Q 19**	**Q 20**
Programme 1: Accelerating Household Access to Cleaner and More Efficient Energy for Cooking																					
Partnerships established with cooking energy providers and development partners	Mapping of active cooking solution providers and development partners																				
	Consultative forums on the County's clean cooking vision and opportunities																				
	MoU with partners on clean cooking solutions																				

		From Financial Year 2024/2025 to 2027/2028																			
		Yr 1				Yr 2				Yr 3				Yr 4				Yr 5			
Output	**Activities**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 5**	**Q 6**	**Q 7**	**Q 8**	**Q 9**	**Q 10**	**Q 11**	**Q 12**	**Q 13**	**Q 14**	**Q 15**	**Q 16**	**Q 17**	**Q 18**	**Q 19**	**Q 20**
Awareness raised on the benefits of improved cooking solutions	Desk survey on appropriate approaches for awareness creation, considering rural-urban dynamics and different socio-economic groups																				
	Recruit a marketing firm																				
	Roll-out of awareness creation activities																				
	Establish and mainstream an annual Clean Cooking Energy Week																				
A Clean Cooking Fund (CCF) created	Develop a clean cooking fund strategy																				
	The County government to allocate a budget for clean cooking																				
	Mobilise financial resources to strengthen the Clean Cooking Fund (CCF)																				
Dissemination of a clean cooking energy solution mix—ethanol, biogas, and pellets—accelerated	Design a consumer financing facility and a Results-Based Financing (RBF) scheme																				
	Roll-out consumer financing through merry-go-rounds, Saccos, pay-go schemes, etc.																				
	Roll-out an RBF cookstoves facility to enhance the uptake of clean cooking solutions																				
	Strengthen the role of the Clean Cooking Association of Kenya (CCAK) at the County level																				
Programme 2: Accelerating Cleaner Energy for Cooking in Learning Institutions																					
All schools without clean and efficient cooking solutions mapped	Convene the County school heads forum																				
	Map out the cooking solutions used, school population, etc.																				

		From Financial Year 2024/2025 to 2027/2028																			
		Yr 1				Yr 2				Yr 3				Yr 4				Yr 5			
Output	**Activities**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 5**	**Q 6**	**Q 7**	**Q 8**	**Q 9**	**Q 10**	**Q 11**	**Q 12**	**Q 13**	**Q 14**	**Q 15**	**Q 16**	**Q 17**	**Q 18**	**Q 19**	**Q 20**
Creation of a Clean Cooking Fund (integrated with the CCF to establish a common fund)	Adapt the Clean Cooking Fund to suit institutions within the learning cycle																				
	Develop guidelines for institutional stove providers, including aspects such as warranty																				
	Develop a register of certified institutional stove installers in the County																				
	Roll out the institutional stove programme																				
Programme 3: Access to Clean Cooking Energy in Health Facilities																					
Public health institutions without clean cooking solutions mapped	Map out all health institutions without access to clean cooking solutions																				
	Conduct an energy needs assessment																				
	Adapt the CCF to finance health institutions																				
All health institutions equipped with clean cooking solutions	Mobilise development partners for technical and financial support																				
	Roll out clean energy for cooking in health institutions																				
Programme 4: Household Energy for Lighting																					
All HH in the County near grid infrastructure are connected, with off-grid solutions provided for those in remote areas	In liaison with KPLC, map areas planned for grid extension over the next five years																				
	Activate last-mile connections																				
	Develop a database of certified solar PV products, service providers, and technicians																				
	Vet all solar products marketed in the County to ensure quality certification																				
	Promote Solar Home Systems (SHS) and solar lanterns in areas outside the designated zones for KPLC electrification, in partnership with solar PV providers																				

		From Financial Year 2024/2025 to 2027/2028																			
		Yr 1				Yr 2				Yr 3				Yr 4				Yr 5			
Output	**Activities**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 5**	**Q 6**	**Q 7**	**Q 8**	**Q 9**	**Q 10**	**Q 11**	**Q 12**	**Q 13**	**Q 14**	**Q 15**	**Q 16**	**Q 17**	**Q 18**	**Q 19**	**Q 20**
Programme 5: Energy for Lighting and Powering Appliances in Learning Institutions																					
All learning institutions without power mapped	Map out all institutions without electricity, including location and proximity to the grid																				
	Obtain KPLC's institutional electrification plans for the next five years																				
All institutions connected to power, either through grid or off-grid solutions	Design a model for off-grid electrification																				
	Mobilise financial resources to support off-grid electrification solutions																				
	Connect institutions with electricity																				
Programme 6: Energy for Lighting and Powering Appliances in Health Facilities																					
Energy needs assessment conducted	Identify the main causes of power supply interruptions																				
	Develop tailored solutions for each facility																				
Funds raised to support the establishment of a power backup solution	The County government to allocate a budget for enhancing power supply in health facilities																				
	Mobilise financial resources to support power backup solutions for health facilities, matching the County allocation																				
Uninterrupted power supply ensured	Install power backup solutions in health facilities																				
Programme 7: Productive Use of Energy (PUE)																					
Milk coolers provided with adequate power in all milk-producing sub-counties	Conduct an energy needs assessment for milk coolers in the County																				
	Install power and power backup systems for milk coolers																				

		From Financial Year 2024/2025 to 2027/2028																			
		Yr 1				Yr 2				Yr 3				Yr 4				Yr 5			
Output	**Activities**	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15	Q 16	Q 17	Q 18	Q 19	Q 20
Horticulture cold chains established in all relevant fish landing sites and markets	Conduct an energy needs assessment for horticulture cold rooms in the County																				
	Install cold chain storage rooms in key towns and lease them to aggregators at attractive rates to ensure they remain in use																				
	Set up cold storage facilities in the sub-counties																				
Programme 8: Enhancing Energy Efficiency in the County																					
50% of all streetlights retrofitted with solar power	Map out streetlights that need solar retrofitting and identify areas in need of new streetlights																				
	Install solar street lighting																				
All grid-connected streetlights retrofitted with LED lights	Replace conventional streetlights with LED lights																				
A streetlight rapid response desk established	Establish a streetlight rapid response desk to handle streetlight issues																				
	Automate lighting in public places																				
All public buildings adopt energy efficiency measures	Sensitise and educate government staff on energy efficiency practices																				
All new public buildings adhere to green building guidelines	Gazette the green-building guidelines																				
	Train physical planning staff on best practices in green building																				
Programme 9: Policy, Regulations, and Institutions																					
County biomass policy developed	Hold consultative forums																				
	Establish thematic working groups on charcoal, biogas, pellets, and briquettes																				
	Develop a County biomass policy																				

		From Financial Year 2024/2025 to 2027/2028																			
		Yr 1				Yr 2				Yr 3				Yr 4				Yr 5			
Output	**Activities**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 5**	**Q 6**	**Q 7**	**Q 8**	**Q 9**	**Q 10**	**Q 11**	**Q 12**	**Q 13**	**Q 14**	**Q 15**	**Q 16**	**Q 17**	**Q 18**	**Q 19**	**Q 20**
Three energy centres and Innovation Hubs established	Identify suitable sites for energy centres																				
	Develop operational plans for the energy centres																				
	Gazette the energy centres																				
	Identify and engage strategic partners to co-run the centres																				
	Equip the energy centres																				
County Energy Planning Committee (CEPC) established	Hold consultation forums for members as per energy regulations																				
	Gazette the CEPC																				
CEP Secretariat established	Publish the functions of the CEP																				
	Gazette the CEP																				
	Recruit the CEP secretariat core team																				
Programme 10: Cross-Cutting Initiatives																					
Gender considerations integrated into CEP implementation	Undertake a gender needs assessment																				
	Customise the gender policy in energy—Kenya																				
	Promote gender integration in the CEP through training and the involvement of women in implementation																				
	Leverage GHG abatement potential of interventions																				
	Leverage Clean Impact Bonds[66] from health co-benefits of clean cooking access																				

[66] International Finance Corporation. (2023). Clean Impact Bond: Mobilizing Finance for Clean Cooking. IFC. https://www.ifc.org/content/dam/ifc/doc/2023-delta/ifc-clean-impact-bond-052023.pdf

7.3 Detailed budget

Table 38: Detailed budget breakdown

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
Programme 1: Accelerating cleaner and more efficient energy for cooking in households											
Partnership established with cooking energy providers and development partners	Mapping of active cooking solution providers and development partners	1	Study	200	200	200	-	-	-	-	-
	Consultative forums on the County clean cooking vision and opportunities	2	Workshops	1,500	3,000	3,000	-	-	-	-	-
Awareness raised on the benefits of improved cooking solutions	Desk survey on appropriate awareness creation approaches, considering rural-urban dynamics and different socio-economic groups	1	Consultant	5,000	5,000	5,000	-	-	-	-	-
	Recruit a marketing firm	1	Marketing firm	500	500	500					
	Awareness creation roll-out	6	Financial years	1,000	6,000	1,000	1,000	1,000	1,000	1,000	1,000
	Establish and mainstream an annual clean cooking energy week	6	Financial years	5,000	30,000	5,000	5,000	5,000	5,000	5,000	5,000
A Clean Cooking Fund (CCF) created (for households, schools, and health facilities)	Develop a clean cooking fund strategy	1	Consultant	5,000	5,000	5,000	-	-	-	-	-
	County government to allocate a budget for clean cooking	4	Financial years	50,000	200,000	50,000	50,000	50,000	50,000	-	-
	Mobilise financial resources to strengthen the CCF	2	Financial years	5,000	10,000	5,000	5,000	-	-	-	

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
Dissemination of clean cooking energy solutions accelerated—ethanol, biogas, and pellets	Design a consumer financing facility and result-based financing	1	Consultant	5,000	5,000	5,000	-	-	-	-	
	Roll out consumer financing through Merry-go-round, Saccos, pay-go, etc.	1	Financing scheme	100,000	100,000	-	25,000	25,000	25,000	25,000	
	Roll out an RBF cookstove facility to enhance the uptake of clean cooking solutions	1	Financing scheme	100,000	100,000	-	50,000	50,000	-	-	-
	Strengthen the role of the Clean Cooking Association of Kenya (CCAK) at the County level	2	Financial years	5,000	10,000	5,000	5,000	-	-	-	-
		Subtotal			**474,700**	**84,700**	**141,000**	**131,000**	**81,000**	**31,000**	**6,000**
Programme 2: Accelerating cleaner and more efficient energy for cooking in learning institutions											
All schools without clean and efficient cooking solutions mapped	Convene the County school heads forum	6	Annual forums	1,000	6,000	1,000	1,000	1,000	1,000	1,000	
	Map out the cooking solutions used, school population, etc.	1	Study	5,000	5,000	5,000	-	-	-	-	
Creation of Clean Cooking Fund (integrated with the CCF to establish a common fund)	Adapt the clean cooking fund to fit the institutions' learning cycle	1	Study	1	1	500	-	-	-	-	
	Develop guidelines for institutional stove providers—e.g., warranty	1	Study	500	500	500	-	-	-	-	
	Develop a register of certified institutional stove installers in the County	1	Study	300	300	300	-	-	-	-	
	Roll out the institutional stove programme	6	Number of sub-counties	5,000	30,000	0	5,000	5,000	5,000	5,000	5,000
		Subtotal			**41,801**	**7,300**	**6,000**	**6,000**	**6,000**	**6,000**	**5,000**
Programme 3: Access to clean energy for cooking in health facilities											
Public health institutions without clean cooking solutions mapped	Map all health institutions without access to clean cooking solutions	1	Study	500	500	500	-	-	-	-	
	Undertake an energy needs assessment	1	Study	2,000	2000	2,000	-	-	-	-	
	Adapt the CCF to finance health institutions	1	Study	250	250	250		-	-	-	

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
All health institutions fitted with clean cooking solutions	Mobilise development partners for technical and financial support	6	Annual cycle	300	1800	300	300	300	300	300	300
	Clean energy for cooking roll-out	6	Number of sub-counties	1,000	6000	1,000	1,000	1,000	1,000	1,000	1,000
		Subtotal			**10,550**	**4,050**	**1,300**	**1,300**	**1,300**	**1,300**	**1,300**
Programme 4: Household energy for lighting											
All households within proximity to grid infrastructure connected to the grid	Map areas that are planned for grid extension in the next five years, in liaison with KPLC	1	Study	500	500	500	-	-	-	-	
	Last-mile connection activated	72,000	# of households	10	720000	72,000	72,000	72,000	72,000	72,000	72,000
	Develop and manage a database of certified solar PV products, service providers in the County, and solar technicians	6	Financial years	2,000	12000	2,000	2,000	2,000	2,000	2,000	2,000
	Promote Solar Home Systems (SHS) and solar lanterns in areas outside zones marked for electrification by KPLC in partnership with solar PV providers	6	Financial years	1,000	6000	1,000	1,000	1,000	1,000	1,000	1,000
		Subtotal			**738,500**	**75,500**	**75,000**	**75,000**	**75,000**	**75,000**	**75,000**
Programme 5: Energy for lighting and powering appliances in learning institutions											
All institutions of learning without power mapped	Identify all institutions without power: location and proximity to the grid	1	Study	3,000	3000	3,000	-	-	-	-	
	KPLC to share its institutional electrification plans for the next five years	1	Frequency	200	200	200	-	-	-	-	
All institutions connected to power—either through grid power or off-grid solutions	Design a model for off-grid electrification	1	Study	3,000	3000	0	3,000	-	-	-	
	Mobilise financial resources to boost off-grid electrification solutions	1	Number of rounds	6,000	6000	1,000	1,000	1,000	1,000	1,000	1,000
	Connect institutions to electricity	74	Number of institutions	50	3700	740	740	740	740	740	
		Subtotal			**15,900**	**4,940**	**4,740**	**1,740**	**1,740**	**1,740**	**1,000**

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
Programme 6: Energy for lighting and powering appliances in health facilities											
Energy needs assessment undertaken	Identify the main challenges of power supply interruption	1	Study	2,000	2000	2,000	-	-	-	-	-
	Develop a tailor-made solution for each facility	1	Study	4,000	4000	0	4,000	-	-	-	-
Funds raised to support the installation of backup solutions	County government to allocate a budget to enhance power in health facilities	6	Financial years	5,000	30000	0	6,000	6,000	6,000	6,000	6,000
	Mobilise financial resources to establish power backup solutions for health facilities (to match County allocation)	3	Number of rounds	1,000	3000	1,000	1,000	1,000	0	0	0
All health facilities electrified—through grid power or off-grid solutions, ensuring uninterrupted power supply	Mobilise financial resources to enhance off-grid electrification solutions	17	Number of unconnected health facilities	50	850	170	170	170	170	170	
Uninterrupted power supply	Connect institutions to electricity	5	Sub counties	5,000	25000	0	5,000	5,000	5,000	5,000	5,000
		Subtotal			**64,850**	**3,170**	**16,170**	**12,170**	**11,170**	**11,170**	**11,000**
Programme 7: Productive use of energy											
Milk coolers provided with adequate power in all milk-producing sub-counties	Undertake an energy needs assessment for milk coolers in the County	1	Study	5,000	5000	5,000	-	-	-	-	
	Install power and power backup systems for milk coolers	33	Number of installations in 5 sub-counties	1,000	33000	0	1,000	1,000	1,000	1,000	
Egg incubators hybridised with solar and grid power for continuous operation	Undertake an energy needs assessment for incubators in the County	1	Study	2,000	2000	2,000	0	0	0	0	
	Set up demonstration incubators powered by off-grid solar solutions	5	Number of sub-counties	400	2000	1,000	1,000	0	0	0	

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
Cold storage facilities for potatoes set up in sub-counties producing commercial horticultural crops	Conduct an energy needs assessment for the potato cold chain and processing.	1	Study	6,000	6000	3,000	3,000	0	0	0	
	Identify and develop strategic partnerships with the private sector to develop the cold chain and processing (PPP)	1	Financial year	1,000	1000	-	1,000	0	0	0	
	Set up cold storage facilities in the sub-counties	3	# of facilities	30,000	90000	-	-	22,500	22,500	22,500	22,500
		Subtotal			139,000	11,000	6,000	23,500	23,500	23,500	22,500
Programme 8: Enhancing energy efficiency in the County											
50% of all streetlights retrofitted with solar power	Map the streetlights that need to be retrofitted with solar and areas that require streetlights in the County	1	Study	5,000	5000	-	5,000	-	-	-	
	Install solar street lighting	1000	Number of street lights	50	50000	-	25,000	25,000	-	-	
All grid-connected streetlights retrofitted with LED lights	Replace conventional streetlights with LED lights	500	Number of street lights	15	7500	-	3,750	3,750			
A streetlight rapid response desk established	Establish a streetlight rapid response desk to handle streetlight issues	6	Financial years	6,000	36000	6,000	6,000	6,000	6,000	6,000	6,000
	Automate lighting in public places	1	Lump sum	10,000	10000	-	-	10,000	-	-	-
All public buildings adopt energy efficiency measures	Sensitise and educate government staff on energy efficiency measures	6	Financial years	1,000	6000	1,000	1,000	1,000	1,000	1,000	1,000
All new public buildings adopt the green-building guidelines	Gazette the green-building guidelines	1	Lump sum	2,000	2000	-	-	2,000	-	-	
	Train the physical planning team on best practices in green building	3	Cycles	500	1500	-	500	500	500	-	
		Subtotal			118,000	7,000	41,250	48,250	7,500	7,000	7,000

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
Programme 9: Policy, regulations, and institutions											
County biomass policy developed	Hold consultative forums	4	Workshops	500	2000	1,000	500	500			
	Establish thematic working groups—charcoal, biogas, pellets, and briquettes	4	Meetings	500	2000		500	500	500	500	
	Develop a County biomass policy	1	Document	3,000	3000				3,000		
Three energy centres and Innovation Hubs established	Identify the site for the energy centres	1	Financial allocation	2,000	2000	1,000	1,000	-	-	-	
	Develop an operational plan for the energy centres	1	Study	3,000	3000	-	-	3,000	-	-	
	Gazette the energy centres	1	Document	5,000	5000	-	-	5,000	-	-	
	Identify and engage strategic partners to co-run the centres	2	Rounds	1,000	2000	-	1,000	1,000		-	
	Equip the energy centres	2	Financial years	20,000	40000	-	-	-	20,000	20,000	
County Energy Planning Committee (CEPC) established	Conduct consultation forums for members as per energy regulations	3	Meetings	500	1500	1,500	-	-	-	-	
	Gazette the CEPC	1	Document	300	300	300	-	-	-	-	
CEP secretariat established	Publish the functions of the CEP	1	Document	300	300	300	-	-	-	-	
	Gazette the CEP	1	Document	300	300	300	-	-	-	-	
	Recruit the CEP secretariat core team	1	Session	2,000	2000	2,000	-	-	-	-	
		Subtotal			**63,400**	**6,400**	**3,000**	**10,000**	**23,500**	**20,500**	**20,500**
Programme 10: Cross-cutting issues in the CEP											
Gender integration into CEP implementation	Undertake a gender needs assessment	1	Study	2,000	2000	2,000	-	-	-	-	
	Customise the Kenya gender policy in energy	1	Study	1,000	1000	1,000	-	-	-	-	
	Engender the CEP through training and integration of women in the implementation process	4	Financial years	1500	6000		1,500	1,500	1,500	1,500	

						From Financial year 2024/2025 to 2029/2030					
Output	**Activities**	**# of units**	**Unit name**	**Unit cost**	**Total**	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
				KES (000)							
Climate finance accessed	Leverage GHG abatement potential of interventions	3	Training	2,000	6000	2000	2,000	2,000			
Health and time-saving benefits of clean cooking traded	Leverage Clean Impact Bonds from health co-benefits of clean cooking access	3	Training	2,000	6000	2000	2,000	2,000			
		Subtotal			**21,000**	**7,000**	**5,500**	**5,500**	**1,500**	**1,500**	**0**
Monitoring and Evaluation (Cross-cutting across all programmes)	Undertake baseline assessments on unassessed programmes	1	Consultant	4,000	4000	4,000	-	-	-	-	
	Develop indicators	1	Consultant	1,000	1000	-	-	-	-	-	
	Progress monitoring		Internal M&E		0	-	-	-	-	-	
	Mid-term and end-term evaluations	2	Mid-term & end term	6,000	12000	-	-	6,000	-	6,000	
	Documentation of lessons learnt and dissemination	1	Lump sum	2,000	2000	-	-	1,000	-	1,000	
		Subtotal			**19,000**	**4,000**	**0**	**7,000**	**0**	**7,000**	**0**
		Grand total			**1,706,701**	**215,060**	**299,960**	**321,460**	**232,210**	**185,710**	**149,300**

7.4 CEP Secretariat Budget

Table 39: Secretariat Budget

#	Descriptions	Number of units	Unit name	Unit cost KES (000)	Total KES (000)
1	Focal point officer	60	Months	500	30,000
2	Partnership and fundraising officer	60	Months	400	24,000
3	Advocacy and communication officer	60	Months	400	24,000
4	Monitoring and evaluation officer	60	Months	400	24,000
5	Administration Manager	60	Months	300	18,000
6	Office supplies	60	Months	100	6,000
7	Office equipment	5	Years	1,000	5,000
	ICT	1	Lump sum	5,000	5,000
	Total				**131,000**

7.5 Budget Summary

Table 40: Budget Summary

#	Program description	Budget KES (000)
PG1	Accelerating cleaner and more efficient energy for cooking	474,700
PG2	Accelerating cleaner energy for cooking in institutions	41,801
PG3	Health facilities access energy for cooking	10,550
PG4	Household energy for lighting	738,500
PG5	Energy for lighting and powering appliances in institutions of learning	15,900
PG6	Health facilities' energy for lighting and powering appliances	64,850
PG7	Productive use of energy	139,000
PG8	Enhancing energy efficiency in the County	118,000
PG9	Policy, regulations, and institutions	63,400
PG10	Cross-cutting initiatives	21,000
	Monitoring and Evaluation	19,000
	Programme Subtotals	**1,706,701**
	CEP Secretariat Totals	131,000
	Grand CEP Budget	**1,837,701**

7.6 Monitoring and Evaluation

The Monitoring and Evaluation (M&E) system for the CEP will adhere to the County Integrated Monitoring Evaluation System (CIMES) guidelines[67]. This system aims to ensure the timely availability of information on county-level projects and programmes for policy decision-making. CIMES will also enhance accountability and foster strong partnerships among county governments, the national government, the private sector, civil society, and development partners. A detailed CEP M&E framework schedule is outlined in Table 39. Areas lacking baseline data will require the CEP Secretariat to conduct baseline assessments in consultation with partners and stakeholders. The Secretariat will also develop a work plan based on the master CEP work plan and M&E framework, approved by the CEPC. The schedule includes annual work plans, budgets, daily monitoring, reporting plans, mid-term and end-term M&E plans, timelines for CEPC meetings, and other approved needs. As CEP implementation is partnership-driven and projects may start at varying times in the financial year, any project agreement signed with the CEP Secretariat will activate it in the M&E system. This activation will promote accountability and ensure alignment of initiatives towards achieving CEP goals. The core components of the CEP M&E system are outlined below.

7.6.1 Day-to-Day Monitoring

The Secretariat will be responsible for daily monitoring of implementation progress according to the annual work plan and its indicators. They will report any delays or challenges to the CEPC to ensure that timely and appropriate corrective actions are taken.

[67] The National Treasury & Council of Governors. (2019). Guidelines for the development of County Integrated Monitoring and Evaluation Systems, Government of Kenya. https://countytoolkit.devolution.go.ke/resource/guidelines-development-county-integrated-monitoring-and-evaluation-system-cimes-april-2019

7.6.2 Quarterly Monitoring

Periodic monitoring of CEP implementation will occur on two levels. First, the CEP Secretariat will present implementation progress reports at the quarterly CEPC meetings, where these reports will be an essential agenda item. The CEPC chairperson will then report on these updates. Subsequently, the CEPC will inform the Governor about the progress, emerging opportunities, resource mobilisation efforts, challenges, and solutions. This structured reporting will enable all involved parties to promptly assess and address any issues in the implementation process.

7.6.3 Annual Monitoring

The CEP Secretariat will prepare an Annual Progress Report (APR) to be submitted to the CEPC. The APR will highlight progress against targets, any policy issues, and recommendations for CEPC decisions. Separate reviews of each CEP component may also be conducted where necessary, as projects will be on a rolling basis.

7.6.4 Mid-Term Review

A Mid-Term Review (MTR) of the CEP will be conducted halfway through its implementation, at two and a half years. This review will assess how closely activities align with planned objectives, pinpoint areas needing improvement, and address any deviations from the plan. Additionally, the MTR will evaluate CEP activities based on criteria such as relevance, design, efficiency, effectiveness, and sustainability potential. It is strongly recommended that an independent external party conducts the MTR to ensure impartiality. According to the Energy Act 2019, the CEP must be updated every three years, making the MTR a critical opportunity to refine the plan based on evidence and practical insights from its execution.

7.6.5 End-Term Evaluation

An End-Term Evaluation will be conducted to assess the achievement of CEP goals, draw conclusions, capture lessons learned, and inform the next phase of the plan. Like the MTR, it will use CIMES guidelines and evaluate design, relevance, efficiency, effectiveness, impact, and sustainability. It is recommended that an independent external party conduct the evaluation. The Mid-Term Review and End-Term Evaluation will serve two purposes: assessing CEP performance and providing insights for future energy plans. The findings will be shared with the County Assembly, government institutions, and the public via the County website upon completion[68].

Table 41: CEP Monitoring and Evaluation Framework

Programmes	Outputs	Performance indicators	Baseline		Mid-term target	End-term target (cumulative)	Means of verification
			Value	Year			
Programme 1: Accelerating cleaner and more efficient energy for household cooking	Partnership established with cooking energy providers and development partners	5 strategic partnerships signed	0	2024	3	5	Signed MoUs, interviews with strategic partners

[68] The National Treasury & Council of Governors. (2019). Guidelines for the development of County Integrated Monitoring and Evaluation Systems, Government of Kenya. https://countytoolkit.devolution.go.ke/resource/guidelines-development-county-integrated-monitoring-and-evaluation-system-cimes-april-2019

Programmes	Outputs	Performance indicators	Baseline		Mid-term target	End-term target (cumulative)	Means of verification
			Value	Year			
(Continued) Programme 1: Accelerating cleaner and more efficient energy for household cooking	Awareness raised on the benefits of improved cooking solutions	5 countywide awareness campaigns conducted	0	2024	3	5	Awareness campaign reports; field interviews
	A Clean Cooking Fund (CCF) established to support households, schools, and health facilities	Functional Clean Cooking Fund established	0	2024	1	1	Establishment documents; number of cookstoves distributed through the fund
		300 million raised for the CCF	0	2024	150 million	150 million	Bank account statements
	Dissemination of clean cooking energy solutions accelerated — covering ethanol, biogas, LPG, electricity, and pellets	24% increase in households (HH) using cleaner cooking solutions	46%	2024	>10%	24%	Field survey; sales reports
Programme 2: Accelerating cleaner energy for cooking in learning institutions	Mapping completed for all schools lacking clean and efficient cooking solutions	Energy needs assessment report for cooking completed	0	2024	1	1	Needs assessment report
	Institutional cookstoves installed	27% increase in schools equipped with cleaner institutional stoves	TBD	2024	>10%	27%	Field survey; records of stove installations
Programme 3: Access to clean energy for cooking in health facilities	Mapping completed for public health institutions without clean cooking solutions	Comprehensive energy needs assessment report produced	0	2024	1	1	Report
	All health institutions equipped with clean cooking solutions	4% of health institutions fitted with clean cooking solutions	TBD	2024	>4%	4%	Field survey
Programme 4: Household energy for lighting	All HHs connected to electricity	100% of households connected to electricity	41% Aver-age	2024	>60%	100%	Field verification; connection reports
Programme 5: Energy for lighting and powering appliances in learning institutions	Mapping completed for all institutions of learning without power	Comprehensive energy needs assessment report produced	0	2024	1	1	Report

Programmes	Outputs	Performance indicators	Baseline		Mid-term target	End-term target (cumulative)	Means of verification
			Value	Year			
	All institutions connected to electricity, through either grid power or off-grid solutions	6% of additional health institutions connected to electricity	50%[69]	2024	>4%	6%	Field verification; connection reports
	Energy needs assessment completed	Comprehensive energy needs assessment report produced	0%	2024	1	1	Report
Programme 6: Energy for lighting and powering appliances in health facilities	Uninterrupted power supply established	Reduction in blackouts in health facilities (specific % measured)	TBD	2024	<60%	100%	Interviews with health facility management personnel
	Funds raised to support the establishment of a power backup solution	100 million raised to support energy initiatives	0	2024	50 million	100 million	Account statements
Programme 7: Productive use of energy	Energy needs assessment report produced for milk coolers and egg incubators	Energy needs assessment report for various sectors finalised	0	2024	2	2	Energy needs assessment report
	Adequate power supplied to milk coolers in all milk-producing sub-counties	Number of milk coolers with backup power documented	TBD	2024	50%	100%	Field survey; installation reports
	Egg incubators hybridised to use both solar and grid power	Number of egg incubators hybridised with solar and grid power	TBD	2024	50%	100%	Field survey; installation reports
	Cold storage facilities established in sub-counties producing potatoes	3 cold chain facilities established in key locations	0	2024	1	3	Site verification
	Awareness raised on the benefits of walking and cycling	Percentage of the population using Non-Motorised Transport (NMT) increased	TBD	2024	>10%	>20%	Field survey
Programme 8: Enhancing energy efficiency in the County	Streetlights retrofitted with solar power	50% of all streetlights retrofitted with solar power	TBD	2024	20%	50%	Site verifications; records of retrofitting
	All grid-connected streetlights retrofitted with LED lights	100% of grid-connected streetlights retrofitted with LED lights	TBD	2024	50%	100%	Site verifications; records of retrofitting
	Streetlight rapid response desk established	Functional streetlight rapid response desk established	0	2024	1	1	Office verification

[69] Used connected and unconnected primary schools as a proxy for estimating electricity access. The Kenya National Bureau of Statistics is planning a nationwide institutional census in 2024 which will fill the data gap

Programmes	Outputs	Performance indicators	Baseline		Mid-term target	End-term target (cumulative)	Means of verification
			Value	Year			
(Continued) Program 8: Enhancing energy efficiency in the County	Energy efficiency measures adopted by all public buildings	Number of public buildings implementing energy efficiency measures recorded	TBD	2024	50%	100%	Field survey; design records
	All new public buildings designed according to green-building guidelines	Number of new public buildings compliant with green-building guidelines documented	TBD	2024	50%	100%	Field survey; design records
Programme 9: Policy, regulations, and institutions	County biomass energy policy developed	1 biomass energy policy developed and adopted	0	2024	1	1	Policy document
	Energy centres and Innovation Hubs established	3 energy centres established and operational	0	2024	1	3	Site verification
	County Energy Planning Committee (CEPC) established	Functional CEPC in place	0	2024	1	1	Gazette notice; minutes of meetings
	CEP secretariat established	Functional CEP secretariat established	0	2024	1	1	Office verification
Programme 10: Cross-cutting initiatives	Gender needs assessment conducted	Gender needs assessment report completed and published	0	2024	1	1	Report
	Gender considerations integrated into the CEP implementation		0	2024			
Climate finance accessed	GHG abatement potential leveraged for various interventions	tCO_2 avoided or reduced. Number of carbon projects developed Amount of carbon finance leveraged	0	2024			Field verification Reports from enterprises
Health and time-saving co-benefits of clean cooking traded	Clean Impact Bonds accessed from the health co-benefits of clean cooking solutions	Number of enterprises and project implementers sensitised on Clean Impact Bonds Number of Clean Impact Bonds aggregated and traded Revenue generated from Clean Impact Bonds	0	2024			Field verification Reports from enterprises

Chapter 8: ANNEXES

Annex 1: Unconnected health facilities in the County

Table 42: Unconnected health facilities in Nyandarua County

Type	Name	Owner	Latitude	Longitude
Dispensary	Bennedict XVI Dispensary	Kenya Episcopal Conference-Catholic Secretariat	-0,176	36,24414
Dispensary	Geta Forest Dispensary	Ministry of Health	-0,86052	36,56489
Dispensary	Kaimbaga Dispensary	Ministry of Health	-0,07599	36,36284
Dispensary	Kinja Dispensary	Other Public Institution	-0,61053	36,5919
Dispensary	Mikaro Dispensary	Ministry of Health	0,01853	36,37357
Dispensary	Othaya Approved Dispensary	Ministry of Health	-0,03999	36,29082
Dispensary	Sacred Heart Mission Dispensary	Kenya Episcopal Conference-Catholic Secretariat	-0,3864	36,38465
Dispensary	Shauri Dispensary	Ministry of Health	0,01416	36,49169
Dispensary	Tumaini National Youth Service Dispensary	Ministry of Health	-0,33525	36,51321
Health Centre	Baari Health Centre	Ministry of Health	-0,4713	36,50786
Health Centre	Nyeri Town Health Centre	Ministry of Health	-0,39978	36,492
Medical Clinic	Amazing Grace M C	Ministry of Health	-0,5848	36,49115
Medical Clinic	Dr Kanina B K Urology Clinic	Private Practice - Medical Specialist	-0,05701	36,53134
Medical Clinic	Faith Medical CLinic (Kieni West)	Private Practice - Nurse / Midwife	-0,54696	36,56373
Medical Clinic	Iwam Medical Clinic	Private Practice - Nurse / Midwife	-0,176	36,24414
Medical Clinic	Marina Medical Clinic	Private Practice - Nurse / Midwife	-0,47136	36,50622
Medical Clinic	Meridian Medical Centre- Nyeri Town	Private Practice - General Practitioner	-0,25627	36,37512
Medical Clinic	Modern Medical Clinic	Private Practice - Clinical Officer	-0,85503	36,5764
Medical Clinic	Muhoya Medical Clinic	Private Practice - Nurse / Midwife	-0,19249	36,50153
Medical Clinic	Muruguru Medical Clinic	Private Practice - Nurse / Midwife	-0,12227	36,53641
Medical Clinic	Nyeri Medical & Diabetic Centre	Private Practice - Clinical Officer	-0,34034	36,53556
Medical Clinic	Prime Medical Care	Private Practice - Nurse / Midwife	-0,35812	36,32205
Medical Clinic	Ruruguti Afya Clinic	Private Practice - Nurse / Midwife	-0,03864	36,29032
Medical Clinic	St Michael Medical Clinic (Nyeri South)	Private Practice - Nurse / Midwife	-0,18437	36,24555
Nursing Home	St Cecilia Nursing Home	Private Enterprise (Institution)	0,03374	36,5814

Annex 2: Education facilities outside the scope of a transformer

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
ECD/PRE-PRIMARY SCHOOL	ACK CHRIST THE KING KANYAGIA ECD	PRIVATE	36,47525917	-0,077
ECD/PRE-PRIMARY SCHOOL	ACK ST. STEPHENS ECD	PUBLIC	36,59273333	-0,518127
ECD/PRE-PRIMARY SCHOOL	AIC GITHIORO ECD	PRIVATE	36,50341	-0,46948
ECD/PRE-PRIMARY SCHOOL	AIC KIHARA ECD	PRIVATE	36,49935861	-0,067864
ECD/PRE-PRIMARY SCHOOL	AIC PRE-PRI	PUBLIC	36,51586111	-0,193902
ECD/PRE-PRIMARY SCHOOL	AIPCA BONDENI ECD	PRIVATE	36,313113	-0,060399
ECD/PRE-PRIMARY SCHOOL	AIPCA ECD	PRIVATE	36,60461417	-0,538867
ECD/PRE-PRIMARY SCHOOL	AIPCA KANGUU ECD	PRIVATE	36,4035659	-0,044732
ECD/PRE-PRIMARY SCHOOL	ANELA HAPPY ECD	PUBLIC	36,65587	-0,777051
ECD/PRE-PRIMARY SCHOOL	APOSTOLIC FAITH ECD	PUBLIC	36,45730194	-0,580047
ECD/PRE-PRIMARY SCHOOL	ARBERDARE ECD	PUBLIC	36,670445	-0,736945
ECD/PRE-PRIMARY SCHOOL	BAHATI ECD	PUBLIC	36,53100611	-0,14694
ECD/PRE-PRIMARY SCHOOL	BARAINYA ECD	PUBLIC	36,66338972	-0,779958
ECD/PRE-PRIMARY SCHOOL	BARAKA ECD	PUBLIC	36,34386	0,005782
ECD/PRE-PRIMARY SCHOOL	BETA ECD - MACINERY FEEDER	PRIVATE	36,457147	-0,402205
ECD/PRE-PRIMARY SCHOOL	BETHSAIDA ECD	PRIVATE	36,59538694	-0,673463
ECD/PRE-PRIMARY SCHOOL	BIDII ECD	PRIVATE	36,28342	-0,35397
ECD/PRE-PRIMARY SCHOOL	BIDII ECD	PRIVATE	36,49902667	-0,184388
ECD/PRE-PRIMARY SCHOOL	BLUE WATERS ACADEMY	PRIVATE	36,38303	-0,077879
ECD/PRE-PRIMARY SCHOOL	BODY OF CHRIST ECD	PRIVATE	36,60457861	-0,577547
ECD/PRE-PRIMARY SCHOOL	BRETHREN ECD	PRIVATE	36,61086694	-0,636943
ECD/PRE-PRIMARY SCHOOL	BRIDGE VIEW ECD	PRIVATE	36,55460917	-0,61844
ECD/PRE-PRIMARY SCHOOL	BRILLIANT ECD	PRIVATE	36,45091056	-0,530331
ECD/PRE-PRIMARY SCHOOL	CANAAN ECD	PRIVATE	36,61992222	-0,63553
ECD/PRE-PRIMARY SCHOOL	CHURIRI ECD	PUBLIC	36,66250444	-0,753499
ECD/PRE-PRIMARY SCHOOL	CORNER ECD	PUBLIC	36,39393	-0,46742
ECD/PRE-PRIMARY SCHOOL	DENEW JUNIOR ECD	PRIVATE	36,369827	-0,353886
ECD/PRE-PRIMARY SCHOOL	DESTINY CALVARY PRE-SCHOOL	PRIVATE	36,313113	-0,059281
ECD/PRE-PRIMARY SCHOOL	DESTINY DOWNS ECD	PRIVATE	36,282622	-0,126361
ECD/PRE-PRIMARY SCHOOL	EQUATOR NURSERY SCHOOL	PUBLIC	36,308302	-0,062553
ECD/PRE-PRIMARY SCHOOL	FOREST ONE ECD	PUBLIC	36,47986	-0,4307
ECD/PRE-PRIMARY SCHOOL	FOREST VIEW NURSERY	PRIVATE	36,225051	-0,174811
ECD/PRE-PRIMARY SCHOOL	G.G GITHOGORA ECD	PUBLIC	36,53551639	0,0083828
ECD/PRE-PRIMARY SCHOOL	GACHARAGE ECD	PUBLIC	36,55414583	-0,489292
ECD/PRE-PRIMARY SCHOOL	GATHANJI ECD	PUBLIC	36,267521	-0,235099
ECD/PRE-PRIMARY SCHOOL	GATHIMA ECD	PUBLIC	36,344931	-0,236893
ECD/PRE-PRIMARY SCHOOL	GATHIRIGA ECD	PUBLIC	36,50309	-0,4682

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
ECD/PRE-PRIMARY SCHOOL	GATITU ECD	PUBLIC	36,54425444	-0,472922
ECD/PRE-PRIMARY SCHOOL	GATONDO B ECD	PUBLIC	36,509636	-0,295035
ECD/PRE-PRIMARY SCHOOL	GATURUBARI ECD	PUBLIC	36,509636	-0,295035
ECD/PRE-PRIMARY SCHOOL	GENESIS ECD	PRIVATE	36,309173	-0,323593
ECD/PRE-PRIMARY SCHOOL	GIKANO ECD	PRIVATE	36,49338083	-0,158994
ECD/PRE-PRIMARY SCHOOL	GITAU ECD	PRIVATE	36,55935667	-0,572553
ECD/PRE-PRIMARY SCHOOL	GITHIMA ECD	PUBLIC	36,51318	-0,48207
ECD/PRE-PRIMARY SCHOOL	GITHIMA PRE PRI	PUBLIC	36,41442278	0,0616839
ECD/PRE-PRIMARY SCHOOL	GITHIORO ECD	PUBLIC	36,48485	-0,442
ECD/PRE-PRIMARY SCHOOL	GITHIORO ECD	PUBLIC	36,54572972	-0,480399
ECD/PRE-PRIMARY SCHOOL	GLORY ECD	PRIVATE	36,65457083	-0,703422
ECD/PRE-PRIMARY SCHOOL	GLORY OUTREACH ECD	PUBLIC	36,59074778	-0,491586
ECD/PRE-PRIMARY SCHOOL	GOOD SHEPHERD ECD	PRIVATE	36,427356	-0,189852
ECD/PRE-PRIMARY SCHOOL	GRANDSITE ECD	PUBLIC	36,5375275	-0,170313
ECD/PRE-PRIMARY SCHOOL	GREEN GATE NURS	PUBLIC	36,54584583	0,0133314
ECD/PRE-PRIMARY SCHOOL	GREEN HILL ECD	PRIVATE	36,45221833	-0,544132
ECD/PRE-PRIMARY SCHOOL	GREEN RANGES ACADEMY ECD	PUBLIC	36,51318	-0,48207
ECD/PRE-PRIMARY SCHOOL	HAPPY LAND ECD	PRIVATE	36,52938333	-0,158318
ECD/PRE-PRIMARY SCHOOL	HESHIMA ECD	PRIVATE	36,293462	-0,058378
ECD/PRE-PRIMARY SCHOOL	HIANYU ECD	PRIVATE	36,49846444	-0,606286
ECD/PRE-PRIMARY SCHOOL	HILL VIEW ECD	PRIVATE	36,55620861	-0,141861
ECD/PRE-PRIMARY SCHOOL	HORIZON HOPE ECD	PRIVATE	36,49993778	-0,187139
ECD/PRE-PRIMARY SCHOOL	HUHIRIO B NURSERY	PUBLIC	36,478625	-0,249641
ECD/PRE-PRIMARY SCHOOL	IGANJO SCHOOL ECD	PRIVATE	36,292188	-0,044332
ECD/PRE-PRIMARY SCHOOL	JAKI ECD	PRIVATE	36,64314111	-0,153132
ECD/PRE-PRIMARY SCHOOL	JM GOODHOPE NURS	PRIVATE	36,59201167	-0,01017
ECD/PRE-PRIMARY SCHOOL	JOEAN VIEW PRE-PRI	PRIVATE	36,50432917	-0,133994
ECD/PRE-PRIMARY SCHOOL	JOHN PAUL II NUR SCH	PRIVATE	36,34761	0,03354
ECD/PRE-PRIMARY SCHOOL	JOY KAHIGA ECD	PRIVATE	36,41012	-0,4527
ECD/PRE-PRIMARY SCHOOL	KAG ECD	PRIVATE	36,43521778	-0,515759
ECD/PRE-PRIMARY SCHOOL	KAGEMA ECD	PUBLIC	36,283311	-0,082749
ECD/PRE-PRIMARY SCHOOL	KAGOGO ECD	PUBLIC	36,53480111	-0,486033
ECD/PRE-PRIMARY SCHOOL	KAGUNDA ECD	PUBLIC	36,2746152	-0,266885
ECD/PRE-PRIMARY SCHOOL	KAHIGA NUR	PUBLIC	36,41012	-0,4527
ECD/PRE-PRIMARY SCHOOL	KAHINDU ECD	PUBLIC	36,48982583	-0,212437
ECD/PRE-PRIMARY SCHOOL	KAHUHO ECD	PUBLIC	36,5159825	0,0231367
ECD/PRE-PRIMARY SCHOOL	KAMETHA PRE PRI	PUBLIC	36,5155825	-0,215464

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
ECD/PRE-PRIMARY SCHOOL	KAMUKUNJI PRE-SCHOOL	PUBLIC	36,298274	-0,056353
ECD/PRE-PRIMARY SCHOOL	KANDUMA ECD	PUBLIC	36,54675583	-0,395808
ECD/PRE-PRIMARY SCHOOL	KANGUU ECD	PUBLIC	36,4041233	-0,046901
ECD/PRE-PRIMARY SCHOOL	KANGUYO ECD	PUBLIC	36,56222972	-0,504492
ECD/PRE-PRIMARY SCHOOL	KANJOGU PRE-SCHOOL	PUBLIC	36,453383	-0,216936
ECD/PRE-PRIMARY SCHOOL	KARANDI NURSERY SCHOOL	PUBLIC	36,419655	-0,137979
ECD/PRE-PRIMARY SCHOOL	KARATI ECD	PUBLIC	36,56388167	-0,747331
ECD/PRE-PRIMARY SCHOOL	KAREWA ECD	PRIVATE	36,326853	-0,074484
ECD/PRE-PRIMARY SCHOOL	KARIMA SDA ECD	PRIVATE	36,51330167	-0,389891
ECD/PRE-PRIMARY SCHOOL	KARURI ECD	PUBLIC	36,53119139	-0,161397
ECD/PRE-PRIMARY SCHOOL	KIAMBAA PRE PRI SCH	PUBLIC	36,528461	-0,301508
ECD/PRE-PRIMARY SCHOOL	KIAMBURURU PRIMARY	PRIVATE	36,293528	-0,289071
ECD/PRE-PRIMARY SCHOOL	KIAMWERI ECD	PUBLIC	36,64484389	-0,680056
ECD/PRE-PRIMARY SCHOOL	KIENJERO RIVERSIDE VIEW ECD	PRIVATE	36,49885381	-0,583857
ECD/PRE-PRIMARY SCHOOL	KIGOGO PRE-PRI	PUBLIC	36,58557806	0,0190178
ECD/PRE-PRIMARY SCHOOL	KIGUMO NUR SCH	PUBLIC	36,30412	0,01652
ECD/PRE-PRIMARY SCHOOL	KIHARA ECD	PRIVATE	36,49811	-0,232409
ECD/PRE-PRIMARY SCHOOL	KIHARA ECD	PUBLIC	36,49935861	-0,067864
ECD/PRE-PRIMARY SCHOOL	KIHARU NURSERY SCHOOL	PRIVATE	36,382596	-0,096406
ECD/PRE-PRIMARY SCHOOL	KILIMANJARO ECD	PUBLIC	36,50740639	-0,168032
ECD/PRE-PRIMARY SCHOOL	KIMANI PRE-PRI	PUBLIC	36,49786917	-0,090935
ECD/PRE-PRIMARY SCHOOL	KIMATHI ECD	PUBLIC	36,61724722	-0,516878
ECD/PRE-PRIMARY SCHOOL	KIMURI ECD	PUBLIC	36,47434528	-0,610845
ECD/PRE-PRIMARY SCHOOL	KIMURU ECD	PUBLIC	36,44104556	-0,340437
ECD/PRE-PRIMARY SCHOOL	KIRARWA ECD	PUBLIC	36,494883	-0,284969
ECD/PRE-PRIMARY SCHOOL	KIRATHIMO ECD		36,27167	-0,3095
ECD/PRE-PRIMARY SCHOOL	KIRATHIMO JUNIOR NURSERY	PUBLIC	36,48675806	0,0999467
ECD/PRE-PRIMARY SCHOOL	KIRIKO ECD	PUBLIC	36,42554194	0,0336989
ECD/PRE-PRIMARY SCHOOL	KIRIKO NURSERY SCHOOL	PUBLIC	36,282315	-0,127809
ECD/PRE-PRIMARY SCHOOL	KIRIMA ECD	PUBLIC	36,6316	-0,531596
ECD/PRE-PRIMARY SCHOOL	KIRIMA MSASARA ECD	PUBLIC	36,216225	-0,196063
ECD/PRE-PRIMARY SCHOOL	KIRIMAINI NURSERY	PUBLIC	36,312794	-0,291957
ECD/PRE-PRIMARY SCHOOL	KIRIMANGAI NURSERY	PUBLIC	36,336724	-0,143491
ECD/PRE-PRIMARY SCHOOL	KIRIMARA ECD	PUBLIC	36,57355417	-0,025782
ECD/PRE-PRIMARY SCHOOL	LEANN ECD	PRIVATE	36,295919	-0,078535
ECD/PRE-PRIMARY SCHOOL	LINE MOJA ECD	PRIVATE	36,61908917	-0,611468
ECD/PRE-PRIMARY SCHOOL	LITTLE FRIENDS ECD	PRIVATE	36,6272825	-0,813395
ECD/PRE-PRIMARY SCHOOL	LIVING GOSPEL ECD	PRIVATE	36,6186575	-0,544669

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
ECD/PRE-PRIMARY SCHOOL	MADARAKA ECD	PRIVATE	36,343665	-0,093213
ECD/PRE-PRIMARY SCHOOL	MAIRO IKUMI PRE-PRI	PUBLIC	36,44545111	-0,060175
ECD/PRE-PRIMARY SCHOOL	MAKEREKA ECD	PUBLIC	36,43857583	-0,103915
ECD/PRE-PRIMARY SCHOOL	MALEWA B ECD	PUBLIC	36,495564	-0,238564
ECD/PRE-PRIMARY SCHOOL	MANUNGA ECD	PUBLIC	36,49359583	-0,380032
ECD/PRE-PRIMARY SCHOOL	MARPHIL ECD	PRIVATE	36,278619	-0,012305
ECD/PRE-PRIMARY SCHOOL	MARY MOTHER OF WISDOM ECD	PRIVATE	36,260891	-0,046113
ECD/PRE-PRIMARY SCHOOL	MAYOR LEARNING CENTRE ECD	PRIVATE	36,60664694	-0,627018
ECD/PRE-PRIMARY SCHOOL	MBOMBO ECD-KAHIGA FEEDER	PUBLIC	36,411215	-0,452189
ECD/PRE-PRIMARY SCHOOL	MBORA ECD	PUBLIC	36,246166	-0,205469
ECD/PRE-PRIMARY SCHOOL	MICHARAGE ECD	PUBLIC	36,247672	-0,256521
ECD/PRE-PRIMARY SCHOOL	MICHORUI ECD	PUBLIC	36,58126417	-0,5496
ECD/PRE-PRIMARY SCHOOL	MIKEU PRE-SCHOOL	PUBLIC	36,243981	-0,23344
ECD/PRE-PRIMARY SCHOOL	MLAKI VISIONS NURSERY	PRIVATE	36,252764	-0,233506
ECD/PRE-PRIMARY SCHOOL	MTWINI PRE-SCHOOL		36,27951	-0,32486
ECD/PRE-PRIMARY SCHOOL	MUKAMBURA ECD	PUBLIC	36,47249556	-0,054379
ECD/PRE-PRIMARY SCHOOL	MUKURO ECD	PUBLIC	36,417928	-0,327811
ECD/PRE-PRIMARY SCHOOL	MUNANDA ECD	PUBLIC	36,42893389	-0,050446
ECD/PRE-PRIMARY SCHOOL	MUNANDA PRE-PRI	PUBLIC	36,51852861	-0,020074
ECD/PRE-PRIMARY SCHOOL	MUNANDA PRE-SCHOOL	PUBLIC	36,259454	-0,071892
ECD/PRE-PRIMARY SCHOOL	MUNUNGA ECD	PUBLIC	36,46333389	-0,130939
ECD/PRE-PRIMARY SCHOOL	MUNYAKA ECD	PUBLIC	36,56730972	-0,510228
ECD/PRE-PRIMARY SCHOOL	MUTARA PRE-PRI	PUBLIC	36,60727056	-0,005958
ECD/PRE-PRIMARY SCHOOL	MUTERO ECD	PRIVATE	36,285959	-0,091498
ECD/PRE-PRIMARY SCHOOL	MUTHAGIRA PRE SCH	PUBLIC	36,531466	-0,329384
ECD/PRE-PRIMARY SCHOOL	MUTHOMI PRE PRI	PUBLIC	36,47475333	0,0707308
ECD/PRE-PRIMARY SCHOOL	MUTI-UMWE ECD	PUBLIC	36,45281778	-0,054726
ECD/PRE-PRIMARY SCHOOL	MWALI ECD	PRIVATE	36,27565	-0,35404
ECD/PRE-PRIMARY SCHOOL	MWAWO ECD	PRIVATE	36,270062	-0,259488
ECD/PRE-PRIMARY SCHOOL	MWIHOTI PRE-PRI	PUBLIC	36,51593889	-0,134782
ECD/PRE-PRIMARY SCHOOL	MWIRERI ECD	PUBLIC	36,395278	-0,277484
ECD/PRE-PRIMARY SCHOOL	MWITURIA ECD	PUBLIC	36,52768861	-0,189723
ECD/PRE-PRIMARY SCHOOL	NAIROBI KAHEMBE ECD	PUBLIC	36,479075	0,0238428
ECD/PRE-PRIMARY SCHOOL	NDEMI ECD	PUBLIC	36,417928	-0,327811
ECD/PRE-PRIMARY SCHOOL	NDIWA ACADEMY ECD	PRIVATE	36,319529	-0,035186
ECD/PRE-PRIMARY SCHOOL	NEHEMA ECD	PRIVATE	36,331811	-0,065517
ECD/PRE-PRIMARY SCHOOL	NENEVA ECD	PUBLIC	36,54683583	-0,621538
ECD/PRE-PRIMARY SCHOOL	NGATHO NURSERY	PRIVATE	36,287119	-0,068655

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
ECD/PRE-PRIMARY SCHOOL	NGURUMO ECD	PUBLIC	36,43152389	-0,067927
ECD/PRE-PRIMARY SCHOOL	NYAKIO ECD	PUBLIC	36,402169	-0,23805
ECD/PRE-PRIMARY SCHOOL	PBK FARM NURSERY	PRIVATE	36,287444	-0,105099
ECD/PRE-PRIMARY SCHOOL	PCEA KANYAGIA PRE-PRI	PRIVATE	36,47285444	-0,077283
ECD/PRE-PRIMARY SCHOOL	PCEA NYAIROKO NURSERY	PRIVATE	36,293479	-0,160296
ECD/PRE-PRIMARY SCHOOL	PCEA RAITHA ECD	PRIVATE	36,56581556	-0,578265
ECD/PRE-PRIMARY SCHOOL	PESI PRE-PRI	PUBLIC	36,53137083	-0,114389
ECD/PRE-PRIMARY SCHOOL	PIVOT SCHOOL ECD	PRIVATE	36,306586	-0,022194
ECD/PRE-PRIMARY SCHOOL	PURPLE HEARTS ECD	PRIVATE	36,48838917	-0,597303
ECD/PRE-PRIMARY SCHOOL	RE-EBENEZER ECD	PRIVATE	36,287421	-0,083202
ECD/PRE-PRIMARY SCHOOL	RIVERSIDE ECD	PUBLIC	36,407242	-0,271569
ECD/PRE-PRIMARY SCHOOL	RUTUMO ECD	PUBLIC	36,43193	-0,37145
ECD/PRE-PRIMARY SCHOOL	SABA ECD	PUBLIC	36,302449	-0,281089
ECD/PRE-PRIMARY SCHOOL	SACRED HEART ECD	PRIVATE	36,53750333	-0,666587
ECD/PRE-PRIMARY SCHOOL	SATELITE ECD		36,358019	-0,237584
ECD/PRE-PRIMARY SCHOOL	SHALOM ECD	PRIVATE	36,61595972	-0,64902
ECD/PRE-PRIMARY SCHOOL	SIKU NJEMA NURSERY	PRIVATE	36,287096	-0,000772
ECD/PRE-PRIMARY SCHOOL	SILIBWET NURSERY	PUBLIC	36,263995	-0,079914
ECD/PRE-PRIMARY SCHOOL	SIMBA A ECD	PUBLIC	36,363355	-0,372671
ECD/PRE-PRIMARY SCHOOL	SINDA ECD	PUBLIC	36,49488778	-0,130405
ECD/PRE-PRIMARY SCHOOL	ST MARY'S ECD	PRIVATE	36,49145833	0,1060372
ECD/PRE-PRIMARY SCHOOL	ST. EKIRA PRE-PRI	PRIVATE	36,50718611	-0,178406
ECD/PRE-PRIMARY SCHOOL	ST. GEORGES ECD	PRIVATE	36,50341	-0,46948
ECD/PRE-PRIMARY SCHOOL	ST. JAMES ECD	PRIVATE	36,5244975	-0,56053
ECD/PRE-PRIMARY SCHOOL	ST. JOSEPH ECD	PRIVATE	36,55938667	-0,637133
ECD/PRE-PRIMARY SCHOOL	ST. LILIAN JOR PRE-PRI	PRIVATE	36,4897025	0,0032364
ECD/PRE-PRIMARY SCHOOL	ST. LUKE'S ECD	PUBLIC	36,51318	-0,48207
ECD/PRE-PRIMARY SCHOOL	ST. MARY ECD	PRIVATE	36,52758222	-0,528346
ECD/PRE-PRIMARY SCHOOL	ST.ANTHONY ECD	PRIVATE	36,309706	-0,036328
ECD/PRE-PRIMARY SCHOOL	ST.LUCY NURSERY SCHOOL	PRIVATE	36,305819	-0,094626
ECD/PRE-PRIMARY SCHOOL	ST.PETERS ECD	PRIVATE	36,375689	-0,373973
ECD/PRE-PRIMARY SCHOOL	STAR LIGHT ECD	PRIVATE	36,61535806	-0,524133
ECD/PRE-PRIMARY SCHOOL	SUGUROI PRE-PRI	PUBLIC	36,62754417	0,0004489
ECD/PRE-PRIMARY SCHOOL	SUPERSHINE JUNIOR SCH	PRIVATE	36,3650897	-0,112926
ECD/PRE-PRIMARY SCHOOL	TUMAINI ECD	PRIVATE	36,27162	-0,011504
ECD/PRE-PRIMARY SCHOOL	UMOJA ECD	PUBLIC	36,41012	-0,4527
ECD/PRE-PRIMARY SCHOOL	UMOJA ECD	PUBLIC	36,48122694	-0,545037
ECD/PRE-PRIMARY SCHOOL	VICTORS ECD	PRIVATE	36,52486306	-0,147977

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
ECD/PRE-PRIMARY SCHOOL	VICTORY ECD	PRIVATE	36,663575	-0,718912
ECD/PRE-PRIMARY SCHOOL	VISION ECD	PUBLIC	36,65849472	-0,152583
ECD/PRE-PRIMARY SCHOOL	WAIYEGO ECD	PUBLIC	36,59437444	-0,420499
ECD/PRE-PRIMARY SCHOOL	WANJAMBO UPENDO NURS	PRIVATE	36,50702722	0,0380647
ECD/PRE-PRIMARY SCHOOL	WISDOM ECD	PRIVATE	36,53030694	-0,177338
NON FORMAL SCHOOL/ NON FORMAL EDUCATION CENTRE	MAYOR LEARNING CENTRE	PRIVATE	36,60664694	-0,627018
PRIMARY SCHOOL	BLUE WATERS ACADEMY	PRIVATE	36,38303	-0,077879
PRIMARY SCHOOL	BRIDGE VIEW PRI	PRIVATE	36,55460917	-0,61844
PRIMARY SCHOOL	CHURIRI PRI	PUBLIC	36,66250444	-0,753499
PRIMARY SCHOOL	DENEW JUNIOR PRIMARY	PRIVATE	36,369827	-0,353886
PRIMARY SCHOOL	DESTINY DOWNS ACADEMY PRIMARY	PRIVATE	36,282622	-0,126361
PRIMARY SCHOOL	GACHARAGE PRI	PUBLIC	36,55414583	-0,489292
PRIMARY SCHOOL	GENESIS PRIMARY	PRIVATE	36,309173	-0,323593
PRIMARY SCHOOL	GITHIORO PRI SCH	PUBLIC	36,48485	-0,442
PRIMARY SCHOOL	HORIZON HOPE PRI	PRIVATE	36,49993778	-0,187139
PRIMARY SCHOOL	IGANJO PRIMARY SCHOOL	PRIVATE	36,292188	-0,044332
PRIMARY SCHOOL	JACTER KINAGOP PRI	PRIVATE	36,5657025	-0,504012
PRIMARY SCHOOL	JAKI PRI	PRIVATE	36,64314111	-0,153132
PRIMARY SCHOOL	JOHN PAUL II PRI SCH	PRIVATE	36,34761	0,03354
PRIMARY SCHOOL	JURA PRI	PUBLIC	36,44155583	-0,46441
PRIMARY SCHOOL	KAHIGA PRI SCH	PUBLIC	36,41012	-0,4527
PRIMARY SCHOOL	KAHINDU PRI	PUBLIC	36,48982583	-0,212437
PRIMARY SCHOOL	KAMBATA PRI	PUBLIC	36,48122694	-0,545037
PRIMARY SCHOOL	KAMETHA PRI	PUBLIC	36,5155825	-0,215464
PRIMARY SCHOOL	KAMUKUNJI PRI SCH	PUBLIC	36,298274	-0,056353
PRIMARY SCHOOL	KAREWA ACADEMY PRIMARY SCHOOL	PRIVATE	36,326853	-0,074484
PRIMARY SCHOOL	KARIMAINI PRIMARY	PUBLIC	36,312794	-0,291957
PRIMARY SCHOOL	KIENJERO RIVERSIDE VIEW PRI	PRIVATE	36,49885389	-0,583857
PRIMARY SCHOOL	KIGUMO PRI SCH	PUBLIC	36,30412	0,01652
PRIMARY SCHOOL	KIMURU PRI	PUBLIC	36,44104556	-0,340437
PRIMARY SCHOOL	KIRATHIMO JUNIOR	PRIVATE	36,48675806	0,0999467
PRIMARY SCHOOL	KIRATHIMO PRIMARY		36,27167	-0,3095
PRIMARY SCHOOL	KIRIA PRI	PUBLIC	36,62161444	-0,517581
PRIMARY SCHOOL	KIRIMANGAI PRIMARY	PUBLIC	36,336724	-0,143491
PRIMARY SCHOOL	MADARAKA PRI	PUBLIC	36,343665	-0,093213
PRIMARY SCHOOL	MAKEREKA PRI	PUBLIC	36,43857583	-0,103915
PRIMARY SCHOOL	MANUNGA PRI SCH	PUBLIC	36,49359583	-0,380032

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
PRIMARY SCHOOL	MARPHIL JUNIOR ACADEMY	PRIVATE	36,278619	-0,012305
PRIMARY SCHOOL	MARY MOTHER OF WISDOM PRIMARY	PRIVATE	36,260891	-0,046113
PRIMARY SCHOOL	MATHAKWA PRIMARY	PUBLIC	36,267521	-0,235099
PRIMARY SCHOOL	MBORA PRIMARY	PUBLIC	36,246166	-0,205469
PRIMARY SCHOOL	MITI-ITANO ROMBA	PUBLIC	36,475441	-0,278661
PRIMARY SCHOOL	MLAKI VISIONS PRIMARY	PRIVATE	36,252764	-0,233506
PRIMARY SCHOOL	MUKAMBURA PRI	PUBLIC	36,47249556	-0,054379
PRIMARY SCHOOL	MUTI-UMWE PRI	PUBLIC	36,45281778	-0,054726
PRIMARY SCHOOL	MWALI PRIMARY	PRIVATE	36,27565	-0,35404
PRIMARY SCHOOL	MWAWO PRIMARY	PRIVATE	36,270062	-0,259488
PRIMARY SCHOOL	NDIWA PRI	PRIVATE	36,3195286	-0,035186
PRIMARY SCHOOL	NGURUMO PRI	PUBLIC	36,43118722	-0,07476
PRIMARY SCHOOL	NJOMO PRI SCH	PUBLIC	36,50341	-0,46948
PRIMARY SCHOOL	OL'MAGOGO BRILLIANT PRI	PRIVATE	36,45091056	-0,530331
PRIMARY SCHOOL	PCEA NYAIROKO PRIMARY	PRIVATE	36,293479	-0,160296
PRIMARY SCHOOL	PESI PRI	PUBLIC	36,53137083	-0,114389
PRIMARY SCHOOL	PIVOT PREPARATORY SCH	PRIVATE	36,306586	-0,022194
PRIMARY SCHOOL	PURPLE HEARTS PRI	PRIVATE	36,48838917	-0,597303
PRIMARY SCHOOL	RE-EBENEZER PRIMARY	PRIVATE	36,287421	-0,083202
PRIMARY SCHOOL	RUTUMO PRI	PUBLIC	36,43193	-0,37145
PRIMARY SCHOOL	SILIBWET PRI SCH	PUBLIC	36,263995	-0,079914
PRIMARY SCHOOL	ST PETER'S PRI SCH	PUBLIC	36,51318	-0,48207
PRIMARY SCHOOL	ST. EKIRA PRI	PRIVATE	36,50718611	-0,178406
PRIMARY SCHOOL	SUGUROI PRI	PUBLIC	36,62754417	0,0004489
PRIMARY SCHOOL	SUPERSHINE JUNIOR SCH	PRIVATE	36,3650897	-0,112926
PRIMARY SCHOOL	VICTORS PRI	PRIVATE	36,52486306	-0,147977
PRIMARY SCHOOL	VICTORY PRI	PRIVATE	36,663575	-0,718912
PRIMARY SCHOOL	WANJAMBO UPENDO PRI	PRIVATE	36,50702722	0,0380647
SECONDARY SCHOOL	ARBERDARE TECHNICAL SEC	PRIVATE	36,670445	-0,736945
SECONDARY SCHOOL	DIMA COMPLEX SEC	PRIVATE	36,57140917	-0,599952
SECONDARY SCHOOL	GATESTED SEC SCH	PRIVATE	36,54359917	-0,013321
SECONDARY SCHOOL	IGANJO SECONDARY SCHOOL	PRIVATE	36,292187	-0,044332
SECONDARY SCHOOL	KANYIRI SECONDARY	PUBLIC	36,27876	-0,35054
SECONDARY SCHOOL	KIMURI SEC	PUBLIC	36,47434528	-0,610845
SECONDARY SCHOOL	MAWINGO SEC SCH	PUBLIC	36,50309	-0,4682
SECONDARY SCHOOL	MUNYAKA SEC	PUBLIC	36,6183475	-0,682855
SECONDARY SCHOOL	MUNYEKI SECONDARY SCHOOL	PUBLIC	36,34980833	-0,285474
SECONDARY SCHOOL	NYAIROKO HIGH SC.	PRIVATE	36,346592	-0,32461

LEVEL	NAME	STATUS	LONGITUDE	LATITUDE
SECONDARY SCHOOL	PLAIN HILLS GIRLS SEC	PRIVATE	36,49782	-0,586406
SECONDARY SCHOOL	ST. SHARON SEC	PRIVATE	36,55478222	-0,542197
SECONDARY SCHOOL	UHURU SECONDARY	PUBLIC	36,309787	-0,138914
YOUTH POLYTECHNIC	MICHARAGE YOUTH POLYTECHNIQUE	PUBLIC	36,243981	-0,23344
YOUTH POLYTECHNIC	NEWLIGHT NURSERY	PRIVATE	36,398278	-0,134453

Annex 3: Barriers To Productive Use of Energy

#	Challenge	Description	Solution
Agro-Processing			
1	Ever-increasing fuel costs are unfavourable for stable agro-processing	The high cost of fuel used for transport and fuelling machinery makes the cost of processing agricultural produce high. The high prices imposed on the final product (to avoid making losses) contribute to low demand for the commodity	Reduce taxes and levies imposed on petroleum products: Tax reduction or exemption on petroleum products will generally lower the cost of transportation and processing. This will eventually decrease the cost of the final commodity, enabling it to be sold at affordable prices.
2	A low level of agro-processing activities is due to a lack of efficient and affordable sources of energy	Processing firms that rely on electricity experience frequent blackouts, which compels most farmers and traders to sell their produce while still raw. Additionally, farmers perceive that it would take much longer to recoup their investment due to the high cost of being connected to the grid. As a result, they opt to process and sell their produce without using electricity	There is a need to enhance the uptake and use of renewable energy sources such as solar and biogas in processing: The government and other stakeholders in the energy sector should sensitise and facilitate the adoption of clean renewable energy to reduce over-reliance on electricity. A good example is the uptake of modern generators and monocrystalline solar panels for electricity generation. There is also a need to train community members on renewable energy technology, such as solar, by the government. The government should strategise on how to enhance the involvement of stakeholders and investors in clean energy within the county.
3	There is a lack of reliable and efficient energy for mechanisation to increase production	Frequent blackouts, the high cost of being connected to the grid, and dull weather in most parts of the county make farmers and traders hesitant or unable to power their processing activities. The current level of mechanisation is not efficient enough to fully exploit the potential of these activities	A plan should be established to ensure a backup source of energy: Measures should be put in place to guarantee that there is alternative energy available for mechanisation during blackouts, such as generators and solar panels.
4	There is a lack of or low adoption rate of renewable energy and agro-processing technology	Farmers and traders are not informed about the clean energy and technologies that can be used to improve their productivity. The high cost of agro-processing technologies and energy, such as cooling plants for potatoes, cooling rooms, or milk cooling stations, acts as a setback for the full adoption of clean energy and modern technology in processing	There is a need to enhance the uptake and use of renewable energy like solar and biogas in processing: The government and other stakeholders in the energy sector should sensitise and facilitate the adoption of clean renewable energy to reduce over-reliance on electricity. A good example is the uptake of modern generators and monocrystalline solar panels for electricity generation. Additionally, there is a need to train community members on renewable energy technology, such as solar, by the government.
5	The three proposed priority solutions are ranked as follows: 1. Creation of a conducive environment for investors. 2. Sensitisation and awareness campaign on agro-processing technology by the government. 3. Reduction of taxation on agro-processing equipment.		
	Livestock		
1	Lack of expertise to sensitise and train livestock keepers on energy use and the mechanisation of livestock production	The county does not have enough experts in the energy sector who can sensitise and train livestock keepers on clean energy and efficient mechanisation in livestock production	Availing machinery and inputs for energy production: The government and cooperatives should assist livestock keepers in accessing machines and other inputs that require clean energy to operate. They should also provide training on how to use this equipment. The end result will be increased productivity.

#	Challenge	Description	Solution
2	High livestock mortality due to a lack of reliable energy for warming	Most livestock keepers lack clean and reliable energy to warm the young animals they rear. The cold and dull weather in the county causes the majority of young animals to die	Replacing other sources of energy with renewable sources: Energy sources that are costly and not readily available should be substituted with renewable options, such as biogas for cooking and solar panels for lighting instead of relying solely on electricity, among others.
3	High costs of transport, storage, and harvesting due to expensive fuelling result in low profit margins	The high transportation and processing costs are linked to the prices of fuel used to power machinery. The end result is high pricing on the final product, which causes demand to fluctuate. Consequently, the profit experienced is not encouraging	Regulating the cost of available sources: The government should oversee and regulate the prices charged for every unit of energy sold to avoid exploiting herders while encouraging them to purchase commodities. This can also be achieved by ensuring that the market for certain clean energy products is not monopolised.
4	High taxes and duties imposed on electricity units consumed	The available power source is expensive, leading to high costs of livestock production. On the other hand, herders opt not to use modern technology in production. The technology and machinery that require electricity consume energy amounts that result in high bills due to tariffs on units consumed	Introduction of simple alternatives in terms of energy, e.g. jikos, solar energy, and improved, affordable electricity: The county government, cooperatives, and financial institutions need to partner with firms that manufacture and sell solar panels and those that deal with improved clean cooking stoves. The government should introduce these vital players in the energy sector to final consumers (livestock keepers) and facilitate the sales of the products.
5	Lack of access to affordable sources of energy that can serve as alternatives	The herders in rural areas are away from the grid line, which requires high initial capital before connection can take place	Affordable sources of energy: The government needs to assist the herders in accessing affordable sources of clean energy, such as bio-digesters, solar panels, and improved cook stoves, among others. This can be achieved by providing lines of credit, offering subsidies on these commodities, or even allowing options to pay in instalments. This initiative will help them avoid or reduce the anticipated monthly bills for clean energy.
6	Lack of cooling systems that adopt alternative fuels	The herders and dealers of livestock products are only familiar with cooling systems and machinery that use electricity. They shy away from the high cost of electricity that these machines consume	Provision of cooling systems that can use alternative forms of energy: Most coolants rely on electricity to operate, and some of them use more units of electricity, resulting in high monthly bills as long as they are in operation. There is a need to provide alternative means of powering such machines or to encourage the public to acquire cooling machinery that can be adapted to alternative energy sources, such as solar power and generators.
7	The three proposed priority solutions ranked: 1. Availing machinery and inputs for energy production and employing expertise to educate on the use of the machines. 2. Lowering the cost of available sources of energy, limiting the monopoly of power suppliers, ensuring alternative forms of energy are efficient and accessible, and lowering the initial cost of production. 3. Employing technical experts.		
Water Irrigation			
1	High cost of energy for running water pumping and installation of off-grid/ renewable energy technologies	Irrigation in the county is not adopted by most farmers because of the expenses linked to installing off-grid and renewable energy systems. The high bills for the energy consumed also contribute to their reluctance	Subsidise/zero-rate tax on irrigation equipment/systems, e.g. solar panels: Water pumping machinery and solar water pumps should be zero-rated to enhance their uptake by farmers. The import duties imposed on such products should be moderated or lifted.
2	Lack of power/ energy to power irrigation systems; no electricity connection	Most rural areas in the county are not near the grid line. They thus lack access to electricity, which can power the irrigation processes	Acceleration of last-mile electricity connection to households with no access to electricity: There is a need for the government to introduce or expedite last-mile connectivity to enhance the connection of most farmers to the grid. If powered, they will be able to use electricity to pump water to their farms.
3	The three proposed priority solutions ranked: 1. Subsidise/zero-rate tax on irrigation equipment/systems, e.g. solar panels. 2. County to employ more extension officers to build the capacity of citizens regarding gabions, cover crops, and agroforestry trees. 3. Acceleration of last-mile electricity connection to households with no access to electricity.		

Annex 4: Barriers to clean cooking adoption

A. EDUCATION SECTOR			
	Fuel	**Description**	**Solution**
#	**Source of cooking energy**		
1	Firewood	Firewood leads to health complications due to cancer from smoke, time wasted on collecting the wood and cooking (due to low caloric value), and injury because of fire outbreaks. Using firewood contributes to deforestation, leading to an increase in GHG in the atmosphere	Use of improved cook stoves without smoke, e.g. home stoves: Modern cook stoves are designed using technology that enables the stove to use less firewood while not emitting smoke. They can use the heat generated for lighting and charging small electronics.
2	Charcoal	Charcoal leads to fire accidents and respiratory complications due to carbon monoxide emissions, which interfere with the normal functionality of haemoglobin in the blood. The gas can be fatal and also contributes to global warming, which is linked to climate change	Modern clean cooking stoves are designed using technology that enables them to use less charcoal. Examples include Jiko Malkia and Jikokoa. Cooking should also be done in well-ventilated rooms.
3	LPG	The high cost of purchasing and refilling gas cylinders makes them unaffordable for most county residents and health facilities	The government should regulate the prices of cylinders and the cost of refilling gas.
4	Electricity	Due to frequent blackouts, the high cost of installation, and associated bills, it is challenging for health facilities to cook using electricity	The government needs to introduce subsidies for electricity connections, regulate installation charges, and reduce taxes on the units of electricity consumed.
5	The three proposed priority solutions ranked: 1. Capacity building and use of standard materials and experts during electricity installation. 2. Cooking in well-ventilated rooms, proper installation, and sensitisation; i.e. enforce with standard materials. 3. Caution while using gas/safety; propose a by-law to regulate usage and provide sensitisation.		

B. HEALTH SECTOR			
	Fuel	**Description**	**Solution**
#	**Source of cooking energy**		
1	Firewood	Firewood leads to health complications due to cancer from smoke, time wasted on collecting the wood and cooking (due to low caloric value), and injury because of fire outbreaks. Using firewood contributes to deforestation, leading to an increase in GHG in the atmosphere	Use of improved cook stoves without smoke, e.g. home stoves: Modern cook stoves are designed using technology that enables the stove to use less firewood while not emitting smoke. They can use the heat generated for lighting and charging small electronics.
2	Charcoal	Charcoal leads to fire accidents and respiratory complications due to carbon monoxide emissions, which interfere with the normal functionality of haemoglobin in the blood. The gas can be fatal and also contributes to global warming, which is linked to climate change	Modern clean cooking stoves are designed using technology that enables them to use less charcoal. Examples include Jiko Malkia and Jikokoa. Cooking should also be done in well-ventilated rooms.
3	LPG	The high cost of purchasing and refilling gas cylinders makes them unaffordable for most county residents and health facilities	The government should regulate the prices of cylinders and the cost of refilling gas.
4	Electricity	Due to frequent blackouts, the high cost of installation, and associated bills, it is challenging for health facilities to cook using electricity	The government needs to introduce subsidies for electricity connections, regulate installation charges, and reduce taxes on the units of electricity consumed.
5	The three proposed priority solutions ranked: 1. Capacity building and use of standard materials and experts during electricity installation. 2. Cooking in well-ventilated rooms, proper installation, and sensitisation; i.e. enforce with standard materials. 3. Caution while using gas/safety; propose a by-law to regulate usage and provide sensitisation.		

Annex 4: Nyandarua County Net Wood Fuel Balance

	Timber (m^3)	Poles (m^3)	Wood fuel (m^3)			
			Firewood	Charcoal	Total	Total
Supply potential	244,151	80,878	381,960	205,671	587,631	1,500,291
Demand	81,272	21,767	288,832	252,125	540,957	1,184,953
Net Balance	162,879	59,111	93,128	(46,454)	46,674	315,338

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