Covenant of Mayors
in Sub-Saharan Africa

NAKURU COUNTY
COUNTY OF UNLIMITED OPPORTUNITIES

BASELINE EMISSIONS INVENTORY

Nakuru County, Kenya

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Contents

Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
BEI	Baseline Emissions Inventory
BOD	Biological oxygen demand
CH_4	Methane
CHP	Combined heat and power
CIDP	County Integrated Development Plan
CIRIS	City Inventory Reporting and Information System
CoM SSA	Covenant of Mayors in Sub-Saharan Africa
CO_2	Carbon dioxide
CO_2e	CO_2-equivalents
CSA	Climate-smart agriculture
EC	European Commission
ETS	Emissions Trading Scheme
EU	European Union
GCoM	Global Covenant of Mayors for Climate & Energy
GHG	Greenhouse gas
GPC	Global Protocol for Community-scale Greenhouse Gas Emission Inventories
GWP	Global Warming Potential
IE	Included elsewhere
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
JRC	Joint Research Centre
$ktCO_{2\text{-}eq}$	kilotonnes (one thousand tonnes) of CO_2-equivalents
LPG	Liquified petroleum gas
MTP	Medium Term Plan
NDC	Nationally Determined Contribution
NE	Not estimated
NO	Not occurring
N_2O	Nitrous oxide
RVA	Risk and Vulnerability Assessment
SDGs	Sustainable Development Goals
SEACAP	Sustainable Energy Access and Climate Action Plan

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1. The Covenant of Mayors Sub-Saharan Africa (CoM SSA) and Sustainable Energy Access and Climate Action Plans (SEACAPs)

1.1 The Covenant of Mayors Sub-Saharan Africa (CoM SSA)

The Covenant of Mayors Sub-Saharan Africa (CoM SSA) is an initiative launched by the European Union (EU) to support local authorities in sub-Saharan Africa tackle climate challenges and ensure access to clean energy. It is the "regional covenant" or chapter of the Global Covenant of Mayors for Climate & Energy (GCoM). CoM SSA is delivered through a partnership of global and local city networks as well as initiatives funded by the European Commission (EC). It is a bottom-up and voluntary initiative that invites cities to define and meet ambitious and realistic energy access and climate targets set by themselves, in line with GCoM requirements. This means that targets are at least as ambitious as cities' respective government's Nationally Determined Contribution (NDC) under the Paris Agreement. Furthermore, targets need to be in line with National Adaptation Plans (where these exist) and be consistent with the principles around energy access and urban sustainability embodied in the Sustainable Development Goals (SDGs). Local authorities are encouraged to voluntarily commit to the implementation of a climate and energy action plan in their area of influence. They are also encouraged to define long-term vision actions towards a sustainable future based on the pillars of climate change mitigation and adaptation, and sustainable, affordable and secure access to energy. CoM SSA is open to any city in sub-Saharan Africa, regardless of the size. In order to translate the political commitment into practical measures, CoM SSA signatories commit to produce and implement a strategic and operational document called the Sustainable Energy Access and Climate Action Plan (SEACAP).

1.2 Sustainable Energy Access and Climate Action Plans (SEACAPs)

The Sustainable Energy Access and Climate Action Plan (SEACAP) is the key document that sets the strategies, plans and actions for a sustainable and low greenhouse gas (GHG) emission development pathway, while including climate adaptation actions and ensuring access to secure, affordable and sustainable energy, in response to the current and future impacts of climate change in the region. The SEACAP is both a strategic and an operational document. It uses the results of the Baseline Emission Inventory (BEI) to identify the best fields of action and opportunities for reaching the local authority's greenhouse gas (GHG) emission reduction targets. It is based on the climate change Risk and Vulnerability Assessment (RVA), which identifies the most relevant city climate hazards and vulnerabilities. It also includes an Access to Energy Assessment, which articulates a plan to improve the access to secure, sustainable, affordable and reliable energy. The SEACAP defines concrete measures for climate mitigation, adaptation and access to sustainable energy, with timeframes and assigned responsibilities, translating the long-term strategy into action.

1.3 Phases of the SEACAP development within the Mitigation pillar

The Mitigation pillar of the Sustainable Energy Access and Climate Action Plan (SEACAP) development typically involves four phases:

i. **Initiation phase** – Activities in this phase include the identification of national action plans on climate change mitigation, mobilising and engaging stakeholders and affirming political commitment of the heads of the local government to the SEACAP development.

ii. **Planning phase** – This phase includes pre-assessment and development stages. Thus, it involves undertaking a baseline assessment of the status of mitigation in the city via a baseline GHG emissions inventory (BEI). The BEI offers an opportunity for local government authorities to obtain data specific to the city, thus increasing awareness of the current status and providing a premise for further action to improve the status quo. The baseline inventory should measure the emissions of three sectors: stationary energy, waste and transportation. Owing to the complex nature of developing GHG inventories, a first inventory can be developed efficiently using a proxy data tool, and complemented where/if local data are available. Thereafter, target setting and development of long-term action plans to achieve the set targets would begin. These actions, which aim at promoting mitigation, include the development of favorable policies for the consumption of efficient and/or renewable energy in buildings and lighting, efficient land use planning and urban design, low-carbon transport modes, waste and wastewater management, and potential energy generation.

iii. **Implementation phase** – This phase involves delivering practical actions, based on the actions that have been prioritised during the action planning process.

iv. **Monitoring and Reporting phase** – This phase involves reviewing progress and readjusting priorities. The proposed actions are monitored to ensure that the set targets are achieved. Specific procedures and processes for each of the actions are confirmed, while maintaining constant communication with the stakeholders throughout. On a regular basis, the progress made is assessed and priorities are adjusted to fit the current situation as needed. A progress report is to be submitted every second year after the year SEACAP was developed, for monitoring and evaluation.

This document constitutes the Baseline Emissions Inventory, the baseline assessment for the Mitigation pillar, and will be used to set targets for the Mitigation pillar as well as guide the development of actions to reduce or limit the greenhouse gas emissions attributed to Nakuru County, Kenya.

1.4 Purpose of the Baseline Emissions Inventory

A Baseline Emissions Inventory (BEI) allows a local authority to measure their GHG emissions in a base year, according to a common methodological approach. The BEI identifies the principal anthropogenic sources of CO_2 (and other GHG) emissions across the city.

1.4.1 Types of emissions to be included in the BEI

In the framework of the CoM SSA initiative, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) constitute the three types of emissions to be included in the BEI. The three main sources of GHG emissions to be potentially included in the BEI are:

1. Direct emissions due to fuel combustion in the buildings, equipment/facilities and transportation sectors within the city boundary. These emissions physically occur inside the city boundary.
2. Non-energy related emissions: Other direct emissions that are not related to fuel combustion, including: fugitive emissions from the disposal and treatment of waste (including wastewater) generated within the city boundary, which may occur inside or outside the city boundary, and; fugitive emissions from natural gas distribution systems (such as equipment or pipeline leaks).
3. Indirect emissions due to consumption of grid-supplied energy (electricity, heat or cold) within the geographic boundary. Depending on where energy is generated, these emissions may occur inside or outside the city boundary.

1.4.2 Emission sources to be included in the BEI

In the framework of the CoM SSA initiative, local authorities shall consider all categories of emission sources and report all emissions that are considered significant. Exclusion of emission sources shall be disclosed and justified. At the very minimum, local authorities shall report on GHG emissions from the main sectors outlined in **Table 1**.

Table 1: Emission sources to be included in the BEI

Type of emission source	Description
Stationary energy	All GHG emissions (direct emissions from fuel combustion and indirect emissions due to consumption of grid-supplied energy) occurring in stationary sources within the local authority boundary shall be reported. These emissions come from final energy consumption in residential, commercial and institutional buildings and facilities, as well as from industrial buildings and facilities and agriculture/forestry/fisheries. GHG emissions from sources covered by a regional or national emissions trading scheme (ETS), or similar, should be identified. GHG emissions from "energy generation" industries should not be reported under this sector to avoid double counting of emissions. All fugitive emissions within the city boundary shall be reported.
Transportation	All GHG emissions (direct emissions from fuel combustion and indirect emissions due to consumption of grid-supplied energy) occurring for transportation purposes within the local authority boundary shall be reported. In addition, local authorities shall where possible further disaggregate by mode: on-road, rail, waterborne navigation and off-road, and it is recommended to disaggregate road and rail travel by fleet type: municipal, public, private and commercial transport. Local authorities may use the "fuel sales", "geographic (territorial)", "resident activity" and "city-induced" methodologies to estimate activity data in the transport sector.

Type of emission source	Description
Waste/Other non-energy related emissions	All GHG emissions non-energy related from the disposal and treatment of solid waste and wastewater generated within the city boundary shall be reported and disaggregated by treatment type. Where waste/wastewater is used for energy generation, emissions should not be reported under this sector to avoid double counting of indirect emissions (instead the notation key IE should be used for 'included elsewhere').
Energy supply	All GHG emissions from the generation of grid-supplied energy within the local authority boundary, and all GHG emissions from the generation of grid-supplied energy by facilities owned (full or partial) by the local authority outside the local authority boundary shall be reported, disaggregated by electricity-only, CHP and heat/cold production plants. To avoid double counting, these emissions will not be part of the total direct emissions, but accounted through the local emission factor for indirect emissions. In addition, local authorities are recommended to report all activity data for distributed renewable energy generation.

Local authorities shall also report GHG emissions from Industrial Processes and Product Use (IPPU) and Agriculture, Forestry and Other Land Use (AFOLU) sectors where these are significant and feasible.

Each of the emission types outlined in **Table 1** also have various subsectors that shall also be reported on within the BEI[1]. These are outlined in **Table 2**.

[1] If the city reports on IPPU and AFOLU, the subsectors for those sectors can be found in the Global Covenant of Mayors Common Reporting Framework (Global Covenant of Mayors for Climate & Energy, 2018).

Table 2: Subsectors to be included in the BEI

Type of emission source	Subsectors	Description
Stationary energy	Institutional/municipal buildings and facilities	All final energy consumption and related GHG emissions occurring in buildings and facilities (public or owned by the local authority) for cooking, heating and cooling, lighting and appliances usage; e.g. government offices, schools, police stations, hospitals, public lighting. All final energy consumption (and related GHG emissions) due to operation (ex. electricity for pumping, natural gas for heating, etc.) of municipal water supply system, solid waste and wastewater treatment and disposal facilities are also included here. All non-energy related emissions (e.g. methane) produced in these facilities shall be reported under the waste sector.
	Commercial/tertiary buildings and facilities	All final energy consumption and GHG emissions occurring in buildings and facilities of the tertiary sector (services) cooking, heating and cooling, lighting and appliances usage; e.g. offices of private companies, banks, commercial and retail activities, private schools, hospitals, etc. All final energy consumption (and related GHG emissions) due to operation (ex. electricity for pumping, natural gas for heating, etc.) of private water supply system, solid waste and wastewater treatment and disposal facilities are also included here.
	Residential buildings	All final energy consumption and GHG emissions occurring in buildings (including informal settlements and social housing) that are primarily used as residential buildings for cooking, heating and cooling, lighting and appliances.
	Industrial buildings and facilities	All energy consumption and GHG emissions occurring in industrial (manufacturing and construction industries) buildings and facilities. Also, GHG emissions from sources covered by a regional or national emissions trading scheme (ETS), or similar (e.g. above 20 MW as thermal energy input), should be identified. Energy generation industries should not be reported here (to avoid double counting).
	Agriculture/forestry /fisheries	Emissions from energy use in agriculture, forestry and fishing activities, including energy use associated with plant and animal cultivation, afforestation and reforestation activities, and fishery activities. This could include for example the on-site operation of farm vehicles and machinery, generators to power lighting, pumps and heaters.
	Fugitive emissions	All fugitive emissions from the extraction, transformation and transportation of primary fossil fuels within the city boundary, including: 1) fugitive emissions from mining, processing, storage and transportation of coal; and 2) fugitive emissions from oil and natural gas systems, such as equipment or pipeline leaks, evaporation and flashing losses, venting, flaring, incineration, and accidental releases, etc.

Type of emission source	Subsectors	Description
Transportation	Municipal fleet	All GHG emissions from fuel combustion and use of grid-supplied energy for transportation within the city boundary shall be reported and disaggregated by mode: • On-road, rail, waterborne navigation, aviation and off-road: - on-road transportation: urban street network under the competence of the local authority; • On-road transportation serving a larger area and/or not under the competence of the local authority (e.g. highways) may be included if mitigations actions are planned in that area; • Off-road transport: off-road traffic of vehicles/mobile machinery in any activity sector; • Rail transportation: local transport (metro, tram and local trains); long-distance trains, intercity trains, regional and cargo rail transportation may be included if mitigations actions are planned in that area; • Waterborne navigation: local ferries in public and private transport acting on the local territory; • Aviation: local governments may choose to report GHG emissions from the in-boundary component of domestic and/or international aviation (such as the landing and take-off cycle for aviation), or assume these are all out-of-boundary emissions and use the notation key "Included Elsewhere (IE)". **Note:** According to the JRC Guideline, it is not required (but recommended when possible) to provide energy data for each individual fleet type (municipal fleet, public transport, private and commercial transport) but only at the macro-sector level, meaning road and rail travel.
	Public transport	
	Private and commercial transport	
Waste/other non-energy related emissions	Solid waste disposal	All emissions from solid waste that are disposed of at managed sites (e.g. sanitary landfill and managed dumps), and unmanaged sites (e.g. open dumps, including above-ground piles, holes in the ground, and dumping into natural features such as ravines).
	Biological treatment	All emissions from the biological treatment of waste, including composting and anaerobic digestion of organic waste.
	Incineration and open burning	All emissions from waste that is burned either in a controlled, industrial process or in an uncontrolled, often illicit, process. The former is often referred to as incineration, and the latter as open burning. Note that this excludes emissions from waste incineration for the purposes of energy generation, also known as energy recovery.
	Wastewater treatment and discharge	All emissions from the treatment process of wastewater, either aerobically or anaerobically, and direct discharge of wastewater into an open body of water.

Type of emission source	Subsectors	Description
Energy supply	Electricity-only generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating grid-supplied electricity in power plants that solely generate electricity.
	Combined Heat and Power (CHP) generation	In the case of CHP plants, which generate heat and electricity simultaneously, or any other plants not listed, the amount of electricity produced (in MWh), both from renewable and non-renewable energy sources shall be reported.
	District heating/cooling generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating thermal energy in district heating/cooling plants.
	Distributed local renewable energy generation	All activity data and GHG emissions from local energy generation (electricity, heat, etc.) facilities not grid-connected.

2. Local government overview of Nakuru County, Kenya

Nakuru County is located within the Great Rift Valley towards the centre of Kenya (**Figure 1**). The county includes the major towns of Nakuru and Naivasha and covers an area of 7 498.8 km^2, which represents 1.3% of Kenya's total land area (Nakuru County, 2020).

(Source: Nakuru County, 2020)

Figure 1: Geographic boundary of Nakuru County within Kenya

The estimated population of Nakuru County was 2,162,202 people in 2019, with the total number of households estimated at 616,046 for 2019. This equates to 4.5% and 5.1% of Kenya's population and households, respectively (Kenya National Bureau of Statistics, 2019a).

The county's Gross Domestic Product (GDP) for 2019 was estimated at KES 613 billion (at the time of writing this report this equated to approximately USD 6.01 billion), accounting for 6.9% of Kenya's GDP (KNBS, 2019: KNBS, 2020). About 29.1% of the population lives below the poverty line of USD 2 a day, which is slightly below the national poverty level of 36.1% (KIPPRA, 2020). The main economic activities within Nakuru County are agribusiness, financial services, geothermal power generation and tourism (County Integrated Development Plan (CIDP), 2018–2022). The county's economy is mostly built around agriculture, which accounts for approximately 60% of total economic activity (Nakuru County, 2020).

Nakuru County is the location of some of the most significant power generation plants in the country, with one of the largest single geothermal plants in Africa. Electricity is the main source of energy for lighting in the county at 55% according to the 2015–2016 Kenya Integrated Household Budget Survey (KIHBS, 2016). However, most of the residents, especially those in rural areas and informal settlements of the rapidly expanding urban centres, rely mainly on biomass energy for cooking (firewood and charcoal).

The road network in the county is approximately 12,491 km, out of which paved roads are 993.7 km, gravel roads are 4,500 km, and earth roads are 6,998 km. The road infrastructure can be described as 20% good, 35% fair and 45% poor (CIDP 2018-2022). Some roads especially in agriculturally rich areas including Kuresoi North and South, Molo, Njoro Subukia, Naivasha and Gilgil are in poor condition, leading to delays in the transporting of agricultural produce to the market, resulting in farmers incurring losses for perishable goods. A railway line traverses the county to Uganda, and transports cargo mainly from the port of Mombasa to the Malaba border. The proposed Standard Gauge Railway (SGR) will pass through Mai Mahiu (Naivasha) as it joins Narok County and continues all the way to the Malaba border.

2.1 Mitigation policy and regulatory framework

Table 3 and **Table 4** provide an overview of the climate change mitigation policy and regulatory framework at the national and county level, respectively. The development of the Mitigation pillar of the SEACAP (i.e. the BEI and mitigation targets and actions) is anchored in Kenya and Nakuru County's existing climate action initiatives and ambitions. The data contained in this BEI builds on these policy documents, particularly on the 2020 updated Nationally Determined Contribution (NDC), the 2018–2022 National Climate Change Action Plan, the 2018–2022 Nakuru Country Climate Change Action Plan, and the Nakuru County Clean Energy Policy and Action Plan. These particular policy documents are elaborated on in more detail (visions, targets and actions) in Section 2.3.

Table 3: National-level policy and regulatory framework

Policy documents	Mitigation and adaptation provisions
Nationally Determined Contribution (NDC), 2020	The updated NDC sets out an ambitious contribution for Kenya to climate change mitigation. In this document, Kenya commits to abate *GHG emissions by 32% by 2030 relative to the BAU scenario of 143 $MtCO_2e$. Kenya intends to bear 21% of the mitigation cost from domestic sources, while 79% of this is subject to international support in the form of finance, technology development and transfer, and capacity building.* The updated NDC also sets out contributions of mainstreaming climate change mitigation and adaptation into Medium Term Plans and implementing mitigation and adaptation actions. In the NDC, Kenya commits to: • Increase renewables in the electricity generation mix of the national grid; • Enhance energy and resource efficiency across the different sectors; • Make progress towards achieving tree cover of at least 10% of the land area of Kenya; • Make efforts towards achieving land degradation neutrality; • Scale up Nature Based Solutions (NBS) for mitigation; • Enhance REDD+ activities;

Policy documents	Mitigation and adaptation provisions
Nationally Determined Contribution (NDC), 2020	• Implement clean, efficient and sustainable energy technologies to reduce over-reliance on fossil and non-sustainable biomass fuels; • Implement low-carbon and efficient transportation systems; • Promote climate smart agriculture (CSA), in line with the Kenya CSA Strategy with an emphasis on efficient livestock management systems; • Implement sustainable waste management systems; and • Harness the mitigation benefits of the sustainable blue economy, including coastal carbon Payment for Ecosystem Services.
Second National Climate Change Action Plan (NCCAP) 2018–2022	• The plan guides Kenya on the priority climate change adaptation and mitigation actions that help define Kenya's low-carbon, climate-resilient development pathway and lead to the achievement of Kenya's NDC targets. • Counties will align their Strategic Plans and County Integrated Development Plans (CIDPs) to the Vision 2030 national development blueprint, the MTP III, and the NCCAP 2018–2022 through a consultative process.
Constitution of Kenya, 2010	• Kenya's Constitution provides the basis for action on climate change by guaranteeing citizens a clean and healthy environment, which is a fundamental right under the Bill of Rights. • Provides for the devolved system of governance (counties) which ensures participation of communities and equitable national resource distribution to address socio-economic disparities.
Vision 2030, 2008	• Under the social strategy, Kenya aims to be a nation that has a clean, secure, and sustainable environment by 2030 by harmonising environment-related laws for better environmental planning and governance. • Kenya will also enhance disaster preparedness in all disaster-prone areas and improve the capacity for adaptation to climate change.
Vision 2030 Third Medium Term Plan (MTP III) 2018–2022	Thematic area: Climate Change and Disaster Risk Management (DRM). • To mitigate drought, the government will strengthen the Integrated Early Warning Systems and National Drought Emergency Fund. • The government will promote a low-carbon, climate-resilient and green growth development. • This will be achieved through strengthening climate change governance and coordination, climate change monitoring, reporting and verification, capacity building and public awareness, and formulation and implementation of the Green Economy Strategy and the National Climate Change Action Plan.
Climate Change Act, 2016	• The Act provides a framework for mainstreaming climate change across sectors. • It facilitates the formulation of a five-year National Climate Change Action Plan (NCCAP) that addresses all sectors of the economy and provides mechanisms for mainstreaming climate change into all sectors and the County Integrated Development Plans (CIDPs).
Environmental Management and Co-ordination (Amendment), 2015	• Article 56 A on guidelines on climate change: The Cabinet Secretary shall, in consultation with relevant lead agencies, issue guidelines and prescribe measures on climate change.
National Climate Change Response Strategy, 2010	• The mission is to strengthen and focus nationwide actions towards climate change adaptation and GHG emission mitigation.

Policy documents	Mitigation and adaptation provisions
Kenya Climate-Smart Agriculture Strategy (CSA) 2017–2026	• The strategy is to adapt to climate change, and build resilience of agricultural systems while minimising emissions for enhanced food and nutritional security and improved livelihoods. • The strategy was subjected to wider stakeholder consultations that brought together all the 47 counties. • Nakuru County does not have a county CSA strategy. However, the CSA strategy has provision for the county agriculture sector Ministries, Departments, and Agencies (MDAs) to spearhead the implementation of the identified strategies in the counties.
Draft Climate Change Policy, 2018	• This policy was developed to facilitate a coordinated, coherent, and effective response to the local, national and global challenges and opportunities that climate change presents.
Sector Plan for Drought Risk Management and Ending Drought Emergencies 2013–2017	• The plan sets 2030 drought risk mitigation targets defined in Kenya's NDC.
Green Economy Strategy and Implementation Plan (GESIP), 2016–2030	• This strategy is expected to strengthen the resilience of economic, social, and environmental systems to the adverse effects of external shock. • GESIP is linked with the NCCAP 2013–2017, and the National Climate Change Act 2016. • Strategies under the thematic area on sustainable infrastructure are to: – Enhance sustainable mobility; – Increase the share of renewable energy in the energy mix; and – Enhance disaster risk reduction measures. • Other relevant thematic areas include sustainable natural resource management and promoting resource efficiency
National Spatial Plan 2015–2045	The National Spatial Plan supports the mainstreaming of climate change into the national and county planning processes.
The Value Added Tax (Amendment) Act, 2014	The Act offers an exemption from value-added tax (VAT) and import duties for supplies imported or bought for the construction of a power-generating plant or for geothermal exploration. Kenya is expanding geothermal projects to generate clean energy and cut GHG emissions.
Public Finance Management (Climate Change Fund) Regulations, 2018	The regulations provide financing mechanisms to priority climate change actions and interventions, and empowers counties to develop climate finance policy frameworks.
National Policy on Climate Finance (draft), 2016	The policy recognises that climate finance is an important enabling aspect of efforts to address climate change. It prepares the country to tap into external and internal climate finances to support mitigation and adaptation activities. It highlights that significant financial resources from the public and private sectors are expected to be channelled towards climate activities.
The Kenya National Green Climate Fund (GCF) Strategy, 2017	• The strategy strengthens national capacity to effectively and efficiently plan for, access, manage, deploy and monitor climate financing, through the GCF. • It recognises that the country must boost the mobilisation of adequate and predictable financial resources from domestic and international sources. Notably, county governments are critical co-financiers and can take the role of executing entities and/or implementing entities of low-carbon and climate-resilient initiatives (The National Treasury, 2017).

Policy documents	Mitigation and adaptation provisions
Climate Change Indicator Development Guidebook, 2018	• The guidebook identifies climate change indicators at national and county level.
National Urban Development Policy	The policy seeks to create a framework for sustainable urban development in the country and addresses environment and climate change and other themes relevant to urban development. It recommends the following actions to address climate change: • Promote better quality housing that is adaptive to climate change; • Institutionalise the development of green urban landscapes with networks of open spaces and parks; • Enhance climate change resilience through infrastructure design and flood protection; • Promote technological innovation for climate change adaptation and mitigation; and • Expand access to information about climate change through research, education, periodic vulnerability assessments, and impact monitoring at national, county and urban levels.
Integrated National Transport Policy, 2010	This policy provides for transport solutions relevant to climate change mitigation.
National Sustainable Waste Management Policy, 2020	The policy sets out the goal *"to protect public health and the environment, as well as drive job and wealth creation, by creating an enabling environment for sustainable, integrated waste management and the minimisation of waste generation, to contribute to a circular economy."* In addition to this goal, the policy contains objectives, principles and priorities for minimising waste and supporting the circular economy in Kenya.

Table 4: County-level policy and regulatory framework

Policy documents	Mitigation and adaptation provisions
Draft Nakuru County Climate Change Action Plan 2018–2022	• Mitigation and adaptation • Provides the following vision: *Nakuru County has a low-carbon, climate-resilient economy that sustains the livelihoods of its citizens while contributing to the national development agenda* • Anticipated to be achieved through eight strategic objectives, namely: – Food security; – Water security; – Ecosystem conservation for sustainable economic development; – Green energy production and use; – Climate change resilient infrastructure; – Knowledge management and capacity building of community, stakeholders, and county officials; – Sustainable financing for climate change action; and – Governance and coordination of climate change adaptation and mitigation.
Second County Integrated Development Plan (CIDP) 2018–2022	• Provides a strategic focus and programme implementation frameworks and support to tackle climate change, provide policy advice and tools.
Nakuru County Climate Change Fund Bill (at 2nd Reading at the County Assembly), 2020	• Provides for mobilisation of local climate finance and leveraging of international climate finance for county-led climate actions.

Policy documents	Mitigation and adaptation provisions
Nakuru County Climate Change Bill, 2020	• The Nakuru Climate Change Act is aimed at putting in place a framework and mechanisms for mobilisation and facilitation of county government, communities and stakeholders to respond effectively to climate change. The response mechanisms will be through appropriate adaptation and mitigation measures and action.
The Nakuru County Charcoal Bill, 2014	• Mitigation: To support energy-efficient technologies and gradual exit from the use of charcoal and control of tree harvesting for charcoal production. • Establishment of County Environmental Committee
Nakuru County Waste Management Bill, 2019	• Mitigation: To facilitate appropriate waste management and utilisation to generate clean energy
The Nakuru County Agricultural Training and Mechanization Service Bill, 2019	• Establishment of the Agricultural Development Fund • Mitigation: Aim to reduce inappropriate land preparation technologies like burning.
The Nakuru County Urban Agriculture Promotion and Regulation Bill, 2015	• Mitigation: To include urban agriculture in the county as a way of maximising space, introducing green spaces, and using organic waste.
Nakuru County Clean Energy Policy	The policy provides an overarching framework for the county's plans, programmes and initiatives relating to sustainable clean energy supply and use by 2022. The overall objective of the policy is to ensure an affordable, competitive, sustainable and reliable supply of energy to meet county development needs at least cost, while protecting and conserving the environment. The policy seeks to enhance access to electricity for households and small businesses and access to clean cooking solutions for households and institutions.
Nakuru Public Health and Sanitation Act, 2017	This Act is the legal framework relating to health matters in Nakuru County, including dealing with infectious diseases, housing and sanitation, and the management of solid and liquid wastes. It is important in the management of climate change challenges due to the link between emerging diseases and climate change.

2.2 Key players in the emitting sectors

At the national level, the key institution for climate change mitigation and adaptation planning and implementation is the National Climate Change Secretariat (NCCS), which coordinates with the National Climate Change Action Plan Task Force and other national stakeholders as detailed in **Table 5**.

Table 5: National-level stakeholders

Institution	Role
Ministry of Environment and Natural Resources	National Focal Point for the UNFCCC
Ministry of Devolution and Planning	Ensure the integration of climate change in the MTPs
National Environmental Management Authority (NEMA)	National Implementing Entity (NIE) for the Adaptation Fund and the GCF
National Treasury	National Designated Authority for the GCF
Ministry of Transport, Infrastructure, Housing and Urban Development	Member of the National Climate Change Action Plan Task Force
Ministry of Agriculture and Irrigation	Member of the National Climate Change Action Plan Task Force
Ministry of Water and Sanitation	Member of the National Climate Change Action Plan Task Force
Ministry of Energy	Member of the National Climate Change Action Plan Task Force
National Drought Management Authority (NDMA)	• Exercise overall coordination over all matters relating to drought management in Kenya; • Oversees adaptation and resilience-building in the arid and semi-arid lands (ASALs); • The secretariat of the Common Programme Framework in Ending Drought Emergencies in Kenya.

County-based mitigation stakeholders are mainly departments within the Nakuru County Government in charge of County Integrated Development Plans (CIDPs), climate change, and the management of specific sectors. These include the Department of Water, Environment, Energy and Natural Resources; the Department of Agriculture, Livestock, and Fisheries; and the Department of Roads, Public Works and Transport. The County Executive Committee including Subcounty Administration and Chiefs, and County Assembly are also relevant to climate change mitigation action planning.

Community-based initiatives include several CBOs such as the Sustainable Community Development Services (SCODE) working with local communities (e.g. distribution of solar home systems and clean cooking equipment, access to water, forestry programmes, etc). Relevant associations for specific sectors include the Nakuru County Water Resource User Associations (WRUAs) and Community Forest Associations (CFAs) and several conservation organisations, including WWF, the Green Belt Movement, and Kenya Wildlife Services. There are also private sector players such as the M-KOPA and Water & Sanitation Services Co. Ltd. (NAWASCO) as well as the state-owned power generation agency, KENGEN.

2.3 Current mitigation targets and commitments

2.3.1 National mitigation targets and commitments

2020 updated Nationally Determined Contribution (NDC)

Kenya ratified the Paris Agreement on 26th December 2016 which binds the country to reducing greenhouse gas emissions and responding to the impacts of climate change. The Paris Agreement is domesticated in Kenya through the Nationally Determined Contribution (NDC) that sets out the country's actions towards achieving the global goals set out in the Paris Agreement. As noted above, in the updated version of Kenya's First NDC (2020), Kenya commits to:

- Increase renewables in the electricity generation mix of the national grid;
- Enhance energy and resource efficiency across the different sectors;
- Make progress towards achieving tree cover of at least 10% of the land area of Kenya;
- Make efforts towards achieving land degradation neutrality;
- Scale up Nature Based Solutions (NBS) for mitigation;
- Enhance REDD+ activities;
- Clean, efficient and sustainable energy technologies to reduce over-reliance on fossil and non-sustainable biomass fuels;
- Low-carbon and efficient transportation systems;
- Climate-smart agriculture (CSA), in line with the Kenya CSA Strategy with emphasis on efficient livestock management systems;
- Sustainable waste management systems; and
- Harness the mitigation benefits of the sustainable blue economy, including coastal carbon Payment for Ecosystem Services.

The mitigation vision outlined in the 2020 NDC is as follows: *"Kenya seeks to undertake an ambitious mitigation contribution towards the Paris Agreement. Kenya therefore seeks to abate her GHG emissions by 32% by 2030 relative to the BAU scenario of 143 $MtCO_2e$; and in line with her sustainable development agenda. Subject to national circumstances, Kenya intends to bear 21% of the mitigation cost from domestic sources, while 79% of this is subject to international support in the form of finance, technology development and transfer, and capacity building."*

2018–2022 National Climate Change Action Plan:

This plan builds on the first Action Plan (2013–2017) and provides a framework for Kenya to deliver on its NDC under the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). As outlined in **Table 6**, the NCCAP 2018–2022 aims to further Kenya's development goals by providing mechanisms and measures to achieve low-carbon, climate-resilient development.

Table 6: The aim, priorities, strategic objectives and main actions of the NCCAP

Kenya's National Climate Change Action Plan 2018-2022			
Aim: To further Kenya's sustainable development by providing mechanisms and measures to achieve low carbon climate resilient development in a manner that prioritises adaptation.			
Disaster (Drought and Floods) Risk Management	**Food and Nutrition Security**	**Water and the Blue Economy**	**Forestry, Wildlife and Tourism**
Reduce risks to communities and infrastructure resulting from climate-related disasters such as droughts and floods. ▪ Increase number of households and entities benefiting from devolved adaptive services ▪ Improve ability of people to cope with drought ▪ Improve ability of people to cope with floods and increase resilience of infrastructure ▪ Improve coordination and delivery of disaster risk management activities to effectively deal with drought, floods, landslides, disease outbreaks and other disasters	**Increase food and nutrition security through enhanced productivity and resilience of the agricultural sector in as low-carbon manner as possible.** ▪ Improve crop productivity through the implementation of climate-smart actions ▪ Improve crop productivity by increasing the acreage under irrigation ▪ Increase productivity in the livestock sector through implementation of priority climate-smart actions ▪ Enhance productivity in the fisheries sector through implementation of priority climate-smart actions ▪ Diversify livelihoods to adjust to a changing climate	**Enhance resilience of the Blue Economy and water sector by ensuring access to and efficient use of water for agriculture, manufacturing, domestic, wildlife and other uses** ▪ Increase annual per capita water availability through the development of water infrastructure ▪ Climate proof water harvesting and water storage infrastructure and improve flood control ▪ Promote water efficiency (monitor, reduce, re-use, and recycle) ▪ Develop green infrastructure ▪ Improve climate resilience of coastal communities	**Increase forest cover to 10% of total land area; rehabilitate degraded lands, including rangelands; increase resilience of the wildlife and tourism sector** ▪ Afforest and reforest degraded and deforested areas in Counties ▪ Implement initiatives to reduce deforestation and forest degradation ▪ Restore degraded landscapes (ASALs and rangelands) ▪ Promote sustainable timber production on privately-owned land ▪ Conserve land areas for wildlife

Health, Sanitation and Human Settlements	**Manufacturing**	**Energy and Transport**
Mainstream climate change adaptation into the health sector; and increase the resilience of human settlements, including improved solid waste management in urban areas ▪ Reduce incidence of malaria and other vector-borne disease ▪ Promote recycling to divert collected waste away from disposal sites. ▪ Climate proof landfill sites ▪ Control flooding in human settlements ▪ Promote green buildings	**Improve energy and resource efficiency in the manufacturing sector** ▪ Increase energy efficiency ▪ Improve water use and resource efficiency ▪ Optimise industrial and manufacturing processes ▪ Promote industrial symbiosis in industrial zones	**Climate-proof energy and transport infrastructure; encourage electricity supply based on renewable energy; encourage the transition to clean cooking; and develop sustainable transport systems** ▪ Promote the transition to clean cooking with alternative clean fuels such as LPG in urban areas, and clean biomass (charcoal and wood) cookstoves and alternatives in rural areas ▪ Increase renewable energy for electricity generation ▪ Climate proof energy and transport infrastructure ▪ Develop an affordable, safe and efficient public transport system, including a Bus Rapid Transit System in Nairobi ▪ Reduce fuel consumption and fuel overhead costs, including electrification of the Standard Gauge Railway ▪ Promote low-carbon action in the aviation and maritime sectors

2.3.2 Local targets and commitments for climate change

Nakuru County Climate Change Action Plan (2018–2022):

Aligned with the national ambitions and commitments outlined above, Nakuru County, through the Nakuru County Climate Change Action Plan 2018–2022, is guided by the vision: *"Nakuru County has a low-carbon, climate-resilient economy that sustains the livelihoods of its citizens while contributing to the national development agenda"*. The goal of the plan is to *"Mainstream climate change adaptation and mitigation strategies in the economic production and development activities to improve the living standards of Nakuru County residents."*

The county commits to achieve this goal through eight strategic objectives, namely:

1. Enhanced food security;
2. Enhanced water security;
3. Ecosystem conservation for sustainable economic development;
4. Green energy production and use;
5. Climate change resilient infrastructure;
6. Knowledge management and capacity building of community, stakeholders and county officials;
7. Sustainable financing for climate change action; and
8. Governance and coordination of climate change adaptation and mitigation.

Actions for each of these objectives have been developed and prioritised in the Action Plan but are not yet quantified and measurable. Only adaptation initiatives already in place or in the pipeline such as the GCF project titled "Climate-Resilient Aggregation, Storage, Warehousing Receipts, and Trading Facility for Dry Grains in Nakuru County, Kenya" are being refined for implementation. The Nakuru SEACAP will enable additional actions from the County Climate Change Action Plan to be developed further.

The national and local commitments described in detail above will form the bedrock of the targets and actions set in Nakuru's SEACAP. The SEACAP will particularly build on the Nakuru County Climate Change Action Plan, the Second CIDP (2018–2022) and current adaptation and mitigation initiatives[2] in the county. In terms of budget, the Second CIDP has already allocated budget for climate change actions as detailed in **Table 7**.

Table 7: Total budget allocated for climate change actions

Subprogramme	Key output	Key Performance Indicators	Total budget (KES)
Promotion of climate-smart agriculture	Increased adoption of climate change mitigation/adaptation strategies	Number of water pans constructed, greenhouses installed, soil testing kits procured, farmers trained, staff trained, soil samples	10 000 000
Climate change	Increased climate change resilience	Climate Change Action Plan in place	5 000 000
	Updated climate information	Percentage implementation of the Climate Change Action Plan	
	Climate and weather information disseminated	No. of Automatic Weather Stations (AWS) established and operationalised	65 000 000
		RANET community radio stations established	
	1 million-plus trees grown per year, increased forest cover	No. of trees grown, % increase in forest cover, sustained water sources	500 000 000

(Source: Nakuru CIDP, 2018–2022)

[2] For example, the GCF agricultural project under development and the Green Belt Movement, and urban greening research currently conducted in Nakuru Town by the Stockholm Environmental Institute.

2.3.3 Local targets and commitments for the energy, transport and waste sectors

Nakuru County Climate Change Action Plan:

Under Objective 4: Green energy production and use, plans are set out for reducing the reliance of communities on biomass and increasing renewable energy use. The Action Plan recognises the contribution of the energy, road transport and waste sectors to GHG emissions and sets out actions to reduce emissions from these sectors, including to:

- Support clean electric power generation;
- Monitor environmental impacts of geothermal power generation;
- Introduce incentives for clean energy adoption e.g. zero rate tax on solar panels, VAT and excise exemption on cooking stoves and other appliances;
- Adopt renewable energy;
- Set standards to improve household cookstoves;
- Diversify alternative energy sources;
- Construct climate-proofed sanitary landfills with methane capture technology for solid waste disposal in Nakuru City and other major towns;
- Promote improved cookstoves;
- Promote the use of clean energy e.g. LPG;
- Create incentives for car-pooling and use of alternative means of transport e.g. bicycles, public transport, trains;
- Promote the establishment of ICT hubs;
- Introduce tax incentives for ICT products;
- Provide essential services/facilities in satellite towns to decongest the CBD; and
- Improve the road network to reduce traffic jams and to connect SGR.

Nakuru County Clean Energy Policy, 2016

This policy document provides an overarching framework for the county's plans, programmes and initiatives relating to sustainable clean energy supply and use by 2022: maintaining energy security, maximising economic opportunities, cutting emissions, and protecting the most vulnerable. The policy aims to ensure that Nakuru accelerates climate change mitigation through clean energy development and energy efficiency and conservation measures.

The policy identifies priorities for:

- Promoting access to energy, including clean cooking solutions, and electricity for household and productive use;
- Increasing development of renewable energy, including off-grid and grid-connected solar energy, small hydro for electricity generation and mechanical use, and increasing awareness of the use of municipal waste and sewage as alternative energy sources; and
- Promoting energy efficiency and conservation, including through fuel efficiency in the transport sector.

The policy's objectives are to: (a) maximise the percentage of clean energy used in the county; (b) strengthen business society engagement on climate change mitigation, thereby encouraging investments in clean energy; (c) improve access to quality, reliable and affordable sustainable energy services; (d) provide an environment conducive for the development and provision of clean energy services; (e) promote energy efficiency and conservation measures; (f) ensure that prudent environmental, social, health and safety considerations are factored in energy sector developments; (g) ensure that a comprehensive, integrated and well-informed energy sector plan is put in place for effective development; and (h) promote capacity building in the sector through energy research, development, training and local manufacture of energy plants, equipment, appliances and materials.

Nakuru County Clean Energy Action Plan 2017–2022

The clean energy action plan has identified the sector's primary gaps in sustainable clean energy technology diffusion, awareness, investment, research and development, generation and distribution and other key areas, and outlined the steps needed to enhance demand, strengthen supply, and foster an enabling environment for the use of clean energy technologies throughout the county. The purpose of this plan is: *"To facilitate and regulate the provision of clean, sustainable, affordable, competitive, reliable and secure energy services at least cost while protecting the environment."*

The plan articulates the following targets:

- Universal access to modern energy services, including 100% of the population with access to electricity and 100% of the population with access to modern cooking solutions;
- Doubling the rate of improvement of energy efficiency; and
- Doubling the share of renewable energy in the energy mix, including an 80% renewable energy share in total final energy consumption for power and 80% for heat.

3. BEI methodology

3.1 Methodology

The GHG inventory has been developed based on the methodology contained in the *Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC): An Accounting and Reporting Standard for Cities* (Greenhouse Gas Protocol, 2015).

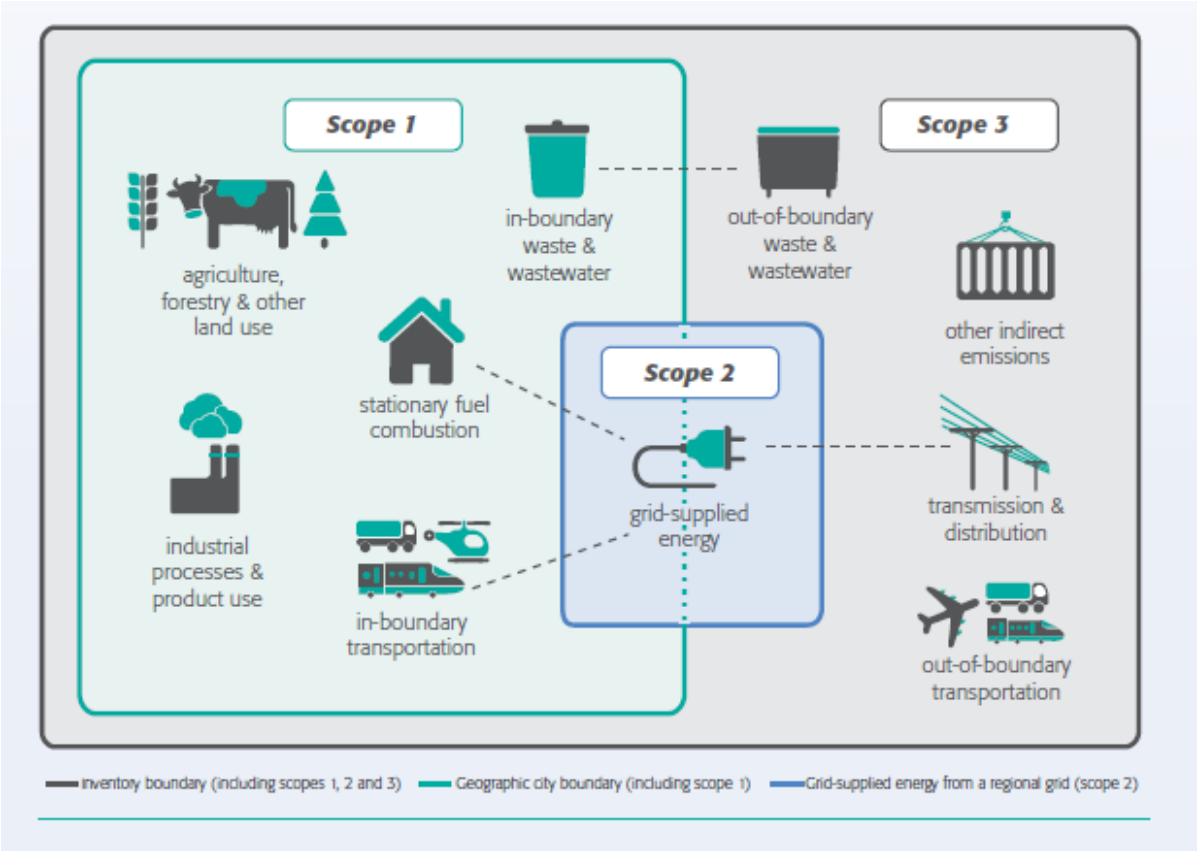
The GPC methodology was developed primarily for cities, although it can be used to assess the GHG emissions of any geographically defined subnational area. This methodology is widely used globally and was thus selected for application in this project, recognising that a number of other municipal and regional emission inventory methods exist[3].

The GPC was co-developed by the C40 Cities Climate Leadership Group, ICLEI – Local Governments for Sustainability, and the World Resources Institute (WRI). It aims to offer a robust and comprehensive GHG emissions inventory method that allows for more accurate benchmarking and comparisons between subnational entities such as regions, counties, cities and municipalities. The GPC also offers guidance on setting goals and tracking emissions over time. The protocol follows international best practices, including those in the GHG Protocol Mitigation Goals Standard, in elaborating how regions or cities can set different types of GHG reduction goals and measure progress consistently as better data and methodologies are adopted.

3.1.1 Levels of reporting

The CoM SSA framework requires that cities use the GPC reporting level (Greenhouse Gas Protocol, 2015) of "BASIC". BASIC includes all Scope 1 emissions from stationary energy (excluding energy generation supplied to the grid), transportation and waste sources, all Scope 2 emissions from stationary energy sources and Scope 3 emissions from the treatment of exported waste. The GPC BASIC and CoM SSA framework requires regions to report their emissions using two approaches: the scopes framework and the "city-induced" framework. The scopes framework distinguishes emissions that occur physically within the inventory area (Scope 1), from those that occur outside the inventory area (Scope 3) and emissions from electricity, steam and/or heating and cooling supplied by the grid (Scope 2), as shown in **Figure 2**. The "city-induced" framework reports only emissions that occur within the inventory boundary, excluding energy generation supplied to the grid.

[3] For example, the Greenhouse Gas Regional Inventory Protocol (GRIP), the International Standard for Reporting Greenhouse Gas Emissions for Cities and Regions (UNEP/World Bank), ICLEI's International Local Government GHG Emissions Analysis Protocol (IEAP – the predecessor to the GPC), and the Greenhouse Gases ISO 14064:2006.



(Source: GPC, 2015)

Figure 2: Sources and boundaries of city GHG emissions

3.2 CIRIS Tool

The emissions calculations for this inventory were undertaken using the City Inventory Reporting and Information System (CIRIS, 2018) tool. The CIRIS tool is an accessible, easy-to-use and flexible Excel-based tool designed to assist cities and other subnational regions to calculate and report their emissions according to the GPC methodology[4] and in turn the GCoM Common Reporting Framework.

The tool assists in the transparent calculation and reporting of emissions from all sectors. The underlying methodology is straightforward for stationary energy, transportation and livestock in that activity data (in the form of fuel consumption, electricity use, livestock etc. in a number of categories) are multiplied by emission factors and global warming potentials to provide an estimate of emissions. For sectors such as waste and wastewater, emission calculations are less straightforward. The tool thus includes built-in calculators to streamline the process of calculating these emissions.

3.3 Proxy Data Tool

A Proxy Data Tool has been developed for ICLEI Africa as an add-on to the CIRIS tool, which assists users to easily compile GHG inventories for subnational jurisdictions where primary data are not always available. The tool includes default national-level data, as well as default per capita factors, for all African countries, which together allow for the compilation of a high-level BASIC level GHG inventory using only census data. Where local-level primary data are available, however, users can choose to override the default data.

[4] The CIRIS tool carries the "Built on GHG Protocol" mark which confirms that the calculation tool is in conformance with GHG Protocol standards.

The Proxy Data Tool builds on the CIRIS tool, with two additional data input sheets having been added to the standard CIRIS tool spreadsheets. The first additional data input sheet requires users to input basic city and census data (country, year of inventory, regional land area, city population and, ideally, city GDP). Based on these data, the Proxy Data Tool draws on built-in data to determine default values for the city's GHG inventory. The second additional data input sheet presents the default national and regional values which are determined based on the first sheet's inputs. On this second sheet, users are able to override these default values where updated and/or more region-specific data are available. The default and/or override data, as well as the reference sources, are then used to populate the CIRIS tool spreadsheets and compile the region's GHG inventory.

The Proxy Data Tool is designed to conform to BASIC level GPC reporting, as this covers emission sources that occur in almost all subnational regions and aligns with the emissions sources listed in Section 1.4.2. BASIC level reporting is typically utilised for first time GHG inventories, with subsequent inventories building on the BASIC level reporting and including more complex BASIC+ sectors. The Proxy Data Tool therefore includes:

- Stationary energy: Scope 1 and 2 emissions
- Transportation: Scope 1 and 2 emissions
- Waste: Scope 1 and 3 emissions

The Proxy Data Tool does not consider BASIC+ sectors and subsectors and as such does not include:

- Stationary energy: Scope 3 and territorial[5] emissions
- Transportation: Scope 3 emissions
- Waste: Territorial[6] emissions
- IPPU: All emissions
- AFOLU: All emissions
- Other scope 3: All emissions

In the transportation sector, it is assumed that no waterborne navigation and aviation emissions occur, as emissions from these sectors are only included in a GPC compliant GHG inventory where the waterborne craft/aircraft both depart and arrive within the inventory boundaries (i.e. in-boundary transportation). This only occurs in a small number of cases, for example when a tugboat both departs and arrives at a harbour or a helicopter both takes off and lands within a city. Current data sources used for the Proxy Data Tool do not allow for fuel use disaggregation to this level and as such, it is assumed that fuel consumption for in-boundary waterborne navigation and aviation is negligible, warranting a "Not Occurring" notation. Scope 2 emissions from on-road and off-road transportation7 are similarly excluded due to the low number of electric vehicles in use across Africa. Due to a lack of disaggregated data, Scope 1 emissions from off-road transportation are included in the Scope 1 on-road transportation emissions, with these emissions therefore warranting an "Included Elsewhere" notation. As noted above, users have the ability to enter these data directly into the CIRIS tool spreadsheets, should they have data on in-boundary aviation or waterborne navigation occurring within their regions or fuel use for off-road transportation.

[5] Territorial emissions are emissions that occur within the inventory boundary but are not solely related to activities within the inventory boundary. For stationary energy, territorial emissions are from grid-supplied electricity/steam that is generated within the region, although the resultant electricity/steam is not consumed entirely within the inventory boundary.

[6] Territorial emissions are emissions that occur within the inventory boundary but are not solely related to activities within the inventory boundary. For waste, territorial emissions are from waste and wastewater generated in other regions but treated within the inventory boundary.

[7] Charging of electric vehicles.

In the waste sector, the Proxy Data Tool assumes by default that all waste emissions from waste generated within the inventory boundaries are emitted within the inventory boundaries (i.e. all waste emissions are Scope 1). In Nakuru County, there are three solid waste disposal sites, namely Gioto, Naivasha and Mai Mahiu, one of which is a sanitary landfill site, and one a medical waste incinerator (Nakuru County, 2019; Nakuru County, 2020). It is assumed that open dumping, composting and open burning of waste not sent to the landfill or disposal sites occurs within households or communities, meaning that all emissions associated with solid waste generated within the county occur within the inventory boundaries. As such, all solid waste emissions are Scope 1 and Scope 3 solid waste emissions are excluded as they do not occur. All wastewater generated within the county is treated at various wastewater treatment plants or in various household/community sanitation installations within the county (Nakuru County, 2020) and as such, Scope 3 wastewater emissions are not estimated.

The fuel sales approach is used in the transportation sector. Following this approach, all emissions from fuel sold within the inventory boundary are allocated to Scope 1 emissions. Since Scope 3 emissions from transportation are not a requirement for BASIC level reporting, this methodology is regarded as suitable for the Proxy Data Tool.

As historical solid waste generation data are not available, the methane commitment method is utilised to calculate solid waste emissions, using the calculator which forms part of the CIRIS tool. It is noted that the methane commitment method assigns landfill emissions based on waste disposal to a given year, regardless of when the emissions actually occur. As such the GPC notes that "For most cities, the MC method will consistently overstate GHG emissions by assuming that all degradable organic carbon (DOC) disposed in a given year will decay and produce methane immediately". Having said this, the approach is considered appropriate to use, for cases where insufficient historical waste data are available to use the more robust First Order Decay model.

It should be noted that the Proxy Data Tool allows users to quickly and easily generate an approximation of a subnational region's GHG emissions; however, due to the nature of proxy data, the results are an approximation. The quality and reliability of a GHG inventory is directly related to the quality and reliability of input data and therefore users should, wherever possible, review and update the default data utilised by the Proxy Data Tool. For these reasons ICLEI, and the developers of the tool, The Green House, take no liability for the accuracy nor satisfaction with results generated through the tool.

The table below summarises the sources that are included and excluded from the Proxy Data Tool. As per the GPC methodology, the following notation key is used in the table:

- IE: Included elsewhere
- NE: Not estimated
- NO: Not occurring
- C: Confidential

Table 8: Sources and scopes covered by the GPC and by default[8] in the Proxy Data Tool

Sectors and subsectors	Scope 1	Scope 2	Scope 3
Stationary energy			
Residential buildings			NE
Commercial and institutional buildings and facilities			NE
Manufacturing industries and construction		NO	NE
Energy industries		NO	NE
Energy generation supplied to the grid	NE		
Agriculture, forestry and fishing activities		NO	NE
Non-specified sources	NO	NO	NE
Fugitive emissions from mining, processing, storage and transportation of coal	NO		NE
Fugitive emissions from oil and natural gas systems	NO		NE

[8] Recognising once again that users have the option of overriding the defaults in the Proxy Data Tool if data is available.

Sectors and subsectors	Scope 1	Scope 2	Scope 3
Transportation			
On-road		NO	NE
Railways	NO	NO	NO
Waterborne navigation	NO	NO	NO
Aviation	NO	NO	NO
Off-road	IE	NO	NE
Waste			
Disposal of solid waste generated in the region			NO
Disposal of solid waste generated outside the region	NE		
Biological treatment of waste treated in the region			NO
Biological treatment of waste treated outside the region	NO		
Incineration and open burning of waste generated in the region			NO
Incineration and open burning of waste generated outside the region	NO		
Wastewater generated in the region			NO
Wastewater generated outside the region	NO		
Industrial Processes and Product Use (IPPU)			
Industrial processes	NE		NE
Product use	NE		NE
Agriculture, Forestry and Other Land Use (AFOLU)			
Livestock	NE		NE
Land	NE		NE
Aggregate sources and non-CO_2 emissions sources on land	NE		NE
Other Scope 3			
Other Scope 3			NE

Key: ■ BASIC, ■ BASIC+, ■ Sources included in Other Scope 3, ■ Sources required for territorial total but not for BASIC/BASIC+ reporting, ■ Not applicable emissions.

3.3.1 Note on the AFOLU sector

In line with GPC BASIC level reporting requirements, the GHG inventories developed using the Proxy Data Tool do not include agriculture, forestry and other land use (AFOLU) sector emissions. However, it is acknowledged that in certain regions AFOLU sector emissions may be significant and can dominate a region's overall GHG inventory. The inclusion of default values and/or proxy data to allow for the automatic calculation of AFOLU sector emissions is not possible due to the highly location-specific nature of AFOLU sector emission sources. It is noted that certain AFOLU subsectors (e.g. urea application) can be estimated by downscaling national data utilising agricultural GDP; however, this is not included in the Proxy Data Tool. It is advised that users wishing to include AFOLU sector emissions make use of the CIRIS tool spreadsheets included in the Proxy Data Tool ("V – AFOLU" sheet) to ensure reporting consistency and ease of use.

Again, it is noted that AFOLU sector emissions should not be included in BASIC level reporting and are not required for the CoM SSA framework. Furthermore, doing so requires the estimation of other emissions, including industrial processes and product use (IPPU) sector emissions and Scope 3 emissions from the stationary energy and transportation sectors. The inclusion of AFOLU sector emissions by themselves does not, therefore, correspond to a full GHG inventory.

4. Data availability, sources and quality

This section provides a detailed description of data availability, as well as the sources of all data, including both activity data and emission factors, used for the development of this BEI. Based on the data sources, the quality of the data is also assessed, using a high, medium or low rating system as shown in the table below. As per the GPC methodology, the factors used in assessment of data quality include:

- Geographical location of the activity;
- Time and/or age of the activity and any technologies used;
- Assessment boundary and emission source; and
- Whether the data has been obtained from reliable and verifiable sources.

Table 9: Data quality ratings

Data quality	Activity data	Emission factor
High (H)	Detailed/measured activity data	Specific emission factors
Medium (M)	Modelled activity data using robust assumptions	More general emission factors
Low (L)	High-level modelled or uncertain activity data	Default emission factors

4.1 Activity data

Activity data were sourced from publicly available sources. Where possible, country-specific data were sourced; however, where this was not possible, continental or subcontinental data were sourced (see Appendix A for details of the activity data used for each individual country). **Table 10** provides the complete list of data sources.

Table 10: Activity data sources and gaps

Sectors and subsectors	Activity data sources and gaps
General data	
Population: National and county population for 2019 (Kenya National Bureau of Statistics, 2019a) National and county households (Kenya National Bureau of Statistics, 2019a) ***GDP:*** National and county GDP per sector for 2017 (Kenya National Bureau of Statistics, 2019b) National GDP for 2019 (Kenya National Bureau of Statistics, 2020) ***Grid emissions factor:*** Electricity generation per type and import data (KNBS, 2020) Thermal electricity generation per plant (KenGen, 2018; Kenya Power, 2018) Thermal power plant efficiencies (DEA, 2020)	
Stationary energy	
Residential buildings	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) Household cooking and lighting statistics (Kenya National Bureau of Statistics, 2019a) ***Scope 2:*** National fuel and energy consumption by sector (KNBS, 2020) Household cooking and lighting statistics (Kenya National Bureau of Statistics, 2019a)

Sectors and subsectors	Activity data sources and gaps
Stationary energy	
Commercial and institutional buildings and facilities	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) ***Scope 2:*** National fuel and energy consumption by sector (KNBS, 2020)
Manufacturing industries and construction	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) ***Scope 2:*** National fuel and energy consumption by sector (KNBS, 2020)
Energy industries	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) Household cooking and lighting statistics (Kenya National Bureau of Statistics, 2019a)
Energy generation supplied to the grid	NE
Agriculture, forestry and fishing activities	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) ***Scope 2:*** National fuel and energy consumption by sector (KNBS, 2020)
Non-specified sources	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) ***Scope 2:*** National fuel and energy consumption by sector (KNBS, 2020)
Fugitive emissions from mining, processing, storage and transportation of coal	NO
Fugitive emissions from oil and natural gas systems	NO
Transportation	
On-road	***Scope 1:*** National fuel and energy consumption by sector (KNBS, 2020) Household motor vehicle, motorcycle and tuk-tuk ownership (Kenya National Bureau of Statistics, 2019a)
Railways	NO[9]
Waterborne navigation	NO
Aviation	NO due to the negligible nature of in-boundary flights
Off-road	IE

[9] Rail lines exist within Nakuru County; however, neither Kenya's Physical Energy Supply Table (KNBS, 2020) nor the African Energy Commission (AFREC, 2020) report electricity or coal consumption in the transport sector within Kenya. As such, it is taken that rail transportation does not occur within Nakuru County.

Sectors and subsectors	Activity data sources and gaps
Waste	
Disposal of solid waste generated in the region	***Scope 1:*** Per capita waste generation rate (Republic of Kenya, 2015) Waste characterisation (Nakuru County, 2019) Waste treatment methods (Kenya National Bureau of Statistics, 2019a)
Biological treatment of waste generated in the region	***Scope 1:*** Per capita waste generation rate (Republic of Kenya, 2015) Waste characterisation (Nakuru County, 2019) Waste treatment methods (Kenya National Bureau of Statistics, 2019a)
Incineration and open burning of waste generated in the region	***Scope 1:*** National medical waste generation rate (World Bank, 2018) Per capita waste generation rate (Republic of Kenya, 2015) Waste characterisation (Nakuru County, 2019) Waste treatment methods (Kenya National Bureau of Statistics, 2019a)
Wastewater generated in the region	***Scope 1:*** African per capita wastewater generation rate (IPCC, 2006) Subcontinental per capita protein consumption rate (IPCC, 2006) Wastewater treatment methods (Kenya National Bureau of Statistics, 2019a)

The sections below expand on the data sources listed in the table above and provide an explanation on how data were sourced and/or extrapolated. Along with this, the data quality rating is presented, as well as an explanation for the rating.

4.1.1 General data

Population

National and county population data, as well as household numbers, are available for 2019 (Kenya National Bureau of Statistics, 2019a).

Gross Domestic Product GDP

National and county GDP for 2017, disaggregated by sector, is known from gross county product data (Kenya National Bureau of Statistics, 2019b). Total national GDP for 2019 is also known from quarterly reporting (Kenya National Bureau of Statistics, 2020), from which national and county GDP by sector was calculated for 2019.

4.1.2 Stationary energy – Scope 1

National fuel and energy (petrol, diesel, LPG, kerosene, jet kerosene, residual fuel oil, coal, firewood and charcoal) consumption per sector is known for 2019 from Kenya National Bureau of Statistics data (KNBS, 2020). Fuel (diesel, kerosene and residual fuel oil) consumption for electricity generation appeared to be reported under both the electricity generation and manufacturing sectors (i.e. a portion of diesel used for electricity generation was reported under the electricity generation sector, while a portion was also reported in the manufacturing sector). This was deemed to be the case based on the calculated fuel consumption for electricity generation (see grid emission factor description in Section 4.2.2 below) and a comparison with African Energy Commission data for Kenya (AFREC, 2020). As such, national fuel consumption for the manufacturing sector was adjusted to exclude fuel used for electricity generation.

It may be noted that the Kenya National Bureau of Statistics data were used in preference to the Proxy Data Tool's default data, which are sourced from the African Energy Commission (AFREC). This is due to the direct Kenyan data being available for 2019, while there is a delay in data published by AFREC. As such, finalised fuel and energy consumption data for Kenya are only available for 2017 from AFREC, with the 2018 and 2019 data classed as provisional/estimated data.

Residential buildings

National fuel and energy consumption for the residential sector in 2019 are available from Kenya National Bureau of Statistics data (KNBS, 2020). The number of households in 2019 utilising petrol, diesel and kerosene for lighting, as well as LPG, kerosene, firewood and charcoal for cooking is known for Kenya and Nakuru County (Kenya National Bureau of Statistics, 2019a). Residential fuel and energy consumption for Nakuru County was based on the fraction of Kenyan households that utilise the respective fuels/energy sources which are located within Nakuru County. The data are regarded as relatively high quality due to the data matching the inventory year and being based on direct county statistics.

Commercial and institutional buildings and facilities

National fuel and energy consumption for the accommodation and food services, other commercial sectors, and public administration and defence sectors in 2019 are available from Kenya National Bureau of Statistics data (KNBS, 2020). Nakuru County fuel and energy consumption were downscaled from national consumption based on water supply, retail, accommodation and food, IT, financial, real estate, professional and technical services, public administration, education, and health contributions to GDP. The data are regarded as medium quality due to the data matching the inventory year but relying on sector-specific GDP for downscaling.

Manufacturing industries and construction

National fuel and energy consumption for the manufacturing, construction and mining and quarrying sectors in 2019 are available from Kenya National Bureau of Statistics data (KNBS, 2020). Nakuru County fuel and energy consumption were downscaled from national consumption based on mining, manufacturing and construction contributions to GDP. The data are regarded as medium quality due to the data matching the inventory year but relying on sector-specific GDP for downscaling.

Energy industries

Charcoal consumption in the various other stationary energy subsectors (residential buildings; commercial and institutional buildings and facilities; manufacturing industries and construction; and agriculture, forestry and fishing activities) was calculated as described in this section. It was assumed that total charcoal production is equal to consumption. The data was regarded as medium quality due to the data matching the inventory year but relying mostly on sector-specific GDP for downscaling.

Agriculture, forestry and fishing activities

National fuel and energy consumption for the agriculture sector in 2019 are available from Kenya National Bureau of Statistics data (KNBS, 2020). Nakuru County fuel and energy consumption were downscaled from national consumption based on agricultural GDP. The data are regarded as medium quality due to the data matching the inventory year but relying on sector-specific GDP for downscaling.

4.1.3 Stationary energy – Scope 2

National electricity consumption per sector is known for 2019 from Kenya National Bureau of Statistics data (KNBS, 2020).

Residential buildings

National electricity consumption for the residential sector in 2019 is available from Kenya National Bureau of Statistics data (KNBS, 2020).The number of households in 2019 utilising electricity for lighting is known for Kenya and Nakuru County (Kenya National Bureau of Statistics, 2019a). Residential electricity consumption for Nakuru County was based on the fraction of Kenyan households that utilise electricity for lighting which are located within Nakuru County. The data are regarded as high quality due to the data matching the inventory year and being based on direct county statistics.

Commercial and institutional buildings and facilities

National electricity consumption for the accommodation and food services, other commercial sectors, and public administration and defence sectors in 2019 are available from Kenya National Bureau of Statistics data (KNBS, 2020). Nakuru County's electricity consumption was downscaled from national consumption based on water supply, retail, accommodation and food, IT, financial, real estate, professional and technical services, public administration, education, and health contributions to GDP. The data are regarded as medium quality due to the data matching the inventory year but relying on sector-specific GDP for downscaling.

4.1.4 Transport

National fuel and energy consumption per sector are known for 2019 from Kenya National Bureau of Statistics data (KNBS, 2020).

On-road

National diesel, kerosene and petrol consumption for road transportation in 2019 are available from Kenya National Bureau of Statistics data (KNBS, 2020). The number of households in 2019 owning motor vehicles, motorcycles and tuk-tuks is known for Kenya and Nakuru County (Kenya National Bureau of Statistics, 2019a). On-road transportation petrol consumption for Nakuru County was based on the fraction of Kenyan households that own road vehicles which are located within Nakuru County. It is noted that this excludes any public transport vehicles that utilise petrol. On-road transportation diesel and kerosene consumption were downscaled from national consumption based on transportation GDP. The data are regarded as high quality due to the data matching the inventory year and being based on direct county statistics.

4.1.5 Waste

Solid waste disposal

Total solid waste generation in Nakuru County was calculated using Kenya's per capita waste generation rate (Republic of Kenya, 2015). The solid waste sent to the county's waste management sites, which are located within the inventory boundaries (Nakuru County, 2020), or openly dumped was calculated using Nakuru County's solid waste treatment statistics for 2019 (Kenya National Bureau of Statistics, 2019a). This calculation involved multiplying total waste generation tonnages by the percentage of waste sent to landfill or openly dumped. Due to a lack of further information, the county's waste management sites are taken to be unspecified landfill sites as per the IPCC classifications. Waste characterisation data are based on Nakuru County specific data (Nakuru County, 2019).

Due to a lack of historical data, the methane commitment method was utilised to calculate emissions, using the calculator included in the CIRIS tool. The data are regarded as medium quality, due to waste tonnages being calculated from per capita waste generation rates and county-specific waste treatment data, while the waste characterisation data are county data.

It is noted that the methane commitment method assigns landfill emissions based on waste disposal to a given year, regardless of when the emissions actually occur. As such the GPC notes that "For most cities, the MC method will consistently overstate GHG emissions by assuming that all degradable organic carbon (DOC) disposed in a given year will decay and produce methane immediately". Having said this, the approach is considered appropriate to use, particularly where insufficient historical waste data are available to use the more robust First Order Decay model.

Biological treatment of waste

Total solid waste generated in Nakuru County was calculated using Kenya's per capita waste generation rate (Republic of Kenya, 2015). The solid waste composted within the county was calculated using Nakuru County's solid waste treatment statistics for 2019 (Kenya National Bureau of Statistics, 2019a). Waste characterisation data are based on county-specific data (Nakuru County, 2019).

The data are regarded as medium quality, due to waste tonnages being calculated from per capita waste generation rates and county-specific waste treatment data, while the waste characterisation data are county data.

Incineration and open burning of waste

General solid waste generated in Nakuru County was calculated using Kenya's per capita waste generation rate (Republic of Kenya, 2015). The general solid waste openly burned within the county was calculated using Nakuru County's solid waste treatment statistics for 2019 (Kenya National Bureau of Statistics, 2019a). Waste characterisation data are based on Nakuru County specific data (Nakuru County, 2019).

Solid medical waste generated within Kenya is known from World Bank data (World Bank, 2018). Medical waste treated within Nakuru County was downscaled from national data using population. This waste is currently incinerated within the inventory boundaries (Nakuru County, 2020).

The data are regarded as medium quality, due to waste tonnages being calculated from per capita waste generation rates and county-specific waste treatment data, along with downscaled national medical waste and waste characterisation data.

Wastewater

Wastewater generation is calculated using the IPCC 2006 Guidelines default per capita wastewater biological oxygen demand (BOD) generation rate for Africa (IPCC, 2006). Wastewater treatment data, which include the split between wastewater treated using various means or left untreated, are known for Nakuru County in 2019 (Nakuru County, 2020).

Wastewater treatment plants used to treat wastewater collected by sewer networks are located within the inventory boundaries (Nakuru County, 2020). It was assumed that both VIP and covered pit latrines are equivalent to "dry climate, private latrines" as defined by the IPCC 2006 Guidelines, while cess pools, uncovered latrines and bucket latrines are equivalent to "dry climate, shared latrines".

Based on these data, wastewater methane emissions were calculated in accordance with the IPCC 2006 Guidelines, using the calculator included in the CIRIS tool. Similarly, nitrous oxide emissions were calculated using the calculator included in the CIRIS tool, based on Kenyan average per capita protein consumption. The data are considered medium quality, due to the estimations being based on county-specific sanitation data but a generic per capita BOD rate.

4.2 Emission factors

The Proxy Data Tool utilises emission factors from the IPCC 2006 Guidelines for National GHG Inventories (IPCC, 2006).

4.2.1 Scope 1

The Scope 1 fuel emission factors align with the IPCC 2006 Guidelines for National GHG Inventories and are reported in kilotonnes per TJ for each GHG. CO_2 equivalents (CO_2e) are calculated by summing the product of the CO_2, CH_4 and N_2O emission factors and their respective global warming potentials (GWPs). Unit conversions are calculated within the CIRIS calculator, using default conversion factors. The IPCC 2006 Guideline emission factors are considered high quality.

Solid waste emissions are calculated using the GPC methane commitment method to estimate total emissions from solid waste treated, biologically treated, incinerated or openly burned. Default values from the IPCC 2006 Guidelines are used based on the continent (Africa) and subregion (Eastern Africa. As a result, the emission factors for solid waste are classified as low quality.

Wastewater emissions are calculated using default values from the IPCC 2006 Guidelines, based on the methane emissions per tonne of BOD, as well as region (Africa) and country protein consumption proxy data (Kenya). As a result, the emission factors are classified as low quality due to being sourced from international references.

4.2.2 Scope 2

Grid emissions factor

The overall national grid emissions factor was calculated using the percentage of electricity consumption from in-country generation and electricity imports, along with the in-country electricity generation emissions factor and the applicable Power Pool grid emissions factor.

Total in-country generation and electricity imports from Uganda and Tanzania are known for 2019 (KNBS, 2020), while the electricity sales from each of Kenya's thermal power plants are known for 2017/2018 (KenGen, 2018; Kenya Power, 2018). Fuel consumption and the resultant emissions from Kenya's thermal power plants were calculated from the 2017/2018 split between fuel types (diesel, kerosene and residual fuel oil) used in the power plants and generating efficiencies (DEA, 2020). Based on this, the electricity emissions factor for electricity generated within Kenya was calculated and is presented in Section 5.2.2.

Electricity generation and fuel consumption for electricity generation is known for 2017 from the African Energy Commission for both Uganda and Tanzania (AFREC, 2020). The grid emission factors for Uganda and Tanzania were calculated based on these data.

Kenya's grid emission factor was calculated using the split between in-country generation and electricity imports, along with the electricity generation emission factors for Kenya, Uganda and Tanzania.

The grid emission factor for 2019 was calculated as 0.0842 kg CO_2e/kWh, with a biogenic grid emission factor of 0.0001 kg biogenic CO_2/kWh. The grid emission factor is classified as high quality, as it uses Kenya-specific data.

4.3 Global warming potentials

The Nakuru County GHG Inventory uses global warming potentials (GWPs) over a 100-year period from the IPCC Second Assessment Report (AR2) (IPCC, 2013), to align with the national inventory.

Table 11: Global warming potentials of major GHGs

Name	Formula	GWP (kg CO_2e/kg)
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310

(Source: IPCC, 2013)

4.4 Summary of data quality rating

The data quality ratings are summarised in **Table 12** below.

Table 12: Summary of data quality ratings

	Scope 1 data quality rating	Scope 2 data quality rating
Stationary energy		
Residential buildings	H	H
Commercial and institutional buildings and facilities	M	M
Manufacturing industries and construction	M	
Energy industries	M	
Agriculture, forestry and fishing activities	M	
Transportation		
On-road transportation	H	
Waste		
Solid waste	M	
Biological waste	M	
Incinerated and burned waste	M	
Wastewater	M	
Emission factors		
Fuel and energy	H	H
Waste and wastewater	L	

5. Results and discussion

Total GHG emissions for Nakuru County in 2019 were estimated at 1 642 867 tonnes of CO_2 equivalent (tCO_2e). This estimate includes emissions from the stationary energy, transportation and waste sectors. The table below provides a summary of total GHG emissions aggregated according to the scopes framework and city-induced framework (BASIC).

Table 13: GHG emissions summary (tCO_2e)

Sector		Total by scope			Total by city-induced reporting level
		Scope 1	Scope 2	Scope 3	BASIC
Stationary Energy	Energy use	669 273	34 587	NE	703 860
	Energy generation supplied to the grid	NE	–	–	
Transportation	All transportation	544 749	0	NE	544 749
Waste	Generated in the region	394 258	–	NO	394 258
	Generated outside the region	NE	–	–	
IPPU	All IPPU	NE	–	NE	
AFOLU	All AFOLU	NE	–	NE	
TOTAL		**1 608 280**	**34 587**	**NE**	**1 642 867**

For comparison, the national emissions in 2010[10], when considering only emissions from the energy (including transport) and waste sectors were 17 million tCO_2e, which equated to 0.4 tCO_2e/capita (Republic of Kenya, 2015). Nakuru County's 2019 GHG Inventory equates to 0.8 tCO_2e/capita. The global average is estimated at 4.8 tCO_2e per capita in 2018. For Kenya, the total GHG emissions in 2010, including agriculture, land use, forestry and industrial processes were just under 70 million tCO_2e (Republic of Kenya, 2015).

The total GHG emissions in Nakuru County for 2019 are equivalent to 37 000 cars travelling from Nakuru city centre to Nairobi city centre and back every day for a year.

5.1 Emissions by sector

The total GHG emissions for Nakuru County in 2019 (including emissions from stationary energy, transportation and waste) are estimated at 1.6 million tCO_2e. **The largest contributing sector was stationary energy, contributing 43% of emissions, followed by transportation (33%) and waste (24%),** as shown in **Figure 3**.

[10] The latest year for which a full national GHG inventory is available for Kenya.

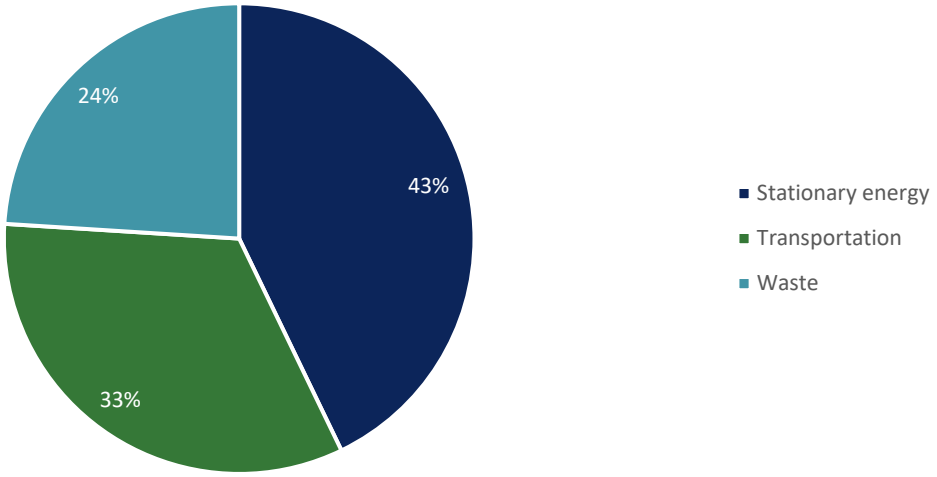


Figure 3: Sector contributions to Nakuru County's GHG emissions in 2019

5.1.1 Stationary energy

Stationary energy emissions account for 703 860 tCO_2e of Nakuru County's total GHG emissions in 2019. The breakdown of stationary energy emissions by subsector is shown in **Figure 4**, with the detailed emissions data provided in **Table 14** below.

As shown in **Figure 4**, residential buildings account for more than a third (37%) of total stationary energy emissions, followed by manufacturing industries and construction (30%) and energy industries (i.e. charcoal production) (23%). The remaining emissions are mostly accounted for by commercial and institutional buildings and facilities (8%) and energy use in agriculture, forestry and fishing activities (1%).

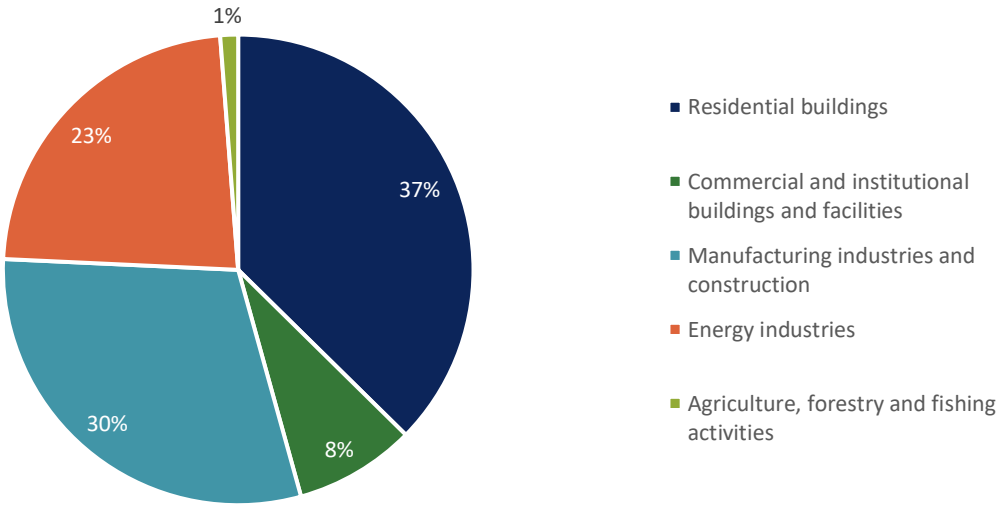


Figure 4: Subsector contribution to stationary energy emissions

Total stationary energy emissions are predominantly associated with fuel consumption (Scope 1 emissions) in residential buildings (35%) and manufacturing industries and construction (30%), as well as with the production of charcoal (23%). Electricity consumption emissions (Scope 2 emissions) only account for 5% of total stationary energy emissions, partly due to Kenya's low grid emissions factor, resulting from the use of renewable energy for electricity reduction. Reporting of Scope 3 emissions from stationary energy and territorial emissions from energy generation supplied to the grid[11] are not a requirement for BASIC level reporting and so are not estimated.

Table 14: Stationary energy subsector emissions

GPC ref No.	Sector/Subsector	Total GHGs (tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
I	**Stationary energy**	**165 458**	**106 231**	**NE**	**228 347**
I.1	Residential buildings	248 168	14 878	NE	263 045
I.2	Commercial and institutional buildings and facilities	38 861	19 710	NE	58 571
I.3	Manufacturing industries and construction	211 466	NO	NE	211 466
I.4.1/2/3	Energy industries	162 153	NO	NE	162 153
I.4.4	*Energy generation supplied to the grid*	*NE*			
I.5	Agriculture, forestry and fishing activities	8 625	NO	NE	8 625
I.6	Non-specified sources	NO	NO	NO	NO
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	NO			
I.8	Fugitive emissions from oil and natural gas systems	NO			

5.1.2 Transportation

The transportation sector was responsible for approximately 544 749 tCO_2e in 2019, all as a result of on-road transportation. As noted previously, disaggregating off-road transportation emissions from on-road transportation emissions is not possible due to a lack of data disaggregation and therefore off-road transportation emissions are included in the on-road transportation total. Detailed emissions data are provided in **Table 15** below.

In this sector, the fuel sales approach was used. Following this approach, all emissions from fuel sold within the inventory boundary are allocated to Scope 1 emissions. Since Scope 3 emissions from transportation are not a requirement for BASIC level reporting, this methodology is regarded as suitable for the Nakuru County GHG Inventory. Nakuru is a major transit county, and so the fuel sales approach – accounting for all fuel sold within Nakuru – is an appropriate approach to capture this transit activity.

Diesel and petrol account for 57% and 43% of these emissions respectively, while a very small amount of kerosene was also used in the transportation sector (**Figure 5**).

[11] Emissions from thermal power plants that supply electricity and/or steam to a centralised grid, with the resultant electricity and/or steam not solely used within the inventory boundary.

Under the GPC, emissions from aviation transportation only includes fuel use for aircraft both departing and arriving within the inventory boundary (i.e. in-boundary transportation). It is assumed that the fuel consumption associated with flights that both depart and arrive within the inventory boundary is negligible.

Table 15: Transportation subsector emissions

GPC ref No.	Sector/Subsector	Total GHGs (tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
II	**Transportation**	**544 749**			**544 749**
II.1	On-road transportation	544 749	NO	NE	544 749
II.2	Railways	NO	NO	NO	0
II.3	Waterborne navigation	NO	NO	NO	0
II.4	Aviation	NO	NO	NO	0
II.5	Off-road transportation	IE	NO	NE	0

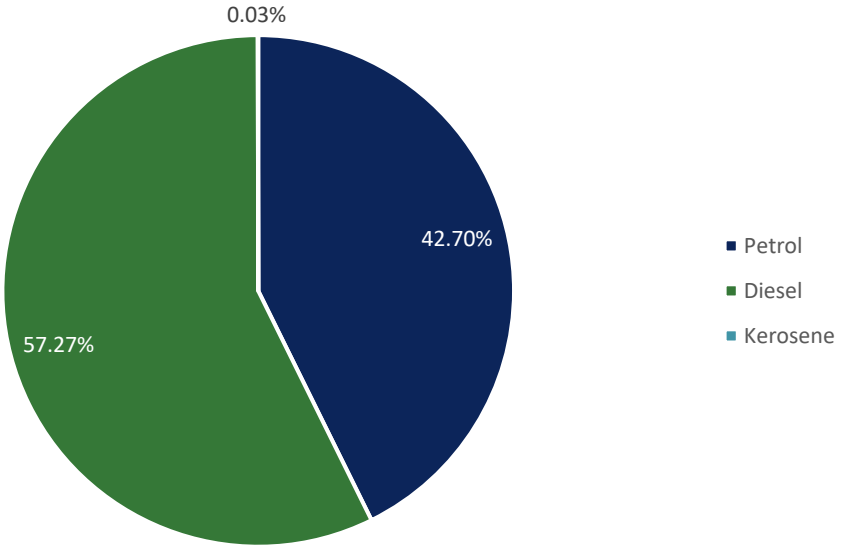


Figure 5: Emissions from the transportation sector in Nakuru County by fuel

5.1.3 Waste

The waste sector was responsible for emitting 394 258 tCO_2e in 2019, all of which arise from waste and wastewater treated in the region (Scope 1 emissions). The breakdown of waste sector emissions by subsector is shown in **Figure 6**, with the detailed emission data provided in **Table 16**. Landfilled and dumped solid waste accounts for the largest portion of waste emissions at 46%, while wastewater accounts for 27% of waste emissions. Incineration and burned waste accounts for a further 26% of the emissions. Biological treatment of waste accounts for 1% of emissions (**Figure 6**).

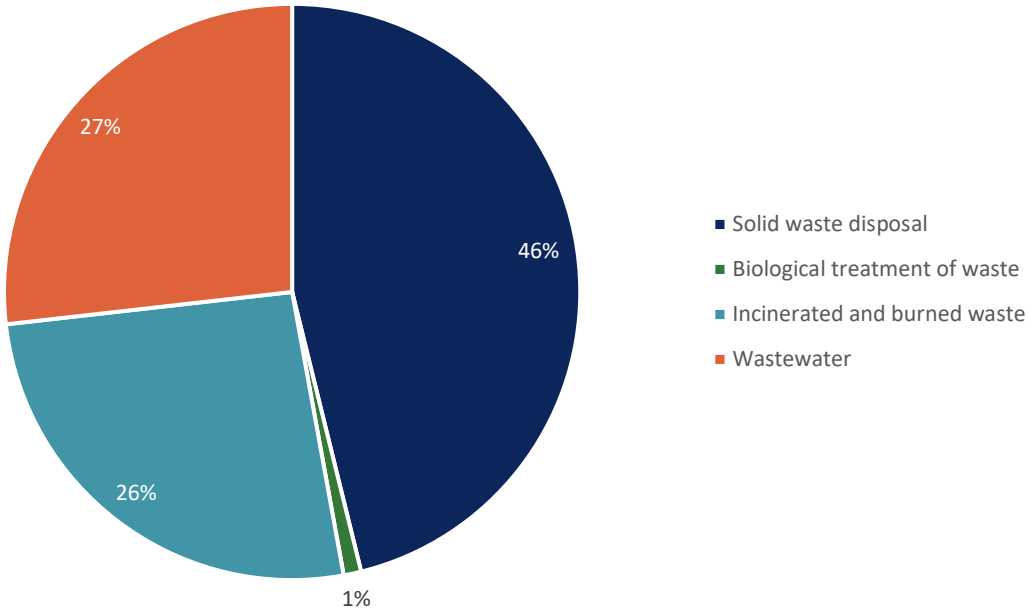


Figure 6: Subsector contribution to waste emissions

Solid waste generated within the county that is collected is landfilled at sites located within the county (Nakuru County, 2020; Republic of Kenya, 2015). Other solid waste generated within the county is dumped, burned and composted, all of which is assumed to occur near to households and is thus within the inventory boundary. Wastewater that is collected via sewer systems is treated in wastewater treatment plants located within the county (Nakuru County, 2020). Wastewater that is collected in septic tanks, latrines and biodigesters or left untreated is assumed to remain within households or communities and therefore all emissions from the waste sector occur within the inventory boundaries (Scope 1).

Table 16: Waste subsector emissions

GPC ref No.	Sector/Subsector	Total GHGs (tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
III	**Waste**	**394 258**	**–**	**NO**	**394 258**
III.1.1/2	Disposal of solid waste generated in the region	181 943		NO	181 943
III.2.1/2	Biological treatment of waste generated in the region	3 888		NO	3 888
III.3.1/2	Incinerated and burned waste generated in the region	102 790		NO	102 790
III.4.1/2	Wastewater generated in the region	105 637		NO	105 637

5.2 Emissions by scope

Under the scopes framework, Scope 1 emissions (direct emissions from the combustion of fuel and emissions from waste that occur within the inventory boundary) and Scope 2 emissions (indirect emissions from the generation of consumed electricity) are reported. Scope 3 emissions from stationary energy and transportation are not estimated due to a lack of data, while Scope 3 waste emissions do not occur. The emissions per scope are as follows:

Scope 1: 1 608 280 tCO_2e
Scope 2: 34 587 tCO_2e

Figure 7 shows the contribution of each subsector to Scope 1 and Scope 2 emissions. On-road transportation and residential buildings account for the largest share of Scope 1 emissions, at 34% and 16% respectively. This is followed by manufacturing industries and construction, solid waste disposal, and energy industries (charcoal manufacturing) which account for 13%, 11% and 10% of Scope 1 emissions respectively. Scope 2 emissions are due to commercial and institutional buildings and facilities and residential buildings, which account for 57% and 43% of Scope 2 emissions respectively.

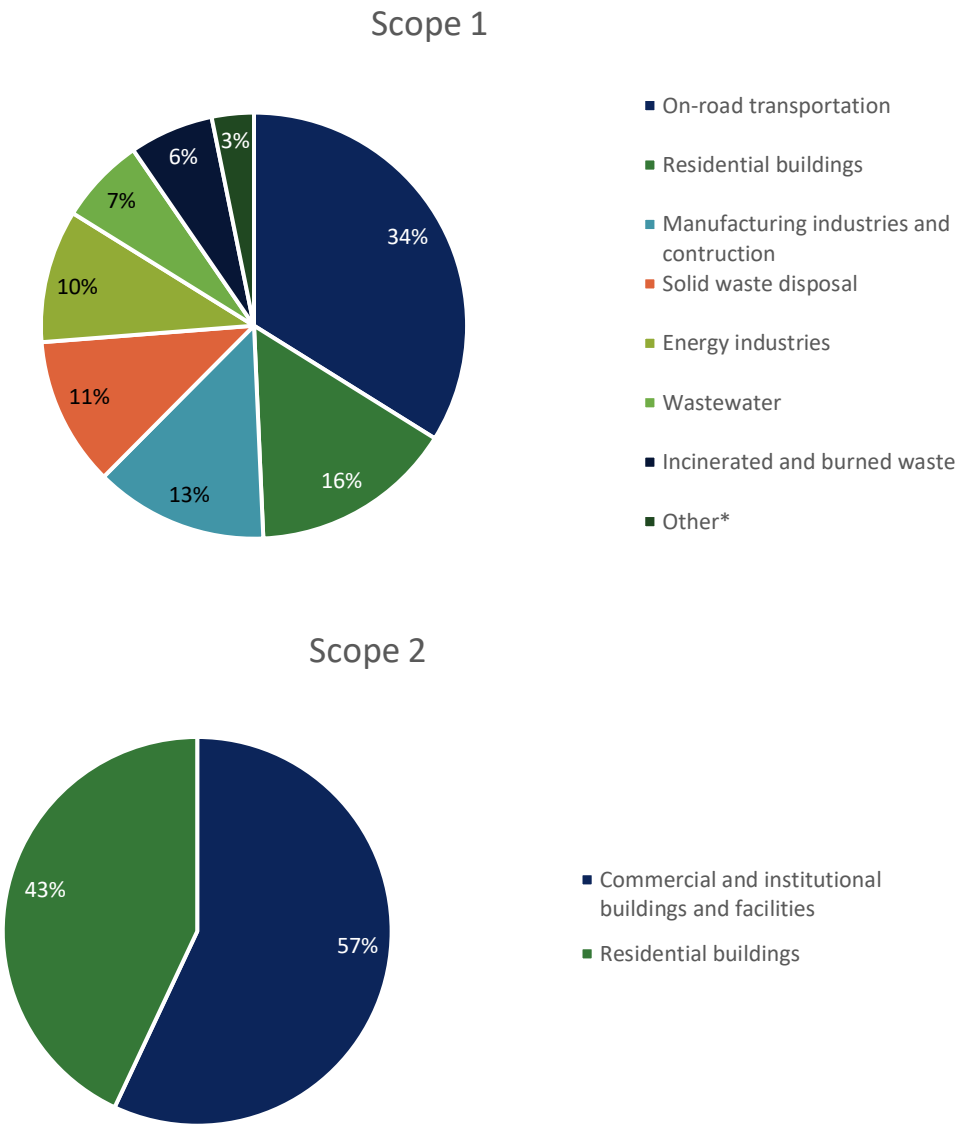


Figure 7: GHG emissions for Nakuru County by scope and by subsector

*Other includes manufacturing industries and construction; energy industries; agriculture, forestry and fishing activities; and non-specified sources.

5.3 Emissions by gas

Figure 8 and **Table 17** summarise the GHG emissions by gas expressed in CO_2 equivalents. Scope 2 emissions (i.e. emissions from electricity consumption) are only reported in CO_2e due to the grid emission factor being expressed as kg CO_2e/kWh and are therefore not disaggregated by gas. Similarly, emissions resulting from charcoal production are only reported in total CO_2e due to the emission factor being expressed as kg CO_2e/tonne. For Scope 1 emissions, carbon dioxide (CO_2) contributes 64% of total emissions, followed by methane (CH_4) at 30% and nitrous oxide (N_2O) at 6%. The high-level of methane and nitrous oxide emissions are attributed to firewood and charcoal consumption in residential buildings.

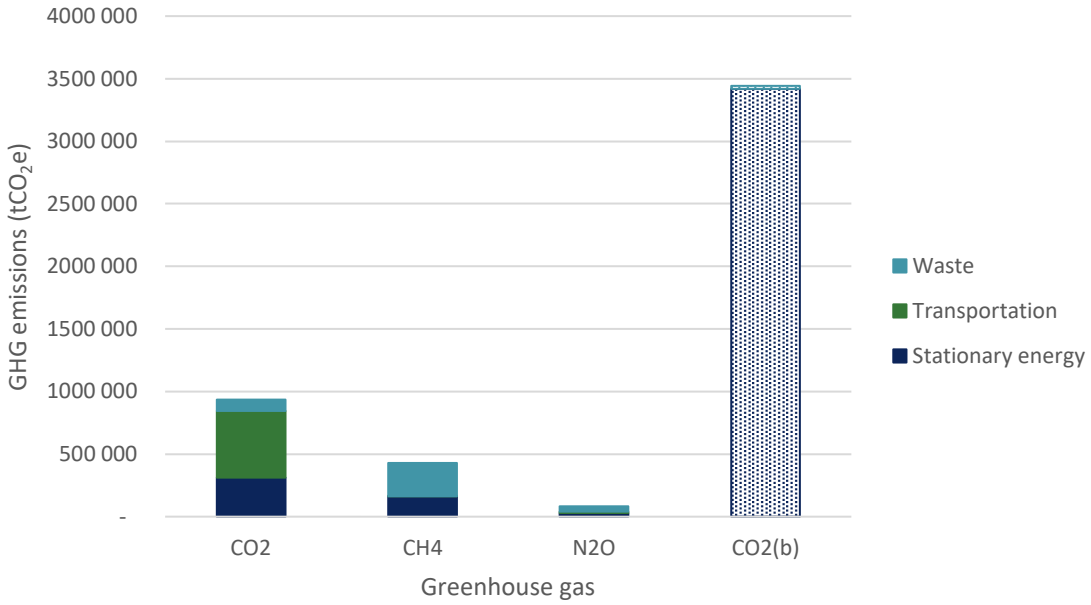


Figure 8: Emissions by sector for each greenhouse gas in Nakuru Country

Biogenic CO_2 emissions (shown as CO_2(b)) for each sector and subsector are shown in **Figure 8** and **Table 17**, respectively. However, CO_2(b) emissions are not included in the total GHG emissions reported from the inventory for Nakuru County. Biogenic CO_2 emissions are those emissions that result from biomass materials that naturally sequester CO_2, including fuels produced by living organisms or biological processes (for example through forestry or agriculture), but not fossilised or from fossil sources. This includes CO_2 emissions from the combustion of wood fuel and charcoal, as well as the combustion of biogenic materials during waste treatment. While CO_2 emitted from any source contributes to the greenhouse effect, following international protocols, these emissions are not included in the overall total for the GHG inventory. This is because they are considered to be offset by the growth of biomass, or accounted under land use and land use change (Greenhouse Gas Protocol, 2015). **It is estimated that 3 442 776 tCO_2(b) were emitted in Nakuru County in 2019 – double the total emissions included in the inventory. 99% of these emissions are linked to the combustion of charcoal and wood in the stationary energy sector, especially in residential buildings.** The remaining 1% of biogenic CO_2 emissions result from solid waste disposal. Reducing the use of unsustainable biomass fuels and thereby reducing biogenic CO_2 emissions can contribute positively to climate change mitigation.

Table 17: GHG emissions per gas[12]

GPC Ref. No.	Scope	GHG emissions source (by sector and subsector)	Notation key	Gases (tonnes) in CO_2e				Biogenic CO_2 ($tCO_2(b)$)
				CO_2	CH_4	N_2O	Total	
I.		**STATIONARY ENERGY**						
I.1		**Residential buildings**						
I.1.1	1	Emissions from fuel combustion within the region		56 540	162 440	29 187	248 168	3 089 619
I.1.2	2	Emissions from grid-supplied energy consumed within the region[13]		–	–	–	14 878	23
I.2		**Commercial and institutional buildings and facilities**						
I.2.1	1	Emissions from fuel combustion within the region		38 669	104	88	38 861	0
I.2.2	2	Emissions from grid-supplied energy consumed within the region[14]		–	–	–	19 710	30
I.3		**Manufacturing industries and construction**						
I.3.1.	1	Emissions from fuel combustion within the region		209 791	591	1 084	211 466	36 925
I.3.2	2	Emissions from grid-supplied energy consumed within the region	NO	–	–	–	–	–
I.4		**Energy industries**						
I.4.1	1	Emissions from fuel combustion within the region[15]		–	–	–	162 153	292 251
I.4.2	2	Emissions from grid-supplied energy consumed within the region	NO	–	–	–	–	–
I.5		**Agriculture, forestry and fishing operations**						
I.5.1	1	Emissions from fuel combustion within the region		8 579	24	21	8 625	0
I.5.2	2	Emissions from grid-supplied energy consumed within the region	NO	–	–	–	–	–
I.6		**Non-specified (NS) sources**	NO	–	–	–	–	–
I.7		**Fugitive emissions from mining, processing, storage, and transportation of coal**	NO	–	–	–	–	–
I.8		**Fugitive emissions from oil and natural gas systems**	NO	–	–	–	–	–
II.		**TRANSPORTATION**						
II.1		**On-road transportation**						
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the region		533 368	600	10 781	544 749	0
II.1.2	2	Emissions from grid-supplied energy consumed within the region for on-road transportation	NO	–	–	–	–	–

[12] The CIRIS tool rounds off data presented in the tables. As such, the totals may be more or less than when calculated manually.
[13] Disaggregation by gas not available
[14] Disaggregation by gas not available
[15] Disaggregation by gas not available

GPC Ref. No.	Scope	GHG emissions source (by sector and subsector)	Notation key	Gases (tonnes) in CO_2e				Biogenic CO_2 ($tCO_2(b)$)
				CO_2	CH_4	N_2O	Total	
II.		**TRANSPORTATION**						
II.2		**Railways**	**NO**	**–**	**–**	**–**	**–**	
II.3		**Waterborne navigation**	**NO**	**–**	**–**	**–**	**–**	
II.4		**Aviation**	**NO**	**–**	**–**	**–**	**–**	
II.5		**Off-road transportation**	**IE**	**–**	**–**	**–**	**–**	
III.		**WASTE**						
III.1		**Solid waste disposal**						
III.1.1	1	Emissions from solid waste generated within the region and disposed in landfills or open dumps within the region		0	181 943	0	181 943	23 928
III.1.2	3	Emissions from solid waste generated within the region and disposed in landfills or open dumps outside the region	NO	–	–	–	–	
III.2		**Biological treatment of waste**						
III.2.1	1	Emissions from solid waste generated within the region and treated biologically within the region		0	2 062	1 826	3 888	0
III.2.2	3	Emissions from solid waste generated within the region and treated biologically outside the region	NO	–	–	–	–	–
III.3		**Incineration and open burning**						
III.3.1	1	Emissions from solid waste generated within the region and incinerated or burned within the region		88 537	342	13 911	102 790	0
III.3.2	3	Emissions from solid waste generated within the region and incinerated or burned outside the region	NO	–	–	–	–	–
III.4		**Wastewater treatment and discharge**						
III.4.1	1	Emissions from wastewater generated and treated within the region		0	79 840	25 797	105 637	0
III.4.2	3	Emissions from wastewater generated within region and treated outside the region	NO	–	–	–	–	
IV.		**Industrial processes and product Use (IPPU)**	NE					
V.		**Agriculture, forestry, and other land Use (AFOLU)**	NE					
		TOTAL[16] (excluding territorial emissions)		**935 484**	**427 946**	**82 696**	**1 642 867**	**3 442 776**

[16] Note that the total emissions is not equal to the sum of emissions from these gases, because emissions are not disaggregated by gas for all sources. For this reason, emissions from grid-supplied electricity are included in the overall total but not in the totals for the three individual gases.

6. Conclusion and recommendations

The development of the Nakuru County BEI was done using the Proxy Data Tool developed for ICLEI Africa, which was built upon the City Inventory Reporting and Information System (CIRIS) GHG inventory tool for subnational governments. The BEI provides a baseline of GHG emissions in Nakuru County and identifies the largest emission sources. If produced consistently, it can be used to track how emissions evolve over time, and for the identification of future appropriate mitigation interventions and low emission targets for the region.

Nakuru County's BEI covers a continuous 12-month period from January to December 2019. Where possible, county-specific data were used to generate the inventory. Where specific data for the county were not available, national-level data were scaled down to the county level. The BEI includes emissions from three major sectors: stationary energy, transportation and waste.

The total GHG emissions for Nakuru County in 2019 was 1 642 867 tCO_2e. This is equivalent to 0.8 tCO_2e per capita, compared to the national emissions for Kenya in 2010 in the same sectors, which were estimated at 0.4 tCO_2e per capita. The stationary energy sector is the largest emitting sector, responsible for 703 860 tCO_2e, equivalent to 43% of total emissions. This is followed by the transport sector, which emitted 544 749 tCO_2e (33%), and the waste sector, which emitted 394 258 tCO_2e (24%).

Under the stationary energy sector, residential buildings account for more than a third (37%) of emissions, followed by manufacturing industries and construction (30%) and energy industries (i.e. charcoal production) (23%). The remaining emissions are mostly accounted for by commercial and institutional buildings and facilities (8%) and energy use in agriculture, forestry and fishing activities (1%).

Under the transportation sector, all emissions are as a result of on-road transportation. Petrol and diesel and petrol account for 43% and 57% of these emissions respectively, while a small amount of kerosene is also used in the transportation sector.

Under the waste sector, all emissions arise from waste and wastewater treated in the region. Landfilled and dumped solid waste accounts for the largest portion of waste emissions at 46%, while wastewater accounts for 27% of waste emissions. Incineration and burned waste accounts for a further 26% of the emissions.

The current Nakuru County GHG Inventory is limited by data availability and particularly data availability at a county level. In order to improve future inventories, it is recommended that the following data are collected:

- Stationary energy
  - Fuel consumption/sales for Nakuru County (i.e. not downscaled data)
  - Electricity consumption/sales for Nakuru County (i.e. not downscaled data)

- Transportation
  - Fuel consumption/sales for Nakuru County (i.e. not downscaled data)

- Waste
  - Waste tonnages received at waste management sites
  - Nakuru County specific per capita waste generation rates or an updated national per capita waste generation rate
  - Nakuru County specific waste characterisation or an updated national waste characterisation
  - Nakuru County specific per capita wastewater generation rates or a national per capita wastewater generation rate

Stakeholders in Nakuru County indicate that the following associations may be able to supply additional data for future inventories:

- County-specific fuel consumption: Ministry of Energy; Kenya Association of Manufacturing; and Kenya Oil and Gas Association
- County-specific biomass consumption: KENGEN; SNV (Africa Turnaround Limited, 2016)
- Industrial waste: National Environment Management Authority of Kenya (NEMA); Kenya Private Sector Alliance (KEPSA); Nakuru County Sanitation Department; and Kenya Association of Manufacturers (KAM)
- Medical waste: National Environment Management Authority of Kenya (NEMA); Nakuru County Sanitation Department; Nakuru Ministry of Health; and Kenya Ministry of Health
- Any sub-county primary data: Climate Change Kenya (Kinyanjui, 2019)
- Total emissions from deforestation and land degradation, extrapolated from 2015: NASA and African Centre for Technology Studies (ACTS) (ACTS, bilateral discussion, 2021)
- Transport and freight data: Changing Transport Kenya, GIZ Kenya

In addition, the next inventory should include data on Scope 3 emissions from the stationary energy and transportation sectors, as well as the IPPU and AFOLU sectors to ensure the inventory complies with the BASIC+ level reporting requirements. The importance of agriculture within Nakuru County – as well as the contribution of agriculture and land use to national emissions in Kenya - suggests that the AFOLU sector may be a significant source of emissions and therefore future inventories should attempt to include AFOLU sector emissions. In addition, the substantial emissions of biogenic carbon linked to the use of firewood and charcoal suggest that inclusion of emissions from the land sector will be important in future inventories. Stakeholders indicated that GIS technology may be employed for assessing the land use change for AFOLU in future inventories. Support should continue to assist sectors that are demonstrating advances in data and reporting, such as the energy sector. Nakuru County should also motivate for capacity and resource support to improve the local-level data and reporting for more difficult and overlooked sectors such as AFOLU.

Regular meetings should be held with the Nakuru County teams working on the reporting requirements as set out by the Climate Change Act (Republic of Kenya, 2016) to identify potential opportunities for data that can feed into the inventory. Alignment should be prioritised in data collection processes, and should be designed to serve both inventory collation and the completion of reporting format for counties to report on their Climate Change Act-related progress in rep-identified priority thematic areas.

Any subcounty data that can support the accuracy of activity data should be consulted for primary data results. For example, for AFOLU: *The Effects of Climate Variability on Maize Yield in Nakuru County, Kenya* by Koimbori Jackson Kinyanjui (2019). For household cooking, census data should also be referred to.

Any national-level inventory collation and/or data collection that depends on subnational data should involve the Nakuru representatives to ensure consistency as far as possible and develop closer alignment between national data processes and subnational data processes, towards integrated Monitoring, Reporting and Verification systems. This is key to ensure that Nakuru's SEACAP speaks to national climate change strategies. The alignment of the Nakuru County SEACAP with Nakuru's county-level contributions and obligations under the Climate Change Act and Nationally Determined Contribution can be strengthened in a number of ways:

- Incorporate new data as they become available on sectoral projects and programmes at the county level
- Ensure correlation between reporting and data collection processes at national and county levels
- Guide the stakeholder engagements which inform national targets and data collection exercises
- Use lessons from the Nakuru County inventory to guide the development of a subnational inventory framework for other counties

Finally, the capacity of Nakuru County officials should be raised to enable GHG inventory development for the county so that disaggregated county-level data may improve the action planning and implementation process, ensure harmonisation with national reporting and target-setting requirements, and translate the county's contribution to national mitigation ambition.

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