

ENACT

Enabling African Cities for Transformative Energy Access

Kampala City Energy Profile

MAY 2024



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THIS PROJECT WAS FUNDED WITH UK AID FROM THE UK GOVERNMENT
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This city energy profile is developed as part of the Enabling African Cities for Transformative Energy Access (ENACT) project being implemented in Freetown, Sierra Leone and Kampala, Uganda, by ICLEI Africa and Mercy Corps – Energy 4 Impact. It aims to provide an overview of the energy landscape in the City of Kampala through a review of policies and energy grant framework and to identify public sector levers to enable energy access, including opportunities for improved policies.

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Date published: May 2024

Design and layout: Widaad Pienaar

Disclaimer: This material has been funded by UK aid from the UK Government; however, the views expressed do not necessarily reflect the UK Government's official policies.



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Executive Summary

This city energy profile report was produced as a product of the Enabling African Cities for Transformative Energy Access (ENACT) project, implemented by ICLEI Africa in collaboration with Energy 4 Impact – Mercy Corps. The project contributes towards providing an enabling environment for the provision of safe, reliable, clean and affordable forms of energy (especially clean cooking) access to the urban poor residing African urban informal settlements.

With Kampala being one of the ENACT project cities, this report provides an overview of the energy landscape within Kampala, Uganda's capital city, covering energy consumption patterns, applicable policy frameworks, different energy-related interventions and future energy trajectories. The report is informed by an in-depth review of energy policies, programmes, planning documents and scholarly articles, as well as engagements with stakeholders during the project period.

The report sets out by providing an overview of Kampala and provides a situation in general contextualisation of the City as the primate city in Uganda and locus of economic activity and growth. This portion of the report focuses on various key aspects such as its population and demographic statistics, economic conditions, developmental trajectories, and energy development plans. The report proceeds with a description of the geographic landscape of the city, covering the land tenure regime and administration structure of the city.

The report outlines the Ugandan energy policy landscape relevant to Kampala in particular and to local governments more broadly. This section of the report emphasises the City's commitments to improving access to clean energy and enhancing efficiency. It also details policies aimed at reducing biomass use and promoting renewable energy sources. This section also touches on climate change policies and targets relevant to the energy access scenarios of the City of Kampala.

The report further explores the Kampala Capital City Authority's (KCCA) role in energy development, focusing on its support of the central government to enhance local-level energy access and reduce greenhouse gas emissions, some of which include improving infrastructure and sustainable urban planning for improved efficiency and increased modern clean energy access, scaling up energy initiatives through public-private partnerships, and playing a pivotal role in policy advocacy to enable accelerated transition towards clean energy use and reduced carbon footprint emanating from energy use in the city.

Having situated Kampala from a geographical and policy perspective, the report outlines energy consumption patterns in the city across key sectors, including transport, residential, commercial services, industrial sectors and public institutions. It emphasises the city's heavy reliance on non-renewable energy sources and highlights opportunities for improving energy efficiency and access. This analysis underscores the need for integrated planning and investment to diversify and secure the city's energy future.

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Acronyms

AFOLU	Agriculture, Forest and Other Land Use
BAU	Business as usual
BECS	Bundibugyo Energy Cooperative Society
EAC	East African Community
ENACT	Enabling African Cities for Transformative Energy Access
ERA	Energy Regulatory Authority
ETP	Energy Transition Plan
EVs	Electric Vehicles
GHG	Greenhouse gases
GW	Gigawatts
IEA	International Energy Agency
IPPs	Independent Power Producers
KCCA	Kampala Capital City Authority
KIL	Kilembe Investments Limited
KIS	Kalangala Infrastructure Services
LG	Local Government
LPG	Liquified Petroleum Gas
MEMD	Ministry of Energy and Mineral Development
MSW	Municipal Solid Waste
MW	Megawatts
NDCs	Nationally Determined Contributions
NDPIII	Third National Development Plan
PAU	Petroleum Authority of Uganda
PV	Photovoltaic
UBOS	Uganda Bureau of Statistics
UEDCL	Uganda Electricity Distribution Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UNEP	United Nations Environment Programme
WENRECO	West Nile Rural Electrification Company
WHO	World Health Organisation

Introduction

Kampala, the capital city of Uganda, serves as the nation's administrative, economic, and cultural centre and is a major regional economic hub. The city is home to a night-time population of approximately 1.7 million residents, rising to an estimated daytime population of four million once the commuter workforce is considered (UBOS, 2021; Yiran et al., 2020). The city experiences an annual population growth rate of approximately 3.9 per cent, making it the 13th fastest-growing city in the world (KCCA, 2019) among Dakar, Lagos, Dar es Salaam, Kinshasa and Luanda, to mention a few in Africa (World Economic Forum, 2021). As the seat of government, Kampala holds significant importance in the governance of Uganda. The governance and administration of the five divisions of the city of Kampala have been overseen by the Kampala Capital City Authority (KCCA), a central government agency, since 2011.

From an economic perspective, Kampala is the primate city in Uganda, contributing 65 per cent to the country's gross domestic product (GDP) of 45.57 billion in 2023 (World Bank, 2023). The economic significance of Kampala is further underpinned by the commercial and industrial activities taking place within its boundaries, which account for 80 per cent of Uganda's output. The city's economic landscape is characterised by a thriving informal sector, with the gap between the formal and informal city being significant. Approximately 80 per cent of all residents of Kampala reside in unplanned or informal settlements, and 60 per cent of economic activity in the city is classified as related to the informal economy (KCCA, 2020).

In 2020, KCCA adopted its 2020/21-2024/25 Strategic Plan, through which the City committed to actively contribute to the development of the city environment, its human and social capital, and to offer high-quality services to residents and provide support to businesses in Kampala. Notably, the City acknowledges the prevalence of informality and concomitant inequality between the formal and informal sectors, noting that 80 per cent of residents reside and work in this sector. In response, the City's strategic plan and the embedded programme of implementation are aligned with the economic growth and job creation targets of Uganda's Third National Development Plan (NDPIII) 2020/21-2024/25 and its theme of "sustainable industrialisation for inclusive growth, employment and sustainable wealth creation" (KCCA, 2021). Overarching both the NDPIII and KCCA's strategic plan is the Uganda Vision 2040, the country's overarching vision to develop Uganda from a predominantly low-income to a competitive upper-middle-income country by 2040.

Kampala is currently experiencing rapid urbanisation, and along with the ambitious electrification aspirations outlined in the Uganda Vision 2040, these are seen as drivers of socio-economic transformation. This will necessitate significant attention to the development of various aspects of Kampala's energy system over the coming years. Despite this, no specific strategic objectives, programmes, or implementation plans directly related to sustainable energy exist in the KCCA Strategic Plan, which concludes at the end of KCCA's 2024/25 five-year planning cycle. Although KCCA's 2020-2025 Strategic Plan documents a diversity of city-level sub-programmes aligned with NDPIII, there is no specific KCCA programme aligned to either NDPIII's Sustainable Energy Development programmes. This is despite local governments in Uganda being listed as actors within the NDPIII. In particular, the role of local government is noted in the promotion of sustainable energy technologies, including solar PV, clean cookstoves, and broader demand side management measures (NDPIII, 2020).

The International Energy Agency's (IEA) 2023 review of Uganda's Energy Policy 2023 highlights the ongoing need for better policy coordination across government, including enhancing dialogue and communication with local governments to enable long-term planning. The review suggests that local government plays an important role, and the IEA recommends the development of an Integrated Energy Resources Master Plan for the country. It also recommends that the national government coordinate with local counterparts to expand the collection, analysis and dissemination of energy-related data (IEA, 2023).

Despite ambitious plans for electrification in Uganda, Kampala's energy mix is characterised by a high dependence on biomass fuels for cooking and heating, with approximately 90 per cent of the population relying on this fuel source as a primary means of cooking. This is the case for users across market segments, including those living in informal settlements and slums, residents of formal areas, and institutions (Kimuli et al., 2022). This household reliance on the combustion of biomass, together with the combustion of petroleum in the transport and industrial sectors – making up the largest proportion of Kampala's energy mix (47 per cent) – contributes to poor air quality in the city. Based on the 2021 World Air Quality Report, Kampala was ranked among the cities with polluted air five to seven times higher than the World Health Organisation (WHO) air quality standards (Ninsiima et al., 2022).

Geographic and demographic context

Figure 1: Aerial view of Kampala

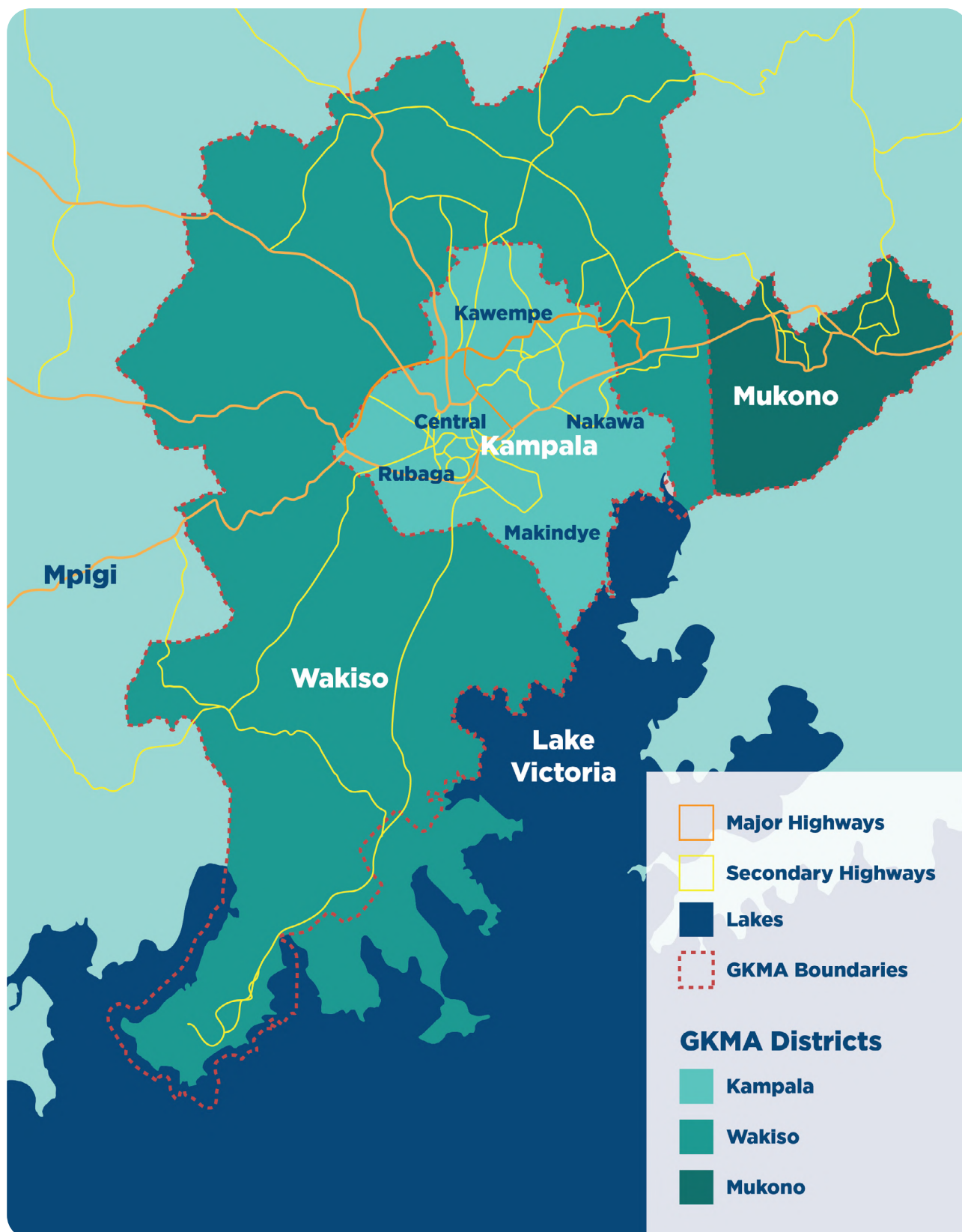


Kampala was first established as a municipal city in 1947 and became Uganda's capital city at independence in 1962. The rapid population growth in the city is a result of a combination of factors, including rural-urban migration trends, as many people come into the city searching for economic opportunities (Vermeiren et al., 2012). The city has the highest unemployment rate of all the sub-regions in Uganda (Ernstson and Mukwaya, 2021), particularly among the youth between the ages of 15 and 34 years. The majority of economically active residents are employed in the informal sector (Ernstson and Mukwaya, 2021).

The management of the city of Kampala is under the responsibility of the KCCA. This is a statutory body which was established by the Parliament of Uganda and created in terms of the Kampala Capital City Authority Act of 2011 to administer the entire city on behalf of the central government. The city of Kampala is subdivided into five distinct urban administrative divisions; the Central Division, Kawempe, Makindye, Nakawa, and Rubaga, with each division headed by an elected mayor. The five divisions of the capital city under the management of KCCA are situated within the broader Greater Kampala Metropolitan Area, incorporating the environs of KCCA, Wakiso, Mukono and Mpigi Districts. This broader urban agglomeration around Kampala derives symbiotic economic benefits from the city due to its geographic proximity to the city (Ernstson and Mukwaya, 2021).

Politically, KCCA is headed by the Lord Mayor, who reports to the Authority and the Minister for Kampala Capital City and Metropolitan Affairs and whose core duties include performing ceremonial and civic functions. Technical administration is headed by the Executive Director, who provides strategic guidance and monitors the City's operations.

Figure 2: Greater Kampala Metropolitan Area (GKMA) including the 5 Divisions of Kampala Capital City



Energy policy and climate commitments

3.1 National policy and institutional context

The Government of Uganda has clear targets and policies in place to enable its vision of universal access to clean energy for the people of Uganda. Different policies developed by the government and the target created to reduce the use of biomass for cooking indicate a strong political will to transition towards clean energy in Uganda. The current policy framework and strategies provide clear guidance to the energy sector and promote foreign investment in the country's energy sector. The government further provides incentives as well as tax and import duty exemptions as a means to promote energy (including clean cooking) access and investment in the sector.

The following is an overview of the policy and regulatory frameworks developed by the Ugandan Government to spur access to energy.

Table 1: Relevant national policies on energy access in Uganda

National Energy Policy, 2023	
Goal	To meet the energy needs of Uganda's population for social and economic transformation in an environmentally sustainable manner
Key points	<ul style="list-style-type: none"> • Promotes sustainable biomass energy, equitable and widespread use of clean cooking technologies, and access to liquified petroleum gas (LPG) • Aims for 50 per cent of the population to use clean cooking technologies by 2040 from a baseline of 10 per cent in 2012
Expected role of local government (LG)	<ul style="list-style-type: none"> • Administer multilateral and bilateral projects and programs channelled through local government • Provide input into the tailoring of the government's energy strategies and plans • Monitor and coordinate the implementation of enabling policies to drive local economic development • Be directly responsible for all decentralised service delivery, including those related to energy at the grassroots • Develop bylaws to sustainably guide the development and utilisation of local energy resources and systems • Support the promotion and implementation of government energy programmes • Enforce laws on energy development and use • Mobilise access to long-term, low-cost and reliable funding



Renewable Energy Policy, 2007 (target year was 2017)

Goal	<ul style="list-style-type: none"> • Formed by the Directorate of Energy in 2012 • The units are responsible for organising and conducting research and development in renewable energy (RE), energy efficiency (EE) and rural electrification
Key points	<ul style="list-style-type: none"> • Establishes the link between energy and development and relates it to goals of poverty eradication and national development • Notes the necessity for renewable energy technology to demonstrate reliability and efficiency in order for market acceptance • Emphasis on the role of the private sector and the government's enabling role through policy and regulation
Proposed role of LG	<ul style="list-style-type: none"> • Legislate and regulate the installation of residential and commercial solar systems • Promote uptake of renewable energy and clean energy sources • Host District Energy Offices • Implement energy efficiency measures • Facilitate the flow of knowledge of renewable energy to the lowest level

Electricity Connections Policy, 2018

Goal	To achieve a 60 per cent level of electricity access by 2027
Key points	<ul style="list-style-type: none"> • Enabling policy establishing principles to enable the government's grid electrification goals associated with national strategy • Emphasis on access to the grid targets increasing per capita electricity consumption • Connection subsidies to bridge the affordability gap associated with grid connection • Sustained financing for connection of customers • The primacy of financial sustainability
Proposed role of LG	Provide information dissemination support at the grassroots level.

Oil and Gas Policy, 2008

Goals	To use the country's oil and gas resources to contribute to the early achievement of poverty eradication and create lasting value for society
Key points	<ul style="list-style-type: none"> • Supports the use of the country's oil and gas resources to meet domestic demand and export the surplus within the region and subsequently overseas • Promotes the use of the country's oil and gas resources to address the country's electricity shortage
Proposed role of LG	<ul style="list-style-type: none"> • Undertake development plans, capacity building and infrastructure development • Ensure local government policies are aligned with the broader goal of unlocking the potential of oil and gas resources towards poverty eradication and value addition to society • Undertake plans and capacity building that take cognisance of oil and gas activities • Mitigate the risk of the development of slums in the vicinity of oil and gas activities • Integrate oil and gas activities in local governments' plans and programmes

»

Uganda Green Growth Development Strategy, 2017

Goals	To achieve an inclusive low emissions economic growth process that emphasises effective and efficient use of natural, human and physical capital while ensuring that natural assets continue to provide for present and future generations
Key points	<ul style="list-style-type: none"> • Focuses on green energy for growth and increased renewable energy investment, especially in biomass and solar power • Developed in the context of the Paris Agreement and Uganda Vision 2040
Proposed role of LG	Development of projects, securing financing, implementation and monitoring of outputs

Third National Development Strategy 2020-2025 (Uganda Vision 2040)

Goals	Reduce the use of biomass for cooking to 50 per cent by 2025
Key points	<ul style="list-style-type: none"> • Aims to reduce biomass energy for cooking from 88 per cent in 2015 to 50 per cent by 2025 • Promotes alternative cooking technologies (electric, biogas, LPG) • Encourages the reviewing of existing policies to address gaps in alternative sources of energy for cooking, sustainable exploitation of biomass and development of nuclear and geothermal resources for power generation
Proposed role of LG	<ul style="list-style-type: none"> • Participate in the alignment of plans, budgets and implementation • Planning and implementation for driving local economic development (LED) • Facilitate bottom-up participative planning and decision-making

Uganda's Sustainable Energy for All (SEforALL) Initiative Action Agenda (2015)

Goals	To ensure that more than 98 per cent of the population has access to electricity and more than 99 per cent has access to access to modern cooking solutions by 2030 while achieving more than 90 per cent of renewable electricity production
Key points	<ul style="list-style-type: none"> • Targets universal access to modern energy services by 2030, with 98 per cent electricity access and 99 per cent access to modern cooking solutions • Promotes international affordable standards and rigorous testing protocols and enhances monitoring and evaluation of clean cooking technologies • Recommends the establishment of a renewable energy data centre to improve market data for planning and investment purposes
Proposed role of LG	The role of local government, in this case, is similar to and aligned with national policies and strategies »

Biomass Energy Strategy Uganda, 2015

Goals	To secure a stable biomass energy supply for long-term social and economic development in Uganda, including poverty reduction
Key points	<ul style="list-style-type: none"> • Biomass energy should not be viewed as an isolated sub-sector • Proposes that interventions related to sustainable use may require public institutions to take a more results-oriented and multi-sectoral planning approach • Links biomass to local and international investment opportunities, including the government's role in the development of attractive feasibility studies that factor in opportunities for carbon financing • Suggests that the government should provide incentives and clear policies and regulations incentivising investments in green charcoal¹
Proposed role of LG	A key stakeholder in multi-sectoral planning, regulation and enforcement of the sector, and identification of strategies to address communities that are dependent on the biomass energy value chain

National Electrification Strategy for Uganda, 2021

Goals	The sustainable and rapid increase of national electricity access (on-grid and off-grid) to achieve the Government of Uganda's (GoU) national electrification targets as stipulated in the NDP III and Uganda Vision 2040, taking into consideration technical, institutional, and financial aspects
Key points	<p>The scope of the strategy includes:</p> <ul style="list-style-type: none"> • Analysis of the electricity institutional framework • Analysis of policies and electrification strategies • Strategy for the incorporation of productive uses into the NES • Analysis of off-grid business models and options • Analysis of the legal and regulatory framework • Technological review and analysis • Analysis of capital investment strategies and control mechanisms • Least cost electrification planning approach and methodology • Development of a national electrification strategy for Uganda • Monitoring and key indicators
Expected role of LG	Notes the roles, responsibilities, and mandates of local governments as articulated in Ugandan policy. Identifies requirements for enhanced multi-level government engagement as well as relevant capacity building to enable local governments to effectively fulfil these



¹ Green charcoal refers to the manufactured carbonised and non-carbonised briquettes from palm kernel husks, rice husks, coffee husks and other agricultural wastes, creating sustainable products that replace both charcoal and firewood.

Energy Transition Plan – ETP, 2023

Goal	Lays the groundwork for Uganda's net zero ambitions. Identifies and provides recommendations and actions to ameliorate current challenges of the energy system while also focusing on the affordability, security and sustainability of the sector
Key points	<p>The ETP supports the achievement of the following objectives of MEMD:</p> <ul style="list-style-type: none"> • Provide universal access to electricity and cleaner cooking by 2030 • Modernise and diversify Uganda's energy mix and promote its efficient use across all sectors to support industrial growth, poverty reduction and socio-economic transformation • Ensure a secure and affordable energy supply • Mitigate energy emissions in line with Uganda's conditional climate commitments, which imply a 20 per cent reduction compared to baseline emissions in 2030 • Position Uganda as an energy hub for the East African region
Expected role of LG	ETP actions and recommendations should be considered to be complementary to the policies of the Republic of Uganda and to be implemented through appropriately mandated national and local government structures and institutions

3.2 Climate change

Uganda's updated Nationally Determined Contributions (NDCs) target includes an ambitious economy-wide mitigation goal for 2030. The country aims to achieve a 24.7 per cent reduction in greenhouse gas (GHG) emissions below the business-as-usual (BAU) scenario (Ministry of Water and Environment, 2022), which marks a progression from the 22 per cent reduction target communicated in its first NDC in 2016. However, only 1.57 per cent of the total contribution to planned reductions is directly attributable to the energy sector itself, with the majority share (20.43 per cent) being related to the Agriculture, Forest and Other Land Use (AFOLU) sector. Nevertheless, a large proportion of the contributions originating in the AFOLU sector is related to the preservation and reforestation of forests, the loss of which can be attributed to the unsustainable production of charcoal. The energy sector and its value chain are thus of great importance in helping to reduce emissions.

The Biomass Energy Strategy of 2015 discusses the overall effect of Kampala's charcoal demand on the available biomass stock in the vicinity of Kampala. In summary, the number of trees that can be converted into charcoal has reduced, and a much bigger area is required to service Kampala's charcoal demands. Charcoal producers have responded to this situation by exploiting biomass located deeper into the woodlands. The charcoal supply chain providing Kampala now extends over far larger distances than historically, with regions in Northern Uganda being sites for production. In 2023, President Museveni issued a presidential decree to the effect of banning the trade in unsustainable charcoal in these Northern regions (President Museveni, 2023).

Uganda's electricity generating capacity is primarily renewable, with approximately 92 per cent coming from sources such as hydro, sugar cane bagasse-fired plants and solar photovoltaic (PV) plants. The country introduced feed-in tariffs for renewable energy projects under 20 MW in 2007 and has plans to further increase non-hydro renewable electricity generating capacity. Amendments to the Electricity Act in 2022, including provisions for net metering and allowing generators to sell directly to customers, are some of the indicative steps towards liberalising the energy market, although full implementation is still

pending. The amendment of the act also opened up the electricity transmission space, initially monopolised by the central government, to private sector investment. Currently, private companies can bid to develop transmission lines across the country.

The Energy Transition Plan (ETP) launched at COP28 (2023), in collaboration with the IEA lays the groundwork for Uganda's net zero ambitions with 2030 as a target. The ETP is an ambitious plan aiming to transition 94 per cent of the population from biomass to renewable energy by 2030. It also sets a goal to increase the country's renewable energy capacity to 52 GW by 2040. The policy aims to complement existing national policies and includes several key objectives. It seeks to provide universal access to electricity and cleaner cooking, modernise and diversify Uganda's energy mix and promote its efficient use across all sectors to support industrial growth, poverty reduction and socioeconomic transformation. Additionally, the policy aims to ensure a secure and affordable energy supply, mitigate energy emissions in line with Uganda's conditional climate commitments, and position Uganda as an energy hub for the East African region. This initiative reflects Uganda's commitment to reducing carbon emissions and enhancing environmental sustainability.

The ETP notes that biomass is the predominant energy source nationally, accounting for 94 per cent of total energy consumption. Although this is a national figure, it is only marginally higher than that of the city of Kampala. The ETP further notes that this national reliance on biomass is attributable to cooking in rural areas. The country aims to address the high deforestation rates and firewood scarcity by promoting more efficient use of biomass and exploring alternative energy sources. Recommendations included in this report and designed to meet this ambition include the development of LPG infrastructure, the application of incentives, awareness-raising strategies, as well as the development of a national legal framework – aligned to Article 6 of the Paris Agreement – for accessing carbon markets for clean cooking projects.

Similarly, the KCCA developed a Climate Change Action Strategy (2016) that aims to ensure the city's development takes a low-emission approach, builds resilience and maximises the co-benefits of efficiency, economic diversity and human well-being. This strategy is part of a broader initiative to transform Kampala into an attractive, vibrant and sustainable world-class city. The plan encompasses a variety of actions and implementation strategies to address climate change and its impacts. It aims to reduce dependence on biomass and charcoal fuel, promote more energy-efficient technologies and foster better waste management practices. Additionally, it emphasises the importance of gender and social inclusivity, seeking to integrate climate-responsive solutions at both community and individual levels.

Also, Kampala is focusing on clean air targets as part of its environmental initiatives. In May 2023, the City launched a Clean Air Action Plan, which is based on extensive data collection and aims to improve air quality for its residents. This plan aligns with the United Nations Environment Programme's (UNEP) integrated climate and air quality targets, emphasising the critical role of improving air quality in tackling the broader challenges of climate change, biodiversity loss and pollution.

3.3 Key stakeholders in the energy sector of Uganda

The generation and transmission of electricity are under the purview of the central government through the Ministry of Energy and Mineral Development (MEMD). MEMD assumes the responsibility of developing and implementing energy-related policies in the country. With the recent amendment to the Electricity Act, power generation and transmission are liberalised (that is, open to competition and private sector participation). The private sector can now bid to develop transmission lines across the country. The generation of electricity in Uganda is divided between government-owned power plants, independent power producers (IPPs), and public-private partnerships (PPPs). Eskom Uganda operates the state-owned Uganda Electricity Generation Company Limited (UEGCL), which is the main power generator.

The bulk supplier and single buyer of power for the national grid is the state-owned Uganda Electricity Transmission Company Ltd (UETCL). UETCL purchases all independently generated power in the country and is also responsible for publishing standardised tariffs for renewable energy generation of up to 20 MW capacity based on the “avoided cost principle” (referring to the cost that the utility avoids by purchasing power from these renewable sources instead of generating the power itself or buying it from other, potentially more expensive, sources).

Electricity generation is diversified across four distinct sources, including hydro, geothermal, PV and others, with the highest proportion (80 per cent) generated through hydroelectric generation. However, electricity currently makes up approximately 2 per cent of the energy mix in Uganda, with only 20 per cent of Ugandans receiving a grid supply and an additional 10 per cent accessing electricity via solar home systems offered through private sector channels. The current electricity supply is not reaching all households partly due to affordability issues on the part of some of the households who are the majority (Bongomin and Nziu, 2022). Over the years, Uganda’s electricity generation sub-sector has grown from an installed capacity of 320 MW in 2002 to over 1,346 MW in 2023 (IEA, 2023). This excludes the recently commissioned Karuma Dam Hydro Power plan, which has a total capacity of 600 MW peak. Uganda Vision 2040 targets 80 per cent of the population to have access to electricity by 2040, and an approximate electricity consumption of 3,668 kWh per capita by the same year (Mutikanga, 2023).

The Electricity Regulatory Authority (ERA) is responsible for regulating electricity generation, transmission and distribution. This independent entity was created under the Electricity Act of 1999, but is answerable to the MEMD.

Over the years, a remarkable improvement in the distribution of electricity in Uganda has been realised owing to a conducive regulatory environment created by the ERA (Kimuli et al., 2022a). To promote the growth of access to clean energy across the country, many electricity distribution operators were licensed by ERA. Thus, the number of electricity distribution companies now stands at nine. Umeme Limited, a publicly listed company, is the largest distribution entity empowered to trade and supply electricity at 33 kV. Other distribution companies include Uganda Electricity Distribution Company Limited (UEDCL), Bundibugyo Energy Coop Society (BECS) and Kilembe Investments Limited (KIL). Off-grid distribution companies include West Nile Electrification Company (WENRECO) and Kalangala Infrastructure Services (KIS). There are also some mini-grid distribution systems and one off-grid generation and distribution company called the West Nile Rural Electrification Company Ltd. These companies are operating in various regions of the country, which has, in a way, contributed to access to electricity. Access has grown from a perennial 12-15 per cent to 51 per cent between 1997 and 2019, according to the most recent access statistics released by the Uganda Bureau of Statistics in 2021 (UBOS, 2021).

The exploration, distribution and use of all petroleum products in the entire country are under the mandate of the Petroleum Authority of Uganda (PAU). PAU is a statutory body established under Section 9 of the Petroleum Exploration, Development and Production Act of 2013 by the National Oil and Gas Policy of 2008. The mandate of the PAU is primarily to monitor and regulate both the exploration, development and production, together with the refining, transportation, and storage of petroleum products in Uganda. Table 2 below shows some of the actors in Uganda's energy sector and their respective roles.

Table 2: Some of the actors in the energy sector of Uganda

Sector	Actor	Role or responsibilities
Generation	Uganda Electricity Generation Company Limited (UEGCL)	UEGCL generates electricity from various sources, including hydroelectric power stations and other renewable sources. The company is responsible for some of Uganda's major hydroelectric plants, such as the Nalubaale and Kiira power stations
	Independent power producers (IPPs)	<p>The IPPs generate electricity from various sources, including renewable and non-renewables, to supplement the national supply. Some of the notable IPP projects in Uganda include:</p> <ul style="list-style-type: none"> • Bujagali Hydroelectric Power Station: This is one of the largest hydropower stations in the country, developed in partnership with private investors • Tororo Solar North: This solar power plant contributes significantly to the country's renewable energy output • Kakira Sugar Works: This is a biomass plant that generates power primarily from bagasse, a by-product of sugar manufacturing
Transmission	Uganda Electricity Transmission Company Limited (UETCL)	<p>UETCL is responsible for the bulk transmission of electricity from power generation stations to distribution substations across Uganda. The company operates and maintains the high voltage transmission network, ensuring the stability and reliability of the electricity supply</p> <p>UETCL also handles the negotiation and management of power purchase agreements with independent power producers (IPPs) and other electricity generators</p> <p>The company is also involved in integrating renewable energy sources into the national grid, supporting Uganda's commitment to sustainable energy</p>

Sector	Actor	Role or responsibilities
Distribution	Uganda Electricity Distribution Company Limited (UEDCL)	<p>UEDCL is responsible for the distribution of electricity from transmission substations to end-users, including residential, commercial and industrial customers. The company also maintains the distribution network for reliable delivery of electricity. It also manages and upgrades the distribution of infrastructure to meet growing demand and improve service quality</p> <p>UEDCL also handles customer service operations, including billing, connections and complaint resolution to ensure customer satisfaction and engagement</p>
	Umeme Ltd	Umeme Ltd is the largest electricity distribution company in Uganda, licensed to distribute and supply electricity to various parts of the country. It plays a crucial role in Uganda's electricity supply chain.
Tariffs	Electricity Regulatory Authority (ERA)	Sets and regulates electricity tariffs to ensure fair pricing and sustainability of the energy sector
Finance	Uganda Energy Credit Capitalisation Company	Provides financial mechanisms to support energy investments in Uganda
Policy and regulation	Uganda National Bureau of Standards (UNBS)	Sets standards for the energy sector to ensure quality and safety
	Ministry of Energy and Mineral Development	Develops and implements national energy policies and regulations
	National Environmental Management Agency	Ensures that energy projects comply with environmental standards and regulations

Figure 3: Charcoal seller in Kisenyi, Kampala



Role of KCCA in energy development

As previously mentioned, KCCA significantly contributes to the broader goals of enhancing energy efficiency and promoting the use of clean and sustainable energy among its residents. KCCA's initiatives encompass a range of activities which include implementing energy-efficient technologies in public infrastructure, encouraging the adoption of renewable energy sources and facilitating educational programs to raise awareness on sustainable energy practices. In addition, KCCA can collaborate with various stakeholders to develop policies and regulations that support energy access and the reduction of greenhouse gas emissions, thus fostering a more sustainable urban environment and smart city. Plans developed by KCCA touching on the above include:

Table 3: Strategic plans describing the role of KCCA in energy development in Kampala

Plan	Goal	Key Features
Kampala Capital City Strategic Plan 2020/21-2024 /25	By June 2025, Kampala will be an inclusive, liveable, resilient, and well-planned city that provides economic opportunities	Continued delivery of Kampala Street Lighting Project as part of the implementation of the Greater Kampala Multi-Modal Urban Transport Master Plan
Kampala Climate Change Action Strategy (2016)	Aims to mainstream climate change response in all city services to put the city on a low-carbon development path for all sectors. Aligned with KCCA Strategic Plan 2015-2019	<ul style="list-style-type: none"> • Annual energy efficiency audits conducted • Improved cookstoves distributed to and purchased by institutions and households • Amount of money and energy saved as a result of energy audits conducted: <ul style="list-style-type: none"> • 50 MW of renewable energy produced on the territory (solar, waste to energy) • 50 per cent of charcoal (2015 baseline) replaced with alternative cook fuel (briquettes, biogas) • 15 per cent of the energy mix from renewables

Plan	Goal	Key Features
KCCA Energy and Climate Profile (2015)	To make Kampala a vibrant, attractive and sustainable city that contributes to the international and local challenge of climate change	<ul style="list-style-type: none"> • Nomination of focal points within the Directorates in charge of the follow-up of the energy figures • Recommends study on how to adapt the ISO 14001 or ISO 50001 to the KCCA context for energy management² • Recommends the creation of a specific department of energy to manage energy-related issues within the KCCA perimeter • Promotes the use of solar energy, eco-stoves and other environmentally friendly technologies (especially in public buildings and in schools) • Promotes use of solar energy for street lighting • Suggests the creation of an Energy and Climate Local Agency • Suggests the development of a city energy master plan

Below are some further ways in which KCCA is involved in energy development pathways at present:

4.1 Infrastructure development

KCCA's primary responsibilities encompass urban planning, public health and sanitation (Haas, 2022). It engages in infrastructure development through the planning and development of urban infrastructure, which includes the development and maintenance of roads, street lighting and public buildings (Haas, 2022). Part of this responsibility involves adopting and incorporating energy-efficient technologies and renewable energy sources to reduce the city's carbon footprint. To reduce the carbon footprint from the transportation sector, KCCA supports the adoption of clean transportation options, such as electric buses and bicycles, and the development of the necessary infrastructure like charging stations (KCCA, 2024). The full implementation of the Greater Kampala Transport Master Plan aims primarily to upgrade road infrastructure. This improvement is designed to alleviate traffic congestion, enhance energy efficiency and, consequently, lower both the demand for energy and emissions within the transport sector.

4.2 Sustainable urban planning and energy efficiency

The City's vision to become a smart city is anchored on three pillars, which are technology, infrastructure and people's well-being, therefore indirectly mandating KCCA to adopt and enforce policies that promote the use of clean energy sources (KCCA, 2024). KCCA's role in this regard, therefore, includes zoning regulations that encourage or mandate the use of solar panels in new developments or retrofitting public buildings with energy-efficient technologies. To expedite central government's efforts in promoting energy efficiency, the authority has a role to play in implementing programs aimed at reducing energy consumption in both the public and private sectors. This includes initiatives like energy audits, public awareness campaigns on energy-saving practices and incentives for businesses and households that adopt energy-efficient technologies.

² ISO 14001 is the internationally recognised standard for environmental management systems (EMS). It provides a framework for organisations to design and implement an EMS, and continually improve their environmental performance.

ISO 50001 is designed for organisations committed to addressing their impact, conserving resources and improving the bottom line through efficient energy management. (Available at: <https://www.iso.org/standards.html>)

4.3 Public-private partnerships

Apart from urban planning and infrastructure development, KCCA facilitates or enters into partnerships with private entities to develop renewable energy projects, such as solar, biomass, or waste-to-energy plants, that can provide cleaner energy sources for the city's residents and businesses. KCCA's intention to enhance and reorganise the Kiteezi landfill by introducing a waste-to-energy management facility through a public-private partnership showcases the City's pivotal role and involvement in energy development and support of renewable energy initiatives. Based on experience and lessons learnt from managing the Kiteezi landfill, the authority plans to license private energy development companies to generate biofuels, particularly biogas, from the waste at the landfill which is mostly 65 per cent organic (Aryampa et al., 2021). Similarly, KCCA has also facilitated exemplary public-private partnerships through initiatives such as the Bodawerk and Zembo, which introduced over 200 new and upgraded electric motorcycles for public transportation in the city (REN21, 2021). This advancement in electric mobility, particularly through e-motorcycles, offers KCCA a pathway to support both national and international efforts in combating climate change by integrating renewable energy sources within the transportation industry.

4.4 Policy advocacy and regulation

KCCA plays a crucial role in policy formulation and advocacy; hence it can similarly advocate for policies at the national level that support energy development, particularly in the areas of renewable energy and energy efficiency, and can also enforce local regulations that support these goals.

Figure 4: Aerial view of Kampala



Energy consumption in Kampala

5.1 Energy consumption in the transport sector

Figure 5: Minibus taxi rank in Kampala showcasing the dominant mode of public transport in the city



Approximately 1.4 million vehicles are in the motorised vehicle fleet of Uganda, with Kampala having half of these (United Nations Economic Commission for Africa, 2018). According to the Global Status Report on Renewables in Cities, the transport sector is the largest consumer of energy in the city and contributes the largest share of the fossil fuel consumption within the city's energy mix (REN21, 2021). The primary fuel utilised in the city is diesel (88.3 per cent) followed by petrol (11.7 per cent) (KCCA, 2015). The sector's reliance on diesel and petrol underscores its contribution to fossil fuel consumption patterns and thus greenhouse gas (GHG) emissions and Kampala's air quality.

The city's public transportation is dominated by minibus taxis (matatus) and motorcycle taxis (boda-bodas). These constitute approximately 96 per cent of mass transportation in the entire city. Since 2000, commercial motorcycles, commonly referred to as boda-bodas, have become a major form of public transportation, particularly in urban areas across the entire country. In Kampala, the United Nations Economic Commission for Africa (2018) stated that the number of motorcycle taxis has seen a remarkable growth rate of about 58.7 per cent since 2007, such that by 2014, the count of these motorcycles had escalated to approximately 405 124 up from just 15 979 in 2007.

Figure 6 Public transport in Kampala

Similarly, between 2003 and 2019, the number of minibus taxis operating in the Greater Kampala region increased from 7 000 to about 15 000 (Kiggundu et al., 2021). This growth in vehicle numbers reflects the urban expansion and the increasing demand for mobility solutions by Kampala's residents and businesses. However, this growth is not matched with the pace of vehicle technological advancement as some of the vehicles are less fuel-efficient and more polluting, exacerbating the environmental impact. Based on business-as-usual projections from a 2015 report by the KCCA, it is clear that by 2030, the largest portion of the city's GHG emissions will be due to the transport sector's continued reliance on fossil fuels. This is expected to lead to worsening impacts on local air quality.

The growing number of vehicles in the city, alongside traditional fuel consumption patterns, suggests the need for sustainable urban mobility solutions and clean energy consumption practices. The city's future transport energy consumption outlook hinges on strategic interventions aimed at reducing reliance on fossil fuels, enhancing the efficiency of public transport systems and promoting alternative, cleaner modes of transportation. These can include:

a. Adoption of electric vehicles

Electric vehicles (EVs) offer a promising solution to reducing GHG emissions in Kampala. Their adoption hinges on supportive policies, investments in charging infrastructure and public awareness campaigns highlighting their environmental and economic benefits. Transitioning to EVs can reduce the city's transport sector's direct reliance on fossil fuels, reduce its carbon footprint and lead to improvements in localised air quality. The GoU recognises the need to champion e-mobility as evidenced by the establishment of state enterprises like the Kiira Motor Corporation, whose mandate is to champion value addition of the current vehicles through technology transfer and supply chain localisation of electric vehicles. The GoU is also driving a rapid transition to electric vehicles and electric boda-bodas through the engagement of international partners. At present, among electric vehicles in Kampala, electric motorcycles, known as e-bodas, are the most prevalent (Okello and Reynolds, 2022). They primarily utilise services such as battery swapping, battery leasing and access to charging stations. Although the initial purchase cost of e-bodas exceeds that of petrol-powered engines, largely because of expensive batteries, their overall life cycle costs are more economical (Okello and Reynolds, 2022).

Figure 7: Electrical lines and transport in Kampala



b. Enhancement of public transport systems

Improving the efficiency and coverage of the public transport systems presents an avenue for reducing traffic congestion, creating efficiencies and reducing fossil fuel consumption. Enhanced public transport would not only decrease the number of private vehicles on the road but also provide a cleaner, more efficient way for residents to commute. Investment in modern, fuel-efficient buses and the development of dedicated lanes for public transport could significantly cut GHG emissions. The National Transport Master Plan for Uganda acknowledges the need for improving mass transportation in urban centres (Enriquez, Tun and Platzer, 2018). Similarly, the Multi-modal Urban Transport Master Plan for Greater Kampala sets out targets to reduce the number of taxis and replace them with bus transit systems and rail transit systems. Under the plan, KCCA is expected to construct and operate a robust mass rapid system and light rail system by 2040 (Enriquez, Tun and Platzer, 2018).

5.2 Energy consumption in the residential sector

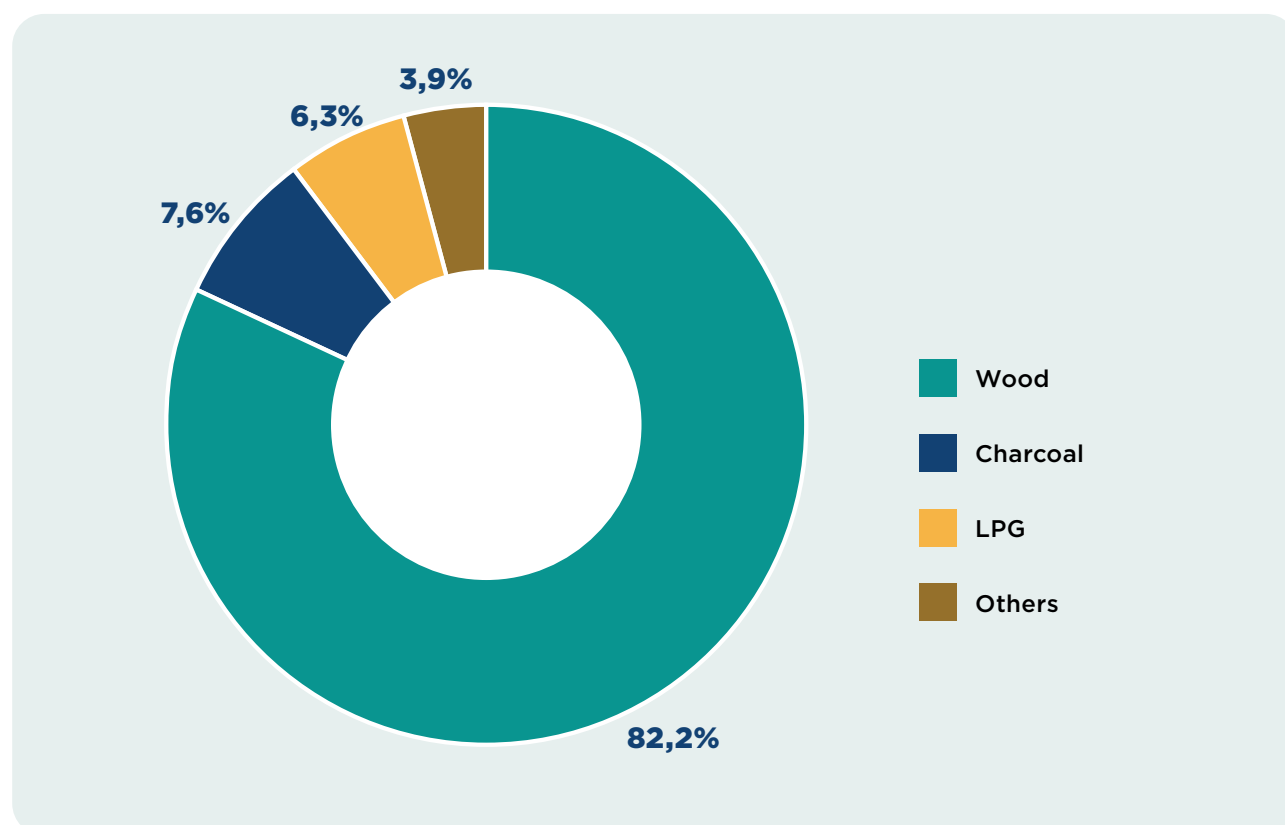
With a mixture of high-density, medium and low-density suburbs and informal settlements, residential areas in Kampala use a combination of energy sources. The household survey conducted by the Uganda National Bureau of Statistics (UBOS) in 2021 demonstrated that electricity is primarily used for lighting (25 per cent), followed by refrigeration (24 per cent), television (10 per cent), irons (9 per cent), water heating and air conditioning (each 8 per cent), radio (5 per cent), fans and cooking (each 4 per cent), kettles (2 per cent), and computer equipment (1 per cent). For homes not connected to the grid, electricity is mainly for lighting (51 per cent), then television (18 per cent), refrigeration (10 per cent), radio (12 per cent), and fans (9 per cent) (UBOS, 2021). Residential households form 94 per cent of the customer base and consume 22 per cent of the total power supplied in Kampala (IEA, 2023). The ERA further cited that residential energy consumption peaks towards the evening, and Umeme similarly reported that the peak demand period spans from 19:00 to 23:00, during which time, there is a national demand for 2.2 GW of electricity daily (Umeme Ltd, 2022).

While almost all households in the city have access to either grid or solar-powered electricity, very few households (one per cent of the surveyed households) use it as a means of cooking (MECS, 2020). The 2021/22 National Service Delivery Survey found that less than 6.3 per cent of the households in Kampala are

using electricity as a primary energy source for cooking, and there is a predominance of charcoal (82 per cent) as a primary fuel source for cooking (Figure 4). This is largely due to the relatively high retail prices for electricity as well as electricity instabilities (IEA, 2023). This is further disaggregated by the 2021 UBOS survey, which notes the initial cost of connection (32 per cent) and landlord decisions (22 per cent) of the total associated costs as other drivers contributing to households not being connected to the grid.

Figure 8: Types of energy sources used for cooking in Kampala

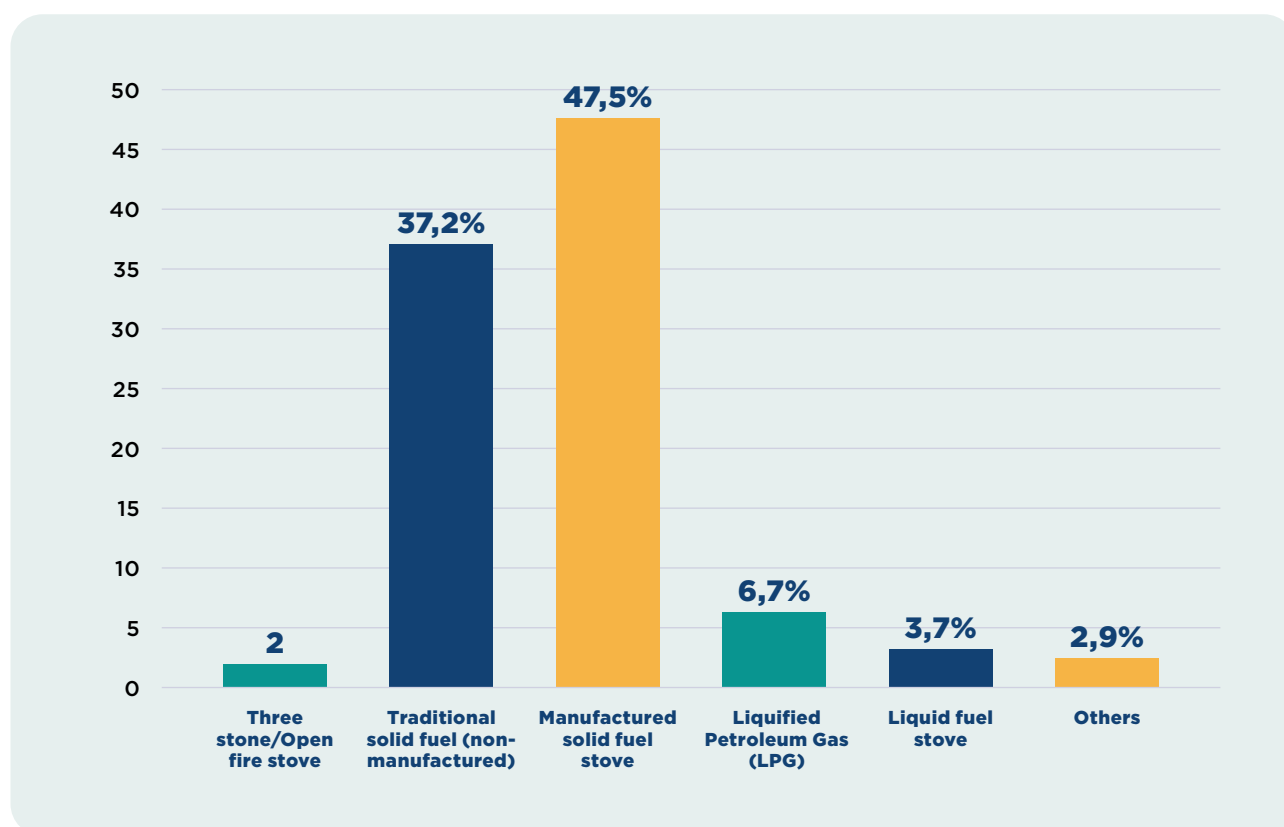
(extracted from Uganda National Household Survey 2021/22)



Households and institutions in Kampala use a combination of cooking technologies. The 2021 National Service Delivery Survey report highlighted that 2 per cent of the households in Kampala use a three stone fire for cooking, while about 37 per cent use the traditional biomass fuel stove (Figure 9).

Figure 9: Household distribution by type of cook stoves (%) in Kampala

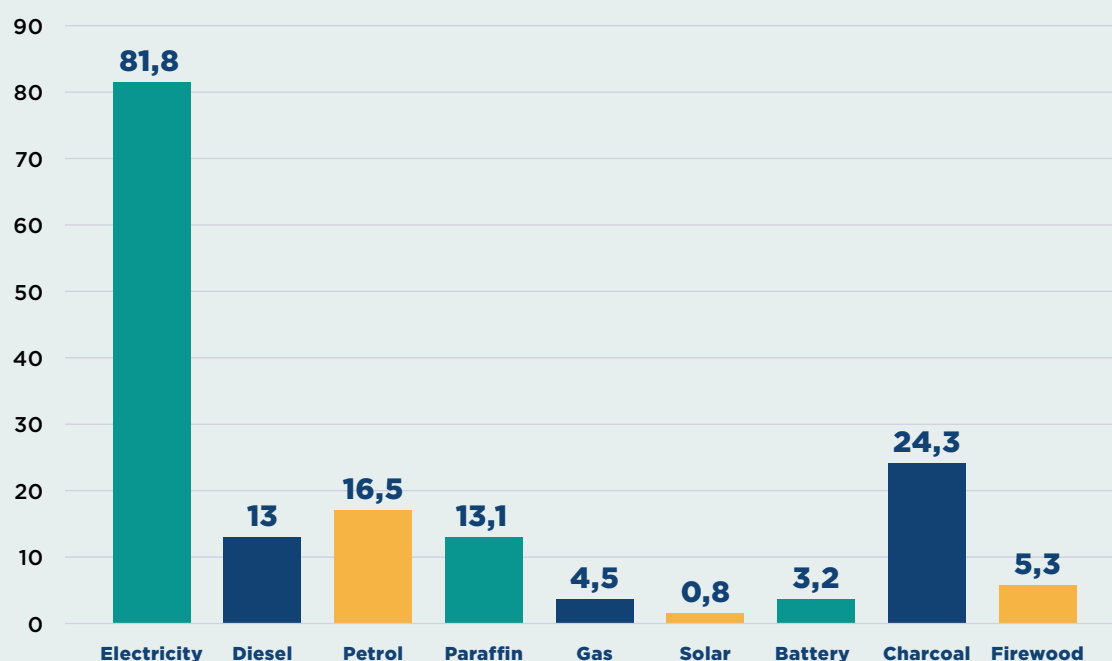
(extracted from *National Household Service Delivery Report, 2021* pp151).



5.3 Energy consumption in commercial services and industrial sectors

Grid electricity is the main energy source for commercial businesses in the formal economy, followed by charcoal and petroleum fuels. Commercial buildings are also largely reliant on diesel generators as a mitigation against unstable electricity supply. This sector's share of total electricity consumption is quite significant, with medium to large industrial consumers using over half of the electricity in the city, despite residential households forming 94 per cent of the customer base and consuming 22 per cent of the power (IEA, 2023). Data on carbon emissions from energy consumption in commercial buildings in the city is scarce. Nevertheless, the indirect carbon emissions from energy generation and consumption in Kampala's commercial and institutional facilities amount to 10 972.5 tonnes of carbon dioxide equivalent (tCO₂e), with direct emissions reaching 797 821 tonnes of carbon dioxide (Lwasa, 2017).

Figure 10: Proportion of business enterprises using various sources of energy in Kampala (extracted from the UNBOS 2012 report on Energy and Rural Electrification in Uganda)



5.4 Public Institutions

Public institutions considered are mainly schools, health facilities, city street lighting, vocational training facilities, and tertiary education institutions. Public institutions in the city exhibit a diverse energy consumption trend and reflect a mix of both traditional and renewable energy sources.

In 2019, Kampala had a total of 1 450 health facilities within its jurisdiction (KCCA, 2019). Of these, 89.4 per cent of the facilities demonstrated a high reliance on electricity and diesel generators (88.6 per cent), with solar energy (20.6 per cent) playing a lesser but significant role (UBOS, 2021). The use of gas (LPG) and charcoal for cooking stands at 10.1 per cent with an approximate 90 per cent reliance on biomass for cooking purposes.

In secondary schools, statistics from the UBOS (2021) survey demonstrated that firewood is the primary fuel used for cooking in secondary schools (43 per cent), followed by electricity (30 per cent), charcoal (11 per cent), and biogas (7 per cent). Similarly, in primary schools, 92 per cent of the schools rely on firewood for cooking (Expertise France, 2023) with variations in usage of cooking technology such as three-stone fires and improved cookstoves. The Expertise France, 2023 survey results also showed that a large portion, 43 per cent (32 schools), spend up to UGX 500 000 on firewood per month. This is primarily applicable to those schools with an enrolment of less than 1 000 students and utilising multiple energy sources for cooking. However, nearly as many schools (40 per cent) spend between UGX 500 000 and 1 000 000,

while four per cent of the sampled schools have a monthly expense ranging from UGX 5 000 000 to 10 000 000 (Expertise France, 2023). This depicts firewood as a significant ongoing cost in schools therefore underscoring the importance of exploring new technologies to reduce expenses.

Table 4: Source of cooking energy in selected primary schools in KCCA Kampala
(Expertise France, 2023)

Main Source of cooking energy in the school	Number of schools	Percentage
Briquettes	1	1%
Firewood	73	92%
Firewood and charcoal	3	4%
Others	2	3%
Grand total	79	100%

Figure 11: Clay sigiris



Figure 12: Aerial view of Kampala

Source: Green Lens



Sources of Energy for the City of Kampala

The city of Kampala is dependent on multiple sources for its energy needs. Fossil fuels at 47 per cent dominate the energy mix, followed by biomass (46 per cent) and electricity from the grid (7 per cent) (UBOS, 2021). Using 2014 as the base year, a business-as-usual forecast by Munu and Banadda in 2016 predicted that the proportion of fossil fuels in Kampala's energy mix would rise to 55 per cent by 2030. Additionally, the share of electrical energy, which stood at 17 per cent, was expected to see only a modest increase, eventually accounting for about one-quarter of the city's total energy mix by 2030. The projection also indicated a minimal contribution from renewable energy sources, with little to no wind energy integration into the grid.

Figure 13: Kampala's energy mix 2030 projections under a business-as-usual scenario with 2014 as the base year (KCCA, 2015)



6.1 Hydropower

Hydropower plays a significant role in the nation's energy landscape. The total installed capacity was 1 402 MW as of December 2022 (ERA, 2023). This capacity primarily comes from the country's two major hydroelectric power plants, the Bujagali power station, with a capacity of 250 MW that became operational in 2011, and the Karuma station, which added 650 MW to the grid in 2023 (IEA, 2023). As of 2021, Uganda's Large Hydro Power Plants (HPP) included Kiira and Nalubaale Hydro Complex (380 MW), Bujagali HPP (250 MW), Isimba HPP (183 MW), and Achwa 2 HPP (42 MW). The reliable capacity available fluctuates around 496 MW, depending on the prevailing hydrological situation. The electricity that powers Kampala is generated by plants located beyond its borders and is delivered to the city through 132 kV and 220 kV transmission lines, entering from the eastern side.

West Nile Rural Electrification Company Limited (WENRECO) and Kalangala Infrastructure Services (KIS) Limited are the leading off-grid (generate and sell) electricity distributors in Uganda, generating power from the solar-thermal hybrid power generating station on Bugala Island, Kalangala District. According to ERA (2023), WENRECO and KIS generated 32.8 GWh during the year 2022, of which 27.1 GWh was sold to the end-users (domestic = 44 per cent, commercial = 34 per cent, and industrial = 21 per cent). The sales in 2022 grew by 12 per cent as compared to sales in 2021 (ERA, 2023).

6.2 Biomass

Biomass, in the form of charcoal and firewood, is the main energy source for cooking in the whole Greater Kampala Metropolitan area, with over 90 per cent of households depending on these resources for cooking (Kimuli et al., 2022). These resources are not just confined to household use; they are also utilised by educational institutions and various industries for cooking, heating and other industrial processes. Both charcoal and firewood are mostly sourced outside of Kampala. Kimuli et al. (2023) recorded that a substantial amount (45 per cent) of charcoal/biomass supply to Kampala originates from three districts which are Masindi, Luweero, and Nakasongola entering the city through Kawempe. Other significant entry points include Nansana, Bweyogerere, and Kyengeru, contributing 19 per cent, 13 per cent, and 11 per cent of the charcoal/biomass supply to the city, respectively (Bongomin and Nzi, 2022).

In Uganda, charcoal serves as the primary fuel for cooking across the nation, with its usage exceeding 80 per cent in Kampala alone for meeting cooking energy requirements. Annually, the charcoal industry generates revenue of approximately \$23 million (Kimuli et al., 2022). The rapid deforestation from 24 per cent forest cover in 1990 to 18 per cent in 2005, particularly in the northern parts of Uganda where most of the charcoal used in Kampala comes from, underscores the environmental impact of this energy source, as noted by Kimuli et al., (2023). Due to population growth and rapid urbanisation, MECS (2020) projected a rapid rise in demand for charcoal and its production over the next few decades in the Greater Kampala Metropolitan Area. Nonetheless, the president of Uganda signed an executive order prohibiting the cutting down of trees for commercial charcoal production in northern Uganda. This has resulted in decreasing supplies and rising prices of charcoal, therefore putting to the fore the need for alternative energy sources.

6.3 Renewable energy

Renewable energy potential, particularly from municipal solid waste (MSW), solar and wind, presents an opportunity for sustainable energy management in Kampala (Figure 7). The city's equatorial location offers high solar radiation, ideal for solar power generation, which could be further optimised through net metering systems allowing surplus solar energy to be fed into the national grid. The wind energy potential along Lake Victoria's shores, capable of supporting wind farms, highlights another renewable avenue. However, the realisation of these renewable energy sources is hindered by financial, technological and infrastructural challenges and deficiencies.

Figure 14: Aerial view of Kampala



Energy use in buildings and infrastructure

Buildings play a crucial dual role in the context of clean energy transitions and low-emission development pathways. On one side, energy-efficient structures mitigate against climate change impacts. Energy in office buildings is primarily used for lighting, heating and cooling, which accounts for about 65 per cent of total use in most buildings. Energy waste due to inefficient design is notable. Efforts like the Compact Fluorescent Distribution Program have shown significant energy savings. Diesel generators are a major energy source for commercial buildings as a backup option or primary source of energy, especially among small-scale businesses. However, investments in solar PV systems could offer quicker paybacks and energy conservation opportunities.

Despite the critical reliance of over 80 per cent of households in Kampala on wood and charcoal for their energy needs, there is limited quantitative analysis targeting energy consumption in buildings and its effects on air quality and climate change within the city (Kimuli et al., 2023). Nevertheless, the energy demand in the building sector is on an upward trend to meet air conditioning, lighting and refrigeration needs. This increase is largely due to the addition of new buildings to the national inventory at a rate that outpaces the retirement of older structures.

Data from selected buildings in Kampala indicate that the primary energy demands within the building sector are for air conditioning and mechanical ventilation, lighting, domestic hot water, catering, laundry, lifts and health clubs. Additionally, the growing industrial sector requires more energy, predominantly in the form of electricity and petroleum fuels (Lwasa et al., 2009). Reliance on fossil fuels for powering industries, including the use of oil furnaces for heating, poses greater environmental challenges in the city (REN21, 2021). There is a pressing need for sustainable alternatives like solar thermal technology to decrease oil consumption and the associated CO₂ emissions.

Figure 15: Buildings in Kampala



Renewable energy deployment

The NDP III for 2020-2025 identifies energy as a priority area for development, with a goal of increasing access to electricity and clean cooking solutions by increasing the national electricity access rate to 60 per cent by 2025 and promoting renewable energy sources. The potential for renewable energy in Kampala is underpinned by two key instruments, which are the government's will and a flexible policy framework. Efforts to improve access to clean energy have been on the government's agenda over the past few years (UBOS, 2021). This comes from the concerns of heavy reliance on biomass as the primary source of energy for cooking. To lessen reliance on trees and other forest resources, minimise pollution and help households save money, the government, through the MEMD, is encouraging the adoption of efficient cooking technologies. The National Energy Policy (2023) outlines a plan to create an enabling framework to incentivise households to switch from biomass to efficient and modern fuels and technologies, including electric pressure cookers.

Uganda is richly endowed with renewable energy resources for energy production and the provision of energy services. The total estimated potential is about 5 300 MW. These resources, however, remain largely unexploited, mainly due to the perceived technical and financial risks (Bongomin and Nziu, 2022). Hydro and biomass are considered to have the largest potential for electricity generation, with geothermal energy having a significant potential for exploitation. Additionally, solar power is also receiving increased attention from investors.

Although Uganda's power generation comes largely from hydropower (Figure 7), its potential is also not yet fully exploited. Large hydropower accounts for around 80 per cent (1 073 MW) of the generating capacity, followed by sugar cane bagasse-fired facilities at 8 per cent (112 MW) and solar PV plants at 4.5 per cent (61 MW). Of this total, over 92 per cent of the capacity is derived from renewable sources (Rüdenauer, 2023). There are still enormous opportunities for hydro and solar power energy. Uganda's annual solar radiation incident reaches at least 1 600 kWh/m² nearly all over Uganda and in some parts of the country could even go above 2 000 kWh/m² (Rüdenauer, 2023). In terms of wind potential, available wind measurements reveal that prospects in Uganda are "low" for large-scale electricity generation from wind energy resources. Other sources of energy with huge promise also include waste to energy (Box 1).

Table 5: Proportion of energy generation by source in Kampala (ERA, 2023)

Generation in 2021	GWh	%
Non-renewable	105	2
Renewable	4,749	98
Hydro and marine	4,279	88
Solar	140	3
Wind	0	0
Bioenergy	329	7
Geothermal	0	0
Total	4,854	100

Box 1: Integrated waste biogas in Uganda**Integrated waste biogas in Uganda**

Kampala, , generates a considerable amount of waste annually, mainly organic, totalling about 730 000 tonnes. This waste is typically disposed of in distant landfills, resulting in escalating transportation expenses. Since 2018, the United Nations Development Programme (UNDP) has been executing a project known as "Integrated Waste Management and Biogas in Uganda." This initiative, backed by the Global Environment Facility (GEF), unites various Ugandan ministries and local authorities from cities like Kampala, Jinja, Mbale, Masaka, and Mbarara.

The project's primary objective is to update waste management strategies and regulations in urban areas to prioritise biogas production and electricity generation from waste materials. Feasibility studies have been conducted to attract private investment, exploring options like biogas generation at wastewater treatment plants.

A significant aspect of the project is the establishment of public-private partnerships to trial waste-to-electricity technology in key urban centres across Uganda, particularly those producing substantial organic waste. For example, in Kampala, a 4.4 MW waste-to-energy plant could be feasible using the daily organic waste output from local farmers' markets.

Additionally, the Kampala Capital City Authority is actively pursuing energy recovery solutions at the Dundu landfill, which could potentially be replicated in other burgeoning cities throughout Uganda.

Energy efficiency initiatives

Kampala, as part of Uganda's broader efforts, has embraced several initiatives aimed at enhancing energy efficiency and promoting the use of renewable energy. Energy efficiency is an initiative aimed at ensuring optimum energy utilisation across various sectors of the economy, such as industry, commerce, education, residential areas, transportation and agriculture. This initiative serves as a critical strategy to minimise the economic strain caused by the need to supplement energy through imports to meet energy demands and reduce emissions from the burning of fuels for energy. Table 6 indicates some of the national interventions to enhance energy efficiency.

Table 6: Relevant energy efficiency interventions in Uganda

Initiative	Description	Key focus areas	Expected outcomes
Compact fluorescent lamps (CFLs)	Implemented through the Ministry of Energy and Minerals Development and other development partners	<p>A key component of this intervention has been an educational campaign targeted at households, highlighting the importance of adopting energy-saving practices</p> <p>Promotion of compact fluorescent lamps (CFLs), which are being increasingly adopted in place of traditional, high-energy-consuming incandescent bulbs</p>	This transition not only contributes to the reduction of energy consumption, but also plays a vital role in fostering a sustainable energy future for the city

Initiative	Description	Key focus areas	Expected outcomes
Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP)	Commissioned by the German Federal Ministry for Economic Cooperation and Development and co-funded by several international partners, it aims to improve access to clean energy in rural and peri-urban areas of Uganda	<p>Mini-grids for rural electrification</p> <p>Market development for clean cooking and solar energy technologies</p> <p>Access to decentralised renewable energy systems</p>	Enhanced access to clean energy in targeted areas
Energy Efficiency Roadmap for Uganda	Developed with Power Africa and the United Nations Sustainable Energy for All (SEforALL), it outlines the role of electrical energy efficiency in achieving Uganda's energy access goals	<p>Adoption of efficient technologies</p> <p>Energy savings and demand reductions</p> <p>Reduction of carbon dioxide emissions</p>	<p>2,224 GWh saved by 2030</p> <p>341 MW of peak demand reduction. Energy access for an additional 6 million rural customers</p> <p>10.6 million tonnes of CO₂ emissions reduced by 2030</p>
East African Centre for Renewable Energy and Energy Efficiency (EACREEE)	Located at Makerere University College of Engineering, Design, Art, and Technology (CEDAT) in Kampala. It supports the East Africa Community (EAC) Partner States' initiatives in renewable energy and energy efficiency	<p>Policy and capacity development</p> <p>Knowledge management and awareness</p> <p>Investment and business promotion</p>	Strengthened policy frameworks, successful program execution, and co-funded initiatives in renewable energy and energy efficiency

Figure 16: Buildings in Kampala



Recommendations for Energy Development in Kampala

10.1 Promote Sustainable Energy Practices:

Kampala should align closely with Uganda's Energy Policy 2023, which emphasises increased energy supply and access, integration of emerging technologies, and sustainable energy utilisation. Initiatives should include public-private partnerships and advocacy for regulatory changes to drive the transition to cleaner energy sources.

10.2 Enhance Policy Advocacy and Implementation:

Local government efforts should focus on enhancing energy sector governance, capacity building, and integrated planning. Advocacy for regulatory changes that support clean energy adoption is crucial. Aligning local policies with national objectives will ensure that Kampala contributes to Uganda's energy goals while addressing unique urban challenges.

10.3 Facilitate Public-Private Partnerships:

Encourage and facilitate public-private partnerships to drive infrastructure development and innovation in energy solutions. Leveraging private sector expertise and resources can foster projects such as clean cooking initiative, distributed solar PV generation, and waste-to-energy systems, which are essential for improving energy efficiency and creating sustainable models for energy production and consumption.

10.4 Invest in Infrastructure Development:

Prioritise infrastructure development to enhance electricity generation, transmission, and distribution within Kampala. This should align with Uganda's Energy Policy 2023 objectives to strengthen energy infrastructure, support the city's growing population, and meet industrial needs. Improved infrastructure is crucial for increasing electricity access and uptake of modern energy forms, such as renewable energy sources.

10.5 Develop Financial Mechanisms and Attract Investment:

Address the insufficient investment in clean cooking technologies and comprehensive energy sector planning for the urban poor. Efforts should focus on attracting investment and developing innovative financial mechanisms, such as microfinance schemes and pay-as-you-go models, to make clean energy solutions more accessible. Public funding can de-risk private investments, encouraging businesses to invest in clean energy solutions.

10.6 Enhance Capacity Building and Public Awareness:

Implement comprehensive education and public awareness programs to promote clean energy adoption. These programs should bridge the knowledge gap and encourage households to transition to cleaner energy options. They must be culturally and socially nuanced to resonate with the target audience. Additionally, enhance the capacity of local institutions to manage and implement energy projects for sustainable long-term outcomes.

10.7 Ensure Environmental and Health Safeguards:

Align initiatives with Energy Policy 2023 with emphasis on managing energy-related environmental, health, and social safeguards. Promote the sustainable utilisation of biomass and advocate for sound health and safety practices in energy activities. These efforts are crucial in mitigating the negative impacts of traditional biomass use and improving overall public health.

10.8 Coordinate Efforts in the Greater Kampala Metropolitan Area (GKMA):

Extend energy strategies to the GKMA, ensuring coordinated and comprehensive energy planning and implementation. Integrated planning involving multiple local governments and stakeholders will develop a cohesive energy strategy. This approach will ensure that energy infrastructure and services are uniformly developed across the metropolitan area, addressing disparities and promoting equitable access to clean energy.

10.9 Expand Renewable Energy Sources:

Promote the expansion of renewable energy sources, such as solar and wind, within the GKMA in line with EP2023's objectives. This initiative aims to reduce reliance on non-renewable energy sources and promote environmental sustainability across the metropolitan region.

10.10 Leverage Urban-Rural Synergy:

Promote energy solutions that benefit both urban centres and surrounding rural areas by leveraging the urban-rural synergy. This includes expanding the electricity grid and off-grid solutions to improve energy access and economic opportunities in peri-urban and rural communities.

Conclusion

The Kampala city energy profile provides an examination of the city's energy landscape, highlighting significant progress and ongoing challenges. As Uganda's economic centre, Kampala's energy strategy is critical for national development, impacting economic activities and residents' quality of life. Kampala has made notable progress towards improving its energy landscape, yet significant challenges remain. The city's heavy reliance on biomass is a pressing issue that requires urgent attention. By focusing on policy enhancements, increasing investments, leveraging innovative financing models, and boosting public awareness and institutional capacity, Kampala can make significant strides towards a sustainable and equitable energy future. KCCA's role is central to this transition, driving the city towards its clean energy goals and setting an example for other urban centres in Uganda and beyond.

Aligning with the Energy Policy 2023, KCCA's efforts in infrastructure development, public-private partnerships, and policy advocacy are important for achieving sustainable, affordable, and quality energy services for all Ugandans by 2030. The mandate of local governments, as outlined in Energy Policy 2023, provides a clear framework for KCCA to enhance energy sector governance, build capacity, and ensure integrated planning. Through these strategic initiatives, KCCA is well-positioned to lead Kampala and the Greater Kampala Metropolitan Area towards a more sustainable and resilient energy future.

The role of Kampala Capital City Authority (KCCA) in the energy development of Kampala is both pivotal and multifaceted. As outlined in Uganda's Energy Policy 2023, local governments are mandated to administer multilateral and bilateral projects - financed through national government or channelled directly to local government - provide input into national energy strategies, monitor and coordinate policy implementation, develop local bylaws, enforce energy laws, and mobilise funding. KCCA's leadership in this space is therefore key to achieving the broader goals of Uganda's energy policy, including within the Greater Kampala Metropolitan Area (GKMA).

The GKMA, encompassing key urbanised elements of Kampala and its surrounding districts of Wakiso, Mukono, and Mpigi, represents a significant urban agglomeration with a complex energy landscape. The rapid urbanisation and population growth within this region heighten the demand for energy, necessitating a robust and comprehensive approach to energy management and development. KCCA, as the administrative body of Kampala, plays a central role in this context, ensuring that energy policies are effectively localised and implemented.

One of the key areas of KCCA's focus is the transition to clean energy sources. The city's high reliance on biomass, which accounts for approximately 90% of the energy used for cooking, poses significant environmental and health challenges. KCCA's efforts in this domain are crucial for mitigating deforestation, reducing indoor air pollution, and improving overall public health. Official documentation from the Government of Uganda, including the Energy Policy 2023 and Uganda Vision 2023, targets a reduction of biomass usage for cooking, aiming for 50% of the population to adopt clean cooking technologies by 2040. KCCA has been instrumental in promoting alternatives to biomass, such as liquefied petroleum gas (LPG) and improved cookstoves.

The authority has been active in exploring the potential of solar and wind energy, leveraging Kampala's equatorial location for optimal solar power generation. Projects like the electric motorbike charging stations launched by KCCA highlights a commitment to integrating renewable energy solutions and promoting

sustainable urban mobility. These initiatives not only contribute to reducing the city's carbon footprint but also align with national and global climate commitments.

The Energy Policy 2023, also outlines the role of local governments in enforcing energy-related laws and developing bylaws to guide the sustainable utilisation of local energy resources. KCCA's regulatory functions are therefore integral to the broader energy governance framework. This includes ensuring compliance with energy efficiency standards, promoting energy conservation practices, and facilitating the adoption of clean technologies. Through these mechanisms, KCCA supports the national agenda of sustainable energy development and contributes to the resilience of the urban energy system .

The symbiotic relationship between Kampala and the surrounding districts within the GKMA underscores the importance of a coordinated regional approach to energy management. KCCA's leadership in this metropolitan context involves collaborating with neighbouring local governments to address shared energy challenges, optimise resource use, and enhance energy infrastructure. This collaborative approach is vital for achieving energy security and sustainability across the entire metropolitan area .

KCCA's strategic planning and policy implementation must continue to target the socio-economic aspects of energy access. With high unemployment rates and a significant informal sector, particularly among the youth, KCCA's energy programmes should aim to create employment opportunities and foster economic development. By supporting local energy enterprises, promoting skills development in the renewable energy sector, and facilitating access to affordable energy, KCCA contributes to the socio-economic upliftment of Kampala's residents .

In conclusion, KCCA's role in energy development of Kampala is comprehensive, encompassing policy implementation, regulatory enforcement, renewable energy promotion, and socio-economic development. The authority's efforts are crucial for advancing the objectives of Uganda's Energy Policy 2023 and ensuring a sustainable energy future for the Greater Kampala Metropolitan Area. As Kampala continues to navigate the challenges and opportunities within the energy sector, its leadership and strategic initiatives will remain central to the GKMA's sustainable development trajectory.

Figure 17: Aerial view of Kampala



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MAY 2024