TECHNICAL REPORT

THE SUSTAINABLE ENERGY ACCESS & CLIMATE ACTION PLAN (SEACAP):

"SUSTAINABLE ENERGY ACCESS PILLAR"

THE COUNTY GOVERNMENT OF NAKURU, KENYA

Submitted on: **29th January 2021**

By:

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Africa Research and Impact Network

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LIST OF ACRONYMS

MECS Modern Energy Cooking Services

SCODE Sustainable Community Development Services

KPLC Kenya Power and Lightening Company

GDC Geothermal Development Company

LPG Liquefied petroleum gas

CBO Community Based Organization

KNBS Kenya National Bureau of Statistics

GDP Gross Domestic Product

MSMEs Micro, Small, or Medium-level Enterprise

KenGen Kenya Electricity Generating Company

KETRACO Kenya Electricity Transmission Company

EPRA Energy and Petroleum Regulatory Authority

REREC Rural Electrification and Renewable Energy Corporation

IPPs Independent Power Producers

REA Rural Electrification Authority

KPC Kenya Pipeline Company

KPRL Kenya Petroleum Refinery Limited

NOCK National Oil Company of Kenya

KNEB Kenya Nuclear Electricity Board

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EXECUTIVE SUMMARY

Transition to a clean energy agenda in line with SDG No. 17 requires local actions where households, communities, and local authorities interact with energy for lighting, cooking, and other public utility. Local authorities (e.g., County Governments in Kenya) operating at the subnational level are closer to the people and have a clear understanding of the contextual energy needs informative to the desired clean energy transition.

The GIZ, through ICLEI Africa, commissioned technical support for the development of the **"Sustainable energy access" pillar of the Sustainable Energy Access and Climate Action Plan (SEACAP) for the county government of Nakuru, Kenya**. The SEACAP is an initiative facilitated by the Covenant of Mayors in Sub-Saharan Africa (CoM SSA) - a regional pillar of the Global Covenant of Mayors for Climate & Energy (GCoM). ICLEI Africa and GIZ lead the SEACAP implementation in Nakuru County to support local authorities such as Nakuru County in tackling the interconnected challenges of climate change and access to sustainable energy.

This report outlines a baseline energy access assessment for Nakuru County upon which strategic and realistic energy planning and target setting for the county will be based. The report is based on a triangulation of data collection and consultative engagements with the county, national governments, NGOs, and local communities. Based on the sustainable energy indicators developed under the Joint Research Centre guidelines, the study focused on access to electricity and clean cooking initial document review, review of secondary databases (e.g., SE4All, Kenya Bureau of Statistics, Kenya Power and Lightning, among others) and analysis of national and county level policies to identify available data and develop a contextual understanding of Nakuru county energy needs, trends and ambitions. The desk reviews were triangulated with primary data collected where 400 households (total, 56 percent of men and 44 percent of women) across the 11 sub-counties were interviewed to understand household-level energy access and use. The data was then used to develop indicators for sustainable energy access for the county focusing on three security elements, sustainability and affordability - a basis for planning and target setting for the county.

Key Findings

Generally, Nakuru is endowed with resources that support renewable energy development and thus provide the fundamental potential for the clean energy transition. Nakuru county is projected to increase energy demand from 114.3 MW in 2015 to 616.7 MW in 2030, the fourth highest after Nairobi, Kiambu, and Mombasa Counties. This means the transition to clean energy access in Nakuru has a significant contribution to national clean energy targets. In terms of potential, geothermal has the highest potential in the county (10,000 MW), followed by hydropower (34.4. MW), wind power (29.3 MW), solar power (7.4 KW/M2/day), and Biogas (TBC). This potential can meet the county's energy targets, including universal access (100%) to electricity and clean cooking and a renewable energy share of 80% of the total energy mix.

In terms of household access, Electricity is generally available in most parts of Nakuru County, with about 88.5% of the residents confirming that their areas are covered with the various on-grid and off-grid electrification initiatives. The national grid is the main electricity source in Nakuru, with about 88% of the residents having their meters connected to the national grid. While electricity infrastructure is available for most households, only about 64% of households are connected and able to use electricity in their households. Almost all the other 36% unconnected are

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willing to be connected to the electricity grid. The world bank reports estimate the national electrification rate at about 75% in 2018. The 64% reported in this study is relatively lower than the 75% reported by the International Energy Agency (IEA, 2019). This difference could be because of the inability of some households to get connected despite the availability of electricity infrastructure within their vicinity. The connected households (64%) vary across the eleven (11) sub-counties. Access is generally high in the urban areas such as Nakuru, Naivasha which have 90.4% electricity access on average, while rural areas have about 26.35% electrifications on average. This implies that despite the reported increase in Nakuru electricity access, this access is still unequal with access mainly concentrated in urban areas while rural areas still have significantly low access.

In terms of clean cooking energy, the use of traditional biomass as a fuel for cooking is still common in Nakuru County, with 46% of households using this energy source. However, the uptake of gas stoves is also improving, and about 30% of households are using Gas (LPG) stoves. The use of the traditional *Jiko* for cooking that stands at 19% is still very common – in Nakuru County, especially in the rural areas, an indication of the deforestation for charcoal production and biomass fuel. Most households in Nakuru County prefer the use of clean energy sources, with 50% preferring Gas stoves while 21% prefer to use electric stoves. About 97% of the households are willing to transition to clean cooking energy.

In terms of sustainable energy indicators defined around the share of the population with access to electricity and additional indicators around security, sustainability, and affordability, there is relatively good progress towards the access to electricity targets (inequalities notwithstanding) with the 64% share population with access to electricity. However, the progress is slow for clean cooking, where only 31% can access clean cooking, with a majority relying on biomass. The county's energy sustainability is good, with over 90% of its electricity from renewable sources, thus indicating sustainability. Affordability remains a key impediment even as over 98% of households are willing to transition to clean energy options.

Overall, the assessment shows that access to electricity and clean cooking is driven by many factors, including geography, urban versus rural systems, policies, and household characteristics, including income levels. While clean energy options are available in most parts of the county, many households – especially in rural areas are unable to afford both the initial and operating costs. Even for those who have been able to connect to these options, the usage is relatively narrow, mainly focused on lighting for electricity, while LPG is largely used as a secondary source after biomass. This means that the full potential for clean energy is not yet exploited. There is a need for a more catalytic strategy that will open up technologies and innovation for households and institutions to embrace full-range clean energy usage, including entrepreneurship for poverty alleviation.

The assessment has also revealed the inequalities in clean energy access, both inspired by income inequalities (as already highlighted above), developmental and geographical differences. Access to electricity in Nakuru is largely skewed towards urban and peri-urban areas enabled by infrastructure, affordability, and market demand. To address these inequalities, pro-poor and innovative strategies that explore a mix of grid and off-grid options could be useful.

Additionally, the range of clean energy usage is constrained by reliability issues. Power outages, for instance, limit demand for electricity and associated uses, e.g., electric cooking. Consequently, electricity is mainly used for lighting while other options remain relatively dominant. This calls for innovations that catalyze technological access to various electricity sources and usages. Promoting diversity of uses is a particularly critical part of the clean energy

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transition. The assessment indicates that clean energy transition is not only defined by access and connectivity but the ability to use clean energy. This presents a paradigm shift in global clean energy pursuit where the transition has largely been measured by access rather than sustained usage.

Ultimately, affordability, accessibility, and reliability are key elements that define the transition to clean energy. These three elements define the gap between clean and traditional energy options. Lack of any of the three elements means households simply revert to traditionally- more available options such biomass (wood fuel and charcoal) and, at the same time, reduce the scope of clean energy usage, i.e., using electricity for lighting only. Local authority or county-led Policies/strategies and actions that target to strengthen these and their linkages could be central to clean energy transition in Nakuru and beyond.

Key challenges to clean energy

Various households and community groups in Nakuru experience several challenges in their efforts to access electricity and clean cooking. Some of these challenges are more specific to household characteristics, e.g., low-income levels as already enumerated above, but other challenges are more organizational and policy-oriented. Challenges span across concerns of affordability, availability, and accessibility: 1) poor rural households cannot afford initial electrical installation costs, as well as operation, costs 2) Delayed availability, i.e., delayed or lack of connection to the National grid, especially in rural areas with poor infrastructure 3) Lack of consolidated country-led strategy for enabling the transition to clean energy especially at the county government level thus efforts are unconsolidated 4) Lack of data for evidence-based energy planning and action 5) Deep-rooted social-cultural perceptions and acceptance built over histories of biomass dependency and intermediary socially promoted techniques such as cookstoves, among others.

Preliminary Recommendations

a. Promote county-led energy action strategy that could enhance pro-poor and contextualized actions, better coordination, and linkages to national-level resources. The SEACAP process is a step towards this direction and could be comprehensively embedded in ongoing county energy planning and legislative processes.
b. Enhance universal access to electricity across urban and rural areas: access to electricity in Nakuru is largely skewed towards urban and peri-urban areas enabled by infrastructure, affordability, and market demand, thus creating inequalities. There is a need for pro-poor and innovative strategies that explore a mix of grid and off-grid options for both contexts.
c. Establish an energy database for Nakuru and other Counties to inform strategy, planning, and actions. Currently, lack of data or its access impedes clean energy strategies especially decision on where to intervene. Data on clean energy at the county level is neither well-coordinated nor properly archived and thus the difficulty in retrieval and sharing.
d. A dedicated stakeholder forum for Nakuru County could help spur dialogue and enable effective coordination and promote synergies in developing and operationalizing county energy plans.
e. Diversification of clean energy usage is a critical part of the clean energy transition. The assessment indicates that clean energy transition is not only defined by access and connectivity but the ability to use the clean energy itself. There is a need for innovations that catalyze clean energy technological access and usage.

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f. Capacity building and systematic awareness are key to unlocking clean energy information and technologies for a wider Nakuru community segment. Capacity support to the county to enable it to develop energy access programs and mobilize resources for action. Awareness for the wider community to break systemic socio-cultural barriers to clean energy transition.

Next Steps

a. Undertake consultative dialogue with the county departments to identify the legislative opportunities for strengthening country-led energy planning.
b. Provide technical support to the county to develop/update the specific energy policy/strategy drawing on the findings from this assessment
c. Undertake capacity building on clean energy innovation and provide linkages with various opportunities pursuing the same.
d. Explore options for scaling the SEACAP model to other counties in close collaboration with the national government and related county energy planning initiatives.

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CHAPTER 1: INTRODUCTION

The GIZ, through ICLEI Africa, commissioned technical support for the development of the **"Sustainable energy access" pillar of the Sustainable Energy Access and Climate Action Plan (SEACAP) for the county government of Nakuru, Kenya**. The SEACAP is an initiative facilitated by the Covenant of Mayors in Sub-Saharan Africa (CoM SSA) - a regional pillar of the Global Covenant of Mayors for Climate & Energy (GCoM). ICLEI Africa and GIZ lead the SEACAP implementation in Nakuru County to support local authorities such as Nakuru County in tackling the interconnected challenges of climate change and access to sustainable energy.

The development of the Energy access Pillar of the SEACAP generally includes conducting an energy access assessment to ascertain the County baseline information upon which strategic and realistic targets on enhancing sustainable energy access will be set and action plans developed. The process also includes energy modeling to be undertaken later to inform action planning considering different scenarios. The development of the Energy access pillar also allows the County to continually report to the Covenant of Mayors on its progressive implementation of the Action plans and endeavors towards the set targets.

The SEACAP process in Nakuru involves three interconnected pillars that include climate change mitigation (emission accounting), climate change adaptation (vulnerability assessment and adaptation planning and the energy access assessment (a dashboard for overviewing energy access status for the county). Therefore, this report focuses on the development of the **Sustainable energy access pillar of the** SEACAP as guided by the Joint Research Centre (JRC) Guidebook.

A. AIMS AND OBJECTIVES

While the specific objectives of the development of the Energy access pillar of the SEACAP included: Assessing energy access status in Nakuru County focusing mainly on electricity and clean cooking; energy modeling to help Nakuru Energy planning and emission reduction, setting targets, and developing action plans on energy access in the County, this report focuses on the **Energy access assessment** conducted in the county in 2020 exploring both access to electricity and clean cooking energy

This technical report details the methodology applied in conducting the energy access assessment in Nakuru County and outlays the specific results from the various data analyzed. More specifically, the report focuses on the methodology and outputs of the access to electricity and clean cooking methods in Nakuru County. The report is structured to give an overview of Nakuru County capturing the demographics, economics, and political landscape; explore the county's renewable energy potentials, mapping the key stakeholders and the energy access commitments before presenting the key indicators and the assessment outcomes. The report ends by giving relevant recommendations to improve energy access in Nakuru County.

GENERAL INFORMATION OF NAKURU COUNTY

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Nakuru County is among the 47 counties/sub-nationals of the Republic of Kenya that came into existence with the Kenyan Constitution 2010. The county is cosmopolitan, comprising a populace of different ethnicities and nationalities (KNBS, 2019). About 54.2% of Nakuru people live in rural areas, whereas 45.8% live in urban areas. According to the 2019 National Population and Housing Census, the County's population was approximately 2.16 million, with 1.077 million male, 1.084 million female, and 95 intersexes. Individuals aged 18-35 are approximately 33%, which is a predominantly youthful population (KNBS, 2019).

The major economic activities within Nakuru County are; agribusiness, financial services, and tourism (CIDP 2018-2022). Nakuru's economy is built around agriculture, accounting for approximately 60% of total economic activity (Nakuru County, 2020). The County's Gross Domestic Product (GDP) for 2019 was estimated at KSh 613 billion (at current prices), accounting for 6.9% of Kenya's GDP (KNBS, 2019, 2020c). The county's poverty level is still real, with about 29.1% 0f the residents generally considered poor. Compared to the National poverty level, at 36.1 percent, Nakuru County's general poverty level is relatively below this national rating at 29.1 percent[1]. Nakuru County covers approximately 7,498.8 Km² inland area size and has eleven sub-counties hosting 55 wards (KNBS, 2019).

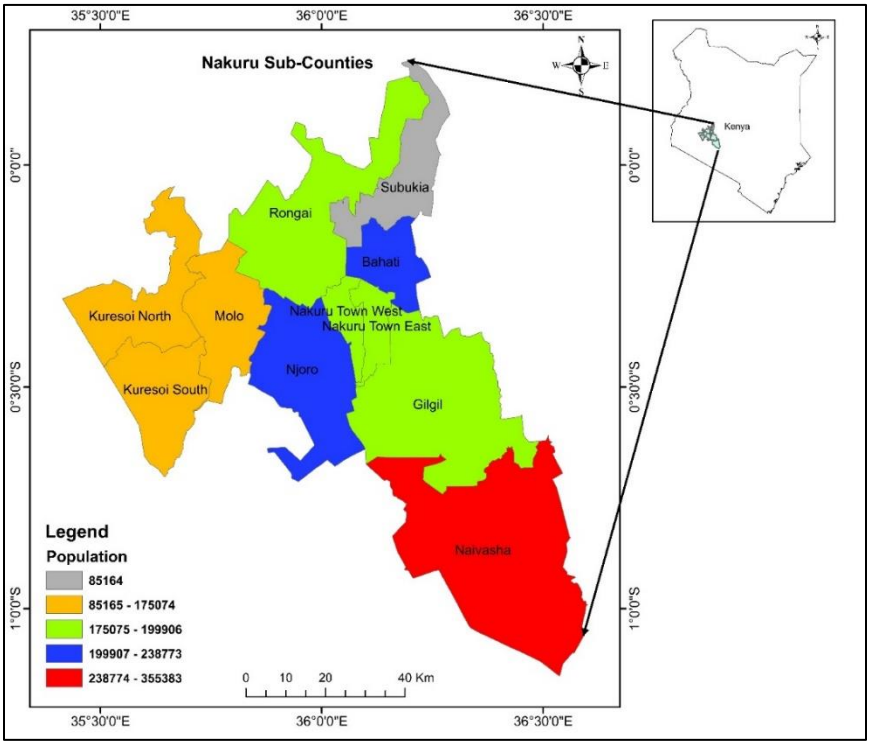

Figure 1: A map of Nakuru County with the Sub counties and their respective 2019 population Source (KNBS, 2019)

B. ENERGY POLICY AND REGULATORY FRAMEWORK

The infographic in Figure 2 given below indicates the summary of the international, national, and local policy landscape of Nakuru in relation to Energy access and sustainable energy planning. The energy regulatory frameworks are developed cognizant of the existing global and national regulations, policies, and frameworks and thus the interrelationships that must be taken note of in the pillar's development. A key observation is that National and International level energy regulations are still dominant. County-level regulations are still emerging and developing-

[1] https://www.unicef.org/esa/media/7021/file/UNICEF-Kenya-Nakuru-County-Budget-Brief-2020.pdf

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an opportunity for SEACAP to support such processes and particularly to create linkages with the national processes. At the national level, the Energy Act 2019 establishes national-level frameworks for clean energy transition through both strengthened and incentives institutions (including the creation of renewable energy directorate). The Act also requires strengthened action at the county level, especially through the country's energy planning. For Nakuru County, the county draft energy strategy is under development with a focus on guiding county-based actions towards clean energy transition.

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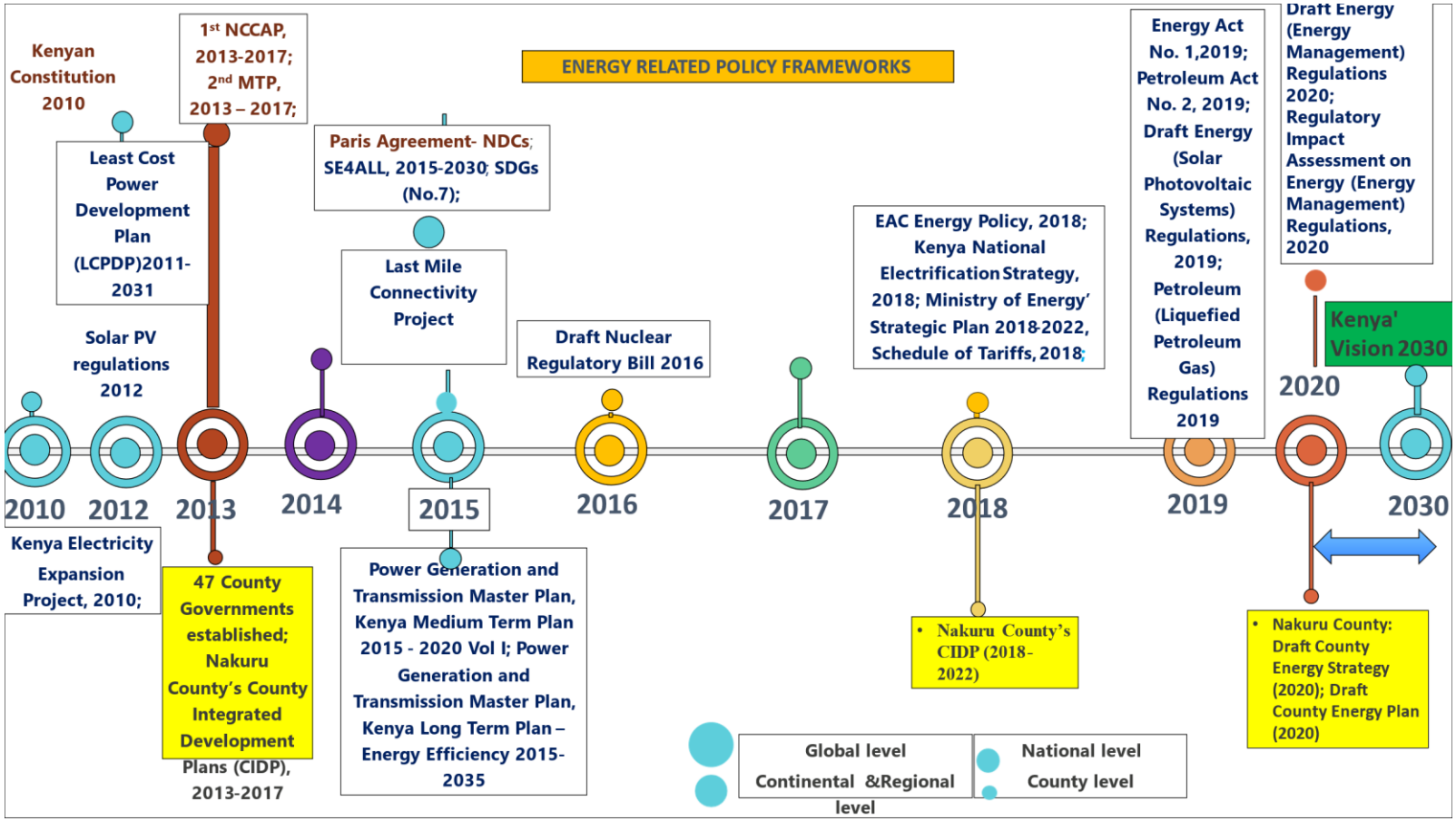

Figure 2: Energy Policy & Regulatory Frameworks relevant to Nakuru County

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KEY PLAYERS IN THE ENERGY SECTOR (ROLES AND RESPONSIBILITY)

I. NATIONAL LEVEL

Government Agencies– the Ministry of Energy

The Ministry of Energy is the overall government institution responsible for policies and regulations in the energy sector (Figure 3). The ministry implements its development programs and projects through semi-autonomous government agencies, including:

- **Kenya Electricity Generating Company (KenGen)-** is the leading electricity power-generating company in Kenya, producing approximately 70% percent of electricity consumed in the country, mostly from renewable sources[2]. The company utilizes various energy sources to generate electricity ranging from hydro, geothermal, thermal, and wind. It is 70% owned by the Government, and 30% of the shareholding is in the public's hands (MoE, 2020).
- **Kenya Electricity Transmission Company (KETRACO)** is responsible for planning, designing, constructing, operating, and maintaining a high voltage electricity grid. The Company is 100% Government-owned.
- **Kenya Power and Lighting Company (KPLC)** - is a state corporation responsible for electricity transmission, distribution, and retail sales. It operates Power Purchase Agreements with KenGen and the Independent Power Producers for onwards transmission and distribution.
- **Energy and Petroleum Regulatory Authority (EPRA)-**is an independent statutory body with a regulatory mandate in the entire energy and petroleum sectors' operations. EPRA exists to protect the consumer, investor, and other stakeholders' interests by enforcing the Energy Act. It has the power to formulate and enforce secondary legislation.
- **Rural Electrification and Renewable Energy Corporation (REREC)** - is charged with implementing the Rural Electrification Programme. It is 100% Government-owned. The Authority is expected to increase the speed of implementing several projects lined up for implementation throughout the country.
- **Geothermal Development Company (GDC)** - is a state-owned company responsible for geothermal resource assessments, including exploration, appraisal, and steam production. It explores and develops steam fields and sells geothermal steam to KenGen and Independent Power Producers (IPPs) for electricity generation.
- **Energy Tribunal** - arbitrates disputes between the Energy and Petroleum Regulatory Authority and other aggrieved stakeholders in the energy sector.

Other Government Ministries - The Ministry of Energy cooperates with other Ministries and Departments to establish enabling regulatory framework, implement projects and mobilize resources. For instance, t**he**

[2] https://www.africaoilandpower.com/wp-content/uploads/2020/03/AES_Kenya-Special-report-2020.pdf

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Ministry of Finance-responsible for controlling the government budgets and expenditures on energy, The Ministry of Agriculture managing energy-related raw materials for biofuels. Both Ministry of Water and Ministry of Environment and Natural Resources influence water regulation for hydropower installations and climate change actions, especially clean energy for reduced greenhouse gas emissions.

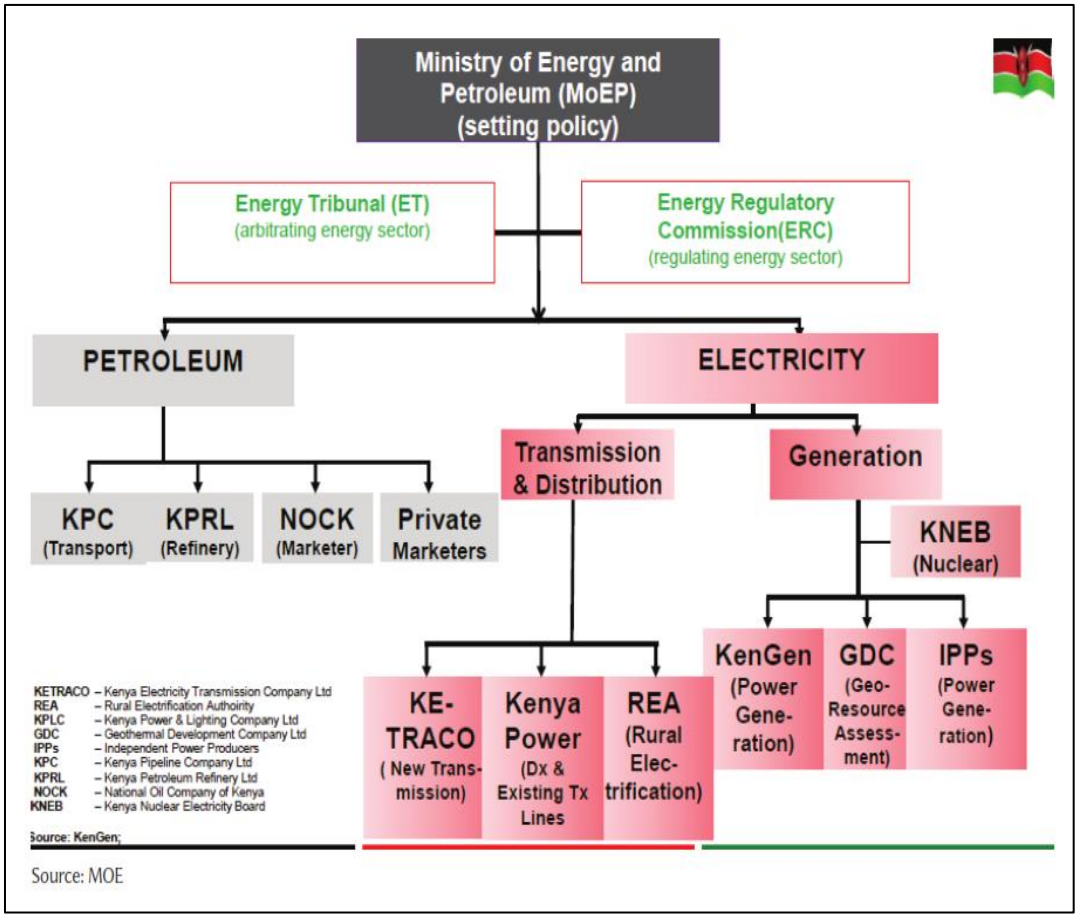

Figure 3: Key institutions under the Ministry of Energy and their Roles

Independent Power Producers (IPPs) –

These are private companies (non-state) that generate power and supply the electricity in bulk to Kenya Power and Lighting Company. In Nakuru County, multiple IPPs play a critical role in national power generation (Table 1).

Table 1: Independent Power Producers in Nakuru County

Ref No	License	Technology	Location of Power Plant(s)	Capacity (MW)	Date Granted	Duration (Years)	Supply to	Remarks

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G1.05.18	Oserian Development Co.ltd	Solar	Nakuru	1	22nd August 2018	20	Captive	
G1.03.14	QPEA Menengai	Geothermal	Nakuru	35	4th Dec 2014	25	Grid	
G1.04.14	Sosian-Menengai20	Geothermal	Nakuru	35	4th Dec 2014	25	Grid	
G1.02.15	OrPower 22	Geothermal	Nakuru	35	16th July 2015	25	Grid	
GD.03.15	Biojoule Kenya Ltd	Biogas	Nakuru	2.6	3rd Dec 2015	25	Self & Grid	The energy will be supplied primarily to Gorge Farm and surplus to the grid.
GD.01.17	Oserian Development Company	Geothermal	Nakuru	3.7	26th April 2017	20	Captive	Amended on 26th April 2017 to include distribution & supply

Source: EPRA/ELEC/LICPO-3.02 (Register of Licences and Permits for Electric Power Undertakings as of May 2020)

Development Partners

These are stakeholders who provide financial and non-financial resources towards the development of the energy sector. This category includes foreign governments, financial institutions, exploration companies, and other investors such as Geothermal development Company, with interests in the energy sector

The Civil Society

a) Several key civil society groups are playing a role in clean energy policy advocacy and implementation. These include examples such as Kenya Climate Change Working Group, Clean Cooking Alliance, NGOs such as world vision, among others.

II.SUB-NATIONAL- LOCAL-LEVEL

The County Government of Nakuru is largely responsible for managing energy issues at the sub-national level as mandated by the Constitution of Kenya 2010. The NCG engages different sub-national level agencies through public-

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private partnerships (PPPs) with the Independent Power Producers (IPPs), Individual IPPs that sell electricity from renewable energy plants. The County government facilitates such partnerships by creating enabling environment and incentives for investments, e.g., land allocation for energy plants. The NCG further facilitates the energy value chain- creating and licensing affordable and accessible distribution channels for both lighting and cooking enterprises such as the LPG, M-KOPA Solar, etc., in line with the. 2019 energy Act. As part of supporting community-level energy access, several CBOs such as the SCODES, World Vision, Clean Cooking Alliance, and M-Kopa operate in various sb-counties to promote clean cooking, solar home systems among households and community groups. Current energy access targets and commitments

Nakuru County has committed to clean energy targets by 2030, which are aligned with the National Energy Policy, 2015, and the United Nations Sustainable Energy for All (SE4ALL) targets. These targets are illustrated in table 2:

Table 2: Clean Energy Targets for Nakuru County *Source: CCEAP 2018-2023*

Universal access to modern energy services		Doubling the global rate of improvement of energy efficiency	Doubling share of renewable energy in the global energy mix	
Percentage of the population with electricity access	Percentage of population with access to modern cooking solutions	Rate of improvement in energy efficiency	Renewable energy share in Total Final Energy Consumption	
			Power	Heat
100%[3]	100%		80%	80%

The NCG has made forth various plans towards achieving these targets. These plans target to promote partnerships, markets, technology, and policies that lead to quality and sustainable energy to all residents of the county (CCEAP 2018-2023) (Figure 4):

[3] Projected to be reached by 2022

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Figure 4: Key strategic actions stipulated by NCG towards energy targets aims

C. THE RENEWABLE ENERGY POTENTIAL OF NAKURU COUNTY

Nakuru is endowed with resources that support renewable energy development and thus provide the fundamental potential for the clean energy transition. Nakuru county is projected to increase energy demand from 114.3 MW in 2015 to 616.7 MW in 2030, the fourth highest after Nairobi, Kiambu, and Mombasa Counties (CCEAP 2018-2023). This means the transition to clean energy access in Nakuru has a significant contribution to national clean energy targets. The major energy sectors identified as having the capability to help the county transition to a clean and circular economy. Table 3 outlines the potential from different sources.

Table 3: Energy Projections for Nakuru County

Electric power generation	Resource potential	Installed Capacity 2015	Target 2020	Target 2025	Target 2030
Geothermal	10,000 MW	593 MW	1,500 MW	3,000 MW	5,000 MW
Biogas	-	2.2 MW	10 MW	15 MW	50 MW

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Solar power	7.4 kWh/m2/day	-	40 MW	100 MW	200 MW
Wind power	29,286 km^2 with average speeds of 6.52m/s	-	10 MW	50 MW	100 MW
Hydropower	34.4 MW	-	5 MW	10 MW	15 MW
Municipal waste	-	-	5 MW	10 MW	15 MW

Source: CCEAP 2018-2023

GEOTHERMAL ENERGY: Nakuru is located in the Great Rift valley, where geomorphological processes allow for geothermal energy generation. Geothermal energy potential in Rift Valley currently stands at 7,000 MW, according to the Ministry of Energy and Petroleum (UNDP, 2014). About 78% of this potential (i.e., 5,500 MW) is expected to be harnessed by 2030. Nakuru county alone has a capacity of 593 MW as of 2015, and the potential to tap into the geothermal space is huge, with a target of USD 5,000 MW by the year 2030. (CCEAP 2018-2023).

SOLAR ENERGY: Nakuru County occurs within the tropics and much closer to the Equator, thus receive long hours of sunshine and plenty of solar energy resources. The potential for solar energy in Nakuru counties remains high but under-tapped even though there are increasing solar panel installations. Nakuru County has explicitly the potential of generating about 7.4 kWh/m2/day of solar energy and targets to generate about 200 MW from the Solar energy resource by 2030 (CCEAP 2018-2023).

WIND ENERGY: Nakuru County has a maximum annual mean wind speed of 6.52 m/s, only second to Turkana with a maximum of 7.11 m/s (MoE, 2013). A study commissioned by the Ministry of Energy has classified wind speed for Nakuru as class IV, measured at the height of 100 m. Although not classified under major wind hotspot areas for Kenya, Nakuru County is viable for generating wind energy to supplement Kenya's energy mix. Premised on the current capacity and the county's potential, Nakuru county targets 100 MW wind energy generation by 2030 (CCEAP 2018-2023).

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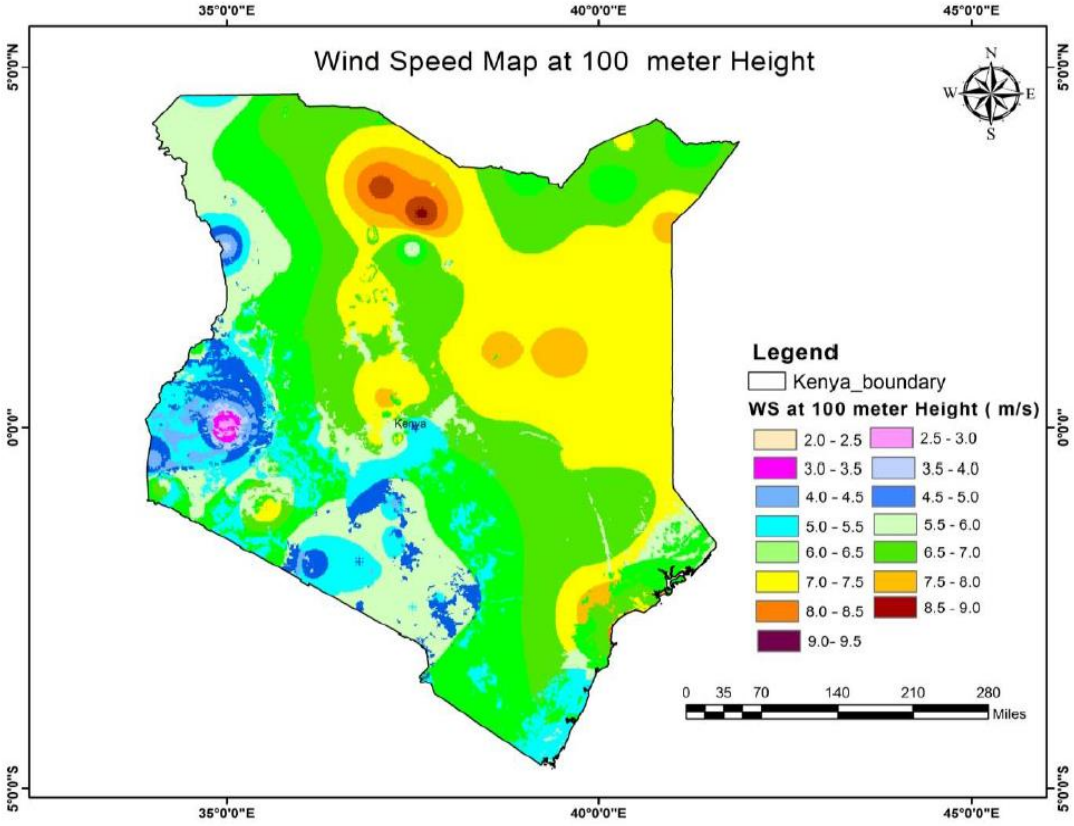

Figure 5: Kenya's Wind Potential *Source: Ministry of Energy, 2013*

BIOGAS ENERGY:

This form of energy largely depends on Biomass - organic material from plants and/or animals. In Kenya, biogas energy generation is still at low inception levels, which could be attributed to many factors such as costs, policy limitations, technology adoption, socio-cultural factors, among others of 2015, the unknown potential exists for the government and private entities. The county targets 50 MW capacity by 2030.

HYDRO ENERGY; This is the most viable and common energy generation model contributing over 40% to the national grid (CCEAP 2018-2023). With the climate variability and change, energy production from hydro-sources is expected to fluctuate. For Nakuru, which was generating 34.4 MW from hydro sources, the potential is expected to drop drastically to 15 MW due to reduced rainfall in the region.

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CHAPTER 2: BASELINE ASSESSMENT OF ENERGY ACCESS

A. UNDERSTANDING THE ENERGY ACCESS PILLAR OF THE SEACAP

Energy access is a very significant pillar of economic transformation and social development, well-being, and dignity of people. Despite the significant increase in international funding for developing countries from 10.1 USD billion in 2010 to 21.1 USD billion in 2017 to support clean energy, only 0.2 billion people were shown to have transitioned to clean energy access (World Bank Custodian Agencies, 2020). Sub-Saharan Africa is still experiencing energy poverty, with only 45% having access to electricity and 90% still relying on traditional biomass, coal, or biomass for cooking. East Africa has shown a progressive improvement in the electrification rate from 49% to 54% from 2014 to 2018.

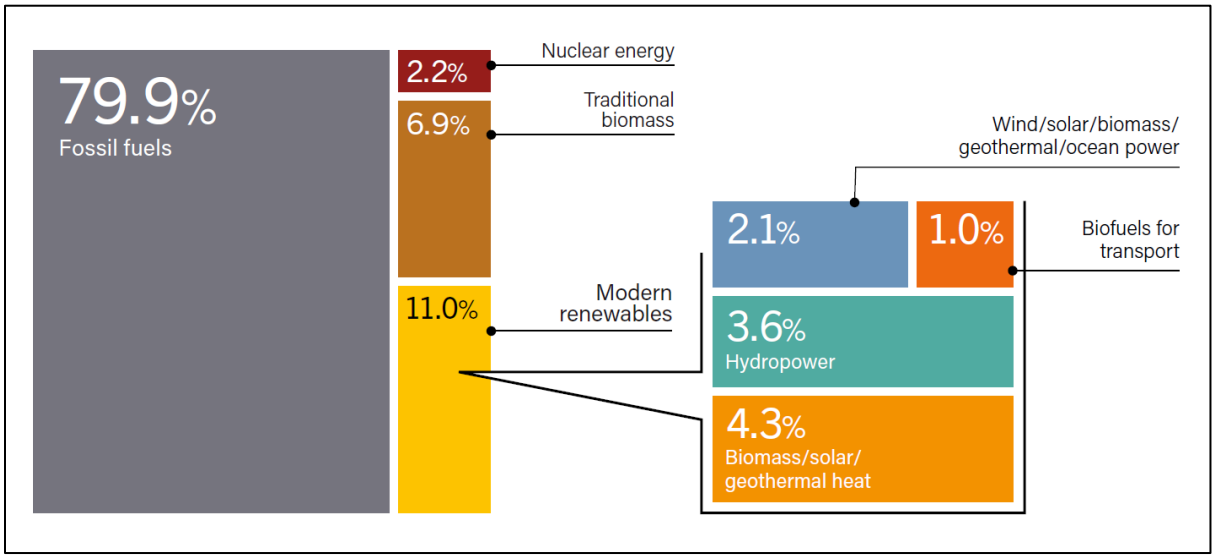

Figure 6: Renewable Share of Total Final Energy Consumption *(Murdock et al., 2020)*

With the expected population surge in urban cities, especially in Africa, a lot of focus is needed to address the current energy poverty and inequality as well as prepare adequately to ensure the projected population growth in such cities does not overtake energy access rates. It's against this backdrop that the Sustainable Energy Access and Climate Action Plan (SEACAP) initiative targets to support local authorities in Sub-Sahara Africa with sustainable energy planning towards clean energy transition.

The SEACAP process for Nakuru County, Kenya, has been described in the introduction and further illustrated in Figure 7. The process follows the Joint Research Centre (JRC) guideline seeking to provide adequate contextual analysis to inform priority actions based on a set of indicators (JRC, 2019). The SEACAP process in Nakuru, therefore, involved assessing the County's energy situation based on secondary and primary data gathered through situational analysis and desktop review, interaction with the key stakeholders, and household interviews. The outcomes from the baseline information regarding energy access in the County provide a basis for energy planning and target setting.

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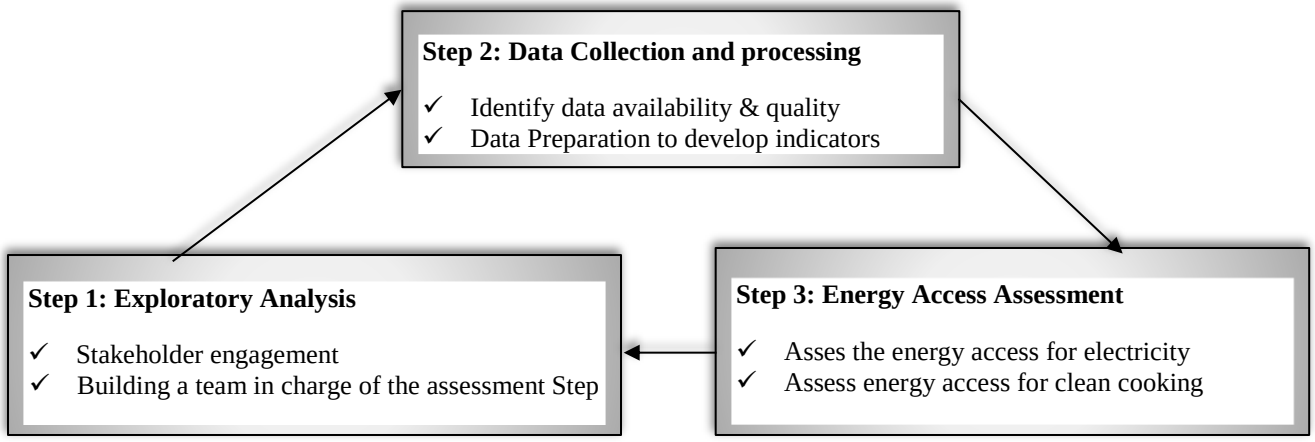

Figure 7: The iterative process of Energy Access Assessment (Pascua & Rivas, 2018)

B. DATA COLLECTION FOR THE ENERGY ACCESS PILLAR

The data needs and possible data sources were identified through continuous document review, consultations with the various stakeholders, and guided by the JRC guidelines. Data collection involved the triangulation of secondary and primary data.

SECONDARY DATA

The various data sets required to comprehensively assess the energy access in Nakuru County in terms of Electricity and Cooking energy were retrieved from different sources. Through the support of the County Government of Nakuru, GIZ, and ICLEI Africa, the electricity demand and supply, including generation mini-grids, were sourced from the Kenya Power and Lighting Company, Energy and Petroleum Regulatory Authority, and the Ministry of Energy. National and County level policies, strategies, and assessments were also reviewed to retrieve information and data relevant to Nakuru. The secondary data were analyzed to contextualize the energy access situation in Nakuru based on the JRC indicators and to inform primary data collection.

PRIMARY DATA

Primary household data was collected to triangulate secondary data and to fill up the existing data gaps identified through secondary data search. The primary data was mainly collected through the household surveys using questionnaires based on a representative household sample drawn from the eleven (11) sub-counties of Nakuru.

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Before the sampling and household interviews, a rapid appraisal was undertaken through consultative discussions with selected key stakeholders, including county government, National Government stakeholders - Nakuru KPLC office, and the Kenya Bureau of Statistics? - Nakuru office, the civil society –World Vision, and the community-based organization worked on energy issues in the area- Sustainable Community Development Services (SCODE). The rapid appraisal was aimed at identifying and characterizing the sub-counties and collectively designing appropriate sample sizes.

SAMPLING HOUSEHOLDS FOR QUESTIONNAIRE SURVEY

Random stratified sampling was adopted and designed to capture the physical and socio-economic diversity of the County. The sampling process drew from the household population of 616,046 in the County based on recently concluded National housing and population 2019 census results (KNBS, 2019). Using Solvin's formula (Eq. 1) below, a sample size of 400 was arrived at against the total household population within a confidence limit of 95%, and an error margin of 0.05 only. An additional 20 households were also selected for testing/piloting the data collection bringing the total sample to 420 households (i.e., the statistical sample plus the test sample). To for piloting the data collection process. The equation below shows Solvin's formula used:

N=Total Population

N=Sample size = $N \div (1 + Ne^2)$.

N=Number of households in the County= 616046 household

e= error margin (0.05)

n=Sample size

$$n=1000/(1 + 1000 \times 0.05 \times 0.05)$$

n=399.74 ≈400

Equation 1: Household Sample Calculation

The household study noted that local communities are heterogeneous and are made up of diverse social groups with varying perceptions and entitlements to energy access and use (Scoones, 1998). As such, the 420 sample size was differentiated through 3 main variables that capture this heterogeneity and defines energy access: 1) geographical contexts, i.e., samples distributed in each of the 11 sub-counties based on sub-county households' numbers ii) gender – where samples were drawn from both male and female-headed households and iii) wealth ranking - where we applied income-based wealth ranking (Scoones, 1995) to differentiate households into various wealth categories and draw insights on how income define the access and use of clean energy. Ultimately, the 420 households distributed across the sub-counties (Figure 8) were contacted for telephone interviews even though nine of these declined due to different reasons, including network challenges.

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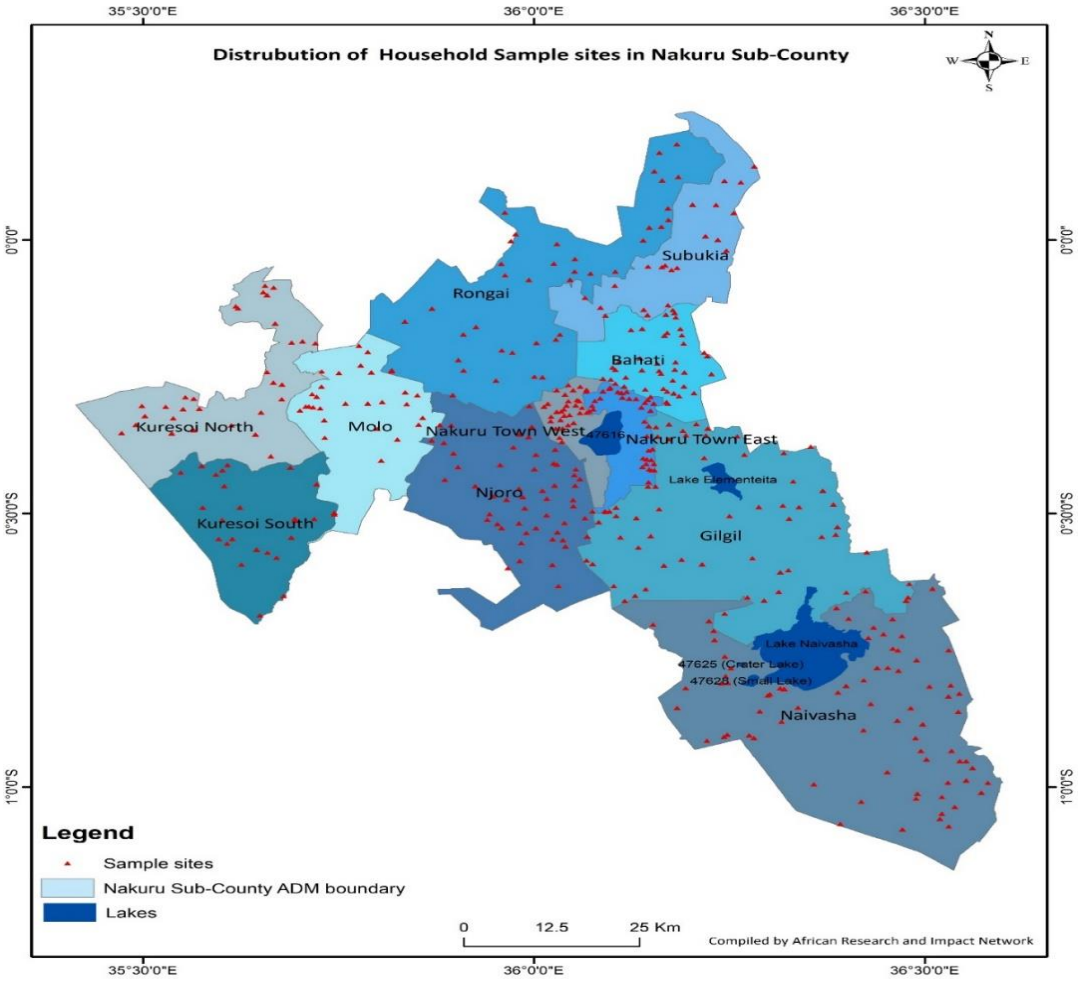

Figure 8: Household random distribution sample sites in Nakuru Sub-County

To effectively execute the interviews amidst the COVID-19 restrictions, virtual data collection was designed using the Kobo toolbox and phone interviews. The phone numbers of the 420 households were acquired and verified through the Sub-county officers working under the County Government of Nakuru. Twelve field assistants were taken through a two-day face-face covering the overall introduction to the SECAP process and aims, virtual data collection process, -using phone interviews, the use of the Kobo-toolbox, and general ethics in engaging households amidst COVID-19.

Pilot interviews were executed with a sample of twenty households during the training session, allowing for testing the tool's effectiveness, identifying gaps, and timely remedial guidance. The actual data collection then commenced 2 days after the training and involved conducting phone call interviews surveys to the sampled households. The Kobo-tool box aided the monitoring of the data collection process. The interviews were audio-recorded and stored as part of the study's database used to verify and authenticate the information filled in the Kobo toolbox.

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The interviews captured both qualitative and quantitative aspects of energy access (e.g., knowledge, perceptions, views, and attitude of the locals concerning clean energy transition, among others) and quantitative aspects (e.g., the share of energy availability, use, and demographic proportion of the residents with access to electricity and clean cooking options. The questionnaire was also designed to capture the willingness and preparedness to adopt sustainable energy options. Premised on the assumption that the respondents had not made prior contacts with study questions, all the information obtained was classified as primary raw data as they emerged from the study contexts without any tinkering.

Data were analyzed using GIS, where energy access was visually represented for the different sub-counties and wealth groups. Excel and SPSS were used to undertake qualitative and quantitative analysis were employed. Qualitative data drawn from the interviews and stakeholder engagements were coded to draw out themes (Hopkins, 2007). Household questionnaire data were analyzed using SPSS to generate descriptive statistics and non-parametric statistical tests.

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CHAPTER 3: RESULTS AND DISCUSSIONS

This section presents the results following the household data analysis supplemented by the secondary data analyzed in the energy access assessment. To best understand the energy access status in Nakuru County, the study explores the household characteristics, access to electricity, access to clean cooking energy, and explores electrification and electricity access in a public building. In this report, Casual employment also known as informal employment refers to those whose payments are irregular and thus inconsistent and cannot be predicted. The households with such income sources are therefore not having a regular recorded income. Formal employment is those that have regular remunerations and are thus predictable and can be used to plan the household.

HOUSEHOLD CHARACTERISTICS AND OUTLOOK

During the survey, 56 percent of men and 44 percent of women, mostly within the age bracket 35 and 44 years, were interviewed, with most households headed by males. The majority of those interviewed had secondary education implying desirable literacy levels. (Table 4).

Table 4: Summary of the demographic characteristics of the Households interviewed

Variable	Percentage (%)
Gender of the respondent	
Male	56
Female	44
Education Level	
Pre-school	2
Primary	26
Secondary	44
Tertiary	29
Age of the respondent	
<65 Years	5
18-24 Years	4
25-34 Years	21
35-44 Years	30
45-54 Years	24

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55-64 Years	17
Household main Earner	
Child	7
Father	67
Mother	25
Don't know	0.8
Both parent	2

HOUSEHOLD INCOME

The majority (38%) of the households are just within the poverty line earning Ksh. 6000 -15000 per month (about US$ 2-3 a day) while another 26% fall below the poverty line earning less than US$ 2 a day (Table 5). Only 3% earn above Ksh. 75,000 per month. With a majority of the Households falling within the poverty line, the county energy plans should consider pro-poor interventions (e.g., affordable technologies, subsidies, energy equalization funds) in efforts to transition to clean energy.

Table 5: Household Monthly Income

Household income	Percentage
Less than 5000	26%
6000-15000	39%
16000-25000	15%
26000-35000	7%
36000-45000	4%
46000-55000	5%
56000-65000	3%
75000+	3%

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The main income source for most households (36%) is farming/agriculture, followed by casual employment (29 percent). About 22% depend on small to medium enterprises. Only 12% of households interviewed are in formal employment, and this could mean that the informal sector is key to households' economy (Figure 9).

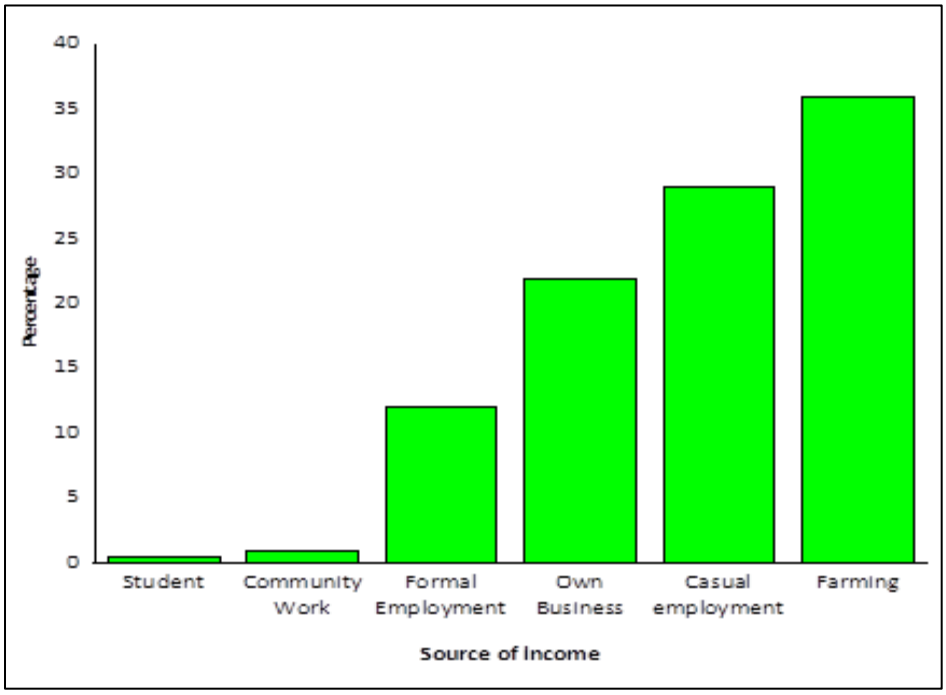

Figure 9: The household source of income

MEANS OF TRANSPORT

In Nakuru county, 12% of the residents use non-motorized forms of transport (bicycle and walking), whereas 79% of the population utilize public transport. This has implications on energy budget – with non-motorized and public transport potentially reducing energy footprints. The County has the potential to reduce energy footprints and promote a green economy/infrastructure through the transport sector.

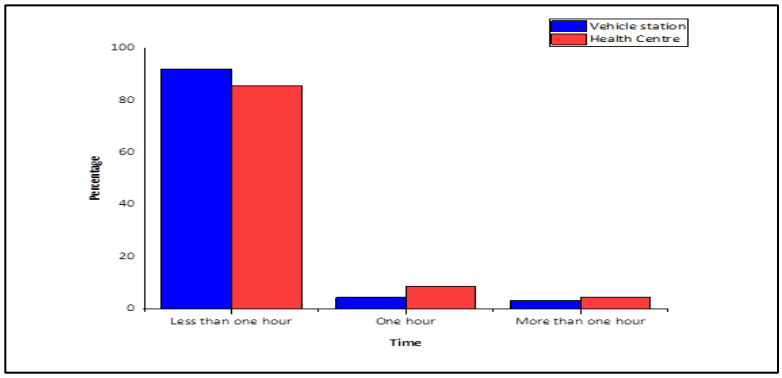

Figure 10: Time is taken to reach the nearest Health facility

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Table 6: Household means of transport.

Household Means of Transport	Percentage (%)
Own bicycle	4%
Walking	8%
Own Car	10%
Own motorcycle	12%
Public Transport	79%

HOUSE APPLIANCES

This study identified the various household appliances owned by residents that have both socio-economic and energy demand, access, and use implications. The owned items in the households can be used to assess the use of certain types of energy. Most residents in Nakuru County own a radio (83%), a television set (74%), and mobile phones (72%), amongst other electric appliances (Table 7). This is an indication of the wider energy needs of the Nakuru County residents beyond cooking and lighting.

Table 7: Household Appliances

Appliances	Percentage
Radio	83
Television	74
Smartphone/Tablet	72
Electric Iron	26
Laptop/desktop computer	19
Electric kettle	10

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Microwave	8
Heater	7
Fridge	4
Fan	3
Torch	2
Water dispenser	1
Washing Machine	1
Dishwasher	1
Blow-dry	1
Water Pump	1

ACCESS TO ELECTRICITY

Electricity is generally available in most parts of Nakuru County, with about 88.5% of the residents confirming that their areas are covered with the various on-grid and off-grid electrification initiatives. The national grid is the main source of electricity in Nakuru, with about 88% of the residents have their meters and connected to the national grid. While electricity infrastructure is available for most households, only about 64% of households are connected and able to use electricity in their households. Almost all the other 36% unconnected are willing to be connected to the electricity grid.

The 2009 population and housing census reveal that 34% of Nakuru households had access to electricity. There was an improvement in 2016 and 2017 to 54% due to the rural electrification and the last mile connectivity national programs. The world bank reports also reveal that the national electrification rate was estimated to be about 75% in 2018. The 64% reported in this study is relatively lower than the reported 75% reported by the International Energy Agency (IEA, 2019). This difference could because of the inability of some households to get connected despite the availability of infrastructure within their vicinity.

The connected households (64%) vary across the eleven (11) sub-counties. Access is generally high in the urban areas such as Nakuru town West (97.6%), Nakuru Town East (97.1%), Naivasha sub-County (76.6%). Similarly, the Peri-

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Urban Counties such as Subukia, Njoro, and Molo also have significantly higher electricity access at 69.6%, 69.2%, and 66.7%, respectively. However, the connection is relatively low for rural areas such as Kuresoi South (24.1%) and Kuresoi North (28.6%). More generally in Kenya, on average, 84% of the urban population have electricity access while 71.7% of the rural population have electricity access[4]. This implies that despite the reported increase in electricity access in Nakuru, this access is still unequal, with access mainly concentrated in urban areas while rural areas still having significantly low access. There is a need to focus on more interventions that could support connectivity in rural areas if the county achieves 100% electrification by 2030.

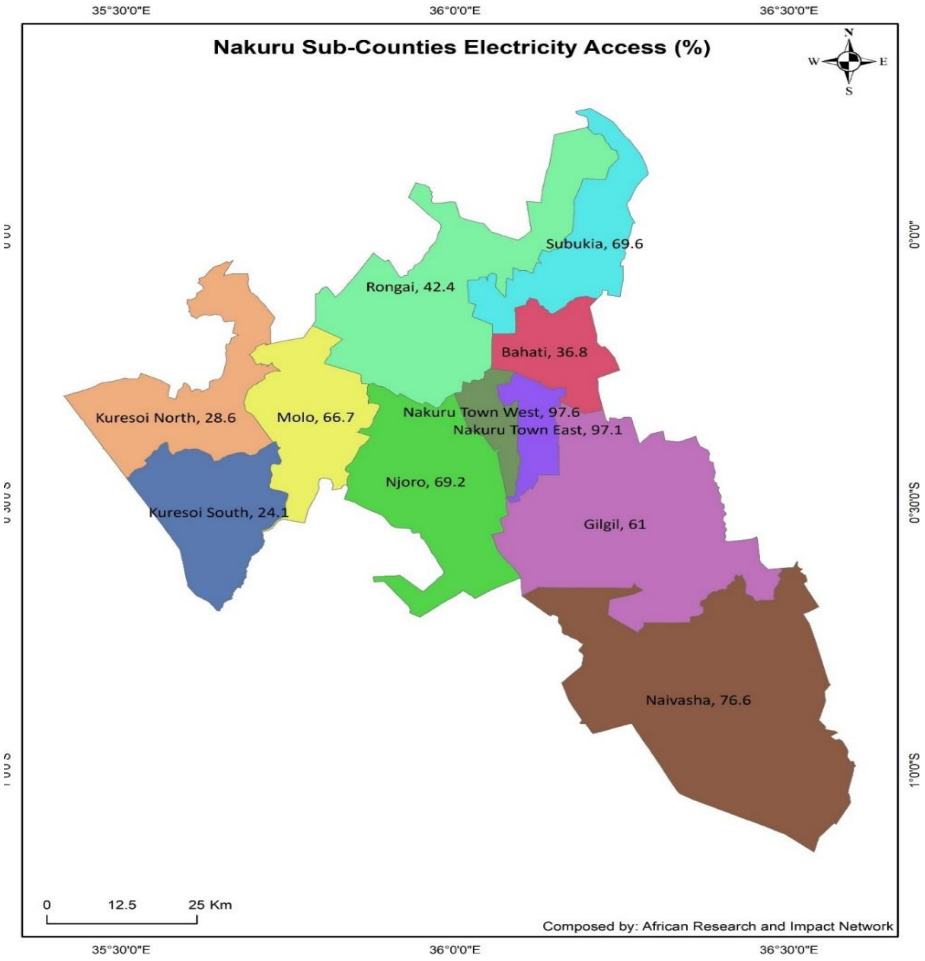

Figure 11: A map showing the Percentage of electricity Energy Access Per Sub County in Nakuru

[4] https://data.worldbank.org/indicator/EG.ELC.ACCS.UR.ZS?locations=KE

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The study explored the various reasons why 36% of households are not connected to electricity. Among the key reasons include high initial costs and lack of infrastructure, especially in the county's rural/remote parts (Table 8). Most households are unable to afford connections due to low-income levels/poverty. About 32.2% of households who are not connected cannot afford the initial connection fees. Simultaneously, some areas are difficult to access due to terrain and sparse population, thus presenting high distribution costs. About 62.2% of those not connected to electricity stated that the gridlines are not available in their areas.

Table 8: Factors that hinder connection to electricity

Constraints	Percentage %
The connection fee is expensive	32.2
Gridlines are not available near my area	62.2
The household does not like electricity	2.1
Delay in installation	4.2

USE OF ELECTRICITY

In Nakuru County, electricity is mainly used for daily lighting. Other uses such as cooking, heating, and cooling are still minimal but increasing as well. For instance, most households (32%) using electricity for cooking do so once a month. Simultaneously, there is relatively higher usage, 48% for daily heating (48%) and daily cooling (62%).

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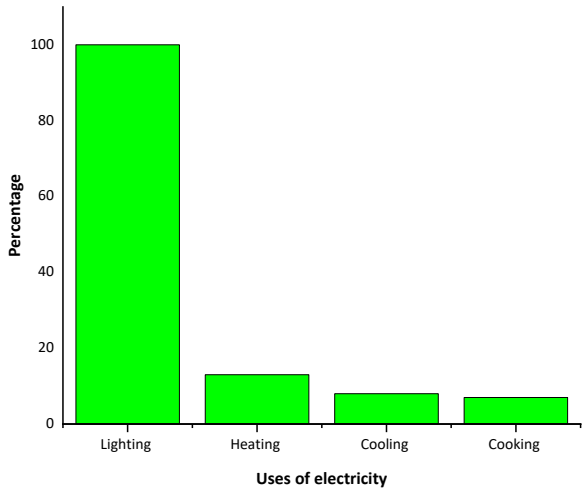

Figure 12: Uses of electricity.

Households provided various reasons for their use of electricity. The majority of the households use electricity for lighting because it's affordable, while for coo4king because it is available and easy to use. As for heating, ease of use is key for most households. Ultimately the affordability element of electricity is key in household's decisions around usage in Nakuru County.

Table 9: Factors that influence the use of electricity.

Attribute	**Use**			
	Lighting	Cooking	Heating	Cooling
It is affordable/cheap	42%	37%	15%	51%
It is easily available	37%	37%	27%	1%
It is easy to use	16%	21%	48%	4%
It is safer	6%	5%	9%	3%

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This study identified methods of payment of electricity, including pre-paid, postpaid, and private entity channels. The majority of those with their meters preferred the prepaid and postpaid methods, whereas a fairly big proportion of residents with shared meters preferred to pay a private person. A segment of postpaid users also uses the shared meter, as illustrated in the table below:

Table 10: Methods of payment for electricity by households

Electricity payment	Percentage (%)
I get it free	0.2%
I pay a private person	0.5%
Post-paid	23.4%
Pre-paid	37.3%

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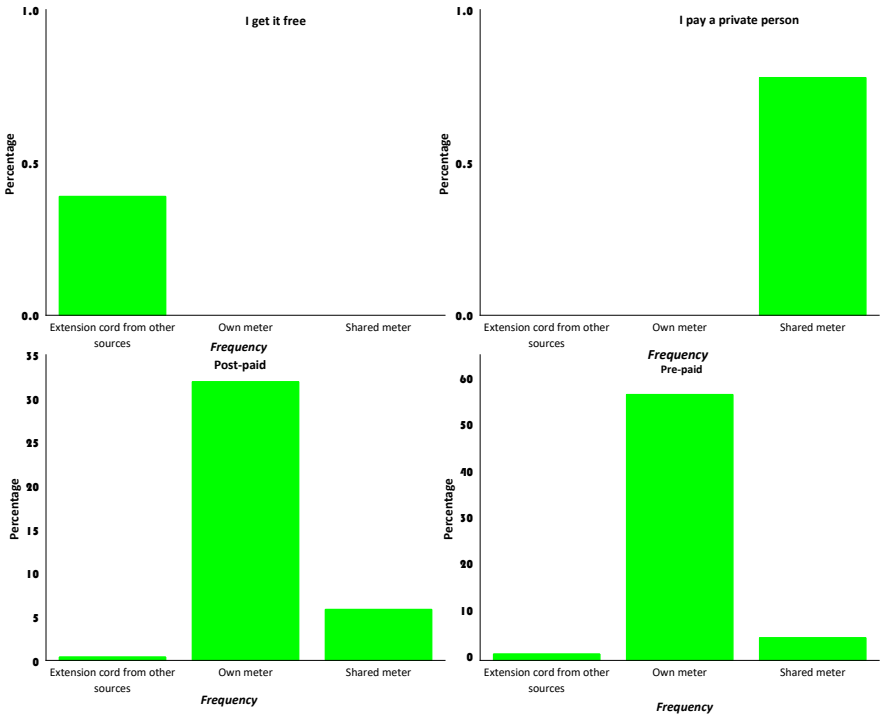

Figure 13:Electricty Payment modalities among Nakuru County Households

In terms of frequency for electricity purchase,[5] 56 % admitted buying electricity monthly, 21% buy only when they can afford it, whereas 6% and 17% buy on a daily and weekly basis, respectively. The purchasing power is largely defined by income levels and source of income. Averagely, households spend Ksh 1805 per month on electricity with a minimum of Ksh 50 and a maximum of Ksh 8000 per month

Table 11: Frequency of buying electricity.

Frequency of buying electricity	Percentage (%)
Daily	6

[5] The Frequency of buying electricity is defined here as the number of times those connected to the grid buy electricity for use – dictated by several factors such as affordability and amount needed.

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I buy when I can afford it	21
Monthly	56
Weekly	17

Additionally, 62% of the respondents with electricity acknowledged they had experienced a power outage. The power outage rate in Nakuru averages about 3.76 hours a day, leaving only 20.24 hours in a day with electricity (Maende & Alwanga, 2020). Other than outages, disconnections due to high bills are a major challenge, with about 51% of connected households having experienced power disconnection/suspension due to inability to pay bills.

Overall, the study on electricity access and usage show that Nakuru County has great potential to achieve 100% electricity connection due to its rich energy resource base. However, connection costs, reliability are key factors that cause inequalities in access and use of electricity, with most poor households unable to afford connections and sustained use. While lighting remains the dominant use, the potential to open up multiple usages, including clean cooking and other energy enterprises, could provide opportunities for clean energy transition and poverty alleviation in line with the SDGs. Pro-poor interventions need to be scaled up to enhance access and use, especially for the poor, and to avoid widening inequalities in access and benefits.

ACCESS TO CLEAN COOKING

The use of traditional biomass as a fuel for cooking is still common in Nakuru County, with 46% of households using this energy source. However, the uptake of gas stoves is also improving, and about 30% of households are using Gas (LPG) stoves (Table 12).

Table 12: Primary methods of cooking in Nakuru County

Primary Cooking method	%	Illustration
3 stone firesides (Firewood)	46%	
Biogas	1%	

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Energy-saving Jiko	4%	
Gas (LPG) stove	30%	
Traditional Jiko	19%	
Paraffin stove	0.3%	

The use of the traditional *Jiko* for cooking (19% of households) is still very common – in the County and more particularly in the rural areas where deforestation for charcoal production and biomass fuel is reportedly rampant.

Fuel stacking

The assessment further identified the current fuel stacking by comparing households' primary and secondary energy preferences for cooking. The results show that using three-stone cooking methods where the use of biomass, especially the firewood is still common, especially in rural areas, while charcoal jikos are dominantly preferred for secondary usage, i.e., complementing the secondary. However, the preferred primary cooking option is LPG gas stoves (Figure 14).

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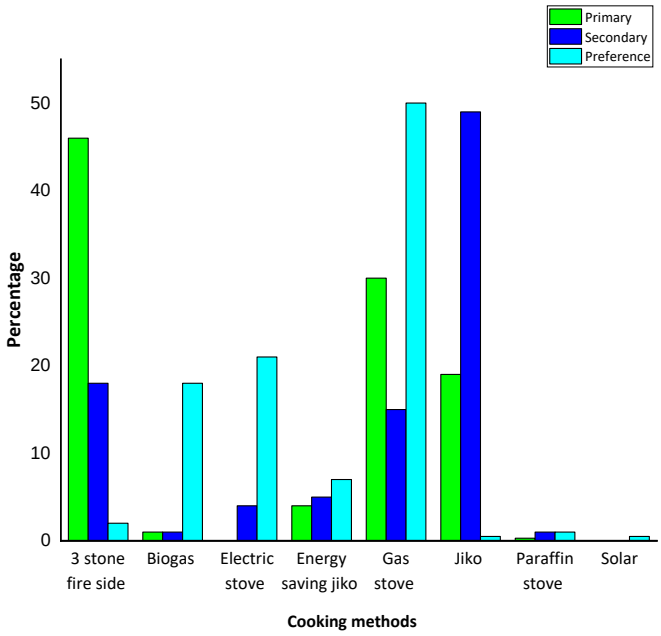

Figure 14: Primary, Secondary and preferred cooking Methods

USE OF FIREWOOD

Considering that the use of biomass fuel for cooking is still common amongst households in Nakuru, the study interrogated further on how the fuel is acquired. About 53% of households using biomass admitted that they fetch the firewood. The dominant use of fuelwood is mainly because it is affordable, i.e., easily freely collected, easily available, and accessible from the nearby forests. Most households spend less than 1-hour to get firewood for cooking (Table 13). About 24% of firewood-dependent households buy firewood at least once a week, while 19% of them do so either monthly or once in a while. The implication is that the majority do not actually buy firewood but instead freely access them in the nearby forests and/or bushes to access them. Even though LPG is also available, the cost of purchasing and transporting the cylinder is relatively higher for most households.

Table 13: Duration of firewood collection and frequency of purchase

Duration	Percentage (%)
1-2 hours	26%
3-5 hours	6%

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6 hours or more	4%
Less than 1 hour	64%
Frequency of purchase	
2 times a week	9%
3 times a week	14%
At least once every week	24%
Daily	16%
Once a while	19%
Once every month	19%

USE OF LPG

In this study, 90% of the respondent acknowledged that LPG gas is universally distributed in their area, even though only 54% of respondents use LPG gas. The LPG is predominantly used in the urban and peri-urban areas while users in rural areas do so occasionally as part of secondary fuel after biomass. A key factor impeding the use of LPG is the costs of purchasing, filling, and transporting the cylinders. About 57% of the residents felt that LPG is too expensive, while 27% of the households conceded that their households couldn't afford gas cookers and other appliances associated with LPG. The LPG cylinders are also not available in certain rural and remote parts of Nakuru thus hindering access let alone affordability. Overall, while the LPG provides an opportunity for clean cooking, several factors including costs, distribution as well as cooking culture hinder its adoption by certain households, especially in rural areas.

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Table 14: Factors that hinder or promote the use of LPG

Identified factors	Percent respondents (%)
Gas is not available in my area	7%
Household can't afford gas appliances	27%
The household does not like gas	3%
I don't know	1%
It is too expensive	57%
Prefer to use firewood	5%
Gas is not available in my area	7%
Why some households prefer to use LPG	
Easy to use	50%
Easily available	8%
Affordable	35%
Safer	7%

The majority of the respondents prefer to use LPG because it's convenient, while 35% prefer it for its affordability; 8% and 7% believe it is readily available and safe. To assess the LPG supply to the households in Nakuru, the study explored how the residents refill their LPG gas cylinders. The local shop vendors play a very significant role in supplying 68.2% of residents with LPG while the other 30.9% obtain their LPG from petrol stations. The other 1% uses supermarkets and independent suppliers to get their LPG. A majority of Nakuru County households buy their LPG every month, whereas 18% only buy the LPG when they can afford it. On average, most of the LPG household users in Nakuru County spend Ksh 1300 per month on LPG. This shows that strengthening the supply chain especially the retail suppliers and diversifying payment options could enhance the adoption of LPG, especially among rural households.

THE USE OF PARAFFIN

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The use of Paraffin seems not to be common in Nakuru, but some households still use it anyway. About 74.5% denied using paraffin; nearly 40% admitted lacking paraffin appliances and thus not using paraffin, while 27% attributed disuse due to its dangerous nature. Despite a lot of respondents, 81.25% admit to being aware of its availability within the county. There's a fairly good proportion of 15% saying they would prefer an alternative source of energy. Among those interviewed, only 8% cited cost as the reason for them not using paraffin.

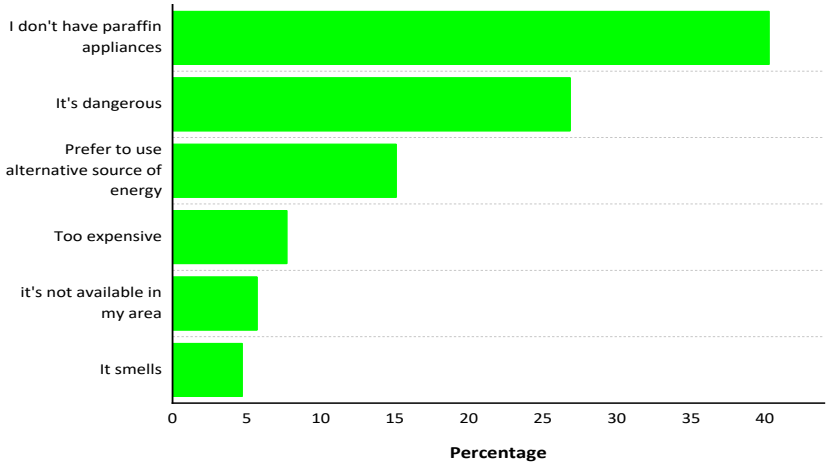

Figure 15: Reasons for Household preference not to use paraffin.

The study reveals that out of those using paraffin in their households, 63.73% use it for lighting while 36.27% for cooking purposes. On average, the respondents buy 46 liters with a minimum of 1 liter and a maximum of 800 liters in a month. The amount bought is dependent largely on how much they can afford (57%) and the quantity needed for various uses (37%).

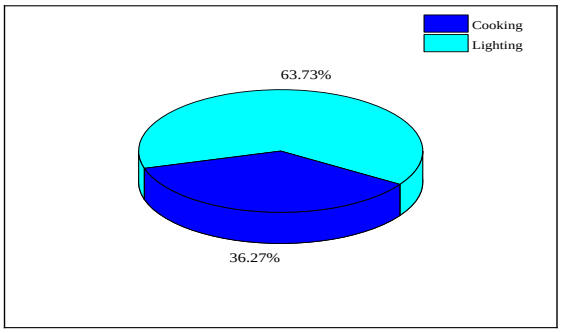

Figure 16: Uses of Paraffin.

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Paraffin use is largely labeled as a secondary/alternative fuel as many of those interviewed admitted to using it only when their charcoal is out of stock, during a blackout, and when the gas is depleted. About 29% of those using paraffin buy it monthly, 23% every week, while a significant 22% buy it when the need arises.

Table 15: Frequency of paraffin in the HHS

How often do you buy paraffin?	Percentage (%)
Daily	8%
I buy when I can afford it	13%
Monthly	29%
Weekly	23%
Bi-weekly	6%

About 69% of the respondents have been without paraffin because they did not have enough cash to purchase. On average, the respondent spends Ksh 464 on paraffin with a minimum of Ksh 45 and a maximum of Ksh 9000 per month.

OTHER SOURCES OF ENERGY

The assessment further interrogated the households the other possible sources of energy they would prefer to use if Grid-electricity isn't available in the area. This was to explore the preference of the households in Nakuru and awareness of the other alternative energy sources. A majority of the households would prefer Solar energy as an alternative energy source to that supplied by the national grid. About 80.9% of the Nakuru Households prefer the use of off-grid solar energy sources as an alternative while 18.04% and 1.03% of the households would prefer the use of generators and candles respectively as shown in the figure below. This shows the awareness of the potential of solar energy in the County and thus consideration to explore by the County.

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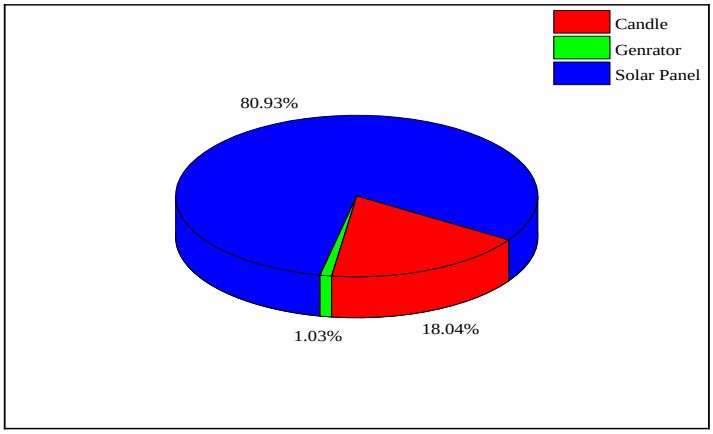

Figure 17: Other sources of energy used by the household

Preferred cooking options (i.e., desired options) The study also interrogated the preference of cooking methods in Nakuru County. Generally, most households (97%) are willing to transition to clean cooking options.

Most households (50%) in Nakuru County prefer LPG while 21% prefer to use electric stoves. The preference for a Gas stove is because it's readily available in the market and convenient for cooking. About 18% of households prefer Biogas' For cooking while paraffin, firewood, and traditional jikos, are less preferred even though they are currently common. Despite these preferences, many factors including accessibility, convenience, availability, affordability determine households' ability to adopt them. Nonetheless, the goodwill by households to embrace clean cooking options is an opportunity for the county to adopt interventions that address underlying socio-political factors impeding the ability to access these clean options.

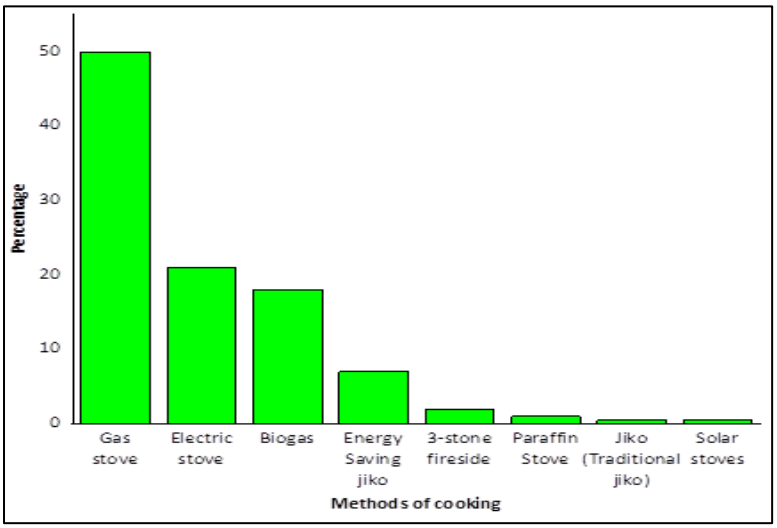

Figure 18: Preferred method of cooking

Since there are costs associated with the transition, the study further explored the households' readiness to spend towards the transition to clean cooking methods. About 55% of the household agreed to spend an amount less than

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their current fuel energy spending. Only 17% agreed to spend the current fuel cost on the transition, while 5% would be reluctant to spend any amount of money on the clean energy transition. This reveals that the transition to clean cooking energy should be less costly to most households compared to their current Expenditure on fuel stoves for cooking.

Table 16: Willingness to transition to clean cooking stoves

Willingness to transition	Percentage (%)
I don't know	1%
Disagreed	2%
Agreed	97%

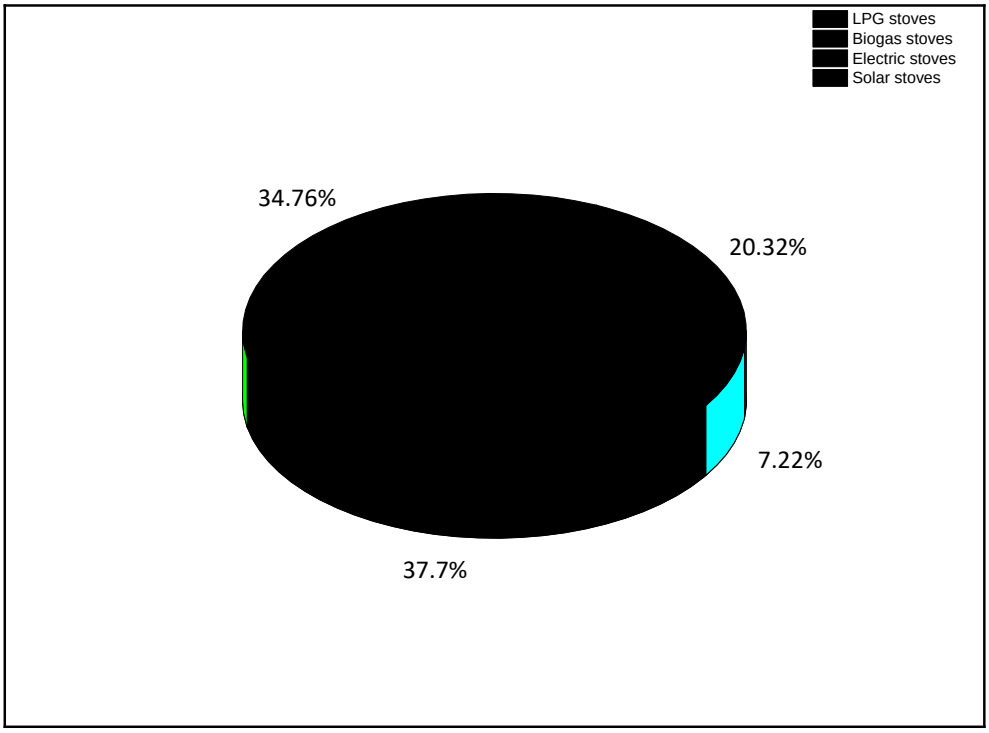

Figure 19: Preferred clean cooking options

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SUPPORT RECEIVED BY HOUSEHOLDS TOWARDS THEIR PREFERRED CLEAN COOKING/LIGHTING OPTIONS

While the residents of Nakuru County have not received the expected level of support in enhancing their access to clean energy, there are various ongoing efforts to support especially around awareness creation and empowerment especially by Community Based Organizations. Additionally, various sub-counties have benefited from emerging social entrepreneurship and business models such as pay-as-you-go mainly promoted by MKOPA- where households are allowed to pay for solar home systems in installments through mobile money savings. Community groups also receive cooking equipment e.g., improved Jiko, electric pressure cookers technical support especially from, from SCODE, KPLC, and Delight access. Additionally, Besides, Jiko Okoa Access CBO sensitizes the community on biogas energy-saving cooking stoves while Delight Access distributes energy-saving bulbs, support from the NAWASCO to communities. The Nakuru, Water and Sanitation Company (NAWASCO- Private Company) has also supported the community with briquette production machines utilizing wastes to produce briquettes for sale to households and institutions. The Modern Energy Cooking Services Programme (www.mecs.uk.org) has been supporting seed-grants (https://mecs.org.uk/challenge-fund/past-funds/) to CBOs such as SCODE to pioneer clean cooking innovation – including electric pressure cookers with various community groups. While the National level continues to drive the major energy policies including the last mile connectivity initiative, the county government legislative agenda is still evolving through renewable energy plans and strategies. There is nonetheless the need for the county government to closely engage with ongoing energy support initiatives – especially by the Non-Governmental Organizations to catalyze better coordination, policy incentives as well as synergies in activities.

C. SUMMARY OF ACCESS TO ENERGY INDICATORS

The above sections have provided a general assessment of energy status in Nakuru County focusing on electricity and clean cooking. This information can be standardized in the context of JRC indicators that are majorly parameterized by sustainability (SU), security (SC), and affordability (AF). The assessment has also considered other parameters such as acceptability by evaluating the households'' perception, attitude, willingness, and beliefs.

ACCESS TO ELECTRICITY INDICATORS

Table 17 outlines the indicator values for energy access via electricity. The overall indicator of access to electricity is identified, according to Pascua & Rivas (2018), as the Percentage of Population or Households having Access to Electricity (grid/off-grid) [%]. The access to electricity in Nakuru County has been increasing steadily in the last decade and now stands at 64% as per this study. This slightly differs from the reported 75'% which could have been based on the availability of an electricity grid in a particular area rather than actual connections. While many of the Nakuru County households still find it expensive and unaffordable to pay the installation fees, some other issues such as inaccessibility due to rough terrain and no power supply lines in some areas still exist. The specific data on electricity interruption in Nakuru are not easily available, but values can be derived from the national and regional estimates. From the previous assessment studies, Nakuru County experience about 4.7 days of electricity interruptions in a month. This estimation shows that electricity is available for an average of 20.24 hours a day in

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the County of Nakuru. The electricity sources in Nakuru County are majorly from renewable energy sources at about 93%. While the County is aiming to achieve universal access to electricity, more awareness and enabling environment are still required. Affordability remains a major impediment especially for the low-income earners but certainly, several underlying socio-cultural also impede adoption and use of electricity.

Table 17: Indicators of Energy Access – Electricity

INDICATORS		Value
Share of population or households with access to electricity (grid/off-grid) [%]		64%
Security (SC)		Value
SC2	Number of hours per day of available electricity [h/day]	20.24
SC3	The average number of electricity interruptions (unscheduled outages) per day [n°/day-n°/week]	1.175
SC4	Number of days without electricity per year [n°/year]	56.4
Sustainability (SU)		Value
SU5	Percentage of local electricity from Renewable Energy Sources RES [%]	93
SU6	Number of mini-grids and stand-alone systems [n°]	0
SU7	Laws and regulations in place for mini-grids/stands-alone systems [+/-]	Yes
Affordability (AF)		Value
AF8	Percentage of the population able to pay for electricity [%]	64
AF9	Percentage of expenditure of Public Buildings and infrastructures for electricity [%]	TBC
AF10	Financial and regulatory incentives for renewable energy in place [+/-]	Yes

ACCESS TO CLEAN COOKING INDICATORS

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Table 18 outlines the indicator values for clean cooking energy access. The indicators consider security, sustainability, and affordability of clean cooking energy. About 31% of the households have access to clean cooking energy (LPG, electric Cooking, Solar stoves) while 46% of households rely on biomass fuels (firewood). There is a high willingness (97%) to transition to clean cooking even though affordability remains a major concern for residents. While several CBOs and community initiatives are promoting awareness around clean cooking, this is relatively uncoordinated and characterized by duplication of activities. The role of the county government in strengthening the coordination of intervention could be upscaled to catalyze actions and build synergies. So far, the national government seems to be central in the energy policy agenda even though there is a huge potential for the county government to downscale national efforts to local levels. The County is already working on an overall energy strategy that will be informed by this assessment.

Table 18: Indicators of Energy Access – Clean Cooking

INDICATORS		Value
Percentage of population or households with clean cooking access [%]		31
Security (SC)		**Value**
SC2	Percentage of population/households relying on the traditional use of biomass for cooking [%]	46%
SC3	Percentage of population/households relying on LPG or other sources [%]	30%
SC4	Availability of resources: time or distance to gather fuelwood [h or km]	1-2 hrs
Sustainability (SU)		**Value**
SU5	Number of improved cookstoves used [n°]	40,164
SU6	Charcoal production in a sustainable way [Y/N]	Yes
SU7	Awareness and/or Education programs in place [Y/N]	Yes
Affordability (AF)		**Value**
AF8	Financial and regulatory incentives or subsidy mechanisms in place [Y/N]	Yes
AF9	Percentage of the population able to pay (or willing to) for the transition to clean cooking [%].	97%

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PUBLIC BUILDING ELECTRIFICATION STATUS

The SEACAP development requires an assessment of energy access in public buildings. While retrieving this data has been a challenge, the Nakuru County clean energy action plan 2018-2023 shows that 675 (96.4%) out of 700 public primary schools have been electrified using on-grid and off-grid (solar) connections spatially distributed as per Table 19. It is however worth noting that electrification in public buildings is yet to penetrate some rural Sub Counties, especially in Kuresoi North and South.

Table 19: Public electrification status

Constituency	Electrified		Completed awaiting commissioning	In progress	Newly identified sch.	Grand total
	Grid	Solar				
Bahati	37	0	0	0	0	37
Gilgil	56	1	2	0	3	62
Kuresoi North	65	6	3	1	0	75
Kuresoi South	70	0	3	0	0	73
Molo	69	5	2	0	1	77
Naivasha	74	3	2	1	1	81
Nakuru Town East	39	0	0	0	0	39
Nakuru Town West	28	0	0	0	0	28
Njoro	80	0	0	0	2	82
Rongai	94	0	0	2	0	96
Subukia	47	1	0	0	2	50
Total	**659**	**16**	**12**	**4**	**9**	**700**

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Table 20: Electrification status of main public and other public facilities in the county

Nakuru Sub-Counties		Kuresoi North	Kuresoi South	Molo	Naivasha	Nakuru town	Njoro	Rongai	Subukia	Total
Market Centres/ Trading Centres/ Villages/Beaches	Electrified	66	1	42	77	68	0	50	22	326
	Non-electrified	70	0	19	16	6	3	15	7	136
Secondary Schools/poly, institutions of higher learning	Electrified	82	0	65	58	55	0	47	45	352
	Non-electrified	0	0	2	3	0	6	0	0	11
Health Centres/ Dispensaries	Electrified	40	1	33	48	55	0	47	11	235
	Non-electrified	0	0	0	0	0	0	0	0	0
Administrative offices	Electrified	17	0	1	0	54	0	22	0	94
	Non-electrified	6	0	3	0	0	0	1	0	10
Police posts	Electrified	0	0	0	0	0	0	33	5	38
	Non-electrified	10	0	5	0	0	1	1	0	17
Water Projects	Electrified	17	3	8	7	27	0	17	3	82
	Non-electrified	1	0	10	6	0	1	1	0	19
Tea Buying Centres	Electrified	20	3	0	0	0	0	19	0	42
	Non-electrified	11	1	1	0	0	0	0	0	13
Factories/ Processing Plants	Electrified	3	0	0	0	0	0	0	0	3
	Non-electrified	0	0	0	0	0	0	0	0	0
Churches/ mosques	Electrified	48	1	0	0	50	0	110	33	242
	Non-electrified	0	0	12	0	6	0	16	6	40
Total	Electrified	293	9	149	190	309	0	345	119	1414
	Non-electrified	98	1	52	25	12	11	34	13	246
Cost of non-electrified facilities in KES M		196	2	104	50	24	22	68	26	492
Grand Total		391	10	201	215	321	11	379	132	1660
Electrification	Electrified	75 %	90%	74%	88%	96%	0%	91%	90%	85%
	Non-electrified	25%	10%	26%	12%	4%	100%	9%	10	15

Source: Nakuru County Clean Energy Action Plan 2018-2023

MAJOR CHALLENGES FACED IN ACCESSING ELECTRICITY AND CLEAN COOKING ENERGY BY HOUSEHOLDS IN NAKURU

Various households and community groups in Nakuru experience several challenges in their efforts to access electricity and clean cooking. Some of these challenges are more specific to household characteristics e.g. low-income levels as already enumerated above but other challenges are more organizational and policy-oriented:

- The cost of installation for energy such as electricity is expensive and thus most households especially in the rural poor cannot afford the initial installation fees and related appliances. Similarly, many households

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– especially in rural areas are unable to afford clean cooking equipment such as LPG cylinders in addition to costs of refilling and accessing such cylinders.

- Delayed connection to the National grid. Some parts of the county have experienced delays in the electricity connection than expected especially after submitting applications. This is common in rural areas where transformers are sparsely distributed. Ultimately, such delays disincentivize the goodwill to adopt and use electricity.
- Corruption in getting electricity access: Corruption, bribery, and mismanagement of power fund has delayed universal distribution of electricity. This has meant that some households – unable to get a fair chance of connection and power supply. This challenge is exacerbated by delays in settling the electricity bills, illegal connection, and vandalization of the equipment.
- Access to information and awareness creation is not inclusive especially on awareness campaigns and training to enlighten people on the benefits of improved cooking systems and transitioning to clean energy.
- Lack of clear strategy for enabling the transition to clean energy especially at the county government level. While there seem to be many opportunities to enhance transition, a county government-led strategy would help in coordinating, catalyzing, and linking local clean energy actions to broader opportunities. This is critical because the transition is not only a local agenda but a wider global agenda requiring wider support to happen.
- Focus on electrification mainly for lighting and leaving out cooking in most instances thus slowing down focus and investment in modern energy cooking services
- Inadequate or vague policy prescriptions and incentives on clean cooking create deficits in implementation, regulations, and a level of uncertainties.
- Deep-rooted social-cultural perceptions and acceptance built over histories of biomass dependency and intermediary socially promoted techniques such as cookstoves, among others.

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CHAPTER 4: OVERALL SUMMARY, GENERAL RECOMMENDATIONS, AND NEXT STEPS

The assessment above shows that Nakuru County has the potential to transition to universal clean energy access in line with the SDG 7. This is evidenced by the enormous renewable energy resources in the county as well as the willingness by residents to embrace clean energy options for a variety of uses including lighting, cooking, heating, cooling, and general energy entrepreneurship. The assessment shows that access to clean energy especially electricity and clean cooking is driven by several factors including geography, urban versus rural systems, policies, and household characteristics including income levels. While clean energy options including electricity infrastructure and LPG are available in most parts of the county, many households – especially in rural areas are unable to afford both the initial and operating costs. Even for those who have been able to connect to these options, the usage is relatively narrow mainly focused on lighting for electricity while LPG is largely used as a secondary source after biomass. This means that the full potential for clean energy is not yet exploited and there is a need for a more catalytic strategy that will open up technologies and innovation for households and institutions to embrace a full range of clean energy usage including entrepreneurship for poverty alleviation.

The assessment has also revealed the inequalities in clean energy access both inspired by income inequalities (as already highlighted above), developmental and geographical differences. Access to electricity in Nakuru is largely skewed towards urban and peri-urban areas enabled by infrastructure, affordability, and market demand.. . To address these inequalities, pro-poor and innovative strategies that explore a mix of grid and off-grid options could be useful. Additionally, the range of clean energy usage is constrained by reliability issues. Power outages, for instance, limit demand for electricity and associated uses e.g. electric cooking. Consequently, electricity is mainly used for lighting while other options remain relatively dominant. This calls for innovations that catalyze technological access to various electricity sources and usages. Promoting diversity of uses is a particularly critical part of the clean energy transition. The assessment indicates that clean energy transition is not only defined by access and connectivity but the ability to use clean energy. This presents a paradigm shift in global clean energy pursuit where the transition has largely been measured by access rather than sustained usage.

Overall, affordability, accessibility, and reliability are key elements that define the transition to clean energy. These three elements define the gap between clean and traditional energy options. Lack of any of the three elements means households simply revert to traditionally- more available options such biomass (wood fuel and charcoal) and at the same time, reduce the scope of clean energy usage i.e. using electricity for lighting only. Local authority or county-led Policies/strategies and actions that target to strengthen these and their linkages could be central to clean energy transition in Nakuru and beyond.

PRELIMINARY RECOMMENDATIONS

ii. Data availability on energy access is a major challenge that could impede clean energy strategies especially decisions on where to intervene. Data is largely under the custodian of different semi-autonomous institutions and is largely incomplete. Further, the data is neither well-coordinated nor properly archived and thus the difficulty in retrieval and sharing. It is highly recommended that an energy database for Nakuru and other Counties be created for such data to inform strategy, planning, and actions.

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iii. The energy matters are not fully devolved to the counties. The national government still plays major roles in the clean energy agenda yet there is a huge potential for the county to steer locally viable clean energy strategies and actions. Strengthening county-level energy strategies with clear implementable actions and linking these to national processes as evidence of what works or not is key in the energy transition. The SEACAP process is a step towards this direction and could be comprehensively embedded in ongoing county energy planning and legislative processes (see next steps).

iv. The assessment has also shown that different stakeholders promote clean energy in various ways including awareness, technical support, social entrepreneurship advocacy, among others. A dedicated stakeholder forum for Nakuru County could help spur dialogue and enable effective coordination and promote synergies in developing and operationalizing county energy plans.

v. Promoting diversity of uses is a particularly critical part of the clean energy transition. The assessment indicates that clean energy transition is not only defined by access and connectivity but the ability to use the clean energy itself. This presents a paradigm shift in global clean energy pursuit where the transition has largely been measured by access rather than sustained usage. There is a need for innovations that catalyze clean energy technological access and usage. For instance, beyond promoting household connectivity to the national grid, the County government can promote the use of electric cooking appliances for the residents to adopt cooking using electricity.

vi. Capacity building and systematic awareness are key to unlocking clean energy information and technologies for a wider segment of the Nakuru community. Currently, despite the many clean energy opportunities existing across the county, there are a lack of coordinated and sustained capacity building and awareness creation programs. The SEACAP development requires localized support to ensure the county can develop and handle the energy access programs, mobilize resources and enhance the efforts towards universal energy access as desired by the SDG7.

vii. Access to electricity in Nakuru is largely skewed towards urban and peri-urban areas enabled by infrastructure, affordability, and market demand. A national-level study on the adoption of modern energy cooking services (Atela et al., 2020) revealed that the prices of LPG, mainly, are high in Kenya compared to other countries and thus needs policy interventions to increase affordability. To address these inequalities and affordability concerns, pro-poor and innovative strategies that explore a mix of grid and off-grid options could be useful.

PROPOSED NEXT STEPS

This energy access assessment provides a robust basis for sustainable energy planning for Nakuru County. The assessment reveals some opportunities for action that may be pursued to link mainstream findings into policy actions. As such, we propose the following next steps:

a. Undertake consultative dialogue with the county departments to identify the legislative opportunities through which these findings can be ushered in. This includes but is not limited to the ongoing clean energy planning and strategy development by the county as well as the county climate action plan.

b. Provide technical support to the county to develop/update the specific energy policy/strategy drawing on the findings from this assessment

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c. Undertake capacity building on clean energy innovation and provide linkages with various opportunities pursuing the same.
d. Explore options for out-scaling the SEACAP model to other counties in close collaboration with the national government and related county energy planning initiatives.

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Useful Links

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ANNEXURES

a. Primary data collection questionnaire

DEMOGRAPHIC INFORMATION

1. Gender of the respondent

Male Female Prefer not to tell Transgender.

2. Education level?

Pre-school Primary Secondary Tertiary

3. **Age of the respondent**

18-24 years 25-34 years 35-44 years 45-54 years 55-64 years <65 years

A. HOUSEHOLD INCOME

4. Please select all relevant sources of income for your household

Formal EmploymenT Casual employment (Kibarua) Own Business Farming Other

5. How much is your household income per month (KShs)?

Less than 5000 6000-15000 16000-25000 26000-35000 36000-45000
46000-55000 56000-65000 66000-75000 75000+

6. Who is the main earner in the household?

Father Mother Child Grand-child Non-relativeOther

B. COOKING OPTIONS

7. What is the Primary cooking method used by the household?

Electric stove Gas stove Paraffin Stove Energy Saving jiko (Jiko Okoa)
Jiko (Traditional jiko) 3-stone fireside Briquette Biogas Other

8. What is the secondary type cooking method do you use in the household?

Electric stove Gas stove Paraffin Stove Energy Saving jiko Jiko (Traditional jiko)
3-stone fireside Briquette Biogas Other

9. If you had a choice, what will be your preferred method of cooking?

Electric stove Gas stove Paraffin Stove Energy Saving jiko (Jiko Okoa)
Jiko (Traditional jiko) 3-stone fireside Briquette Biogas

10. Are you willing to transition to the use of cleaner cooking stoves for cooking?

Yes No I do not Know

11. Which clean cooking options are you willing to transition to?

Solar stoves Biogas stoves LPG stoves Electric stoves Other

12. How much are you willing to pay to transition to a cleaner means of cooking (operation costs)?

Nothing Less than my current fuel cost Same as my current fuel cost
More than my current fuel cost Up to double my current fuel cost I don't know

13. Does your household collect firewood for cooking (or making fire)

Yes No

14. How often do you collect firewood?

Daily Several days in week Weekly Bi-weekly Monthly

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15. Does your household buy firewood for cooking (or making fire)

Yes No

16. How far do you travel to get your firewood (km)

17. How much do you spend in buying firewood per month

18. How long does it take you when you got out to fetch firewood

Less than 1 hour 1-2 hours 3-5 hours 6 hours or more

19. How often do you buy firewood (wood to be used for cooking)

Daily 2 times a week 3 times a week At least once every week

Once every month Once a while Never

C. ACCESS TO ELECTRICITY

20. Is electricity universally available in your area?

Yes No I don't know

21. Do you use electricity in your house?

Yes No

22. Why are you not connected?

The connection is fee expensive Gridlines are not available near to my area

The household does not like electricity

23. Are you willing to use electricity

Yes No

24. Do you use electricity for cooking?

Yes No

25. How often do you use electricity for cooking?

Daily 3-4 times a week Twice a week once time a week

Once time a month Not often I don't know

26. Why do you use electricity for cooking?

It is affordable/cheap It is easily available It is easy to use It is safer

27. Do you use electricity for lighting?

Yes No

28. How often do you use electricity for lighting?

Daily 3-4 times a week Twice a week once time a month Not often

29. Why do you use electricity for lighting?

It is affordable/cheap It is easily available It is easy to use It is safer

30. **Do you use electricity for heating**?

Yes No

31. How often do you use electricity for heating?

Daily 3-4 times a week Twice a week once time a week

once time a month Not often

32. Why do you use electricity for heating?

It is affordable/cheap It is easily available It is easy to use It is safer

33. Do you use electricity for cooling?

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Yes No

34. How often do you use electricity for cooling?

Daily 3-4 times a week Twice a week once time a month

Not often I don't know

35. Why do you use electricity for cooling?

It is affordable/cheap It is easily available It is easy to use It is safer

36. Where do you get your electricity supply?

National utility grid Own Renewable energy generation Local mini-grid

Diesel generator Gas generator

37. How is your household connected to electricity?

Own-meter Shared meter Extension cord from another source Own system

38. How do you pay for electricity?

Pre-paid meter Postpaid I pay a private person I get it free

I don't know

39. Have you ever stayed without electricity due to load shedding or technical faults from your electricity supplier?

Yes No

40. What amount of electricity do you get in a month for free (amount in units or kWhs)?

41. How often do you buy electricity?

Daily Weekly Monthly I buy when I can afford it I don't know

42. Is it the same amount every time?

Yes No

43. Have you ever been without electricity because you did not buy enough?

Yes No I can't remember

44. What determines how much electricity you buy?

How much I can afford How much I need Other I don't know

45. Has the electricity supply ever been suspended because the household did not pay the bill?

Yes No I don't know

46. **On average, how much money do you spend on electricity in a month (amount in local currency)?**

D. USE OF GAS IN THE HOUSEHOLD

47. Is gas (LPG) energy for cooking universally available in your area?

Yes No

48. Do you use gas (LPG) in your household?

Yes No

49. Which other type of gas do you use?

Biogas Natural gas otheR

50. Why don't you use gas?

The household does not like gas It is too expensive Household can't afford gas appliances

Gas is not available in my area I don't know

51. Are you willing to use gas?

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Yes No

52. What do you use gas for?

Cooking Lighting Heating Cooling Other

53. Why do you prefer to use gas?

It is affordable/cheap It is easily available It is easy to use It is safer

54. How often do you use gas?

Occasionally Not often I don't know Daily

55. Where do you usually buy your gas?

Petrol station Local shop vendor Other

56. How often do you buy gas?

Daily Weekly Monthly I buy when I can afford

On average how much money do you spend in a month on gas?

E. USE OF PARAFFIN IN THE HOUSEHOLD

57. Is paraffin available in your area?

Yes No I don't know

58. Do you use paraffin in your household?

Yes No

59. Why don't you use paraffin?

Too expensive It smells It's dangerous I don't have paraffin appliances

it's not available in my area I don't know what it is Other

60. Are you willing to use paraffin in your household?

Yes No I don't know

61. What do you use paraffin for?

Cooking Heating Lighting

62. How much do you buy each time (Amount in liters)?

63. What determines how much paraffin you buy?

How much I can afford How much I need Size of the container

64. How often do you buy paraffin?

Daily Weekly Monthly I buy when I can afford it Other

65. Have you ever been without paraffin because you did not buy enough?

Yes No

66. Besides money issues, have you ever not had paraffin in the household?

Yes No

67. On average, how much money does the household spend a month on buying paraffin (Kshs)?

F. Enabling Support

68. What support do you receive from other agencies towards electricity/cooking energy access?

69. What are the main challenges you face in accessing energy for lighting (electricity) and cooking?

70. Which other source of energy do you use?

Solar Panel Wind Other

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