ROADMAP TOWARDS 100% RENEWABLE ENERGY

UNIVERSAL ACCESS TO RELIABLE AND AFFORDABLE 100% RENEWABLE ENERGY FOR SUSTAINABLE DEVELOPMENT IN KISUMU COUNTY BY 2050

Kisumu County, Kenya

ICLEI Local Governments for Sustainability

100% RENEWABLES CITIES & REGIONS ROADMAP

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

This 100% Renewables Roadmap for Kisumu County, Kenya, is the culmination of the work under the 100% Renewables Cities and Regions Roadmap project. It represents the final outcome of an extensive consultation process, beginning with securing political commitment and engaging relevant stakeholders, and progressing through data collection and energy systems modelling to provide a feasible pathway towards 100% renewable energy use. This roadmap document outlines the local strategies, implementation mechanisms and recommendations for the local government to realise this vision.

AUTHOR

Ms Sayuri Chetty, ICLEI Africa Secretariat

CONTRIBUTORS

Dr Azizat Gbadegesin, ICLEI Africa Secretariat
Ms Carine Buma, ICLEI Africa Secretariat
Ms Stéphanie Canac, ICLEI Africa Secretariat
Ms Sharin Govender, ICLEI Africa Secretariat
Ms Kanak Gokarn, ICLEI World Secretariat
Mr Rohit Sen, ICLEI World Secretariat
Mr Laban Okeyo, County Government of Kisumu
Mr Nickson Bukachi, EPRA
Ms Enna Folkerts, ICLEI World Secretariat
Ms Andreina Garcia Grisanti, ICLEI World Secretariat

DESIGN

Ms Olga Tokareva, ICLEI World Secretariat
Ms Jarita Kassen, ICLEI Africa Secretariat
Ms Widaad Pienaar, ICLEI Africa Secretariat

ABOUT 100% RENEWABLES CITIES AND REGIONS ROADMAP PROJECT

The 100% Renewables Cities and Regions Roadmap project facilitates the energy transition by raising local awareness on renewable energy sources, showcasing how local and national governments can create coordinated enabling frameworks and policies, exploring access to public and private sector finance, and building local renewable energy projects to address electricity, heating and cooling.

The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded by the International Climate Initiative (IKI), which is implemented by the Federal Ministry for Economic Affairs and Climate Action (BMWK) in close cooperation with the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the Federal Foreign Office (AA).

ABOUT ICLEI – LOCAL GOVERNMENTS FOR SUSTAINABILITY

ICLEI – Local Governments for Sustainability is a global network working with more than 2,500 local and regional governments committed to sustainable urban development. Active in 125+ countries, ICLEI influences sustainability policy and drives local action for low-emission, nature-based, equitable, resilient and circular development. ICLEI's members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

COPYRIGHT

CONTACT

ICLEI – Local Governments for Sustainability e.V.
Kaiser-Friedrich-Str. 7
53113 Bonn | Germany
Tel. +49-228 / 97 62 99-00
sustainable.energy@iclei.org
www.iclei.org

ICLEI Africa Secretariat
Sable Park, Century City
Cape Town | South Africa
Tel: +27 21 202 0381
iclei-africa@iclei.org
www.africa.iclei.org

CONTENTS

ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
BAU	Business as usual
CBO	Community-based organisation
CCAP	Climate Change Action Plan
CEP	County Energy Plan
CGK	County Government of Kisumu
CIDP	County Integrated Development Plan
EE	Energy efficiency
EPPs	Emergency power producers
EV	Electric vehicles
FiTs	Feed-in tariffs
GDP	Gross domestic product
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent power producers
KPLC	Kenya Power and Lighting Company
LED	Light-emitting diode (bulbs)
LPG	Liquified petroleum gas
MLG	Multi-level governance
NDC	Nationally Determined Contribution
NMT	Non-motorised transport
NPAG	National Project Advisory Group
PAYG	Pay as you go
PIT	Project implementation team
PPF	Project preparation funding
PPP	Public-private partnerships

PV	Photovoltaics
RE	Renewable energy
REP	Rural Electrification Programme
SDG	Sustainable Development Goals
SWH	Solar water heaters

A MESSAGE (FOREWORD) FROM THE SECRETARY GENERAL OF ICLEI

Our cities are home to over half of the world's population, are responsible for over two-thirds of global energy consumption, and produce over 70% of carbon dioxide emissions. The role of subnational governments as key actors and sites of transformation throughout the energy transition cannot be overstated. They are at the frontlines, dealing with both the challenges and opportunities of reducing emissions and making their communities more resilient against the impacts of climate change.

GINO VAN BEGIN

Secretary General of ICLEI – Local Governments for Sustainability

Renewable energy can contribute significantly to both these goals. The journey to 100% renewable energy is not an easy one, and we commend the bold ambition of the cities and regions that have undertaken it under the 100% Renewables Cities and Regions Roadmap project, notably Avellaneda in Argentina, Kisumu County in Kenya, and the Province of West Nusa Tenggara in Indonesia. Through their roadmaps, each has charted its own path towards creating a renewables-based energy system that serves the needs of their respective communities, while contributing to global efforts to tackle the climate emergency.

The goal of 100% renewable energy demands bold action to match the level of ambition. It is more than a technological shift—it is a systemic transformation of how we live and relate to our planet, requiring placing sustainable energy systems at the core of our planning efforts while remaining conscious of the socio-economic realities of our communities. Each of the roadmaps developed through the project symbolize what can be achieved when subnational governments become dynamic leaders in the shift towards renewable energy.

It is important to note that this journey cannot be undertaken alone—forging new and lasting partnerships with various stakeholders is critical for turning ambition into reality. Working closely with national governments through improved multilevel governance can help create national frameworks that enable subnational governments to succeed.

We celebrate these cities and regions for taking on a leading role in the sustainable energy transition. Through their efforts and experience, they inspire other cities and regions to set ambitious renewable energy targets and drive climate action at the local and regional level.

PREFACE FROM CEC DEPARTMENT OF ENERGY, ROADS, TRANSPORT AND PUBLIC WORKS, COUNTY GOVERNMENT OF KISUMU

Kisumu County has been on the forefront in driving decentralization and acceleration of energy access through a journey that begun in 2013 on sustainable local governance. Since devolution, energy policy path of the energy sector in Kenya has been governed by the National Policies including Energy Act, 2019 that consolidated all the laws relating to energy and provided for National and County Government functions. However, Counties have different energy resource mix that calls for development of County specific policies, strategies and action plans to harness their immense potential.

We are proud to be the first County in Kenya to achieve deep-dive preparation of the 100% Renewable Energy Roadmap under the 100%RE Project. This work was accomplished as a result of extensive consultation and commitment of a proactive Project Implementation Team (PIT) comprising of representatives from National Government Agencies, Development partners, County Technical Officers, CSOs as well as community members. The process leaves behind an empowered team with capacity to drive the next frontier in realizing the potential of the County and other local governments in the energy investment space.

Key areas of focus within the roadmap include; - solar power development, electric mobility, clean cooking, and harnessing biomass and are pegged on sustainability, circular economy and energy efficiency across all sectors.

HON. SALMON ORIMBA

CECM - Energy, Transport, Roads & Public Works

Implementation of this roadmap will require intensive project preparation and development to unlock climate finance and encourage investors, facility providers, developers and other multinationals to invest in Kisumu County. The reason we are calling on our stakeholders to continue supporting us in various ways and capacities as we accelerate decentralized energy access for sustainable local governance. We wouldn't ask for more apart from imploring further linkages to enable us achieve the targets within our roadmap - short term 2030, long term 2050.

Together we can achieve this!

Hon. Salmon Orimba
CECM - Energy, Transport, Roads & Public Works

KISUMU COUNTY'S 100% RENEWABLES VISION STATEMENT 2050

Setting an energy transition vision is an important first step in creating a narrative that broadly articulates the County's future goals. It further provides strategic direction and outlines the County's commitment to a pathway of 100% renewable energy (RE).

An initial Visioning workshop was held in November 2020, which set the foundational work for setting the vision for the County. A Community visioning, Target setting and Action planning workshop held in February 2022 further validated the initial vision statement that Kisumu County agreed on, as mentioned below:

Vision 2050

To achieve universal access to reliable and affordable 100% RE for sustainable development in Kisumu County by 2050.

EXECUTIVE SUMMARY

The 100% Renewables Cities and Regions Roadmap (100%RE) Project aims to support local governments in developing ambitious strategies, policies and actions to support sustainable development and energy security. It also aims to drive the transition to 100% RE in cities and regions in three selected countries – Argentina, Kenya and Indonesia. Kisumu County was chosen as a deep-dive city in Kenya in 2019. As the project's main beneficiary, the county has received technical assistance for long-term planning and developing a 100% Renewable Energy (RE) Roadmap to guide the transition to RE in the three main energy demand sectors, i.e., electricity, transport and clean cooking. The 100% RE Roadmap was designed in a participatory and collaborative manner and led by Kisumu County with the support of national governmental, industry, civil society, academia and finance actors.

As key steps before developing the roadmap, the project team established a baseline where the National Energy Situational, Stakeholder Analysis and Initial Energy Status Report were developed. Following that, land-use categorisation, geographic information system (GIS) mapping and modelling of the energy system of Kisumu County were undertaken. Key findings from these reports form the foundation for the roadmap and are described and integrated in the subsequent sections of the roadmap below. As the next steps, the 100% RE vision, principles and values, objectives, goals and indicators, actions and enabling conditions were co-identified and agreed upon during various workshops, engagements and meetings with the Project Implementation Team (PIT), National Project Advisory Group (NPAG) and other key sector stakeholders.

The energy system modelling, carried out by the Fraunhofer Institute for Solar Energy Systems (ISE), provides an overall framework for the roadmap and demonstrates the possibility of reaching 100% RE by 2050 in all the energy scenarios evaluated. Solar photovoltaics (PV) is the main electricity source in the two most feasible scenarios with a share of 90-98%, biogas supply at 2% in both scenarios, while hydropower supplies 8% in the hydropower fixed scenario and is not utilised in the least-cost scenario.

The roadmap is structured into three parts: the context, roadmap and implementation mechanisms. With the context above presented in the first part, the second and third parts of the roadmap suggest three pillars for accelerating the transition to a RE system, based on the three focal energy demand sectors of electricity, transport and clean cooking. Goals and targets have been suggested based on the County's mandate, as well as echoing national ambitions. The roles and responsibilities of various stakeholder groups needed to meet these targets have been presented. The second part concludes with an overview of political/regulatory, economic/financial and cultural/educational barriers hindering the transition.

Next, the third part of the roadmap focuses on implementing actions for each of the three pillars. For the electricity pillar, there are seven specific actions to be undertaken. The transport pillar involves implementing six actions, and the clean cooking pillar will see the implementation of three actions. This encompasses a brief description of each action, followed by its policy linkages, required resources, implementation strategies, economic, social and environmental benefits, identified risks, and the stakeholders needed to put the particular action into play. Financing is a critical part of implementing all projects, energy inclusive. Therefore, this roadmap ends by highlighting various financing options tailored to some of the actions proposed herein and a monitoring and evaluation framework. The report is concluded with a summary of relevant local policy recommendations (as presented in the Local Policy Review and Recommendations report) to support the implementation of the actions.

PART 1

CONTEXT

INTRODUCTION

Climate scientists have advised that this is the decade to act and steer the world towards a net-zero or near-net-zero future as far as possible to avoid some of the most devastating effects of climate change. Avoiding or prolonging mitigation action will only be more costly in the end and will further compound the current development and service delivery issues experienced by cities. It will also reduce the developmental gains made over the years. According to the 2022 report from the Intergovernmental Panel on Climate Change (IPCC), it is still within reach to limit global warming to the critical threshold of 1.5°C/2.7°F. However, the precondition is urgency, and that we undertake transformational action in all sectors. It is also well known that the Global South, particularly Africa, will disproportionately bear the brunt of the effects of climate change. Consequently, cities must prioritise sustainable solutions and leverage the abundant RE resources as part of their climate action towards the Paris Climate Agreement and build their climate resilience.

The 100% Renewables Cities and Regions Roadmap project is a global initiative supporting local and regional governments with their energy transitions by developing local RE strategies, raising local awareness on RE sources, showcasing how governments can create coordinated enabling frameworks and policies across multiple levels of government, exploring access to public and private sector finance, and developing local RE projects to address the electricity, heating and cooling, and cooking sectors. The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK) through the International Climate Initiative (IKI).

This roadmap is the result of a culmination of several activities under the 100% RE Cities and Regions Roadmap Project. It serves as an overarching plan to guide the 100% RE transition for the Kisumu County Government in Kenya. This roadmap aims to describe the pathways, critical steps, targets and actions necessary to achieve the goal of a 100% RE system by 2050, according to the vision of Kisumu County. Figure 1 provides an overview of the steps that formed the development of the roadmap:

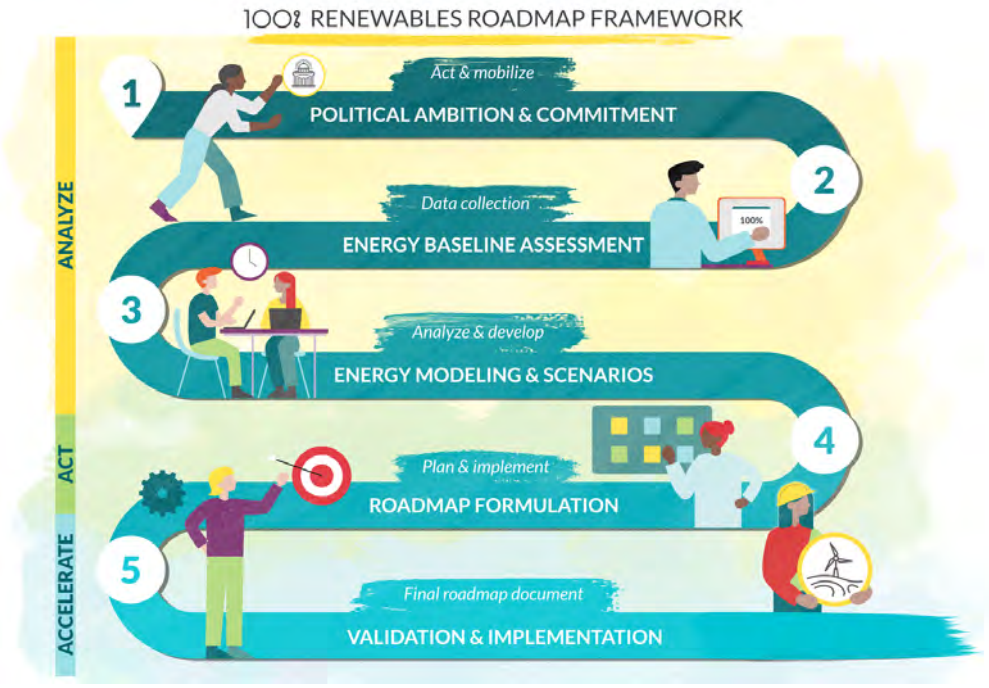

Figure 1: The 100% Renewables Cities and Regions Roadmap Framework

The roadmap is structured into three parts. The first section provides an overview of the key characteristics and statistics of the County, providing the context for the roadmap development. The second section describes the pathway for the 100% RE transition in detail, and the last section covers some of the implementation mechanisms of the roadmap.

KISUMU COUNTY OVERVIEW

LOCAL CONTEXT

LOCATION AND COUNTY BOUNDARIES:

Kisumu is a vibrant port city in western Kenya that borders Lake Victoria. It is the third largest Kenyan city after Nairobi and Mombasa, comprising 2086 km^2 of land and 567 km^2 of water (County Government of Kisumu (CGK), 2018). Neighbouring counties include Vihiga County to the northwest, Nandi County to the northeast, Kericho County to the east, Nyamira County to the south, Homa Bay County to the south, and Siaya County to the west.

Figure 2: Location of Kisumu County, Kenya (Source: Initial Energy Status Report, Kisumu County, Kenya, 2020)

POLITICAL STANDING:

Kisumu County, number 42 out of 47 counties, was established in 2010 through the devolved system of governance established by the Constitution of Kenya (Buma, 2020). It has seven sub-counties and 35 wards, and the capital of the county is Kisumu City (CGK,2018).

Kisumu County is one of the focal cities in Kenya's Vision 2030. It has been designated specific roles and is expected to receive the necessary support to facilitate the implementation of the plan accordingly (CGK, 2020).

POPULATION AND DEMOGRAPHICS:

According to the 2019 Kenya Population and Housing Census, Kisumu County was estimated to have a population of 1.15 million residents, 51.5% of whom were female and 48.5% male (Kenya National Bureau of Statistics, 2019). There are around 300,745 households in Kisumu, with an average of three people living together per household, similar to the national average. The majority of people in Kisumu live in rural areas (61,8%), with a high poverty rate (48%) (CGK, 2019a).

ECONOMIC ACTIVITIES:

Kisumu is well-placed as a commercial hub. Out of the 47 counties in Kenya, Kisumu County contributes an average of 2.6% to Kenya's GDP every year and is ranked seventh nationally, according to a KNBS report, 2023.

The city is also well connected for transport and freight, with a reliable road network and water gateway and is home to the Kisumu International Airport (CGK, 2018; CGK, 2020).

Kisumu is rich in agricultural land and fisheries, and the main economic activities are subsistence farming,

livestock keeping, fishing, rice farming, sugar cane farming, small-scale manufacturing and trading. There are also activities around apiculture, quarrying and sand harvesting, sugar processing, cement, ballast and lime production, food processing, bottling, handicrafts, and boat building, amongst others (CGK, 2018; CGK, 2020).

Kisumu also has several tourist destinations such as wildlife attractions, heritage and cultural sites, museums and the blue economy around the lake (CGK, 2018; CGK, 2020).

Figure 3: Aerial view of a section of Kisumu County

CLIMATE AND WEATHER CONDITIONS:

Kisumu has a tropical climate with rich biodiversity, varying topographical landscapes and ecosystems which contribute to sustenance, opportunities for social and economic development and regulatory environmental services (CGK,2019b). The mean annual temperature is 23°C, with a maximum annual temperature between 25-35°C and a minimum temperature between 16-18°C. January and February are dry, hot months. Average annual rainfall varies from 1,000-1,800 mm during the longer rainy season from March to May and 450-600 mm during the shorter rainy season from September to November (Buma, 2020). Altitude variation (between 1144-1525 metres above sea level) across the county also influences rainfall and temperature patterns (CGK, 2018).

ENVIRONMENTAL CHALLENGES AND CLIMATE CHANGE:

Kisumu often experiences torrential downpours and is prone to flash flooding, which is further exacerbated by inadequate drainage systems and water storage in the County. In addition, natural disasters, further compounded by climate change and the unsustainable use of land, contribute to land degradation and soil erosion (CGK, 2018).

While Kisumu is endowed with Lake Victoria, one of the largest freshwater lakes in the world, together with two major river systems, the Nyando and Sondu-Miriu rivers, and seven permanent rivers in its catchment, the unfortunate paradox is that water is still scarce. As a result, water shortages and access to water challenges persist, impacting electricity production from hydropower systems. In addition, Lake Victoria often experiences an overgrowth of hippo grass and water hyacinth, which poses further environmental, economic and social problems (CGK, 2018).

Air and noise pollution are issues for the county, which are mainly derived from the industrial sector (CGK, 2018). Although the transport industry is not considered a major emitter at the moment, it can become one, especially considering the recent spike in the use of private vehicles and the lack of regulations for emission standards for vehicles (CGK, 2020).

With regards to waste, the county generates around 5,720 tons of solid waste daily. Unfortunately, only 25% of this is collected for disposal at the Kachok open dump site. Despite this, it is estimated that most of the waste generated is organic and can be beneficiated (CGK, 2018).

ACTORS AND STAKEHOLDERS

The Roadmap for Kisumu County was co-developed by various stakeholders, including county authorities, national government agencies, private sector players, civil society, academia and trade associations. Table 1 below describes the roles of these actors and stakeholders who were involved in the roadmap development process.

Table 1: 100% RE Cities and Regions Roadmap project participants and their roles

Category	Interested Party	Roles and Responsibilities
Operators	• Kenya Power and Lighting Company (KPLC) • KenGen	• Members of the National Advisory Group provided strategic guidance and input where necessary
Companies and organizations	• Expertise France • Netherlands Development Organisation (SNV) • GIZ Kenya • Fraunhofer ISE • GIS Limited	• Service providers or actors in the space doing complementary work • Involved in workshops • Provided input into the various project activities and their outputs
Trade Associations	• Clean Cooking Association of Kenya (CCAK) • Kenya Association of Manufacturers (KAM)	• Involved in workshops, provided input into the various project activities and their outputs
Civil society and representativegroups	• KEYO Women's Group • Suswatch Kenya	• Provided input into the various project activities and their outputs
National Government Ministries/Agencies	• Ministry of Energy and Petroleum (MoEP) • National Treasury • Rural Electrification and Renewable Energy Corporation (REREC)	• NPAG members • Provided oversight and strategic guidance and input into the various project activities and outputs where necessary
Local authorities	• CGK, Department of Energy, Roads, Transport and Public Works • Nakuru County • Mombasa County	• Primary beneficiary and partner of the project. Provided input into the development of the project activities and co-created outputs • Implementer of the roadmap • Nakuru and Mombasa were network cities who contributed to various workshops
Regulators	• Energy and Petroleum Regulatory Authority (EPRA)	• NPAG members • Involved in workshops, provided strategic guidance and input where necessary

Implementation	• ICLEI World Secretariat • ICLEI Africa • CGK, Department of Energy, Roads, Transport and Public Works	• Implementing agents of the roadmap project
Academia and research institutions	• Maseno University • Kenya Industrial Research and Development Institute (KIRDI)	• Participated in workshops, provided input into the various project activities and their outputs

KISUMU COUNTY'S BASELINE STATUS

This section defines the baseline of the county's energy system, greenhouse gas (GHG) emissions, policies and perceptions of the PIT according to the Initial Status Report[1] published in October 2020, which compiled the status quo before project implementation. Due to some initial data gaps, baseline information will be used from other available data sources and referenced accordingly.

STATUS OF THE ENERGY SYSTEM

ELECTRICITY MIX AND GENERATION CAPACITY:

At the national level, Kenya has an impressive share of RE already in the electricity mix. As of 2024, this was recorded at 84.93% with contributions from wind (14.3%), solar (3.54%), geothermal energy (44.55%) and hydropower (22.5%), with 2.8 GW of installed capacity (Energy and Petroleum Regulatory Authority, 2024). KenGen, the national utility, owns the majority of generation assets (74%), independent power producers (IPPs) own 26% and a smaller portion is owned by smaller entities such as the emergency power producers (EPPs) and the Rural Electrification Programme (REP, Government of Kenya). In addition, contributions are also imported from Uganda (UETCL), Tanzania (TANESCO) and Ethiopia (EEPCO), with regular export of electricity as well.

At the county level, an energy access assessment undertaken as part of the County's integrated climate change action plan development reported that 85.9% of grid-connected electricity is generated from RE sources, with several households using off-grid solar energy as well (CGK, 2022). The electricity generation assets located in Kisumu County include two hydropower plants and one thermal power plant owned by KenGen. Three sugar factories in the county also produce electricity from bagasse (with an installed capacity of 21 MW) for their own consumption, and one gas turbine that replaced the decommissioned Aggreko thermal power plant in 2016 (see Annexure 7.1).

ENERGY CONSUMPTION AND DEMAND SECTORS:

As of 2021, Kenya's total annual energy consumption amounted to ~192.6 TWh from the electricity, transport and heat sectors (International Energy Agency, 2021). Of this, electricity accounted for ~9.7 TWh. In terms of electricity access in the country, 2018 reports suggest that 13 million people did not have access in Kenya, constituting 25% of the population. Increasing electrification is considered a national priority, and universal access to clean and sustainable energy for all (especially access to electricity and clean cooking) is echoed in many national and local policies and plans. Considering that most citizens have access to electricity in Kenya and that there is already a high percentage of RE in the generation mix, a special focus needs to be on increasing the uptake of modern and clean cooking solutions, both at the national and local county level.

As with most sub-Saharan African countries, access to clean cooking is still challenging for Kenya. According to the 2019 national census, the main cooking fuels used in the country were firewood (55.1%), liquefied petroleum gas (LPG) (23.9%), charcoal (11.6%) and paraffin (7.8%). To a much smaller extent, electricity (0.9%), biogas (0.5%) and solar (0.2%) were utilised by residents for cooking. In 2010, the extensive use of polluting fuels for indoor cooking in Kenya was linked to approximately 14,300 premature deaths due to indoor air pollution.

Kenya's transport system depends on road, air, rail and water modes of transport for trade and the movement of people, and is the country's largest consumer of petroleum products (GIZ, 2021). With regards to transport, as of 2018, 3,280,934 cars were registered in Kenya.

At the local level, Kisumu County recorded a peak electricity demand of 1,926 MWh in February 2020, with 235,287 customers connected to the grid (52.6%). In addition, 282.1 MWh of the energy demand goes for street lighting. Most grid-connected households use electricity for lighting, while others use paraffin and solar energy. As reported in the CIDP (2018-2022), the County had a target to increase on-grid and off-grid electrification to 90% by 2022.

Due to the low variation in temperature range, the county has minimal need for heating and cooling. If heating is required, it is traditionally generated from wood and oil. Even though Kisumu is designed for motorised traffic, many residents use non-motorised transport (NMT) and public transport (CGK, 2018). However, according to the Baseline Emissions Inventory Report conducted in 2021, transport was shown to be the largest contributor of GHG emissions at 84.92% and 7,845,864 $MtCO_2e$ (CGK, 2022).

[1] Initial Status Report: https://www.kisumu.go.ke/wp-content/uploads/2021/02/Initial-Status-Report_Kisumu-County_8-February.pdf

IDENTIFIED STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS

Some of the main strengths, weaknesses, opportunities and threats that were identified to directly or indirectly influence the outcomes of the project are summarised in Table 2 below. They were proposed during the various workshops and meetings held with stakeholders since the beginning of the 100% RE project.

Table 2: SWOT analysis (Source: Adapted from the Initial Energy Status Report, Kisumu County, Kenya, 2020)

Strengths	Weaknesses
• Kenya and Kisumu County are both naturally endowed with rich RE resources • At a national level, there is already a strong national policy landscape, which is enabling for the transition • Kisumu County's progressive approach to energy development • Kisumu County has a dedicated department in charge of matters related to energy within the county – the Department of Energy, Roads, Transport and Public Works	• Challenges with data availability for baseline GHG emissions per sector, as well as robust, up-to-date data for the county's energy sector in general • Some of the procurement processes are complicated at the national level and require capacity at the county level to undertake • Appropriate tariffs to enable storage (bulk vs retail tariff and/or time of use) do not currently exist • Energy efficiency (EE) is not currently optimised in Kisumu County • While Kenya has a strong national policy landscape, there are some gaps between national legislation and county level understanding of their mandates with regard to energy. For example, counties are responsible for reticulation, but are usually concerned with street lighting and not typically energy generation • County's low budget allocation for RE and climate change projects (<1%)
Opportunities	**Threats**
• Peer exchange with Nakuru and Mombasa to assist them with developing their own transition pathways, energy plans and bankable projects • Counties can use their County Integrated Development Plans (CIDPs) to align with national policies • Kisumu has unstable power supply, even for those grid-connected, who want solar systems to overcome this • Need to generate more power locally in the county to reduce losses and increase supply stability • Multitude of social, environmental, good governance and economic benefits of the 100% RE transition • Current solutions for increasing energy access are expensive – RE provides a cheaper and decentralised alternative. Kisumu County can lead other Kenyan counties in developing policies supporting "green" buildings	• Insufficient financial and human resources to implement the various strategies and actions identified • Resistance from entrenched interests (e.g., fossil fuel producers/users, large utilities, etc.) • Low affordability of sustainable energy technologies and solutions • More pressing socio-economic development priorities that might divert capacity/attention away from sustainable energy solutions • Low uptake of solar home systems due to prior experience from using substandard solar products

EMISSIONS BASELINE AND BASELINE SCENARIO

The Ministry of Environment and Forestry reported that Kenya contributed less than 0.1% to global GHG emissions in 2018, which amounted to around 61 million tCO_2eq (Kenya Ministry of Environment and Forestry (2019). On 28 December 2016, Kenya submitted their Nationally Determined Contribution (NDC) and aimed to reduce GHG emissions by 30% by 2030 relative to the BAU scenario (143 $MtCO_2eq$). This was increased to 32% in 2020. Some of the priorities in terms of mitigation include increasing the share of RE in the generation mix, using sustainable energy technologies, reducing biomass fuel use and shifting to low-carbon transport systems. Adaptation is a priority for Kenya, and many of the proposed programmes and initiatives will have mitigation co-benefits as well.

As per the 2021 baseline emission inventory (BEI) that was undertaken as part of Kisumu's integrated climate action plan, the assessment found that the transport sector was the highest contributor, with 84.92% (7,845,846 tCO_2e) of total emissions. The stationary energy sector followed with 11.95% (1,103,251 tCO_2e), waste contributed 2.69% (248,345 tCO_2e), and agriculture, forestry and land-use (AFOLU) practices contributed less than 1% at 41,856 tCO_2e [31].

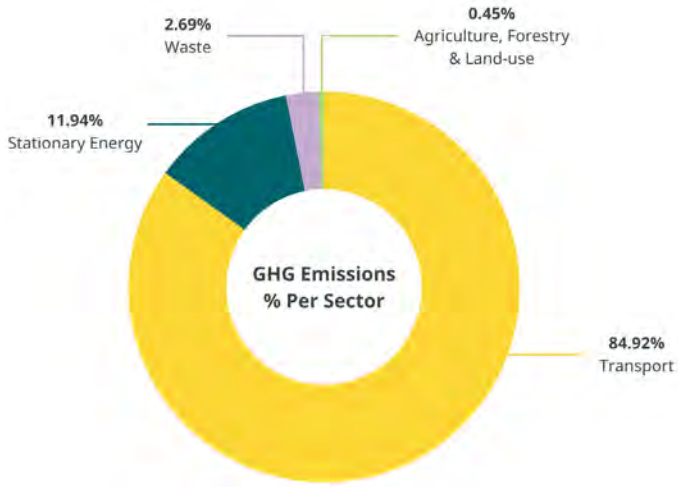

Figure 4: Overview of the GHG emissions per sector for Kisumu County (CoK, 2022)

Under stationary energy, residential buildings contributed the most emissions. Firewood usage (74.30%) and charcoal (20.90%) were amongst the top contributing fuels in residences, with smaller amounts from kerosene, LPG and electricity usage. The second highest emitter was the commercial buildings sector which assessed emissions for micro, small and medium enterprises and commercial offices. Charcoal (54.7%) and firewood (44.9%) were the highest emitters for this sub-sector, with the remaining fuel constituting LPG (see Annexure 5.2a, 5.2b). In the Kisumu County Integrated Climate Change Action Plan (KCICCAP), the emissions' reduction target scenarios in 2030 and 2050 respectively project emissions will reduce by 50% and 80% in the Stationary energy, Transport, and AFOLU sectors, while the Waste sector will reduce by 50% and 85%, by 2030 and 2050 respectively.

KISUMU COUNTY'S RENEWABLE ENERGY POTENTIAL

According to the 2018 CIDP II, Kisumu County residents utilise electricity and thermal energy from traditional fuel sources such as firewood, charcoal, kerosene, LPG, biogas and solar power. However, the county has not fully tapped into the potential of RE in general, particularly solar PV.

RESULTS FROM THE INITIAL ENERGY STATUS REPORT AND GIS MAPPING AND MODELLING REPORT

In addition to the identified resources in Kisumu as presented in the 2018 CIDP II, further RE potentials were also estimated for the purpose of the energy system modelling for Kisumu County. This was based on GIS mapping. A GIS data assessment was conducted by GIS Limited in 2021 to generate shapefiles of land use, land cover and building footprint. The results were synthesised in the modelling report and showed eight different land cover types identified in Kisumu County (see details in Annexure 7.3). These categories of land were used to assess the RE generation potential of the county and to serve as input data for the county's energy modelling exercise.

SOLAR PV

The land area deemed suitable for free-field solar PV was land that was covered by herbaceous vegetation and bare/sparse vegetation. Of the 785.8 km^2 covered by herbaceous vegetation and bare/sparse vegetation, it was estimated that 20% of this land could be used for free-field solar with a total installed capacity of 15,716.26 MW. Further, all buildings in the county were mapped and assessed for the potential space for solar rooftop PV. This was estimated to be around 20.65 km^2, of which 25% is deemed suitable in each cardinal direction to consider the variation in roof angles and elevations. As a result, approximately 1.0325 km^2 can be utilised in the county for rooftop PV with 206.5 MW worth of installed capacity. This is considered to be a conservative estimate, as rooftop potential is likely to be much higher upon detailed site identification and assessment. Installing solar PV in cropland can also be pursued. This is referred to as agri-voltaics, where certain crops can thrive under solar PV panels (those that usually require some shading for optimal growth). However, the potential for this was not assessed.

WIND

Assessing wind speed data for Kisumu showed that commercial wind power plants could not be operated feasibly. Some sites could have the potential for smaller wind power plants. However, the feasibility of this highly depends on the specific conditions at the chosen site. As a result, the potential of wind could not be included in a model that depicts the whole of Kisumu.

BIOGAS

Several biomass feedstock options were evaluated to understand the potential of biogas in the county. Between 40-50% of the crop residues from different types of crops cultivated in Kisumu can be used – the rest of it plays an important role in agriculture and cannot be used. As a result, the total primary energy of the biogas that can be produced from crop residues is 24,516 MWh. In addition, manure from livestock results in a biogas potential of 464,575 MWh.

SUSTAINABLE FIREWOOD

Currently, the rate of firewood use in Kisumu is not sustainable as it contributes to deforestation. Based on the current forest area in Kisumu, the amount of wood that can be used sustainably was deemed to be 2,469 m^3 per year.

BAGASSE

In Kisumu, sugarcane is cultivated and processed into sugar. Bagasse and ethanol are produced as by-products and can be used as fuels.

Figure 5 shows a summary of the RE potentials for each technology used in the energy modelling exercise for Kisumu County. The largest potential, with 89.4%, is from solar PV, including rooftop and free-field potentials.

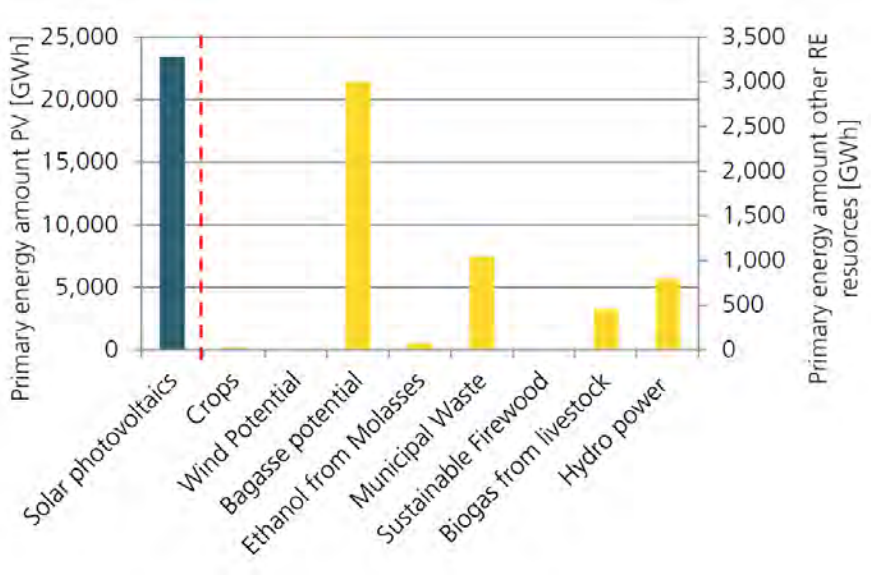

Figure 5: Renewable energy potentials of energy resources in Kisumu County (Source: Energy System Modelling Report, 2022)

KISUMU'S 2050 SCENARIOS

In order to determine whether a 100% RE future was possible for Kisumu County, modelling[2] of the energy system was undertaken by Fraunhofer ISE using the KomMod simulation software. Computer-aided modelling allows for robust results, taking into consideration the effects of variable RE, storage, the increased prominence of sector coupling and so forth. The modelling exercise was performed in hourly time steps to ensure supply security and included all relevant demand sectors. In the specific case of Kisumu County, these included heating and cooling, electricity demand, and cooking demand in households and the commercial sector, as well as energy demand for transport on land. All relevant demands were evaluated and projected to the year 2050 in different demand scenarios.

RE potentials were calculated based on GIS data, statistical data, and secondary data from studies, and downscaled from national data in cases where no specific data for Kisumu County was available.

TRENDS

All relevant energy demand sectors (i.e., electricity, energy for cooking demand, transport) were included in the scenarios. For the transport sector, only road traffic is considered, and cooling demand was assumed to be part of electricity demand. Based on extrapolations, downscaling of national data, comparison with similar cities and using a variety of sources, the electricity demand for 2050 (excluding electrified transport, which is addressed separately) in the reference case is 2,137 GWh. In the low-demand scenario, electricity demand in 2050 is 1,402 GWh, and in the high-demand scenario, it is 4,104 GWh. For Kisumu County, the projected electricity demand is between 689.2 and 2,017.6 kWh per capita, depending on the demand scenario in 2050.

OVERVIEW OF ALL 100% RE SCENARIOS

Seven different 100% RE scenarios were modelled by varying the energy demand, fuel price of biogas, the fixed usage of different RE technologies (i.e., full available potential is used) and heating demand. In addition, a BAU scenario was modelled to allow the comparison of costs and carbon dioxide (CO_2) emissions. The BAU scenario, as well as the two leading scenarios viable for the county, are presented in Table 3 below.

Table 3: Overview of some modelled scenarios – BAU and two leading scenarios (Source: Adapted from the Energy System Modelling Report, 2022)

		Variables				
#	**Scenario name**	**Fuel price (low/med/high)**	**Demand (low/mean/high)**	**Full usage of potentials fixed**	**Heating demand**	**Share of RE (%)**
1	Business-as-usual	Low	Mean	-	No	48.1
2	Hydropower fixed	Low	Mean	Hydropower	No	100
3	Least cost	Low	Mean	-	No	100

The results clearly illustrate that a BAU mode of operation will not yield the intended goal of a 100% RE future for Kisumu County by 2050. However, though all seven other modelled options show that a transition to 100% RE is possible (see Energy System Modelling Report), two scenarios in particular, i.e., "hydropower fixed" and "least cost" are considered in further detail. The least cost option considers that technologies are installed and operated under the premise of minimising the total system costs under the given boundary conditions. On the

[2] Energy modelling report: https://www.kisumu.go.ke/downloads/

other hand, the hydropower fixed scenario is a scenario where the full usage of hydropower potential is utilised. This is considered 0.2% more expensive than the least-cost option and can, therefore, be rated as an equal option.

The results of the modelling showed that solar PV, both free-field and rooftop installations, present the most significant potential for energy production for Kisumu. This is followed by energy from bagasse, municipal waste, hydropower and biogas derived from manure and crops. Wind power, however, is not viable as wind speeds in Kisumu are rated too low. While geothermal energy has high potential in some parts of Kenya and is a focus technology of the national government, there is no potential for this technology in Kisumu. As solar PV is the main electricity supply technology in all scenarios, it is recommended that its deployment be pushed forward. Prices are already competitive with other power plants today, and solar PV can contribute to the electrification of remote areas due to its decentralised applicability. It is recommended to install free-field PV systems to aid the transition due to the ability to choose an optimal tilt angle. In contrast, the tilt and angle on rooftop PV systems are dependent on the rooftop elevation and orientation. It is nevertheless recommended that rooftop PV be installed on suitable roofs.

It is important to note that while the energy systems modelling provided a potential scenario of what 100% RE in Kisumu County could look like, it did have some limitations. Notably, the modelling accounts for local demand as well as locally available RE sources. Imports and exports are only included should there be a shortfall in the local energy supply. As such, the Roadmap considers not only the fact that there is a high RE potential in Kisumu County and that Kisumu could theoretically meet its energy demand using only local resources, but that grid electricity in Kenya (which is almost 85% renewables-based) will also be important, particularly considering Kenya's goal of achieving 100% clean electricity by 2030. Therefore, the measures outlined in the Roadmap focus more on transitioning existing energy demand towards electricity and RE sources. This also highlights the importance of national-local coordination.

100 % RE PATHWAYS FOR KISUMU

This section briefly describes the selected scenarios in which Kisumu County can attain 100% RE and the rationale for the selection.

The annual energy demand for the two leading scenarios (hydropower fixed and least-cost) is 9,700 GWh. Solar PV is the main electricity source in both scenarios with a share of 90-98%, biogas supplies 2% in both scenarios, while hydropower supplies 8% in the hydropower fixed scenario and is not utilised in the least-cost scenario. Energy demand for cooking is mainly covered with electric stoves (79-84%), although it is the more expensive cooking technology. However, biomass and biogas potentials are too low and hence are not sufficient to cover energy demand for cooking. Table 4 below breaks down the percentage share of each technology in the two leading scenarios for the electricity sector.

Table 4: Leading scenarios with their comparative RE contributions and generation capacity for the electricity sector (Source: Adapted from the Energy System Modelling Report, 2022)

Technology	Hydropower fixed scenario		Least-cost scenario	
	% share	Generation capacity (GWh pa)	% share	Generation capacity (GWh pa)
Solar PV	90%	9,389 GWh pa	98%	10,397 GWh pa
Biogas	2%	223 GWh pa	2%	239 GWh pa
Hydro	8%	834 GWh pa	0%	0 GWh pa

With regards to cooking demand for Kisumu County, this is primarily met with electric stove technology, covering between 79-84%, while the rest of the demand is covered with ethanol stoves (13%), wood stoves (1%) and biogas stoves (7%). Potentials for ethanol, wood and biogas are fully utilised as these cooking types are cheaper than electric cooking, but these potentials are small. Table 5 captures this below.

Table 5: Leading scenarios with their comparative RE contributions and generation capacity for the clean cooking sector (Source: Adapted from the Energy System Modelling Report, 2022)

Technology	Hydropower fixed scenario		Least-cost scenario	
	% share	Generation capacity (GWh pa)	% share	Generation capacity (GWh pa)
Ethanol stoves	13%	47 GWh pa	13%	47 GWh pa
Wood stoves	4%	1 GWh pa	4%	1 GWh pa
Biogas stoves	7%	26 GWh pa	7%	26 GWh pa
Electric cooking	84%	302 GWh pa	79%	284 GWh pa

Figure 6 below illustrates the share of different drivetrain concepts for the different vehicle types. The lowest-hanging option to transition would be motorcycles since these are already in the market and are much cheaper than electric cars. Since motorcycles can be used for short distances, it is not immediately necessary that a robust network of charging stations is required. The next vehicle type to be electrified is cars, followed by trucks and then buses. Hydrogen production is set to begin in 2032 and can then power vehicles. It is important to note that for transport, a collaborative solution must be pursued at the regional or national level in order to maximise the impact on the transport sector in Kisumu County.

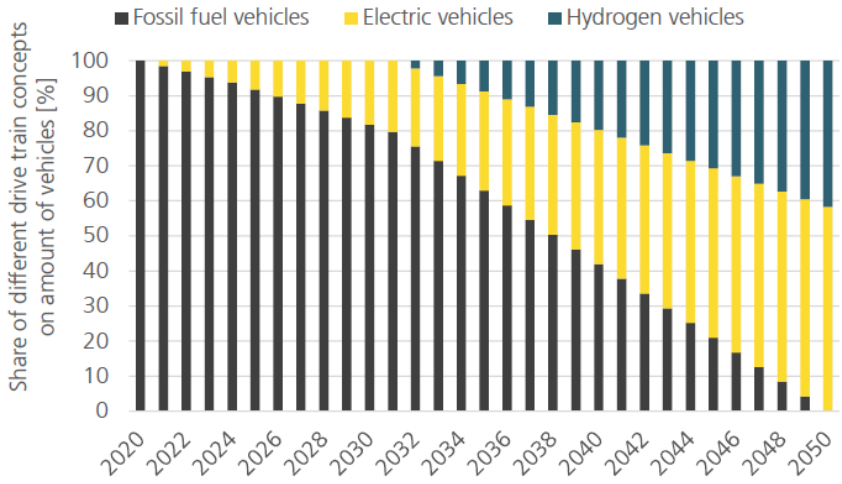

Figure 6: Projected drivetrain concepts until 2050 for all vehicle types (Source: Energy System Modelling Report, 2022)

The hydropower fixed scenario has a higher variation of RE technologies, which makes for an interesting option. It also considers a medium energy demand, making it a more realistic/safer scenario that also provides room for industrialisation and economic growth. In addition, this option considers utilising existing generation assets in which investments have already been made. For these reasons, the transition path is mapped against this scenario.

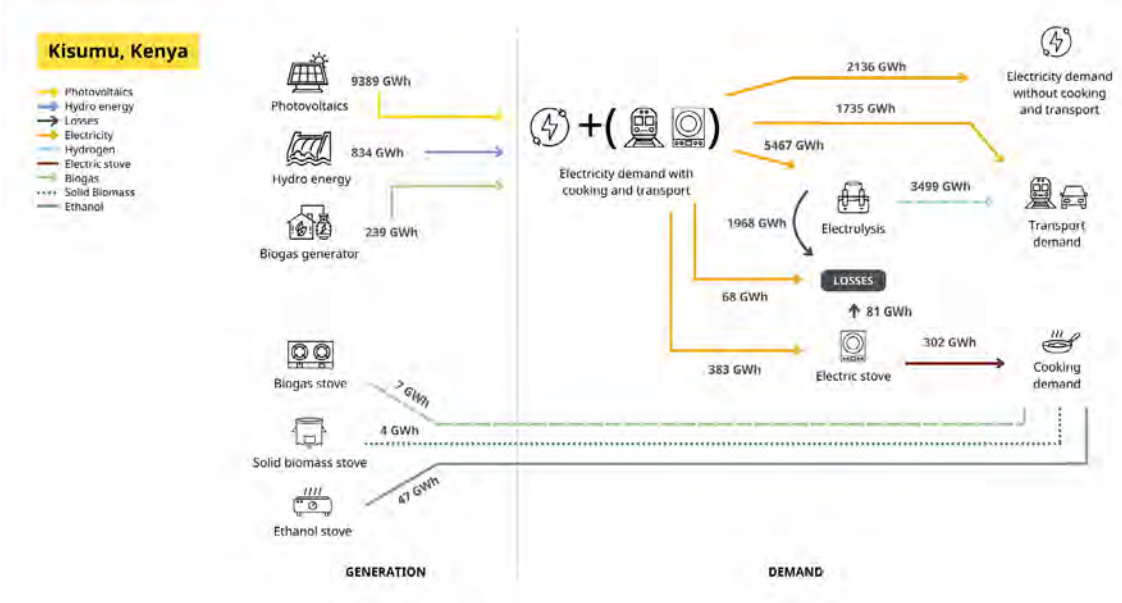

Figure 7: Energy flow diagram for the hydropower fixed scenario (Source: Energy System Modelling Report,2022

PART 2

ROADMAP

The principles which have guided the Roadmap development process and act as the fundamental premise for all the actions included herein are:

- Improving the social and economic welfare of Kisumu County citizens
- Promoting industrialisation and economic growth supported by sustainable energy resources
- Environmental protection and climate action
- Co-development, inclusive participation and robust stakeholder engagement
- Process and whole-system approaches to energy thinking
- Science-based decision-making for climate protection
- City leadership and bold decision-making

PATHWAYS FOR THE TRANSITION TOWARDS 100% RE IN KISUMU COUNTY

A number of engagements and workshops were held from 2019-2023 in order to collectively develop the vision, targets and actions as part of the roadmap. These are developed in line with the above principles and are described in further detail in the subsequent sections.

Vision 2050

Overall vision:

To achieve universal access to reliable and affordable 100% RE for sustainable development in Kisumu County by 2050

Sector targets

Electricity supply and access target:

- By 2050, 100% of electricity generated in Kisumu County should be from RE sources, from solar PV, hydropower, biomass (waste-to-energy e.g., from water hyacinth, bagasse, etc.), including enablers such as green hydrogen
- All stationary energy demand is met through RE technologies and enablers by 2050

Transport:

- By 2050, eliminate the use of fossil fuels in the road transport sector of Kisumu County through the use of NMT, electric vehicles and green hydrogen technology

Clean cooking target:

- By 2028, achieve 100% access to clean cooking technologies in Kisumu County by using electric stoves, efficient biogas and ethanol stoves, briquettes, solar cookers and energy-saving stoves for the residential and commercial sectors and other institutions

Intermediate milestone(s)/interim targets
Electricity supply and access target: • To increase the share of RE in the current mix from 84.93% to 100% by 2050 • 90% of energy generated from RE sources (solar PV, hydropower and biomass) by 2030 • To increase the access to electricity from 52.6% to 100% using RE for all residents in Kisumu County by 2030 • Increase access to energy from 52.6% to 90% by 2025 • To streamline and improve EE in Kisumu County by 2030 • To improve EE by 18% by 2025 compared to a baseline year of 2020 **Transport:** • 100% sustainable transport through NMT, public transport and e-mobility by 2050 • 60% sustainable transport by promoting NMT, public transport and e-mobility by 2030 **Clean cooking:** • 100% adoption of clean cooking methods using electric stoves, efficient biogas and ethanol stoves, briquettes and energy-saving stoves, and solar cookers for the residential and commercial sectors and public institutions by 2028 • 70% adoption of clean cooking methods using electric stoves, efficient biogas and ethanol stoves, briquettes and energy-saving stoves, solar cookers and LPG stoves for the residential and commercial sectors and public institutions by 2025

ROLES AND RESPONSIBILITIES

In order to begin implementing the Roadmap in Kisumu County, a range of stakeholders across society at the national and local levels, within the private sector, and academia need to be onboard and committed. The table below lists the main actors and stakeholders foreseen to be involved in the deployment of the Roadmap, along with their roles and responsibilities.

Table 6: Roles and responsibilities for different stakeholder groups for the roadmap implementation

Category	Interested party	Roles and responsibilities
National authorities	• MoEP • National Treasury • REREC • Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works	• Support with planning and implementation • Collaborate on special projects for implementation of actions • Support with capacity building, awareness raising and upskilling/reskilling • Provide financial support where possible for local energy strategy implementation

Local authorities	• CGK, Department of Energy, Roads, Transport and Public Works • CGK, Water, Environment, Natural Resources and Climate Change • CGK, Department of Physical Planning, Lands and Urban Development	• Implementation lead, and partnering with other stakeholders to accelerate goals • Detailed planning and costing • Monitoring and evaluation • Sourcing of funding for project implementation
Regulators	• Energy and Petroleum Regulatory Authority (EPRA)	• Support with the regulatory reform, development of rules, etc., as required for local and decentralised generation
Operators	• Kenya Power and Lighting Company (KPLC) • Kenya Electricity Transmission Company Limited (KETRACO) • KenGen	• Operation and maintenance of own power generation and transmission assets • Support with the implementation of new generation capacity from RE
Companies and organisations	• Expertise France • Netherlands Development Organisation (SNV) • GIZ Kenya • Fraunhofer Institute for Solar Energy Systems (ISE) • GIS Limited	• Provision of technical support, consultancy services and/or funding for aspects of project implementation • Support with capacity building, awareness raising and upskilling/reskilling
Trade associations	• CCAK • KAM • Kenya Renewable Energy Association (KEREA)	• Provision of guidance and expertise for regulatory and sector reform • Support with capacity building, awareness raising and upskilling/reskilling
Civil society and representative groups	• Community based organisations, youth and women's groups • Suswatch Kenya	• Participation in public participation events e.g., for policy development • Support with capacity building and upskilling/reskilling • Raise awareness about the benefits of switching to RE technologies (e.g., lamps, cooking)
Academia	• Maseno University • KIRDI	• Support with research development and data collection where needed • Support with capacity building, awareness raising and upskilling/reskilling

CHALLENGES/BARRIERS IN DEPLOYING RE IN KISUMU

Some of the challenges and barriers for deploying RE in Kisumu as per the National Energy Situational and Stakeholder Analysis report (2020), Multi-level Governance Dialogue (2022), and the Policy Dialogue (2023) are summarised below in order to inform actions and pathways.

POLITICAL, INSTITUTIONAL AND REGULATORY CHALLENGES

One of the main institutional barriers is that energy is a shared mandate between the national government and counties, which requires policy alignment and efficient devolution of resources from national to local governments. The promulgation of the Energy Act 2019 signals the passing of full responsibilities from the legislature to the executive arm of government, which bears the responsibility to further develop the energy sector. Counties need to implement national policy and standards; however, counties are unique and have varying contexts and resources, so policies require localisation.

The Act mentions that the national government is meant to undertake RE assessments/studies in the counties to assess energy generation potential, but this has not been actively done. The county governments are not defined as energy actors but are rather implementers of the plans. County governments are given roles, but not given means of how these actions will be financed. In particular, the role of the county with respect to energy planning is not very clear. However, this can be tackled through the process of developing the CIDPs, for example.

Obtaining high-level political support from county management, as well as community support and participation, can be a challenge. Not much priority is given to energy; it is often under the environmental department and not well-integrated into other departments and their plans.

With regard to policy and regulations, there are issues with accessing land for projects due to land tenure issues. In addition, approvals for projects, environmental approvals and inter-departmental streamlining for approval processes/coordination between departments are not optimised. There is also no defined/holistic policy for PPPs and projects for RE at the local level. While the national government is trying to develop green building guidelines and policies, as well as the inclusion of solar water heaters (SWH) in buildings that use a lot of heating for water, there needs to be county-level implementation support as the county does have the mandate to approve buildings/plans.

ECONOMIC AND FINANCIAL CHALLENGES

Counties may struggle to prioritise climate action as most financial resources go to wages. Fundamentally, a low-budget allocation of around 0.001% is inadequate to implement long-term RE and climate change projects. Lobbying for budget and prioritising RE/EE needs to take place, and needs should be aligned to the priorities of the county assembly for budgets to be allocated.

Similarly, there is also bureaucracy involved in getting financing for projects at the county level, as the national government must guarantee financing of projects in the county. This makes it challenging to get funding from international sources directly to counties.

The development and formulation of policies and ensuring adequate public participation are capital-intensive. The early project development stages, where activities such as pre-feasibility or feasibility studies need to be undertaken, lack financing and there are few incentives to drive bankable projects from the public sector for the investment required in energy and infrastructure projects. Financing for smaller/community-scale projects where the impact lies, especially in the cooking sector, is also lacking. These financial constraints also affect the ability to maintain and sustain projects in the county.

TECHNICAL CHALLENGES

It is important for the County to develop and incentivise strategies that will enable access to electricity for communities far from the grid and initiatives that will increase the electrification rate in sparsely populated areas in the region.

Limited local/home-grown technology options are not explored adequately. There is also a lack of bankable projects, and the complexities around project preparation, procurement and the PPP process further add to the problem. In addition, there is inadequate data to support energy modelling and County Energy Planning (CEP).

CULTURAL AND EDUCATIONAL CHALLENGES

At the community level, there is limited knowledge on climate change and RE in general, which inhibits meaningful public participation, and the proposing of solutions that incorporate RE.

At the county level, human resources can also be a challenge. There is a high rate of staff turnover, and the available skill sets often do not match the technical competencies required in the energy sector, such as those needed for feasibility studies, specialised large-scale RE projects and climate justice initiatives. Additionally, there is a lack of deep understanding of sustainability concepts related to energy and electricity, which hampers the consideration of long-term solutions. These expertise and knowledge gaps are widespread and significant.

SERIOUS GAMES METHODOLOGY

Stakeholder engagement has been a consistent part of the roadmap development process. As a specific participatory tool for gathering stakeholders' input, ICLEI designed the Sustainable Energy Transition Strategy (SETS) "serious game" with the aim of bringing together stakeholders to address the various challenges involved in the energy transition.

The workshop's purpose was to discuss challenges identified by each stakeholder in an interactive manner. A wide range of stakeholders attended the meeting on 9 May 2023, including CGK officials. Through the game (see Figure 8 below), stakeholders stepped into other people's shoes, differing from their day-to-day roles. This opportunity allowed them to express out-of-the-box opinions and think from different perspectives, with the ultimate goal of defining a collective in-game strategy to achieve the 100% RE target, including various compromises and collaborations with in-game stakeholders.

The scenario for the game was developed based on the Energy Systems Modelling Report for Kisumu County, prepared as part of the Roadmap process, that provided the energy demand that needed to be met in 2050 using a mix of renewable technologies.

Some insights and reflections that surfaced during the workshop were as follows:

- Hydrogen was generally accepted, but in the long term rather than the short term, due to the technology and cost implications and the need for vehicles that can run on hydrogen (new or through retrofits).
- Regarding clean cooking, there was general acceptance for the use of ethanol owing to its production as a by-product of sugar production (already active in Kisumu County).
- For biogas, the distribution method was a point of focus, with canisters being seen as more feasible and cost-effective than a piped gas network. The need for such a network must also be considered for waste-to-energy projects.
- Since Kisumu County will be largely dependent on electricity generated in Kenya, own generation in Kisumu was not seen as a priority as grid electricity is renewables-heavy and more cost-effective. However, the potential for mini-grids, including solar and storage, was discussed, as well as PV for rooftops, homes and free-field.

Figure 8: Sustainable Energy Transition - Strategy 'Serious Games' for active stakeholder engagement

PART 3

ROADMAP IMPLEMENTATION MECHANISMS

The roadmaps produced as part of the 100% Renewables Cities and Regions Roadmap project were developed according to a multi-step and inclusive methodology that sought input from a range of stakeholders, including experts, local government officials, government agencies, civil society, private sector and academia. As per the methodology, shown in Figure 9, participants begin by identifying key priorities through the 100% Renewables Building Blocks. They follow this with a serious games exercise (see Annexure 7.4) that allows for innovative solutions to pressing issues facing the local sustainable energy transition, and this exercise can be revisited for validation as the roadmap is further developed. Participants then identify local strategies for each priority sector i.e., pillars, as well as corresponding actions and implementation mechanisms, which are laid out in terms of their justification, responsibility, supporting policies and technologies, potential financing sources, as well as any associated risks and their mitigation.

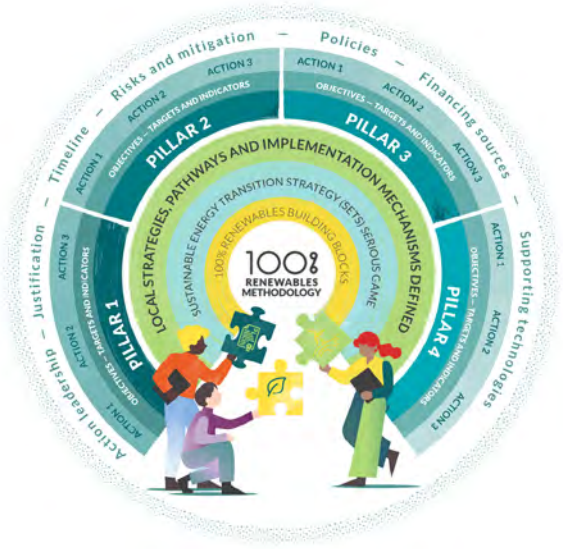

Figure 9: The 100% Renewables Methodology

DEFINITION OF THE ACTION PILLARS

This section elaborates on the strategic action pillars of the Roadmap associated with the energy demand priorities for Kisumu County, namely electrification, transport and clean cooking. Each pillar corresponds to an energy demand sector involved in the vision and presents a strategic objective to be pursued throughout the implementation of the Roadmap.

The definition of each of the elements as seen in the following sections are as follows:

- Objectives are the results to be achieved in each of the strategic pillars. They are defined according to the desired impact on the pillar. The objectives of the pillar must also be linked to progress on the Sustainable Development Goals (SDGs) of the United Nations (UN) and Kenya's NDCs.
- Goals are objectives and actions expressed in quantitative terms and with a defined time scale, considering the short, medium and long term. The SMART (specific, measurable, achievable, realistic, timely) goal framework is used for their definition.
- Indicators are metrics used to evaluate progress on goals through action implementation. They have minimum requirements, such as name, definition, measurement unit, measurement method, periodicity, responsible parties and baseline.
- Actions are the activities that can be carried out to meet the goals and, consequently, the objective of the strategic pillar.

For each action, the enabling conditions have been described to guarantee its achievement. These conditions consider regulations, technologies, experts, governance, and necessary and/or existing infrastructure.

In addition to the goals stated in this chapter, Annexures 7.6 and 7.7 lists a further list of actions found in policy, the Kisumu County Climate Action Plan and actions listed in the Community Visioning workshop that were not prioritised.

PILLAR A: ELECTRIFICATION

The electrification pillar considers improved electricity supply with the use of RE sources, as well as efficient electricity consumption via EE. The objectives, linkages to the SDGs, goals and related indicators are presented in the following sections.

Pillar objective(s)

- To maximise the opportunities from EE in Kisumu County – EE first before RE
- To transition to a fully RE generation system for electricity provision
- To ensure universal access to clean energy for all Kisumu County residents
- To reduce the electricity costs for residents and public institutions
- To increase system reliability and reduce the number of electricity interruptions experienced
- To promote innovation, sustainable consumption patterns and green economic growth

SDGs linked to pillar

- **SDG 3: Good health and well-being –** ensure healthy lives and promote well-being for all at all ages
- **SDG 7: Affordable and clean energy –** ensure access to affordable, reliable, sustainable and modern energy for all
- **SDG 8: Decent work and economic growth –** promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- **SDG 9: Industry, innovation and infrastructure –** build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
- **SDG 10: Reduced inequalities –** reduce inequalities within and among countries
- **SDG 11: Sustainable cities and communities –** make cities and human settlements inclusive, safe, resilient and sustainable
- **SDG 12: Responsible consumption and production –** ensure sustainable consumption and production patterns
- **SDG 13: Climate action –** take urgent action to combat climate change and its impacts

Goals	Intermediate goals	Indicators	Percentage share
To increase the electricity generated from renewables locally in Kisumu County to a share of 100% by 2050	90% of energy generated in Kisumu County is from RE sources (solar PV, hydropower and biomass) by 2025	• Percentage of local electricity generated in Kisumu County from RE sources (%)	100% of electricity generated in Kisumu County is from RE sources

To increase the access to electricity from 84.93% to 100% using RE for all residents in Kisumu County by 2050	Increased access to grid and off-grid electricity from 84.93% to 100 by 2030	• Percentage of the population with access to electricity • Number of new household/businesses with grid and off-grid connections to clean energy (number per annum)	100% of Kisumu County residents have access to electricity
To streamline and improve EE in Kisumu County through reduction in energy consumption by 2050	Reduced annual rate of energy intensity at 3% per annum until and beyond 2025	• Reduction in energy consumption in the public sector (MWh) • Increase in the percentage of EE projects in total county projects (%) • Increase in energy cost savings (KSh) • Rate of energy intensity (TOE/$2005 PPP)	N/A

INDICATORS

Indicators assess the level of electrification within the county and are crucial for tracking progress toward achieving energy access goals. For the goals outlined above, additional detail about relevant indicators is presented below.

Indicator	**Definition**			**Control**	
	Source	**Periodicity**	**Popularity (+/-)**	**Baseline**	**Goals**
Percentage of local electricity generated from RE sources	Network operator/ generator	Seasonal (twice a year)	+	84.9% (KCICCAP, 2022)	100% by 2050
Percentage of the population with access to electricity	Census data, special surveys	Per annum	+	83.2% (KCICCAP, 2022)	100% by 2050
Number of new household/ businesses with grid and off-grid connections to clean energy (number per annum)	Census data, special surveys	Per annum	+	To be established	100% by 2050
Reduction in energy consumption in the public sector (MWh)	Network operator/ generator	Per annum	-	240 MWh (CEMP, 2021)	50% (compared to 2021) by 2030

Percentage increase in the number of EE projects (%)	Projects register	Per annum	+	3%	18% by 2025, 50% by 2030 and 100% by 2050
Increase in energy cost savings (KSh)	Energy audits, cost of supply studies	Per annum	+	30 KSh/kWh (Average for all category of consumers in 2023)	50% reduction
Rate of energy intensity	Energy audits	Per annum	+	0.25 TOE/$2005 PPP (CEMP, 2021)	0.125 TOE/$2005 PPP (CEMP, 2021)

ACTIONS

Action 1	
Adoption of pay-as-you-go (PAYG) options for electricity generation (off-grid systems and embedded/captive generation for households, businesses and large facilities) - Visioning workshop, February 2022	
Description	PAYG business models enable the provision of access to clean energy, whilst allowing customers to pay for their green energy consumption using technology-enabled payment methods, in increments they can afford
Technology supported	Solar PV (solar home systems)
How it responds to defined goals	• Using PAYG options supports the utilisation of green power through solar PV for Kisumu County residents and businesses • Such models can allow alternatives to grid-led electricity access expansion and spur the development of associated skills and businesses
Are there policy linkages at different levels?	Yes • National Climate Change Action Plan (NCCAP, 2018) • National Energy Policy, 2018 • Kisumu County Integrated Development Plan, 2018-2022 • Kisumu County Energy Plan, 2021-2030
Estimated GHG reduction	• Dependent on the number of households and fuels to be displaced • Solar home systems can avoid between 6.15-7.34 tonnes of CO_2 emissions in a medium-sized household over its 20-year lifetime when it replaces diesel (Antonanzas C, 2021)
Estimated reduction in energy consumption	Estimated savings of $750 in four years for a basic kit that supplies lighting and charging of mobile phones[3]

[3] https://www.jstor.org/stable/resrep21860.7?seq=8#metadata_info_tab_contents

Estimated cost/resources required	A solar home system (with a battery, phone charger and smart SIM) enabled with a PAYG method of payment (usually mobile phone) costs a customer an initial deposit of $35 and thereafter daily payments of $0.50. This is typically less than the average consumer's daily spending on kerosene for example[4]
Timeline	Short- to medium-term
Implementation strategy	• Conduct a mapping of private sector or other players offering PAYG services for off-grid or decentralised electrification in Kenya • Engage with private sector partners to promote the use of their solutions in Kisumu County • Collaborate with private sector partners, vocational institutions, associations, etc., to develop the skills and awareness needed to support decentralised solar solutions • Create a citizens' outreach office or portal where citizens can understand the benefits and risks of opting for decentralised RE solutions (e.g., for electrification)
Possible sources of financing	Possible sources of financing/subsiding the solar home systems for households could come from the County's own budget, grant/ development aid funding, green climate funding or from the private sector However, there are also some rental options, and the PAYG model is essentially designed so that most customers can afford it themselves
Environmental co-benefits	• Contributions towards climate change mitigation and the local energy transition • Enhances the city profile as green and sustainable • PAYG business models can be used for other applications such as agricultural irrigation

[4] https://goexplorer.org/pay-as-you-go-solar-energy-to-off-grid-households/

Social co-benefits	• Clean, affordable energy provision for citizens
	  ◦ Provision of better indoor lighting at night enables homework sessions for school-going kids, and outdoor lighting provides greater visibility, thus promoting safety and well-being
	  ◦ PAYG customers do not have to travel distances to collect fuelwood or go to mobile phone charging service stations
	  ◦ Improved indoor air quality which eliminates negative health impacts when solar replaces the use of kerosene, petrol, diesel, coal or fuelwood. This is especially advantageous for women and girls who are usually tasked with household chores and are exposed the most
	• Increase in local green jobs, for example, through PAYG energy service providers, local manufacturing, solar home systems (SHS) distribution agents and installers
	• Digital inclusion for low-income, marginalised and vulnerable groups
	• PAYG can also enable value-added benefits such as building a credit record with certain providers, thus unlocking further opportunities for citizens

Economic co-benefits	• Financial inclusion and economic participation opportunities for low-income and vulnerable groups, which can ultimately lead to an increased quality of life • Households can save money by eradicating the need for expensive fossil fuels, torchlight batteries, candles and mobile phone charging services • The current ability of PAYG solar systems to switch off in case of no payment, can also serve as assurance for financiers
Risks associated with the implementation of the action	• Poor or unsafe installation of PAYG solar systems • Slow uptake due to reservations about the technology, e.g., unreliable power supply due to the weather • Theft of the solar home system and perceived risks thereof with having these systems • Lack of trouble-shooting knowledge and skilled local repair technicians to fix damages to the system
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • Private sector • Donor agencies and development finance institutions (DFIs)

Action 2	
Adopt solarisation of water pumping and irrigation systems - Visioning workshop, February 2022, and Climate Finance and Project preparation workshop, November 2023	
Description	Solar pumps allow for a cheaper, cleaner and lower maintenance system compared to traditional diesel/petrol water pumping systems. This solution is ideal for areas that are not grid connected
Technology supported	Solar PV
How it responds to defined goals	Supports the RE ambitions of the County as most water pumps rely on diesel or grid electricity. Given the importance of agriculture for Kisumu's economy, introducing cheaper and cleaner alternatives can bring about several socio-economic and environmental benefits
Are there policy linkages at different levels?	Yes • National Climate Change Action Plan (NCCAP, 2018) • National Energy Policy, 2018 • Kisumu County Integrated Development Plan, 2018-2022 • Kisumu County Energy Plan, 2021-2026
Estimated GHG reduction	Dependent on the number of water pumps we would like to displace, and the average consumption of diesel/petrol currently used
Estimated reduction in energy consumption	To be determined based on number of replacements made
Estimated cost/resources required	Dependent on size required. Small solar water pumping systems can start from $150 each
Timeline	Short- to medium-term

Implementation strategy	• Engage with communities involved in agriculture to understand the barriers they face in adopting solar water pumps • Engage private sector participants active in Kenya to provide demonstrations and benefits of solar water pumps • Consider pilot projects (with government support) to understand any pitfalls in implementation and build consumer confidence • Support farmers in the county with access to funding for installation of solar water pumping systems • Collaborate with private sector partners, vocational institutions, associations, etc., to increase awareness and develop skills (installation, operational and maintenance skills) needed to support the use of solar water pumps • Create or expand on existing citizens' outreach offices or portals where citizens can understand the benefits and risks of opting for decentralised RE solutions (e.g., for electrification). This can be synergised with other technologies to promote
Possible sources of financing	Donor organisations and DFIs, private sector, national government or green climate financiers can support with the upfront costs of such water pumps or offer innovative financing models
Environmental co-benefits	• Promotes sustainable groundwater extraction • Reduced environmental pollution and a reduction in GHGs when it is replacing diesel or kerosene fuel pumps • Water can also be saved if the efficient irrigation methods are used in conjunction with drip irrigation and low-pressure sprinkler systems
Social co-benefits	• Contributes to increased agricultural productivity and food security when used for irrigation • Residents and farmers need not walk to other communities to fetch potable water • Improved air quality when it replaces diesel or kerosene fuel pumps • Easier to operate than some foot pumps • Savings on fuel, servicing and maintenance and replacements for traditional pumps
Economic co-benefits	• It offers better return on investment compared to diesel powered pumps • Low maintenance frequency and costs • Not associated with periodic fuel price increases • Can be readily deployed in remote rural and agricultural areas

Risks associated with the implementation of the action	• Reliance on other methods on cloudy days might be necessary • Equipment deteriorating after installation, which can be addressed through supporting the development of a local value chain for maintenance services
Lead department	• Department of Energy, Roads, Transport and Public Works • Department of Water, Environment, Climate Change and Natural Resources
Partners and stakeholders	• Department of Agriculture, Irrigation, Livestock and Fisheries • Water Resource Regulatory Board (WASREB) • Community based organisations and SMMEs • Donor organisations and DFIs • REREC • MoEP • KPLC

Action 3	
Increase the uptake of efficient and solar lights for streets and public areas. - Visioning workshop, February 2022; Project identification and prioritisation meeting, March 2023	
Description	Installation of 1,000 existing streetlights to be retrofitted with LED bulbs and/or converted to solar-powered streetlights, mainly in markets, beaches and public areas
Technology supported	Solar PV, LEDs
How it responds to defined goals	Converting lights to more energy efficient technologies such as LEDs and using RE from solar supports Kisumu County with their transition to cleaner technologies. Not only does lighting expand safety and economic opportunities, but efficient lighting can greatly reduce energy consumption
Are there policy linkages at different levels?	Yes • Kisumu Sustainable Mobility Plan, 2020 • Kisumu County Energy Plan, 2021-2026 (Draft)
Estimated GHG reduction	Dependent on the electricity consumption of lighting in the locations identified
Estimated reduction in energy consumption	LEDs are 40-90% more efficient than traditional options (incandescent, halogen, etc.)
Estimated cost/resources required	Typically, $2-5 per LED[5]

[5] https://www.rapidtransition.org/stories/the-lightbulb-moment-the-rapid-shift-to-leds-and-ultra-efficient-lighting/

Timeline	Short- to medium-term
Implementation strategy	• Identify, map, and prioritise areas that need lighting most urgently, and with the most benefit, e.g., marketplaces or unsafe areas • Develop clear guidelines for procurement of energy-efficient lighting to inform future tendering and procurement processes for public facilities • Support regulations that promote the use of LEDs in new public buildings, streetlights and traffic lights • If possible, collaborate with private sector or development institutions to take advantage of programs that aid with EE solutions (e.g., through corporate social responsibility, public-private partnerships (PPPs)). This can link to a broader PPP strategy to be developed as part of the waste-to-energy project (Action 4)
Possible sources of financing	County's own budget, national funding, grant/development aid funding, green climate funding
Environmental co-benefits	• LEDs emit a lower amount of heat and use less energy to produce the same light output as their counterparts • Switching to LEDs contributes to less hazardous waste as they need to be replaced less often
Social co-benefits	• Safety of communities and public spaces is increased due to brighter lighting and better visibility ◦ As a result, this could deter crime, decrease road accidents and improve safety and well-being
Economic co-benefits	• LEDs contribute to lower energy bills. They also last longer, so they need fewer replacements and require less maintenance • Green economic growth through the local manufacturing of LEDs • Creates jobs and opens up the market for LED retailers • Promotes the expansion of new industries and opportunities such as local manufacturing and end-of-life waste management
Risks associated with the implementation of the action	• Traditional light bulbs options are still cheaper upfront, but emphasising lifetime savings could help overcome hesitation • Incorrect disposal after bulbs have reached their end-of-life. This must be aligned with stronger waste management policies at the national level, as well as working with the informal waste management sector in Kisumu
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• MoEP • Donor agencies and DFIs

Action 4	
Develop a PPP strategy for waste-to-energy projects - Visioning workshop, February 2022	
Description	Strategy to be developed to inform an approach for a PPP business model for the implementation of waste to energy projects in the county Kisumu is one of the flagship cities identified in the Vision 2030 for solid waste management. The target is to achieve 80% of waste recovery by 2030, where waste to energy is stated as one of the viable options[6], hence the suggestion to develop a waste to energy PPP strategy
Technology supported	Biogas/combined heat and power (CHP)
How it responds to defined goals	Supports the regulatory reform required to facilitate the usage of RE for power generation
Are there policy linkages at different levels?	Yes • Kisumu County Environment Policy, 2019 • Kisumu County Energy Plan, 2021-2026 (Draft) • Vision 2030 • The Public Private Partnerships Bill (2021)
Estimated GHG reduction	Unable to quantify until strategy is developed – dependent on the size and parameters of the chosen project(s)
Estimated reduction in energy consumption	Unable to quantify until strategy is developed – dependent on the size and parameters of the chosen project(s)
Estimated cost/resources required	Resources to develop the strategy include expertise on RE, public procurement rules and knowledge on structuring PPPs
Timeline	Medium-term

[6] Kisumu County Energy Plan, 2021 - 2026 (Draft)

Implementation strategy	PPP strategy: • Identify local government resources to finance and oversee PPP projects, including own revenues, potential sites, human resources, legal and financial experts, etc., as well as the most promising PPP models • Identify potential partners in the sector and engage with private sector partners to gauge interest • Conduct a review of own sources of revenue and other financing options, including national government support, to determine what PPP models are most suitable and for what applications • Engage the national government to identify what support can be offered, including guidelines, etc. • Participate in capacity building efforts regarding issuing and overseeing PPPs • Create a one-stop-shop for PPPs in Kisumu, including providing information online Waste-to-energy: • Conduct studies to identify potential sources of waste for waste-to-energy plants. Determine if the volume is sufficient, what technology is required, the size of the plant, etc. • Develop an engagement plan with existing waste collectors or associations to improve collection and sorting for feedstock • Align plans for waste-to-energy with any circular development plans or waste reduction plans (such as to ensure sufficient waste feedstocks) • Conduct studies to identify the investment required for a distribution network for any biogas produced
Possible sources of financing	• To develop the strategy: County's own budget, grant/development aid funding • Implementation of waste to energy projects: PPP model. Depending on the model chosen, the private sector can provide financing • In certain cases, financial backing from the national government can also be sought, as outlined in the PPP Bill (2021)
Environmental co-benefits	The strategy will facilitate improved management of waste handling, through diversion away from landfill, whilst generating electricity from methane
Social co-benefits	Stimulation of job opportunities and new skills development
Economic co-benefits	• Upon implementation of the strategy, leveraging of private sector funding • Building experience with PPPs and associated projects can payoff in sectors besides energy

Risks associated with the implementation of the action	• CHP is an expensive technology option compared to other RE options. However, it is more efficient and also supports waste management • Ensuring sufficient waste feedstock could be a challenge, particularly if circular business models are implemented to reduce waste overall
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • Private sector and industry

Action 5	
Encourage EE and conservation in county facilities - Project identification and prioritisation meeting, March 2023	
Description	Audit and implementation of recommendations in selected healthcare facilities and treatment plants. Includes the validation of current audits, design of interventions and facilitation of funding EE interventions include implementing solar water heating, LED lighting, clean cooking solutions and solar PV and storage
Technology supported	Solar PV, SWH, LEDs, clean cooking, storage
How it responds to defined goals	EE and conservation can facilitate the integration of RE by reducing overall loads, and ultimately contributing to fossil fuel divestment, reduced emissions and energy and cost savings. The County can start with its own facilities to demonstrate effectiveness and support the creation of a local value chain
Are there policy linkages at different levels?	Yes • National Climate Change Action Plan (NCCAP, 2018) • National Energy Policy, 2018 • Kenya National Energy Efficiency and Conservation Strategy 2020 • Energy Act, 2019 • Integrated National Energy Planning Framework • Kisumu County Energy Plan, 2021-2030 • Kenyan Building Code
Estimated GHG reduction	To be established once energy audits are validated
Estimated reduction in energy consumption	To be established once energy audits are validated

Estimated cost/resources required	To be established
Timeline	Short- to medium-term
Implementation strategy	• Conduct studies and energy audits to determine the energy conservation and efficiency potential, as well as potential cost savings • Appoint or work with existing building managers to educate them on EE • Work with industry or development partners that can provide capacity building • Launch campaigns to promote energy-saving behaviour by staff in public facilities • When procuring appliances or lighting, include EE criteria (see Action 4 in Pillar B) • Incorporate EE criteria when constructing new public buildings, referencing any national-level legislation or guidelines (see Action 7 on green buildings) • When refurbishing or retrofitting existing facilities, prioritise EE measures • Develop guidelines to oversee the reinvestment of savings from reduced energy consumption into other county plans
Possible sources of financing	National government, County's own budget, climate financiers
Environmental co-benefits	Reduced GHG emissions through reduced energy consumption and reduced reliance on fossil fuel generators
Social co-benefits	• Job creation (energy auditors, inspectors, etc.) • Green economic growth and job creation through the local manufacturing of LEDs, clean cookstoves, solar panels, etc. • Promotes the expansion of new industries and opportunities such as local manufacturing and end-of-life waste management • Improved healthcare service delivery for 392,000 Kisumu County residents
Economic co-benefits	• Lower utility bills and energy cost savings for the lifetime of the facility • Savings recovered can be channelled into funding for other county projects
Risks associated with the implementation of the action	• High upfront cost for implementation • Low investor confidence in county
Lead department	Department of Energy, Roads, Transport and Public Works

Partners and stakeholders	• ICLEI Africa • Private sector and industry • Donor agencies and DFIs

Action 6	
Promote the use of solar mini- and micro- grids in Kisumu County - Project identification and prioritisation meeting, March 2023	
Description	Installation of mini-grids for municipal buildings across the seven districts (multiple grids where possible, rooftop PVs for isolated facilities) in selected locations: • Healthcare facilities: Jaramogi hospital, seven other county hospitals, 74 sub-county hospitals and dispensaries • Water-pumping stations: seven (intake, treatment, distribution) • Agriculture: irrigation and cold storage • Markets: lighting and cold storage
Technology supported	Solar PV
How it responds to defined goals	Solar PV mini-grids support the utilisation of RE for public institutions, offering reliable electricity supply, particularly for off-grid or standalone applications
Are there policy linkages at different levels?	Yes • County Integrated Development Plans (CIDP 2023-2027) • Kisumu County Climate Change Action Plan (KCICCAP, 2022)
Estimated GHG reduction	To be calculated in concept note of a specific project
Estimated reduction in energy consumption	To be calculated in concept note of a specific project
Estimated cost/resources required	CAPEX KSh 81.7 million (about $620,000) for preparation and implementation; and OPEX requirements of KSh 700,000-1,6 million (about $5,300) for a 60 kWp solar mini-grid for Kibuye market
Timeline	Medium-term

Implementation strategy	• Collaborate with the utility to understand the feasibility of such installations, including the capacity that the grid can handle • Conduct studies to determine the total capacity of generation technologies that can be installed on selected locations • Identify further potential areas for setting up microgrids, e.g., industrial facilities, malls, government facilities etc. • Consider mandating solar installations in new buildings when approving new construction • In line with Action 7, explore policy options to enable and scale up such facilities where feasible, e.g., mandates, incentives, etc., for buildings or facilities
Possible sources of financing	• Donor agencies and DFI • Green climate financiers • MoEP • County resources for infrastructure development The above can be deployed in a way to reduce upfront costs or reduce the overall risk of a project
Environmental co-benefits	Reduction in GHG emissions while enabling RE uptake for off-grid and decentralised uses, avoiding the use of fossil fuels (such as via diesel generators)
Social co-benefits	• Creation of jobs associated with the RE value chain • Expansion of productive uses, enabled by RE technologies (lighting, electricity, etc.) • Reduced local pollution through the displacement of fossil fuel technologies
Economic co-benefits	• Energy cost savings due to reduced fuel costs and exposure to price volatility • More reliable energy source • Extended trading hours
Risks associated with the implementation of the action	High upfront cost for implementation
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Lands, Physical Planning, Housing and Urban Development, Kisumu County • ICLEI Africa • Private sector and industry • Donor agencies and DFIs

Action 7	
Support the construction of "green" and energy-efficient buildings in the county - "Energy Efficiency And Energy Management In Counties" training, November 2023	
Description	Kisumu County has oversight regarding building approvals and can use this authority to ensure new buildings are constructed with EE in mind, and existing buildings are retrofitted with energy-efficient technologies as appropriate. In addition, plans for integrating RE technology (such as solar PV) into buildings can be explored as provided for in the National Building Code 2022
Technology supported	Efficiency lighting, Heating, Ventilation and Air Conditioning (HVAC), building materials, glazed windows, digital solutions, building-integrated renewables, rooftop solar PV, efficient appliances
How it responds to defined goals	Given that stationary energy is a large share of energy consumption in Kisumu County, a dedicated policy to support EE and conservation county-wide is critical. Buildings can also be the sites of RE generation, avoiding the use of greenfield areas
Are there policy linkages at different levels?	Yes • Kenya National Building Code 2022 • Kenya National Energy Efficiency and Conservation Strategy (KNEECS)
Estimated GHG reduction	Dependent on the energy saved
Estimated reduction in energy consumption	Dependent on the size and type of building
Estimated cost/resources required	Building costs will be undertaken by developers, but additional resources might be needed to ensure monitoring and compliance with any new guidelines
Timeline	• Short-term (development of the green building plan for Kisumu.) • Medium- to long-term (construction and retrofitting of buildings county-wide.)

Implementation strategy	Energy efficiency: • Begin a process of consultation with developers, contractors, energy service companies (ESCOs) etc., to understand the feasibility of EE measures in Kisumu County • Draft a green building policy for Kisumu County. If needed, collaborate with national and international institutions or networks to identify global best practices for EE and conservation • Identify potential incentives for developers for implementing EE and conservation measures (e.g., reduced energy intensity), such as bonus floor space • Identify indigenous or traditional building practices to be promoted where feasible • Include the promotion of integrating nature-based solutions or renewable technology into building design, e.g., green roofs, or building-integrated PV • Continue to invest and improve a robust monitoring and reporting system to ensure regulations are followed, such as the regular three-year energy audits or hiring inspectors • During stakeholder consultations, plan to share information on best practices in energy-efficiency constructions and materials. Partner with organisations to disseminate information on the same • Support the enforcement of the energy management regulations by EPRA, e.g., preparation of implementation reports and issue of compliance certificates • Explore the use of digitalisation and technologies, particularly in large buildings, to realise energy savings Renewable technologies: • Develop guidelines for the inclusion of RE technologies on rooftops (e.g., the category of building, requirements of the panel size, grid interconnection, etc.) • Consult with the utility company to understand the feasibility of such a plan. If necessary, advocate at the national level for updated guidelines regarding net-metering, etc
Possible sources of financing	County's own sources of revenue, international partnerships, national government funds or partnerships
Environmental co-benefits	Certain nature-based solutions can provide other benefits, e.g., localised cooling and improved air quality
Social co-benefits	Buildings are local issues, so many gains created by developing the value chain are likely to benefit the local community

Economic co-benefits	• Developing a robust EE and conservation value chain can create a lot of economic value locally through new jobs and skills, and associated industry • Successful implementation of such policies can also help attract further investment • Reduced building energy costs when implemented, e.g., through natural lighting
Risks associated with the implementation of the action	• Enforcement of building efficiency can always be a challenge, which can be mitigated by investing in monitoring efforts • Enforcement can also be streamlined by engaging early with developers and contractors to identify mutually beneficial solutions
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Lands, Physical Planning, Housing and Urban Development, Kisumu County • Energy and Petroleum Regulatory Authority (EPRA) • Private sector and industry • ICLEI member cities and regions • Development finance institutions

PILLAR A: QUALIFYING CONDITIONS

This subsection describes the enabling conditions for each action in terms of regulation, research and technology, governance and accountability, and infrastructure.

Action	Qualifying conditions			
	Regulations	**Technology and study**	**Governance and accountability**	**Infrastructure**
Adopt PAYG options for electricity generation (off-grid systems and embedded/ captive generation for households, businesses and large facilities)	Incentive scheme for adoption of SHS	Mobile network access Customer access to mobile phones, or PAYG models with other payment methods Develop guidelines with industry best practice measures such as minimum technical and safety standards, warranties for equipment, energy performance, etc. Promote equipment testing and proper labelling	Willingness of the community to utilise PAYG solar systems, and sensitisation of RE technology/ awareness raising	Suitable and safe roof structures on homes and businesses for solar to be mounted Locations with adequate irradiation, limited shading and suitable roof angle for optimal solar energy production
Adopt solarisation of water pumping and irrigation systems	Incentive scheme for adoption of solar water pumping systems	Guideline prepared on options available in the market for customers to choose from, prioritising local solutions	Host information sessions, mini trade fairs, or pilot demonstration programs by service providers to showcase the solar water pumping systems to local farmers, community members and business owners	Solar panels (fixed/mobile system), water pump, inverter, controller, storage tanks, pipes and accessories
Increase the uptake of efficient and solar lights for lighting streets and public areas	Develop a smart lighting policy/ strategy to assist the phase out of inefficient lighting in public areas	Energy audits to be conducted to identify measures to implement Feasibility study to be conducted	Project steering committee to be set-up	Locations and interventions to be identified for the retrofits – existing locations and additional new ones

Develop a PPP strategy for waste-to-energy projects	N/A	Gauge interest from the private sector to enter into PPPs for waste-to-energy projects	Set up a working group with the regulator and industry to support the development of the guidelines	Site for sorting and treating waste
Encourage EE and conservation in county facilities	EE strategy for the county	Energy audits to be conducted to identify measures to implement Feasibility study to be conducted	Project steering committee to be set-up	Locations and interventions to be identified for the retrofits
Promote the use of solar mini- and micro- grids in Kisumu County	Incentives to use solar PV systems in markets, hospitals and off grid areas	Feasibility study to be conducted	Pilot projects in public areas – engage local installers to promote community ownership	Solar panels (fixed/ mobile system), inverter, charge controller and batteries
Support the construction of "green" and energy-efficient buildings in the county	Developing guidelines for green practices Incentives for adhering to energy-efficient building practices	Availability of energy-efficient technologies and associated value chain	Regular monitoring to ensure compliance with standards	

PILLAR B: TRANSPORT

This subsection describes the enabling conditions for each action in terms of regulation, research and technology, governance and accountability, and infrastructure.

Pillar objective(s)

- A decarbonised road transport sector of Kisumu County through the uptake of e-mobility and NMT in the public transport sector; private cars and trucks
- To increase the well-being and health of citizens and promote a sustainable city for all

SDGs linked to pillar

- **SDG 3: Good health and well-being** – ensure healthy lives and promote well-being for all at all ages
- **SDG 8: Decent work and economic growth** – promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- **SDG 9: Industry, innovation and infrastructure** – build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
- **SDG 10: Reduced inequalities** – reduce inequalities within and among countries
- **SDG 11: Sustainable cities and communities** – make cities and human settlements inclusive, safe, resilient and sustainable
- **SDG 12: Responsible consumption and production** – ensure sustainable consumption and production patterns
- **SDG 13: Climate action** – take urgent action to combat climate change and its impacts

Goals	Intermediate goals	Indicators	Percentage Share
100% sustainable transport through NMT, public transport and e-mobility by 2050	60% sustainable transport by promoting NMT, public transport and e-mobility by 2030	• Number of internal combustion engine (ICE) vehicles • Percentage of citizens using NMT • Total length infrastructure to be constructed to support NMT • Total number of charging stations to support e-mobility	• 100% of vehicles • 55% NMT mode share

INDICATORS

Indicator	Definition					Control	
	Description	Calculation method	Source	Periodicity	Polarity (-/+)	Baseline	Goals
Number of ICE vehicles	Number of ICE vehicles per motor vehicle category	Special road surveys, number of cars registered	Kenya National Bureau of Statistics; National Ministry of Roads and Transport; Kisumu County Department of Energy, Roads, Transport and Public Works	Per annum	-	30,977 motorcycles, 15,929[7] cars, 2,406 buses/ trucks, 2,406 tuk-tuks	0
NMT mode share	Walking, cycling	Census, special surveys on mode share	Kenya National Bureau of Statistics; National Ministry of Roads and Transport; Kisumu County Department of Energy, Roads, Transport and Public Works	At least twice a year	+/-	57,6% (KSMP)	55-60%[8]
Total infrastructure to be constructed to support NMT	Footpaths, cycle lanes, bicycle parking facilities, pedestrian crossing sections, foot bridges, better lighting	Special surveys	National Ministry of Roads and Transport; Kisumu County Department of Energy, Roads, Transport and Public Works	Annually	+	50 kms	200 kms

[7] 15 939 cars as per 2019 National census figures, and approximately 10 electric cars

[8] NMT is already high in the county with most residents choosing to walk (52,7%), and cycle (4,9% - private bicycles and bicycle boda bodas). The goal is to make it safer for pedestrians, and to increase the number of mass public transport options.

Total number of charging stations to support e-mobility	Network of charging stations around the county to be powered by grid electricity or solar power	Special surveys	Kenya National Bureau of Statistics, National Ministry of Roads and Transport; Kisumu County Department of Energy, Roads, Transport and Public Works	Annually	+	1 (Megacity Mall)[9]	70

ACTIONS

Action 1	
Promote one car-free day a month (Saturday/Sunday) - Visioning workshop, February 2022	
Description	This action entails prohibiting the use of ICE motor vehicles for one day a month, which would in turn encourage commuters to use public (mass) transport or use NMT. Whilst the action serves negligibly in GHG emissions reductions, its impact in terms of changing mindsets is significant
Technology supported	Electric vehicles; NMT (electric two and three wheelers)
How it responds to defined goals	Reducing the number of private ICE motor vehicles would promote the uptake of public and NMT, which can help change mindsets and also reveal other benefits such as reduced congestion, reduced air pollution, etc.
Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • National Climate Change Action Plan (NCCAP, 2018) • Kisumu Sustainable Mobility Plan • Kisumu County Transport Bill (2019)
Estimated GHG reduction	15% decrease in transport emissions (KCICCAP)
Estimated reduction in energy consumption	Dependent on average number of cars not travelling

[9] EVChaja

Estimated cost/resources required	Resources required: • Awareness campaigns • Law enforcement
Timeline	Short-term
Implementation strategy	Planning and defining the area: • Define if it will be a specific area of the city. If more than one area is defined, pedestrian paths can link them • Make a previous urban analysis: Consider the type of area (residential, work, shopping), accessibility, surrounding parking, etc. Local involvement and consultation: • Consult with local stakeholders, e.g., small business owners, community groups and potential partners to identify the best days or approach according to their capacity • Engage local businesses, cycling groups, schools and organisations to participate and increase awareness • Collaborate with various stakeholders, including local law enforcement to investigate the feasibility of such a measure • Collect feedback from residents about the impacts and potential improvements. Determine if it is best as a citizen-led or government-led approach Media and publicity: • Create promotional materials such as posters, flyers and a dedicated page on the county website • Keep the local press informed and host a pre-event press conference Enforcement and regulations: • Seek assistance from urban traffic authorities and police for enforcement • Close designated car-free areas with barriers and monitor access Providing alternatives to cars: • Enhance public transport with increased trips and accessibility • Offer special fares, discounts and incentives for using alternative transportation like cycling and micro-mobility services Urgent services and parking: • Grant exemptions for health professionals, emergency services, delivery of large cargo and vulnerable persons (e.g., the elderly, pregnant women, or individuals with disabilities or special needs) • Arrange designated parking areas connected to public transport and provide shuttle services

Implementation strategy	Event execution: • Assemble volunteers and officials well in advance of the event to finalise logistics • Coordinate activities within the car-free area to create a positive and interactive atmosphere Post-event activities: • Evaluate outcomes and gather stakeholder feedback • Identify successes and areas for improvement • Expand the trial to more areas in the county • Improve public and NMT infrastructure to reduce car dependence • Continue promotion for subsequent car-free days and establish regular occurrence (e.g., every last Saturday, or first Wednesday of the month) Measuring impact: • Collect data on fuel consumption, emissions, health benefits, noise and traffic • Use data to highlight environmental, social and economic benefits • Continue to improve infrastructure for public transport and non-motorised forms of transport to encourage a broader societal shift away from cars
Possible sources of financing	County budgets, development partners e.g., World Bank
Environmental co-benefits	• Reduction in GHG emissions from the transport sector • Improved air quality
Social co-benefits	• Reduction in noise and air pollution • Health and social cohesive benefits from active mobility • Reduced traffic congestion
Economic co-benefits	• Pedestrian routes have the potential to stimulate informal trading • Savings on fuel
Risks associated with the implementation of the action	• Lack of take-up and enforcement • Vulnerable groups may be unduly affected, so provision should be made to accommodate their needs
Lead department	Department of Energy, Roads, Transport and Public Works

Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • Community-based organisations (CBOs) and private sector (e.g., e-mobility companies) for support with awareness raising • MoEP • Ministry of Roads and Transport

Action 2	
Designate car-free areas in five streets - Visioning workshop, February 2022	
Description	This action entails prohibiting the use of ICE motor vehicles along five designated streets in Kisumu County. The selection of streets would be informed by traffic assessments
Technology supported	NMT; e-mobility
How it responds to defined goals	Reducing the number of private ICE motor vehicles would promote the uptake of public and NMT, leading to reduced congestion, improved air quality and potentially increased business opportunities in the streets due to increased pedestrian activity
Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • National Climate Change Action Plan (NCCAP, 2018) • Kisumu Sustainable Mobility Plan
Estimated GHG reduction	Dependent on average number of cars to be displaced
Estimated reduction in energy consumption	Dependent on the reduction in car usage
Estimated cost/resources required	KSh 500,000 (KCICCAP)
Timeline	Medium-term

Implementation strategy	Street selection and planning:
	• Liaise with local traffic authorities to identify streets that are the most suitable for this approach
	• Conduct a comprehensive urban analysis including:
	  ◦ Identification of road hierarchy according to their functions and capacities (freeways, arterials, collectors, local roads)
	  ◦ Assessment of surrounding public spaces and their system

Implementation strategy	◦ Evaluation of street surroundings (e.g., commercial, residential, mixed-use) ◦ Assessment of current transportation infrastructure and system Community engagement and publicity: • Engage residents, businesses and community groups on each street • Promote car-free areas with targeted flyers, posters and local media • Consult with local stakeholders, e.g., small business owners, to identify the best streets/zones, or approach according to their capacity Regulations and enforcement: • Coordinate with authorities to enforce temporary street closures • Use physical barriers and signage to restrict vehicle access during car-free periods Alternative transportation promotion: • Improve public transport options along designated streets • Encourage cycling and provide bike-sharing stations • Expand NMT infrastructure (e.g., cycling lanes, shade) to encourage and enable the use of NMT in these areas Accessibility and event coordination: • Ensure access for emergency services and disabled individuals • Organise street events to attract pedestrians and support local businesses Post-event evaluation and impact: • Gather feedback from residents and businesses about car-free days • Analyse data on traffic flow and air quality to assess effectiveness
Possible sources of financing	County's own budgets, national; DFI and green climate finance
Environmental co-benefits	• GHG emission reduction • Improved ambient air quality
Social co-benefits	Health and social cohesive benefits from active mobility
Economic co-benefits	Pedestrian routes and linkages have potential to stimulate informal trade

Risks associated with the implementation of the action	• Traffic may be diverted from car free areas to surrounding streets, causing high traffic volumes and degradation of road infrastructure • Lack of take-up and enforcement • Vulnerable groups may be unduly affected, so provision should be made to accommodate their needs
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Physical Planning, Lands and urban Development • Department of Water, Environment, Natural Resources and Climate Change • CBOs and private sector (e.g., e-mobility companies) for support with awareness raising • MoEP • Ministry of Roads and Transport

Action 3	
Improve infrastructure to support NMT from 50 km to 200 km - Visioning workshop, February 2022	
Description	In order to facilitate more NMT use, citizens need access to infrastructure that increases their safety and usability such as footpaths, cycle lanes, cycle parking facilities, pedestrian crossing sections and foot bridges
Technology supported	NMT, LED and solar streetlights
How it responds to defined goals	Increasing the number of NMT users and making it safer and more accessible for them will contribute to better air quality and reduce GHG emissions from ICE motor vehicles
Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • National Climate Change Action Plan (NCCAP, 2018) • Kisumu Sustainable Mobility Plan
Estimated GHG reduction	Dependent on the uptake of NMT
Estimated reduction in energy consumption	N/A
Estimated cost/resources required	KSh 1 billion per 100 km (KCICCAP)
Timeline	Medium- to long-term

Implementation strategy	• Liaise with the traffic police department and other relevant departments to identify priority areas for NMT infrastructure development • Engage with local stakeholders to identify the most pressing needs (e.g., wider sidewalks, shade, better lighting, cycling infrastructure, etc.) • Integrate NMT into local transport development plan and assign sufficient resources • Define a network of cycling lanes, pedestrian paths, and shared streets based on identified priority areas • Implement pilot projects in strategic areas to showcase the benefits of NMT infrastructure. Use temporary installations or demonstrations to gauge public response and refine design concepts • Evaluate public response and gather feedback to inform larger-scale implementation • Partner with non-governmental organisations (NGOs) and civic groups specialising in urban mobility • Address inclusivity making the new infrastructure accessible for persons with disabilities, such as ramps, tactile paving, crosswalk buttons with audio display, and braille
Possible sources of financing	County's own budgets, national; DFI and green climate finance
Environmental co-benefits	• Reduction in GHG emissions from the transport sector • Improved ambient air quality
Social co-benefits	• Health and social cohesive benefits from active mobility • Less traffic congestion • Safety improved for NMT users • Improved aesthetics of the city
Economic co-benefits	Pedestrian routes and linkages have potential to stimulate informal trade
Risks associated with the implementation of the action	• Increase in traffic and diversion of NMT users during the construction phase, and safety concerns thereof • Expanded infrastructure must be met with improved planning that allows accessibility of areas through NMT
Lead department	Department of Energy, Roads, Transport and Public Works

Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • Department of Physical Planning, Lands and Urban Development • CBOs and private sector (e.g., e-mobility companies) for support with awareness raising • MoEP • Ministry of Roads and Transport

Action 4	
Increase installation of LED/solar/energy-saving streetlights from 25 km to 100 km - Visioning workshop, February 2022	
Description	LED and solar streetlights installed on busy streets in the county will reduce overall energy consumption while providing better lighting and thus increasing safety for road users
Technology supported	Solar PV and LED lights
How it responds to defined goals	Switching to more energy saving lights will save the county money and increased lighting will enhance visibility and safety for road users
Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • National Climate Change Action Plan (NCCAP, 2018) • Kisumu Sustainable Mobility Plan
Estimated GHG reduction	Dependent on number of streetlights to be installed and energy consumption of current streetlights
Estimated reduction in energy consumption	LEDs are 40-90% more efficient than traditional options (incandescent, halogen, etc.)
Estimated cost/resources required	Typically, $2-5 per LED[10]
Timeline	Medium-term

[10] https://www.rapidtransition.org/stories/the-lightbulb-moment-the-rapid-shift-to-leds-and-ultra-efficient-lighting/

Implementation strategy	• Conduct a comprehensive assessment of existing street lighting infrastructure and identify areas where this need is most urgent. Prioritise locations based on factors such as high pedestrian traffic, crime rates, road safety concerns and existing lighting deficiencies • Develop procurement guidelines and standards to define certain EE criteria and ensure that they are followed • Consult with private sector and other partners who may be able to provide financial or other resources • Procure lighting fixtures and equipment, preferably through local supplier sourcing to support economic development and ensure replacements and maintenance in the future • Develop detailed project designs including phases of the project, installation plans, timelines and budget estimates for expanding street lighting coverage • Provide training for city maintenance staff on the operation, maintenance and troubleshooting of LED and solar lighting systems • Coordinate with local utility providers to integrate LED and solar streetlights into the city's energy grid
Possible sources of financing	County's own budget, national funding, grant/development aid funding, green climate funding
Environmental co-benefits	• LEDs emit a lower amount of heat and use less energy. • Since LEDs and solar lights have longer lifespans, they contribute to reducing waste • Better lighting may enhance the attractiveness for NMT users, thus increasing the number of users and contributing to lowering GHG emissions
Social co-benefits	Safety of communities and public spaces are increased due to brighter lighting and better visibility. As a result, this could deter crime, decrease road accidents and improve safety and well-being
Economic co-benefits	• LEDs contribute to lower energy bills and savings in the short to long term. They also last longer, so they need fewer replacements and require less maintenance • Green economic growth through the local manufacturing of LEDs • Creates jobs and opens up the market for LED retailers • Promotes the expansion of ne¬w industries and opportunities such as local manufacturing and end-of-life waste management

Risks associated with the implementation of the action	• Can be costly upfront • Grid instability or energy supply challenges • Limited resources or capacity for ongoing maintenance and servicing • Theft and use of sub-standard materials
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • Department of Physical Planning, Lands and Urban Development • CBOs and private sector (e.g., e-mobility companies) for support with awareness raising • MoEP • Ministry of Roads and Transport

Action 5	
Electrify transportation solutions and advance commercial electric mobility - Project identification and prioritisation meeting, March 2023, and Climate Finance and Project Development workshop, November 2023	
Description	The project envisions a PPP, involving e-mobility service providers, to support the deployment of e-vehicles (manufacture/retrofit of the e-vehicles) as well as to develop and operate the charging infrastructure The aim is to retrofit 3,000 two-wheelers (boda-bodas) and 1,000 three-wheelers (tuk-tuks) and install up to 70 charging stations (42 in peripheral and rural wards, 28 in city centre wards) around the county. These charging stations will be established on land owned by the CGK. The operation of the e-mobility charging infrastructure will be carried out by the private sector under a design, build, finance, and operate (DBFO) agreement, with eventual transfer to the CGK at the end of a long-term lease with provision for renewal Charging stations at malls, parks and public places will allow for the greater electrification of mobility options in Kisumu, including public vehicles, private vehicles and freight in due time Kisumu can also explore the possibility of green hydrogen for fuelling heavy vehicles, including public transport vehicles or freight vehicles. This will need additional feasibility studies and the provision of adequate electricity and water to do so. Given that Kenya's national plans to promote the use of hydrogen will begin to focus on transport after 2032, Kisumu can begin initial explorations but prioritise more urgent electrification actions in the short term
Technology supported	Electric mobility

How it responds to defined goals	Supports the reduction in GHG emissions in the highest emitting sector, as there a shift in dependence on fossil fuels to electricity
Are there policy linkages at different levels?	Yes • Kisumu County Climate Change Integrated Action Plan 2023-2027 • National Determined Contribution of 32% of GHG Abatement • National Climate Change Action Plan of 2023-2027
Estimated GHG reduction	Based concept note: 14,400 tCO_2e (from 4,000 vehicles)
Estimated reduction in energy consumption	Dependent on number of vehicles retrofitted and new ones added
Estimated cost/resources required	Based on concept note: Total capital expenditures (CAPEX): KSh ~1.29 billion Total operating expenses (OPEX) Cost = KSh 280 million
Timeline	Medium-term

Implementation strategy	Adoption of electric vehicles: • Develop PPPs (with transportation operators, fleet owners, and businesses) to accelerate the transition to electric vehicles, starting with two- and three-wheelers • Determine which electrification technology is most suited, for example batteries or hydrogen (for certain classes of vehicles). (Hydrogen can be considered in the longer term, in line with Kenya's national plans) • Raise awareness and promote their use by highlighting their benefits with frequent use, e.g., reduced maintenance, reduced air and noise pollution, etc. • Consider various financial incentives to encourage their promotion, e.g., tax exemptions, subsidies, low-interest loans, leasing options and reduced parking fees • Lead by example by, for example, transitioning county-owned fleets to electric vehicles first, and then determine what other vehicles apart from commercial two- and three-wheelers, are the most appropriate for promotion • Sensitise potential users and operators to safety hazards, including weather impacts on batteries, proper operating conditions, safe disposal and repair, etc. Engage in capacity building to understand the various risks and benefits of electric vehicles in local officials as well • Evaluate urban infrastructure to support electric mobility, such as bike lanes and dedicated electric vehicle lanes Charging infrastructure: • Identify suitable charging infrastructure locations or hubs, e.g., close to bus garages, boda-boda shelters, malls, office buildings and parking areas near public transport options for three-wheelers (which are often used for last-mile connectivity) • Develop capacities to implement and procure charging infrastructure as needed, including familiarity with various designs, compatibility, electricity requirements, etc. • Collaborate with neighbouring counties to ensure reasonable placement of charging infrastructure across county lines • Explore techno-economic feasibility of off-grid charging, in line with Action 6 under Pillar A (mini-grids) to allow the expanded use of EVs • Establish clear regulations and standards for electric vehicle charging infrastructure
Possible sources of financing	County's own budget, national funding, grant/development aid funding, green climate funding
Environmental co-benefits	• Improved local air quality due to a shift away from fossil fuels • Reduction in GHG emissions from the transport sector

Social co-benefits	• Supports improved air quality and general health and well-being • Improved safety • Savings on costly fuel for ICE vehicles
Economic co-benefits	• Resilience to fuel and price volatility • Local economic development, including an EV servicing value chain
Risks associated with the implementation of the action	• Users may be concerned about incurring additional costs of retrofitting their existing two- and three-wheelers, or of high initial costs of buying new e-bikes, compared to traditional two- and three- wheelers • Lack of sufficient infrastructure to support EV uptake – efforts to install charging stations in frequented places can help • Further down the line, proper management and disposal of end-of-life EV batteries • Cooperation with neighbouring governments will be needed to support EV development in a coordinated manner • E-vehicles could be targets of theft and may require additional security technologies
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• MoEP • CGK • National banks (e.g., Kingdom Bank, Co-operative Bank) • Operators: Knights Energy (charging infrastructure), Unitar (two and three-wheelers) • Boda-Boda Association and Tuk-Tuk Association in Kisumu • Electric Mobility Association of Kenya (EMAK) (for advisory on the project)

Action 6	
Expand greening and ecological infrastructure - Visioning workshop, February 2022	
Description	Green spaces encourage walking, jogging, cycling and other NMT methods. Tree planting, especially fruit trees, and general greening of areas act as carbon sinks and can provide shade. In general, green areas can provide cooling effects locally, which can help with county-wide energy conservation. They can help reduce the risk of flooding, thereby protecting transportation infrastructure like roads and pedestrian walkways
Technology supported	Nature-based solutions

How it responds to defined goals	Increasing the greenery in urban spaces supports the reduction in carbon emissions and Kisumu County's ambitions towards sustainability. Green spaces can provide more access to cooling and enable NMT by creating more appealing and safer zones
Are there policy linkages at different levels?	Yes • Kisumu County Climate Change Integrated Action Plan 2023-2027 • National Determined Contribution of 32% of GHG Abatement
Estimated GHG reduction	Between 10-40 kg of CO_2 absorbed per year, per tree planted
Estimated reduction in energy consumption	N/A
Estimated cost/resources required	Up to KSh 300 million (KCICCAP, 2022) KSh 20,000 to plant trees along each road development project already allocated for
Timeline	Short- to medium-term
Implementation strategy	• Conduct an assessment of existing green spaces • Develop a strategic greening plan that identifies priority and potential areas for tree planting • Focus on enhancing aesthetics, improving air quality and providing shade for pedestrians and cyclists • Integrate greening efforts into urban mobility infrastructure projects, such as the transport network, road corridors, bus stops, transport hubs, charging places, public spaces and pedestrian pathways • Identify suitable tree species for planting, and use native tree species to promote ecological resilience, support local wildlife and adapt to specific local climate conditions • Develop a maintenance plan for newly planted trees and green areas, including watering schedules • Conduct educational programs and workshops on the benefits of greening and ecological infrastructure for improving urban liveability and climate resilience
Possible sources of financing	County's own budget, crowdfunding and donations
Environmental co-benefits	• Increasing urban greenery will support the reduction of carbon emissions • Enhances resilience of cities, reinforces soil and prevents erosion • Strengthens ecosystem services and biodiversity • Supports the reduction of the heat island effect and cools down the city

Social co-benefits	• Shade provided by trees will provide comfort for pedestrians and cyclists • Beautification of spaces and increase in aesthetics of the city • Promotes improved air quality, health and well-being
Economic co-benefits	• Trees can provide a number of free ecosystem services
Risks associated with the implementation of the action	• Trees must be pruned when they are short so that visually impaired residents do not walk into branches • Environmental challenges such as extreme weather events, drought or pest infestations that can impact tree health and survival
Lead department	Department of Water, Environment, Natural Resources and Climate Change
Partners and stakeholders	• Department of Planning, Lands and Urban Development • Department of Energy, Roads, Transport and Public Works • Community based organisations • Donor agencies • Civil society and philanthropies

PILLAR B: QUALIFYING CONDITIONS

Action	Qualifying conditions			
	Regulations	**Technology and study**	**Governance and accountability**	**Infrastructure**
Promote one car-free day a month	Develop policy to implement this initiative	Citizen assessment of the initiative – willingness	Awareness campaigns required on the initiative	Infrastructure required to accommodate NMT users
Designate car-free areas in five streets	Develop policy to implement this initiative	Traffic assessment to identify streets	Awareness campaigns required on the initiative	Infrastructure required to accommodate NMT users
Improve infrastructure to support NMT from 50 km to 200 km	Develop policy to implement this initiative	Assessment of mode shares, current NMT condition and site inspections for new infrastructure	N/A	Footpaths, cycle lanes, cycle parking facilities, pedestrian crossing sections, foot bridges

Increase installation of LED/ energy saving streetlights from 25 km to 100 km	EE strategy to be developed	Assessment of sites that require new lights, or replacement of old lights	N/A	Sites identified for intervention
Electrify transportation solutions and advance commercial electric mobility	New regulations governing conversion to e-mobility options for commercial and public sectors	Feasibility study to assess techno-economic viability of retrofit, manufacturing of vehicles and siting charging infrastructure	Government leading by example by changing own fleet to e-vehicles	On-grid (and off-grid) charging and/or swapping stations
Expand greening and ecological infrastructure	N/A – already included as part of construction projects	N/A	Awareness campaigns required on the initiative	Sites identified for intervention

PILLAR C: CLEAN COOKING

Pillar objective(s)

- To transition from inefficient and polluting methods of cooking to cleaner cooking options for all citizens of Kisumu County
- To improve the health and well-being of citizens, especially women and girls, by reducing the reliance on fuelwood/kerosene/etc., for cooking
- To promote responsible consumption patterns and protect forests and ecosystems

SDGs linked to pillar

- **SDG 3: Good health and well-being** – ensure healthy lives and promote well-being for all at all ages
- **SDG 7: Affordable and clean energy** – ensure access to affordable, reliable, sustainable and modern energy for all
- **SDG 10: Reduced inequalities** – reduce inequalities within and among countries
- **SDG 11: Sustainable cities and communities** – make cities and human settlements inclusive, safe, resilient and sustainable
- **SDG 12: Responsible consumption and production** – ensure sustainable consumption and production patterns
- **SDG 13: Climate action** – take urgent action to combat climate change and its impacts
- **SDG 15: Life on land** – protect, restore and prompt sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss

Goals	Intermediate goals	Indicators	Percentage Share

100% adoption of clean cooking methods using electric stoves, efficient biogas and ethanol stoves by 2028 for the residential and commercial sectors	70% adoption of clean cooking methods (including LPG) using electric stoves, efficient biogas and ethanol stoves by 2025 for the residential and commercial sectors 20% adoption of clean cooking methods (excl. LPG) by 2035	• Percentage of the population with access to clean cooking methods (%) • Percentage of the population able or willing to pay for cleaner cooking methods (%)	100% of residents in Kisumu County

INDICATORS

Indicator	Definition				Control	
	Calculation method	Source	Periodicity	Polarity (-/+)	Baseline	Goals
Percentage of the population with access to clean cooking methods	Census data, special surveys	Kenya Bureau of Statistics; MoEP; Kisumu County Department of Energy, Roads, Transport and Public Works	Per annum	+	23% (KCICCAP,2022)	100%
Percentage of the population able or willing to pay for cleaner cooking methods	Census data, special surveys	Kenya Bureau of Statistics; MoEP; Kisumu County Department of Energy, Roads, Transport and Public Works	Per annum	+	70% ((KCICCAP,2022)	85-100%

ACTIONS

Action 1	
Promote the use of cleaner cook stoves in urban and rural areas - Visioning workshop, February 2022	
Description	Promote switching to cleaner fuels and technologies for cooking such as solar, biogas, ethanol-fuelled stoves and improved cook stoves
Technology supported	Solar, biogas, ethanol, improved cookstoves

How it responds to defined goals	Traditional biomass for cooking is a major source of emissions. Adopting cleaner cookstoves supports the transition to clean cooking in the county
Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • Kenya Ethanol Cooking Fuel Masterplan, June 2021 • Kenya National Energy Efficiency and Conservation Strategy, 2020 • The Energy Act, 2019 • The Bioenergy Strategy, 2020-2027 • The Kenya National Cooking Transition Strategy, 2024 – 2028 • The National Climate Change Act, 2016 • Kisumu County Energy Plan, 2021-2030 • The Kisumu County Integrated Climate Change Action Plan, 2023-2027 • The Sustainable Energy Access and Climate Action Plan (2020) • The Kisumu County Climate Change Act, 2020 • The Sustainable Energy Policy (Draft), 2021 • The Kisumu County Climate Change Policy, 2019
Estimated GHG reduction	Between 1-3 tonnes of CO_2e saved per stove per annum[11]
Estimated reduction in energy consumption	Dependent on the stove type
Estimated cost/resources required	• KSh 1,715 each for a two-burner ethanol cooker • KSh 1,500-7000 each for improved cook stoves • KSh 5,000-7,000 for biogas cookers
Timeline	Short- to long-term
Implementation strategy	• Consumer awareness campaigns to highlight the benefits of cleaner cookstoves. Messaging must be tailored to address immediate concerns, e.g., costs, accessing fuel, etc. • Stakeholder engagement in all areas (e.g., with community leaders, fuel sellers) will be crucial as cooking habits can be difficult to shift. While people may be aware of the benefits of cleaner stoves, they may not have sufficient incentives to switch • Collaborating with local NGOs or DFIs for financial assistance to encourage switching can be considered, as well as any national government resources to assist
Possible sources of financing	County's own budget, national funding, grant/development aid funding, green climate funding

[11] https://2017-2020.usaid.gov/sites/default/files/documents/1865/cookstoves-toolkit-2017-complete.pdf

Environmental co-benefits	• Air pollution through the use of traditional biomass is reduced, resulting in improved local air quality • Swapping out wood for cleaner cooking fuels leads to reduced reliance on wood, thereby reducing deforestation and protecting trees and forest ecosystems • Contributes to the reduction in GHG emissions and black carbon
Social co-benefits	Improved indoor air quality leads to improved health and well-being, particularly for women and children
Economic co-benefits	Cost savings as certain options such as kerosene are expensive
Risks associated with the implementation of the action	Cultural habits and having to learn to use new technologies may cause resistance to change and impede the transition
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • Clean Cooking Association of Kenya • Ministry of Energy and Petroleum • Private sector and industry

Action 2	
Promote the uptake of electric cooking in urban areas - Project identification and prioritisation meeting, March 2023; Climate finance and project preparation workshop, September 2023	
Description	The project aims at transitioning from traditional inefficient energy sources for cooking, mainly biomass (firewood and charcoal) and paraffin to on-grid e-cooking with portable pressure cooker units in the urban, peri-urban areas and satellite towns of Kisumu County
Technology supported	Electric stoves and electric pressure cookers
How it responds to defined goals	Adopting electric cooking supports the transition to clean cooking and enables the 100%RE transition in Kisumu County

Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • Kenya Ethanol Cooking Fuel Masterplan, June 2021 • Kenya National Energy Efficiency and Conservation Strategy, 2020 • The Energy Act, 2019 • The Bioenergy Strategy, 2020-2027 • The Kenya National Cooking Transition Strategy, 2024 – 2028 • The National Climate Change Act, 2016 • Kisumu County Energy Plan, 2021-2030 • The Kisumu County Integrated Climate Change Action Plan, 2023-2027 • The Sustainable Energy Access and Climate Action Plan (2020) • The Kisumu County Climate Change Act, 2020 • The Sustainable Energy Policy, 2021 (Draft) • The Kisumu County Climate Change Policy, 2019
Estimated GHG reduction	Dependent on number of stoves being replaced, and fuels displaced
Estimated reduction in energy consumption	Dependent on number of stoves being replaced, and fuels displaced
Estimated cost/resources required	• CAPEX: KSh 38 million – recruitment of implementing partner, subsidy and awareness creation and demonstrations • OPEX: KSh 25 million
Timeline	Short- to medium-term
Implementation strategy	• Integrate electric cooking plans into existing energy plans e.g., how much additional electricity supply will be required to meet demand (the energy systems modelling can be a reference) • Continue to work to ensure sustainable and reliable electricity supply, particularly for vulnerable households • Engage with stakeholders, such as potential users and salespeople, to highlight the benefits of electric cooking • Provide financial incentives from local revenue, or form partnerships with various institutions that can provide such assistance. Take advantage of national government programs • Work with institutions, canteens, hospitals, etc., as transitioning them to electric cooking might be more feasible due to the scale involved • Explore the potential of beginning with county-owned facilities to trial electric cooking

Possible sources of financing	County own budget, national funding, grant/development aid funding, green climate funding
Environmental co-benefits	• Swapping out firewood for cleaner cooking methods leads to more sustainable use of firewood and the protection of trees and forest ecosystems • Contributes to the reduction in GHG emissions and black carbon
Social co-benefits	Indoor air pollution is improved, thus leading to improved health and well-being including fewer respiratory illnesses and related deaths
Economic co-benefits	Cost savings as certain options such as kerosene are expensive
Risks associated with the implementation of the action	• Some citizens may prefer to use what they know instead of using new technologies, which may delay the transition. Effective stakeholder engagement must be matched with appropriate incentives • Some might prefer to use charcoal due to high electricity tariffs. The spread of electric cooking (which forms most of the cooking in the 100% RE scenario) is also dependent on the spread of electricity access and reliable supply, as well as costs. All these constraints must be kept in mind when planning and providing appropriate incentives
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • KPLC • Clean Cooking Association of Kenya • MoEP • Private sector and industry

Action 3	
Strategically use LPG as a transition fuel for a shift toward renewable cooking fuels - Visioning workshop, February 2022	
Description	While LPG is still derived from fossil fuels, it has a higher efficiency than traditional stoves and contributes to less harmful particulate matter emissions. This is an interim solution to address the urgency of the clean cooking challenge since it is already accessible to citizens. However, to achieve 100% RE use in cooking, LPG use must be limited, and plans must be adopted to bypass it or find renewable-sourced alternatives to avoid lock-in of behaviours and technologies. Electric or RE cookstoves will emit even fewer pollutants and GHGs than LPG stoves
Technology supported	LPG cookstoves, RE cookstoves

How it responds to defined goals	Supports the transition to clean cooking by adopting this technology but must be done in a controlled and limited manner with a view towards ultimately phasing out LPG to enable the 100% RE transition in Kisumu County
Are there policy linkages at different levels?	Yes • Nationally Determined Contribution (NDC, 2020) • The National Climate Change Act, 2023 (under public participation) • Kisumu County Energy Plan, 2021-2030 • The Kisumu County Integrated Climate Change Action Plan, 2022-2027 • The Sustainable Energy Access and Climate Action Plan (2020)
Estimated GHG reduction	LPG stoves can emit up to 50 times less pollutants than other options such as biomass stoves, and further protects forests (Alderman, 2018)
Estimated reduction in energy consumption	Usually between 60-65%, but thermal efficiency of up to 82% can be achieved depending on the burner used (Thirumalaikumaran, 2022)
Estimated cost/resources required	KSh 50 million (KCICCAP, 2022)
Timeline	Short- to medium-term
Implementation strategy	• Map the most vulnerable groups and only consider using LPG for them to address urgent and pressing concerns • Through outreach for clean cooking, promote renewable alternatives and highlight their benefits • Improve availability by establishing supply chains for renewable cooking fuel alternatives (such as biogas, briquettes, ethanol, solar) to LPG • Engage existing LPG suppliers to reduce adverse impacts on local jobs due to switching to alternative fuels • Consider reskilling programs to be able to handle the influx of renewable technologies • Offer financial support such as subsidies, grants or loans to businesses and households moving to renewable cooking fuels to offset the upfront costs of stoves
Possible sources of financing	County's own funding for incentives/subsidies, PAYG business model
Environmental co-benefits	• Promotes clean cooking with lower emissions • Contributes to the protection of forests when LPG stoves replace cooking with firewood

Social co-benefits	• Assists with the transition to clean cooking • Improves the health of users when compared to other fossil fuel options such as kerosene, diesel, fuelwood, etc.
Economic co-benefits	When coupled with PAYG models, LPG stoves can increase the affordability for users
Risks associated with the implementation of the action	Switching to LPG as a transition fuel may create lock-ins in terms of behaviours, supply chains and skills if some prefer to use LPG instead of other RE options. Therefore, efforts must be taken to use LPG only in the direst cases to address socio-economic concerns, with the view to shift to electric or other renewable forms of cooking over the medium and long term
Lead department	Department of Energy, Roads, Transport and Public Works
Partners and stakeholders	• Department of Water, Environment, Natural Resources and Climate Change • EPRA • Clean Cooking Association of Kenya • MoEP • Private sector and industry

PILLAR C: QUALIFYING CONDITIONS

Action	**Qualifying conditions**			
	Regulations	**Technology and study**	**Governance and accountability**	**Infrastructure**
Promote the use of cleaner cook stoves in urban and rural areas	Incentives or subsidies for adopting clean cooking solutions	• Clean cooking market study • Assessment of uptake	• Awareness raising on benefits, information sessions and demonstrations • Promote development of local capacity for qualified personnel with skills to install and maintain biogas cook stoves	Infrastructure required to accommodate NMT users

Promote the uptake of electric cooking in urban areas	Incentives or subsidies for adopting clean cooking solutions	• Clean cooking market study • Assessment of uptake	Awareness raising on benefits, information sessions and demonstrations	Grid connected households
Strategically use LPG as a transition fuel for a shift toward renewable cooking fuels	Incentives or subsidies for adopting clean cooking solutions (emphasising sources other than LPG)	• Clean cooking market study for non-LPG sources • Assessment of uptake	Awareness raising on benefits, information sessions and demonstrations	Improved electricity network and biofuel or ethanol production and distribution

FUNDING MECHANISMS

SOURCES OF FUNDING FOR RENEWABLE ENERGY IN KISUMU COUNTY

Funding for energy projects in Kenya comes from two main groups – public finance and private finance, with collaborative arrangements under PPPs and development finance institutions. As county and national governments strive to balance the use of public funds for various competing purposes (health, education, industry, etc.), additional funding is critical in financing the energy sector. It is envisaged that recent changes in global energy policies will lead to additional financing from external funds (such as the "loss and damage" fund).

Public financing for RE (and EE) projects plays a crucial role in driving investment, promoting sustainable development, and accelerating the transition to a 100%RE future. Public funds come from tax revenues and grants, foreign loans, domestic loans and the issuance of state securities (such as government bonds) or by establishing dedicated financing facilities to raise capital for RE projects. At the county level, the government gets funds from taxes, fees (market, cess), retail licenses, license fees, permit fees, etc. These funds may then be used to finance RE projects through grants, subsidies, concessional loans and loan guarantees, feed-in tariffs (FiTs) and tax incentives.

Public finance institutions also provide capacity building and technical assistance to support the development, implementation and management of RE projects. This may include training programs, feasibility studies, project preparation support and policy advisory services.

Private financing: Private sector partners, such as RE developers, financiers and technology providers, bring capital, expertise and innovation to RE projects. They invest in project development, construction and operation, expecting returns through revenue streams like power purchase agreements (PPAs), FiTs, or RE certificates (RECs). Commercial banks, investment companies, private equity and venture capital investors (see Table 7) are also targeting the RE sector in Kenyan counties.

Public-private partnerships (PPP): The public and private collaboration to finance and implement projects accelerates achieving development goals through the involvement of private investment/business entities in the provision of public infrastructure. PPPs offer a flexible and effective mechanism for financing RE projects, mobilising private capital and accelerating the transition to a low-carbon, sustainable energy future.

Public financing for RE projects is often complemented by regulatory frameworks, policies and market mechanisms that create an enabling environment for RE investment.

By strategically leveraging public resources, governments can unlock private sector investment, accelerate RE deployment and achieve climate and development objectives. For instance, the Kenyan national government can support energy projects by providing guarantees and letters of support, while the private sector has access to funds for investing in projects.

They also allow for the sharing of risks between public and private partners, mitigating the investment risks associated with RE projects. The public sector may assume certain risks, such as policy and regulatory risks, while the private sector takes on risks related to project performance, construction and market fluctuations.

PPPs often involve long-term partnerships between the public and private sectors, spanning the entire project lifecycle from development and financing to operation and maintenance. By harnessing the strengths and resources of both the public and private sectors (e.g., public sector resources and private sector expertise), these partnerships can drive investment, innovation and growth in the RE sector.

PARTNERSHIPS FOR PROJECT DEVELOPMENT

For the actions and demonstration projects identified in this section, the tables below (Tables 7 and 8) present some mechanisms for project preparation and implementation.

Project preparation funding (PPF) supports the initial stages of project development, covers costs such as feasibility studies, environmental assessments, technical design and capacity building, and ensures projects are well-prepared, enhancing their investability and increasing the likelihood of successful implementation and long-term impact.

Project implementation funding (PIF) provides funding for the execution of specific initiatives, ensuring the necessary resources for planning, construction and operation, and supports the practical implementation of projects, covering costs associated with materials, labour, equipment and other operational expenses.

Table 7: List of potential project preparation funding options

Project preparation agency	Operating agency	Support offered	Additional information
CICLIA (Cities and Climate in Africa)	AFD	Studies and technical assistance in all sectors of sustainable cities	https://www.afd.fr/fr/ciclia
City Climate Finance Gap Fund	World Bank and EIB	Technical assistance and capacity building to support climate-smart planning and investment in cities in developing and emerging countries	https://www.citygapfund.org/
Urban and Municipal Development Fund	AfDB	Support action planning, capacity building, project identifications and preparation, financial or technical assistance for urban infrastructure projects, technical assistance for cities to improve their creditworthiness and ability to invest	https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/urban-and-municipal-development-fund
African Water Facility (AWF)	AfDB	Grants and expert technical assistance to implement innovative water	https://www.africanwaterfacility.org/
Sustainable Energy Fund for Africa (SEFA)	AfDB	Technical assistance and concessional finance instruments	https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/sustainable-energy-fund-for-africa
Project Preparation Fund	DBSA	Expertise and funding for early-stage project preparation	https://www.dbsa.org/solutions/project-preparation
Global Subnational Climate Fund (SnCF Global)	GCF and Pegasus	Technical assistance	https://www.greenclimate.fund/project/fp152
Transformative Action Programme (TAP)	ICLEI	Technical assistance	https://tap-potential.org/
UNEP energy finance	UNEP	Technical assistance for RE and EE project	https://www.unep.org/explore-topics/energy/what-we-do/energy-finance

Table 8: List of potential project implementation funding options

Funding Agencies	Scope	Lines of Financing	Additional information
The National Treasury of Kenya		National designed authority to the Green Climate Fund (GCF)	https://www.greenclimate.fund/countries/kenya
KCB Bank Kenya Limited	Energy, climate, SDGs, urban development, mobility, economic growth and employment	National designed authority to the Green Climate Fund (GCF)	https://www.greenclimate.fund/countries/kenya
African Development Bank	Climate change, RE, EE	Concessional loans, blended finance	https://www.afdb.org/en
KfW Development Bank	RE, climate, SDGs, urban development, mobility, economic growth and employment, management of water resources	Concessional loans, blended finance, grants	https://www.kfw-entwicklungsbank.de/International-financing/KfW-Entwicklungsbank/
Co-operative bank	All areas	Concessional loans, blended finance	https://www.co-opbank.co.ke/
Stanbic Bank Kenya	All areas	Concessional loans, blended finance, grants	https://www.stanbicbank.co.ke/
Green Climate Fund (GCF)	Overall, 17 active programs in Kenya, including: • Global Subnational Climate Fund • Promotion of Climate-Friendly Cooking: Kenya and Senegal • Universal Green Energy Access Programme (UGEAP)	Specific to each program	https://www.greenclimate.fund/
Global Environment Facility (GEF)	Climate change mitigation, adaptation, biodiversity, gender, youth, sustainable cities, food security	Blended finance	https://www.thegef.org/
Access to energy fund	Access to energy from RE sources, EE, Grid infrastructure	Debt, equity	https://www.fmo.nl/aef
SDG Finance	All areas of the Sustainable Development Goals	Sovereign risk financing mechanisms	https://sdgfinance.undp.org/
Mitigation Action facility (previously NAMA Facility)	Mitigation, including e-mobility	Active projects in Kenya include subsidies, credit guarantees	https://mitigation-action.org/about/nama-facility/

RECOMMENDATIONS

SUMMARY OF POLICY RECOMMENDATIONS

Kenya and Kisumu County have a wide range of policies, plans, instruments and regulations in place to facilitate the improvement of the energy system, enhance energy access and deploy RE. They are taken from the baseline and are briefly described in Table 9 below, along with their synergies with the roadmap.

Table 9: Overview of the baseline energy sector policies and plans (Source: Adapted from the Initial Energy Status Report, Kisumu County, Kenya, 2020))

Name	Category	Brief description	Synergy with the Roadmap
National			
Vision 2030	Plan	Plan with the overall aim to accelerate transformation in Kenya towards a newly industrialising, middle-income country providing a high quality of life to all its citizens by 2030, in a clean and secure environment	RE is a priority: a national resource map is under development, as is a national strategy for resource use – including the research and promotion of municipal waste-to-energy
Kenya's Nationally Determined Contributions	Instrument	The NDC target is to decrease GHG emissions by 32% by 2030, relative to the BAU scenario of 143 $MtCO_2eq$ across the market segments of electricity generation and energy demand, forestry, waste, industrial processes, transport and agriculture	Kenya's NDCs are one of the drivers of RE, EE and low-carbon transport developments in the country and Kisumu County
Green Economy Strategy and Implementation Plan (GESIP 2016-2030)	Plan	The GESIP is geared towards enabling Kenya to attain a higher economic growth rate consistent with the Vision 2030, through a green growth pathway	Supports the development of a green economic growth
Kenya's Climate Change Act (2016)	Law	The Climate Change Act seeks to mainstream climate change planning in all sectors and at all levels of government	The premise of the roadmap is based on a transition to support climate protection
Least Cost Power Development Plan (LCPDP)	Plan	The LCPDP is a Kenyan Energy Sector Report intended to guide the power sector on the status, generation and transmission expansion opportunities, as well as resource requirements for expansion programmes	Prioritises the development of RE. e.g. deploying solar mini-grids for rural electrification

Sustainable Energy for All (SE4All) Action Agenda	Plan/project	Kenya opted into the SE4All initiative and has developed an action agenda, which is a sector-wide, long-term vision from 2015-2030. The agenda outlines how the country will achieve its SE4All goals of universal access to modern energy services, increase the rate of EE and increase RE to an 80% share in the energy mix by 2030	Supports universal access to modern and clean energy services, increases EE and the share of RE
REREC Strategic Plan 2017-2021	Plan	This strategic plan focuses on the roll-out of RE and mini-grids in achieving REREC's electrification targets for public facilities. The plan provides a roadmap for electrification of public facilities and nearby households	By 2020, the plan includes projects to electrify 28,323 public facilities, 3,787 of which will be off-grid areas electrified through solar PV
Kenya National Electrification Strategy, 2018	Instrument	Off-grid solutions are a major component of the National Electrification Strategy launched in 2018. It expects to provide two million of the expected 5.7 million new connections required for universal electricity access by 2022 in Kenya	The least cost and most effective electrification solutions in this electrification strategy are an important consideration for Kisumu County during its transition to 100% RE
Kenya Electricity Sector Investment Prospectus, 2018–2022	Instrument/ plan	The prospectus presents investment and financing opportunities in geothermal development, power generation, electricity transmission and distribution, off-grid electrification and EE. It also presents the opportunity for increased private-sector participation across all sub-sectors through the PPPs framework, FiTs, and RE auctions frameworks, among other things	Promotes finance opportunities for private sector partnering and promotion of RE
Feed-in Tariff (FiT) Policy (2008) – amended 2010, 2012	Instrument	The FiT Policy offers a framework for electricity generated from RE sources (specifically wind, biomass and small hydro) in order to safeguard the investments made by the respective developers in undertaking feasibility studies; and to boost the development of RE sources for electricity generation. FiTs allow power producers to sell RE generated electricity to the off-taker (KPLC) at a predetermined tariff for a given period	Serves as an incentive for all power generated from RE

Data Protection Bill 2018	Instrument	This is a relevant bill to the RE sector and particularly in the '100%RE' project, given its extensive data needs	One provision likely to affect off-grid energy companies is the condition for transfer of data out of Kenya, which prevents employees and customer data from being transmitted or stored in another country unless that country also has similar data protection regulations
The Public Private Partnership (PPP) Act 2013	Law	The Kenyan Parliament enacted the Public Private Partnerships Act 2013, to provide for the participation of the private sector in the financing, construction, development, operation and maintenance of infrastructure projects of the government through concessions or other contractual arrangements. The Act also established the Public Private Partnership Unit to regulate, monitor and supervise the implementation of project agreements on infrastructure	Promotes private sector partnering which can be used to accelerate RE
Energy (Solar Photovoltaic Systems) Regulations 2012	Law	These regulations, made under Section 110 of the Energy Act 2006, provide rules and standards for the installation of solar PV systems in Kenya. They apply to a solar PV system manufacturer, importer, vendor, technician, contractor, system owner and to solar PV system installation and consumer devices	Supports the installation of quality systems which will be key since solar PV is the main workhorse of the transition to 100%RE
Energy (Electricity Licensing) Regulations 2012	Law	Applies to any person who engages/ intends to engage in the generation, transmission, distribution and supply of electrical energy in Kenya per the requirements of the Energy Act. Under the Licensing Regulations, no permit or licence is required to generate electricity where the electricity generated does not exceed 1 MW and is generated for own consumption. A permit is however required for the generation and supply of electrical energy not exceeding 3 MW and a licence is required for generation, transmission, distribution or supply of electrical energy exceeding 3 MW	Regulatory guidance for implementation of large scale RE systems
Kenya Electricity Grid Code 2018	Law	The Grid Code is the primary technical document of the electricity supply industry (ESI), collating the majority of the technical regulations covering the generation, transmission, distribution and supply of electrical energy	Regulatory guidance for implementation of large scale RE systems

Kenya National Energy Efficiency and Conservation Strategy (NEECS) 2020	Strategy	The NEECS was developed to enhance ongoing efforts towards setting and achieving EE goals in the following thematic sectors noted for their high energy demand and potential for improvement of EE and conservation – households, buildings, industry and agriculture, transport and power utilities	Linkages with EE and conservation of energy measures
The National Energy Policy 2018	Instrument	The National Policy provides for a feed in tariff system that promotes generation of electricity from RE sources so as to enhance the country's electricity supply capacity and ensure affordable, competitive, sustainable and reliable supply of energy at the least cost	Promote adoption of RE technologies
Energy Act, 2019	Law	Operationalise The National Energy Policy 2018 and consolidate laws relating to E energy, provide for national and county government functions in relation to energy, establish energy sector entities, promote RE, utilisation of geothermal energy and regulate midstream and downstream petroleum, coal activities and electricity	Promote the generation of RE in the Counties
Local			
The Kisumu County Draft Sustainable Energy Policy 2021	Instrument	This policy was prepared by the CGK, as part of the County's constitutional mandate to regulate energy and energy targets, in line with the targets and measures set out in the SE4All Kenya's Action Agenda and other relevant policies in the country. It also contains policy interventions per objective and target in the county	Linkages with RE development, energy access and clean cooking
The Kisumu County Energy Plan (2021-2026)	Plan	This masterplan details the access to electricity and access to clean cooking status of the county through a household survey that was conducted. It also points out the challenges faced by the county in increasing access to energy and proposes policy recommendations for the county. The current energy mix, energy demand and actors are also outlined in this document. At the time of the baseline report, the masterplan was still in development	Linkages with RE development, EE, energy access, clean cooking and sustainable development
The Kisumu County Integrated Development Plan (2018 – 2022)	Plan	County development plan developed every five years. This CIDP cuts across all the county departments and is currently being reviewed	Linkages with RE development, EE, energy access, clean cooking and sustainable development

Kisumu County Climate Change Policy 2019 & Act 2020	Law	This is meant to ensure that climate change is mainstreamed in the economically and socially vulnerable sectors of the economy, energy in the forefront, and to steer Kisumu County towards climate resilience, blue economy and green development pathway	Ensure energy security of the county in the face of challenges posed by climate change

In addition to the policies highlighted above, the following plans and policies were drafted following the baseline period:

- The Kisumu County Sustainable Energy Access and Climate Action Plan (SEACAP)
- Kisumu County Integrated Climate Change Action Plan 2022-2027
- Kenya's Long-Term Low Emission Development Strategy (LT-LEDS) 2022-2050
- Kenya's National Climate Change Action Plan (NCCAP) 2023-2027
- Climate Change Act (Amendment 2023)

More recently, the Kisumu County Annual Development Plan Financial Year 2023-2024 highlighted recent projects within the county's electricity, transport and clean cooking sectors. These include the installation of a 7 kW solar mini-grid at Kit Mikayi Cultural Centre, one biogas plant installed at Ahero Vocational Training Centre, the distribution of 720 solar lanterns, and the installation of 29 high mast floodlights and 2.9 km of streetlights. For transport, 74.6 km of new roads were constructed with 123 km of roads rehabilitated, while the clean cooking sector projects include sensitisation campaigns on alternative cleaner fuels in three sub-counties

For the actions proposed in this Roadmap to be actualised and drive the transition to seeing a greater uptake of renewables across the three sectors (pillars), policy recommendations at the local level are proposed in detail in the ***Local Policy Review and Recommendations Towards A Transition To 100% RE For Kisumu County, Kenya*** document. It includes an overview of current policy interventions, highlights the policy barriers and presents policy recommendations. A summary of these local policy recommendations proposed for the short, medium and long term include:

ELECTRICITY

Short term

- A change in regulations to give county governments the mandate for electricity generation and purchasing. Lobby government for regulations for wheeling and net metering
- Conduct energy audits in public and commercial buildings
- Old municipal buildings must be retrofitted with solar PV systems, solar water heaters (SWH) and EE interventions

Medium term

- All new power generation in Kisumu to be renewables-based.
- All municipal buildings are to be retrofitted with solar PV and EE retrofits
- All new commercial and public buildings to have solar PV, to be considered when approving building plans in the county
- Expand streetlight coverage – All new street lighting to be LED and solar-powered.

Long term

- Develop a plan to handle e-waste generated from used or broken solar panels and/or batteries and other parts after their useful lifetime.

- All existing and new county facilities to align with EE standards and have installed RE and EE technologies.
- Scale up local production of RE technologies and establish thresholds as part of the FiT or auction schemes.

TRANSPORT

Short term

- Install charging infrastructure in bus depots to facilitate electric transport (buses, mini-buses, etc.). Explore large parking lots for the initial rollout (e.g., the mall).
- Promote the use of electric two- and four-wheelers through awareness campaigns and incentives such as parking benefits, tax exemptions, etc.
- Investigate the possibility of electrifying public transport through electricity or hydrogen, including freight vehicles.

Medium term

- Establish collaboration with neighbouring counties and the national government to jointly enable electric mobility.
- Revisit plans for hydrogen in transport based on Kenya's Green Hydrogen Strategy and Roadmap.

Long term

- Ensure adequate maintenance of NMT infrastructure and expand it as needed.
- Set targets per decade for modern public transport systems, including the number of electric vehicles, kilometres of Bus Rapid Transit (BRT), rail, and NMT, based on expected versus actual performance of such measures.

COOKING

Short term

- Continue with stakeholder engagement to understand any reluctance to take up cleaner cooking methods.
- Investigate infrastructure needs for alternative fuels e.g., electricity, ethanol and biofuels.

Medium term

- Expand the use of electric cooking. Align additional electric cooking demand with plans for improving the electricity supply.
- Target institutional users first when it comes to shifting from LPG, through incentives or disincentives.

Long term

- 100% of cooking in commercial institutions and households is based on renewables-derived sources or electricity.

MONITORING AND EVALUATION

Monitoring and evaluation (M&E) of the transition to 100% renewables is crucial for ensuring that the goals are being met effectively and efficiently. According to the CEMP, the Department of Energy, Transport and Public Works' core responsibilities include the monitoring and evaluation of strategic projects, programs and strategies required to deliver county policies. By implementing a robust M&E framework, Kisumu County can track progress, identify barriers earlier and make informed decisions to accelerate the transition to 100% renewables.

To do this successfully, the following steps are advised:

Establish clear objectives and indicators: The first requirement in developing an effective M&E plan is to define specific, measurable objectives for the transition to renewables, with corresponding indicator(s) to track progress towards these objectives. This will guide what actions need to be taken, when, and by whom. This has been presented above in Part 3 of this Roadmap.

Stakeholder engagement: In addition to the county-appointed team, engaging with stakeholders, such as the National Project Advisory Group, government agencies, businesses, residents, and community organisations, to gather feedback, share information and ensure community buy-in can also provide valuable insights into the effectiveness of RE policies and program

Baseline assessment: An initial assessment of the city's current energy sources, consumption patterns, and emissions levels has been completed and presented in the Initial Energy Status Report and the KCICCAP. This will serve as a baseline against which progress can be measured.

Regular data collection: Implement systems for regularly collecting data on RE generation, energy consumption, emissions and other relevant metrics. This may involve collaborating with utility companies, installing monitoring equipment such as power dataloggers or conducting surveys.

Performance monitoring: Continuously monitoring the performance of installed systems, technologies or infrastructure via tracking key performance indicators (KPIs) will help assess their effectiveness and identify areas for improvement.

Knowledge sharing and learning: Sharing lessons learned and best practices with other counties and stakeholders can promote replication and scaling up of successful RE initiatives. Foster a continuous learning and improvement culture to optimise the transition to 100% renewables.

Mid-term and final evaluation: Conducting mid-term and final evaluations to assess progress towards 100% renewables goals, identifying successes and challenges, and making adjustments to strategies and initiatives as needed will . Evaluate the overall impact of the transition on energy security, environmental sustainability, economic development and social equity.

CONCLUSION

Backed by the energy system modelling that was undertaken, it has been demonstrated that Kisumu County can achieve a 100%RE in the electricity (and buildings), transport, and clean cooking sectors through the county's rich and abundant RE resources. Kisumu County is committed to shifting towards a more low-carbon and sustainable pathway. It is already well on the way, with many targets moving forward to raise the ambition.

The key to the remainder of the transition will be the adoption of sound monitoring and evaluation. This will enable the tracking of progress and inform the County whether any amendments need to be made through additional actions to ensure targets are being met. The Roadmap should also be a live document that is regularly updated, and actions revisited and added as necessary.

A crucial element of the transition will be awareness creation and sensitisation at scale, especially in the transport and clean cooking sectors. Incentives, rebates and subsidies can play a pivotal role in the uptake, especially where community members may be apprehensive about changing cultural views and behaviours considered the norm. In addition, the development of new skills, particularly for youth and women, will be important to support the transition and ensure that the transition provides opportunities for participation in the emerging green economy.

While a number of supportive policies and strategies already exist for RE and climate protection, it is vital that any policy document developed henceforth considers the County's transition goals and secures political support for action and implementation.

The private sector, academia and technocrats have an important role in accelerating some of the County's goals while meeting community needs. Their support should be leveraged further to develop a pipeline of bankable projects and implement local, home-grown, innovative solutions.

Kisumu County is leading by example, and we hope that other cities and regions will be inspired by its bold climate action.

REFERENCES

1. Adepoju, M. and Sen, R. (2021). 100% Renewables Cities and Regions Roadmap Framework. [online] Renewables Roadmap, pp.1–37. Available at: https://renewablesroadmap.iclei.org/wp-content/uploads/2021/09/Framework_Final.pdf [Accessed 16 May 2024].

2. Alderman J.(2018). 'Is LPG really a dirty word? Available at: https://envirofit.org/lpg-clean-fuel-for-energy-poverty/' [Accessed 23 May 2024]

3. Antonanzas-Torres, F.; Antonanzas, J.; Blanco-Fernandez, J. (2021) Environmental Impact of Solar Home Systems in Sub-Saharan Africa. Sustainability 2021, 13, 9708. Available at: https://doi.org/10.3390/su13179708[Accessed online: 10 October 2023]

4. Buma, C. (2020). Initial Energy Status Report, Kisumu County, Kenya. [online] County Government of Kisumu, pp.1–55. Available at: https://www.kisumu.go.ke/wp-content/uploads/2021/02/Initial-Status-Report_Kisumu-County_8-February.pdf [Accessed 16 May 2024].

5. County Government of Kisumu (2018). Kisumu County Integrated Development Plan II (2018-2022). [online] County Government of Kisumu, pp.1–254. Available at: https://www.kisumu.go.ke/wp-content/uploads/2018/11/Kisumu-County-CIDP-II-2018-2022.pdf [Accessed 16 May 2024].

6. County Government of Kisumu (2019a) County Urban Institutional Development Strategy (CUIDS) Kisumu City, pp 1-21.Available at: https://www.kisumu.go.ke/wp-content/uploads/2019/08/Kisumu-County-Urban-Institutional-Development-Strategy-CUIDS-2018-2019-final.pdf.[Accessed 21 May 2024]

7. County Government of Kisumu (2019b) Kisumu County Environment Policy 2019. Available at https://www.kisumu.go.ke/wp-content/uploads/2019/04/Kisumu-CEM-policy-2019.pdf [Accessed 21 May 2024]

8. County Government of Kisumu (2020). Kisumu Sustainable Mobility Plan. [online] County Government of Kisumu, pp.1–102. Available at: https://www.kisumu.go.ke/wp-content/uploads/2020/12/Kisumu-Sustainable-Mobility-Plan-200716.pdf [Accessed 16 May 2024].

9. County Government of Kisumu (2021). Kisumu County Energy Masterplan 2021 – 2030, pp 1 – 909. [Unpublished report]

10. County Government of Kisumu (2022). Kisumu County Integrated Climate Change Action Plan (KCICCAP) 2022-2027. [online] County Government of Kisumu, pp.1–11. Available at: https://www.kisumu.go.ke/wp-content/uploads/KCCCAP-2022-Abridged-Version-Final.pdf [Accessed 16 May 2024].

11. GIZ (2021). Factsheet: Transport Sector in Kenya's Nationally Determined Contribution. [online] Changing Transport. Available at: https://changing-transport.org/wp-content/uploads/2021_GIZ_Factsheet_Transport-in-Kenyas-NDC.pdf [Accessed 16 May 2024].

12. International Energy Agency (2021). Kenya - Countries & Regions. [online] IEA. Available at: https://www.iea.org/countries/kenya/energy-mix [Accessed 16 May 2024].

13. IPCC (2022). Mitigation of Climate Change Climate Change 2022 Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. [online] Available at: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Full_Report.pdf [Accessed 16 May 2024].

14. Kenya Ministry of Environment and Forestry (2020). Kenya's Updated Nationally Determined Contribution (NDC) Available at: https://faolex.fao.org/docs/pdf/KEN210108.pdf [Accessed 21 May 2024]

15. Kenya National Bureau of Statistics (2019). 2019 Kenya Population and Housing Census. Volume 1: Population by County and Sub-County. [online] Kenya National Bureau of Statistics, pp.1–49. Available at: https://www.knbs.or.ke/download/2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county/ [Accessed 16 May 2024].

16. Our World in Data (2023). Per capita CO2 emissions from transport. [online] Our World in Data. Available at: https://ourworldindata.org/grapher/per-capita-co2-transport?tab=chart&country=KEN [Accessed 16 May 2024].

17. Petrik, D., Maina, G., Muriuki, M. and Munyoki, J. (2020). National Energy Situational and Stakeholder Analysis

Kenya. [online] County Government of Kisumu, pp.1–80. Available at: https://www.kisumu.go.ke/wp-content/uploads/2021/02/National-Energy-Situational-Analysis_8-February.pdf [Accessed 16 May 2024].

18. [4], [7], [8], [11], [15], [17], [24] County Government of Kisumu. (2021). Kisumu County Energy Master Plan (2021-2030).

19. Steingrube, A. and Reggentin, P. (2022). Energy System Modelling Results for Kisumu County, Kenya. Available at: https://renewablesroadmap.iclei.org/wp-content/uploads/2022/03/Kisumu_report.pdf [Accessed 21 May 2024]

20. Thirumalaikumaran A. & Ravi, S & Senthil, R & Sathishkumar, N. (2022). Experimental Investigation of LPG Cooking Stove by Improving the Thermal Efficiency Using Different Burners with Wire Mesh and Wind Proof. Available at

21. 2027. Department of Environment, Climate Change and Natural Resources, Kisumu, Kenya

22. County Government of Kisumu (2023). The third county integrated Development Plan (2023 -2027). Available at: https://city.kisumu.go.ke/download/kisumu-cidp-iii-2023-2027/ [Accessed 21 May 2024]

ANNEXURES

ANNEXURE 7.1: LIST OF POWER PLANTS LOCATED IN KISUMU COUNTY

(Source: Initial Energy Status Report, Kisumu County, Kenya, 2020)

Plant name	Plant type	Owner	Installed capacity (MV)	Effective capacity (MV)	Electricity generation (GWh)				
					2013/14	2014/15	2015/16	2016/17	2017/18
Sondu Miriu	Hydro	KenGen	60	60	351	376	419	282	388
Sango'ro	Hydro	KenGen	21	20	109	125	140	90	129
Muhoroni gas turbine	Thermal	KenGen	30	28	-	-	-	108	65.5
Aggreko	Thermal	EPP	-	-	94	63	50	-	-
3 sugar factories (Chemelil, Muhoroni, Miwani)	Bagasse	-	21	-	-	-	82.3 (2015)	-	-

ANNEXURE 7.2: GHG EMISSIONS FROM TRANSPORT AND STATIONARY ENERGY SECTORS

7.2 a: GHG Emissions from publicly-owned transport fleet based on a fuel-sale method of calculation (Source: KCICCAP, 2022)

Sale type	Amount (kWh)	Emissions (tCO_2e)
Government agencies	5,192	1,386
Public institution fleet	1,711	457
County government fleet	1,030	256

7.2 b: Breakdown of the stationary energy sector GHG emissions per sub-sector and contributing fuel type (Source: KCICCAP, 2022)

Sub-sector	Emissions (tCO_2e)	Contributing fuels
Residential buildings	624,758	• Firewood: 74.30% • Charcoal: 20.90% • Electricity: 2% • LPG: 1.90% • Kerosene: 0.90%

Commercial buildings	401,969	• Charcoal: 54.7% • Firewood: 44.9% • LPG: 0.4%
Institutional buildings	60,980	
Manufacturing and construction	15,542	
TOTAL	**1,103,249**	

ANNEXURE 7.3: RESULTS OF THE GIS ASSESSMENT

(Source: Adapted from the Energy System Modelling Report, 2022)

Land cover type	Area (km2)	Description	Suitable for
Forest cover	20.7	Covered mainly by scattered trees and undergrowth in natural and modified landscapes	Not applicable
Shrubs	428.9	Woody perennial plants with persistent and woody stems and without any defined main stem being less than 5 m tall. Shrub foliage can be either evergreen or deciduous	
Herbaceous vegetation	548.1	Plants without persistent stems or shoots above ground and lacking a definite firm structure (tree and shrub cover would be expected to be less than 10%)	Free field solar PV and potentially small wind (upon detailed site assessments)
Herbaceous wet land	38.3	Land with a permanent mixture of water and herbaceous or woody vegetation. Vegetation can be present in either salt, brackish, or freshwater	Not applicable
Bare/sparse vegetation	237.7	Land with exposed soil, sand, or rocks and never has more than 10% vegetated cover during any time of the year	Free field solar PV, and potentially small wind (upon detailed site assessments)

Cropland	763.1	Land covered with temporary crops followed by a harvest and bare soil period (e.g., single and multiple cropping systems). Perennial woody crops were classified as the appropriate forest or shrub land cover type	Potential for agri-voltaics (although not assessed)
Permanent water body	589	Can be either fresh or salt-water bodies	Not applicable
Urban built-up	28.7	Land covered by man-made structures	Not applicable
Urban building footprint	20.7	Land covered by buildings	Rooftop solar PV
TOTAL	2,675.2		

ANNEXURE 7.4: CROSS-SECTION OF PARTICIPANTS AT THE SERIOUS GAMES WORKSHOP

ANNEXURE 7.5 LIST OF PARTICIPANTS AT SELECTED 100%RE WORKSHOPS

Community Visioning workshop (February 2022), Serious Games and Policy dialogue workshops (May 2023) and/or Climate Finance and Project preparation workshop (November 2023)

S/N	Name	Organisation
	Abraham Koching	County Government of Kisumu
	Abdulsalam Omar	County Government of Mombasa
	Adah Omedi	County Government of Kisumu
	Adalla Morelly	Uhai Lake Forum
	Akinyi Ouma	Kisumu National Polytechnic
	Alex Odhiambo	County Government of Kisumu
	Antony Kamau	County Government of Nakuru
	Arnest Kutswa	Stanbic Bank
	Basil Angaga	County Government of Mombasa
	Beatrice Okello	County Government of Kisumu

	Bernard Asuna	County Government of Kisumu
	Billiard Odwor	County Government of Kisumu
	Brian Ondiek	County Government of Kisumu
	Charles Ayoma	Greentrack Energy
	Collins Otieno	County Government of Kisumu
	Concepta Ojwang	KEYO Technovation Limited
	Damaris Nekesa	EPSP Ltd.
	Daniel Okia	County Government of Kisumu
	Daniel Onudi	County Government of Kisumu
	Danson Ligare	EPSP Ltd.
	Dominic Wanjihia	Biogas International Ltd.
	Emily Lubwa	Tamuwa Limited
	Emily Mikwa	County Government of Kisumu
	Emma Atieno	County Government of Kisumu
	Enoch Okiri	Biogas International Ltd.
	Ephren Ouma	County Government of Kisumu
	Elisha Ochieng	Orongo Widows and Orphans
	Eric Ngage	County Government of Kisumu
	Erick Ochieng	Kenya Association of Manufacturers (KAM)
	Erick Orot	County Government of Kisumu
	Evans Gichana	County Government of Kisumu
	Everline Mbaka	Rural Electrification and Renewable Energy Corporation (REREC)
	Felix Akello	County Government of Kisumu
	Fredrick Anyango	County Government of Kisumu
	Gathogo Victor	SNV
	Geofrey Ochieng	County Government of Kisumu
	George Juma	County Government of Kisumu

	George Nyongayo	Ministry of Energy and Power
	Gica Okeich	County Government of Kisumu
	Grace Karanja	County Government of Nakuru
	Ian Omondi	County Government of Kisumu
	James Moya	County Government of Kisumu
	James Nyagol	County Government of Kisumu
	Job Wansala	County Government of Kisumu
	John Awiti	County Government of Kisumu
	John W. Juma	County Government of Kisumu
	Joseph Oganga	County Government of Kisumu
	Judith Wanjallah	County Government of Kisumu
	Justus Munyoki	Independent Consultant/ SusWatch
	Kennedy Mungai	County Government of Nakuru
	Kerich Daniel	Kenya Industrial Research and Development Institute (KIRDI)
	Laban Okeyo	County Government of Kisumu
	Laban Mburu	Kenya Investment Authority(KenInvest)
	Leah Makori	County Government of Kisumu
	Mark Omondi	Uhai Lake Forum
	Matthews Onyango	County Government of Kisumu
	Mercy Jane Opondo	County Government of Kisumu
	Mike Joseph	SusWatch Kenya
	Nobert Nyandire	SusWatch Kenya
	Nicholas Agoro	KEYO Technovation Limited
	Nickson Bukachi	Energy and Petroleum Regulatory Authority (EPRA)
	Orwa Oluoch	Kisumu National Polytechnic
	Rogers Wangila	County Government of Mombasa
	Ronny Cowino	SusWatch Kenya

	Salmon Orimba	County Government of Kisumu
	Sarah Oguya	County Government of Kisumu
	Sharon Atieno	Practical Action
	Stephen Nzioka	Ministry of Energy and Petroleum
	Sylvia Achieng	Kenya Power (KPLC)
	Wanakacha Reinhard	Koko Networks
	Victor Odenda	County Government of Mombasa
	Vincent Ondieki	Expertise France
	Yvonne Okeyo	Koko Networks

ANNEXURE 7.6: LIST OF ENERGY ACTIONS FROM THE VISIONING WORKSHOP

Below, is a long-list of actions that were co-identified in the Visioning workshop but were not prioritised to be included in the roadmap

Electricity	Transport	Clean cooking

• Waste to energy and cogeneration from municipal solid waste
  ◦ Anaerobic biodegradation of municipal solid waste for methane production
  ◦ Need to PPP legal policy framework to enhance co-generation by sugar industries
	• Holding a car-free day once a month in the entire county
	  ◦ Awareness campaigns are important
	  ◦ Public participation is important
		Enhance demand for efficient cooking stoves by creating awareness on the availability and benefits of cooking stoves awareness for effective cooking stoves

• Capacity building
  ◦ Establishment of RE Centre
  ◦ Establishment of RE innovation business centre
  ◦ Value addition marketing of products
  ◦ Basic booking on marketing of the product
	• Designating car-free areas in at least five areas within the city
	  ◦ Mapping and identification of where these zones are
	  ◦ Official gazetting needed
	  ◦ Automation for real-time monitoring
	• Improving air quality
	  ◦ Installation of air quality sensors in the city
	  ◦ Implementation of the Baseline Emission Inventory
	  ◦ Conducting traffic counts for the vehicles, by liaising with the Transport entities like KenHA
		Enhance demand for LPG by sensitisation of potential end-users on the safety and health benefits

• Behavioural change and communication
  ◦ Awareness creation by County stakeholders
  ◦ Compartmentalised garbage trucks for sorting solid waste from households
	• Formulation and regulating of enabling policies and regulations
	  ◦ Fast tracking the development and adoption of Kisumu County Bill, 2019
	  ◦ Formulation of regulations specifically on transport like NMT
	  ◦ Enhancing capacity building
	• Implement and operationalise the relevant Acts from various ACTs (Climate change Acts)
		Promote development of local capacity for qualified personnel, especially the youths, with skills to install and maintain biogas plants

• Resource assessment and geospatial mapping for electricity connectivity
  ◦ Assess connectivity rate in the county
  ◦ Population mapping regarding RE access
	• Improving infrastructure and walkways
	  ◦ Road designation for pedestrians; rehabilitate existing walkways; establish bridges and walkways
		Enhance distribution by creating awareness amongst potential users of ethanol stoves

	• Increase the installation of LED appliances for street lighting ◦ Install smart streetlights with monitoring appliances	Promote the use of solar cookers by training the youth on how to make and use solar cookers

	• Expand the green and ecological infrastructure from 10 green parks to a hundred green parks
	  ◦ Planting of flowers and shrubs
	  ◦ Rehabilitation of green parks
	  ◦ Providing tax incentives
		Provide environment based on PPPs for transition to clean cooking by strategic partnerships with other partners like GIZ (make more specific since PPP is a national act)

	• Establishment of the charging system
	  ◦ Capacity building and awareness
	  ◦ Establishment of charging systems for the electric vehicles
		Establishment of PPP nodes that can conceive and write proposals on PPP bankable projects

		Electric cooking is lacking: Establish technology transfer services, programs and extension services to increase uptake of improved cook stoves in the mid-term
		Promote adoption of biofuels e.g., biogas, ethanol and briquettes at both household and institutional levels

ANNEXURE 7.7: ENERGY ACTIONS FROM THE KCICCAP

Table 1. Stationary energy actions as per the KCICCAP

Residential and commercial buildings	Institutional buildings
Promote the use of solar systems in the county for both domestic and commercial use	Promote the uptake/use of EE improved firewood cooking stoves
Energy audits are undertaken for the status of energy use within commercial buildings	Promote the use of solar in county institutions for backup systems and heating/cooling
Promote uptake of improved and clean cooking solutions	Energy audits are undertaken for the status of energy use within County/institutional buildings
Promote uptake of energy efficient lighting appliances (LED light bulbs)	Promotion of biogas installations for use in cooking

Table 2. Energy actions for lighting as per the KCICCAP

Energy for lighting
Increase access to grid electricity
Increase access to off-grid electricity
Improve on grid uptime by reducing number and duration of interruptions (unscheduled outages) per week
Reduce dependency on standby generators as alternative sources of electricity
Increase number of mini-grids and stand-alone systems [%]
Review and disseminate mini-grid/stand-alone regulations
Making electricity more affordable (connection and token charges)
Save on operation expenditure for public lighting and reducing amount spent on public buildings
Attract and win RE investors

Table 3. Energy actions for transport as per the KCICCAP

Transport
Promotion of NMT
5% of motorcycles used within the city to be replaced with electrical motorbikes
Promotion of buses for town service with dedicated time service and designated parking spaces
Promote the implementation of solar technologies for street lighting and floodlight
Establishment of Integrated Air Quality Management System
Regulations on car-free day established for Kisumu City Centre

Table 4. Energy actions for cooking as per the KCICCAP

Energy for cooking
Promoting use of ethanol
Promoting production and use of biogas and waste-to-energy initiatives
Promoting use of electricity for cooking
Promoting briquette to reduce reliance on traditional biomass
Promote access and affordability of LPG
Promote use of improved firewood and charcoal cook stoves
Promote sustainable charcoal production

100% RENEWABLES CITIES & REGIONS ROADMAP

The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through the International Climate Initiative (IKI).

https://renewablesroadmap.iclei.org/

ICLEI Local Governments for Sustainability

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag
IKI INTERNATIONAL CLIMATE INITIATIVE