

**GOVERNMENT OF NAIROBI CITY COUNTY**



**THE NAIROBI CITY COUNTY ASSEMBLY**

**OFFICE OF THE CLERK**

**SECOND ASSEMBLY-FOURTH SESSION**

NBI CA. PLC. 2020 / (65)

24<sup>th</sup> November, 2020

**PAPER LAID**

Pursuant to Article 185(4) of the Constitution of Kenya, I beg to lay the following Paper on the Table of the Assembly, today Tuesday 24<sup>th</sup> November, 2020.

**THE SESSIONAL PAPER NO. 2 OF 2020 ON NAIROBI CITY COUNTY AIR QUALITY POLICY.**

**(The Leader of Majority Party)**

Copies to:  
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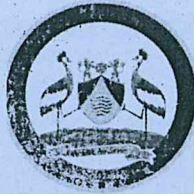
*Paper laid on 24/11/2020  
by Hon. James Mwangi  
& committed to the  
Committee on Environment  
& Natural Resources*  
*[Signature]*  
*24/11/2020*

*Approved*  
*[Signature]*  
*24/11/20*



# NAIROBI CITY COUNTY

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## ENVIRONMENT, WATER, ENERGY AND NATURAL RESOURCES

CO (E&NR)/1/33/399

18<sup>th</sup> November, 2020



The Ag. Clerk,  
Nairobi City County Assembly,  
P.O. Box 45844-00100,  
Nairobi.

### RE: SUBMISSION OF NAIROBI CITY COUNTY AIR QUALITY POLICY DOCUMENT

Reference is made to the above subject.

Forwarded herewith, please find the **Nairobi City County Air Quality Policy Document** which has been prepared by Environment and Natural Resources Sector for your further necessary action.

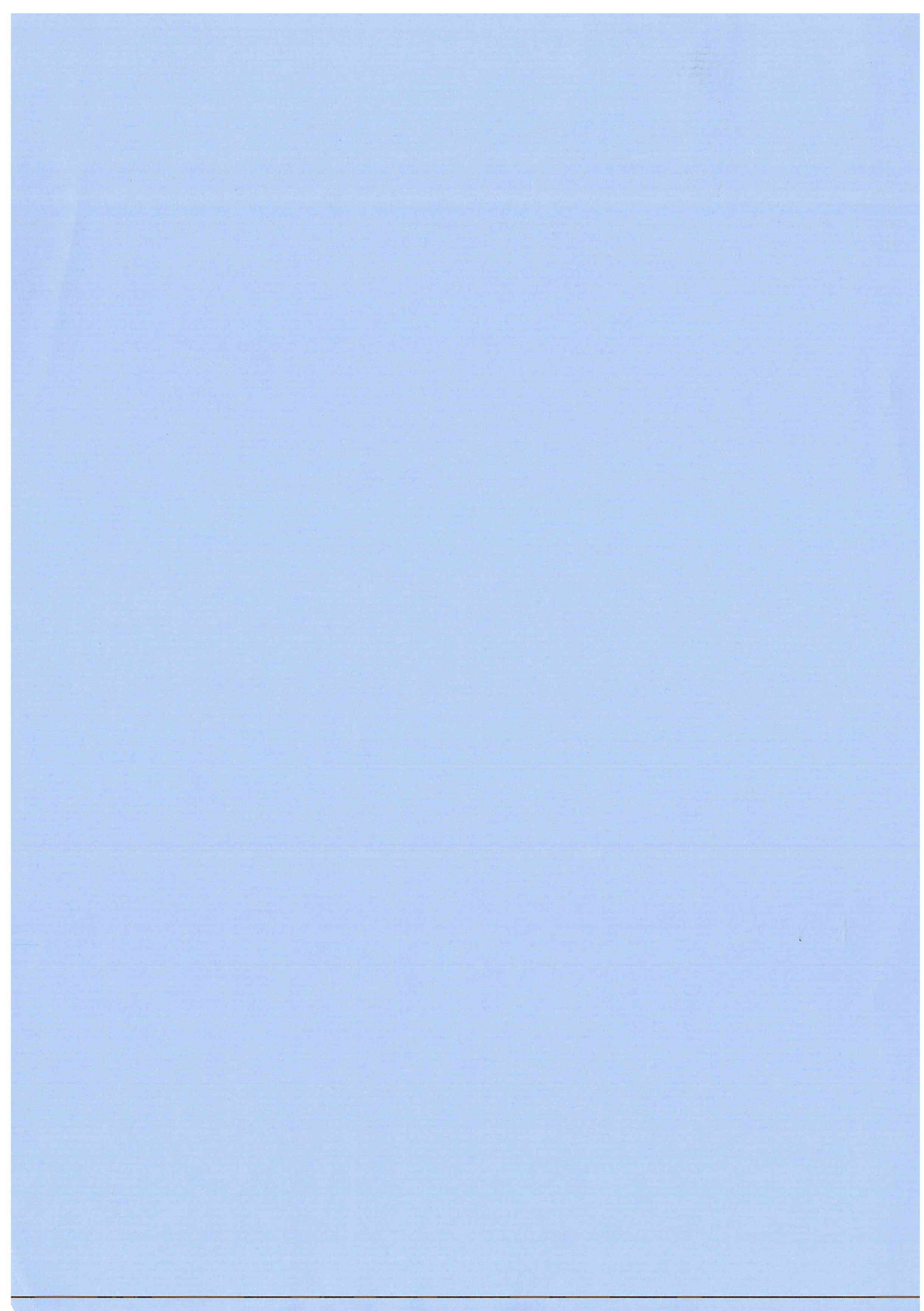
  
MOHAMMED ABDI

FOR: COUNTY EXECUTIVE COMMITTEE MEMBER-  
ENVIRONMENT, WATER, ENERGY & NATURAL RESOURCES

*II. Kindly prepare  
Papers laid for its  
Subsequent Committee  
Same to the Environment  
Committee  
22/11/2020*

*7 DLS LAD  
PCACI-Deal  
Kindly deal  
Ag. Clerk  
23/11/2020*









# **NAIROBI CITY COUNTY AIR QUALITY POLICY**

**NOVEMBER 2020**

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## ABBREVIATIONS AND ACRONYMS

<b>AQM</b>	Air Quality Management
<b>BAT</b>	Best Available Technologies
<b>CIDP</b>	County Integrated Development Plan
<b>ELC</b>	Environment and Land Court
<b>EMCA</b>	Environmental Management and Coordination Act, 1999
<b>GHG</b>	Green House Gas
<b>GDP</b>	Gross Domestic Product
<b>KNBS</b>	Kenya National Bureau of Statistics
<b>NCCAP</b>	National Climate Change Action Plan
<b>NCCRS</b>	National Climate Change Response Strategy
<b>NCD</b>	Non-Communicable Disease
<b>NEMA</b>	National Environment Management Authority
<b>NGO</b>	Non-Governmental Organization
<b>NIUPLAN</b>	Nairobi County Integrated Urban Management Development Plan
<b>PM</b>	Particulate Matter
<b>WHO</b>	World Health Organization



## TERMINOLOGIES

<b>Adulterated Fuel</b>	means contaminated fuel whose quality has been weakened by willfully adding contaminants to it.
<b>Air Pollution</b>	means a mixture of harmful particles and gases released into the air that causes harm to human health, environment and contributes to climate change.
<b>Air Quality Management</b>	means all the activities undertaken by a regulatory body to help protect the environment and human health from the adverse effects of air pollution.
<b>Climate adaptation</b>	means adjustments in ecological, social, or economic systems to climate change related effects or impacts by changes in processes, practices and structures to mitigate against potential damages or to benefit from opportunities associated with climate change.
<b>Emission</b>	means releasing harmful contaminants into the air.
<b>Green Bond</b>	means a fixed-income instrument established to raise money for climate and environmental projects.
<b>Green Building</b>	means a building whose construction, design or operation reduces negative effects on the environment.
<b>Hydroponic Farming</b>	means a method of growing crops in a soilless medium. The roots of the plant are grown in a nutrient rich solution instead.
<b>Incinerator</b>	means an apparatus for burning waste material at very high temperatures.
<b>Mainstreaming</b>	means in the context of climate change the incorporation of climate change considerations into development programs, policies or management strategies.
<b>PM</b>	<p>This stands for particulate matter, a mixture of solid particles and liquid droplets found in the air. They include</p> <ul style="list-style-type: none"> <li>• PM<sub>10</sub>: inhalable particles, with diameters that are generally 10 micrometers and smaller; and</li> <li>• PM<sub>2.5</sub>: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.</li> </ul>
<b>Sustainable Development</b>	means development that meets the needs of present generations without compromising the ability of future generations to meet their own needs.



## FORWARD

### EXECUTIVE SUMMARY

Nairobi City County is home to Kenya's capital, Nairobi, one of the fastest growing cities in Africa with a population of over 4.4 million people. Nairobi City County is one of the 47 counties and borders Kiambu County to the North and West, Kajiado to the South and Machakos to the East and has a total of 17 constituencies. Nairobi has experienced rapid development in the last 20 years. This growth trend has resulted in deterioration of the city's air quality posing a threat to the environment and the health and wellbeing of Nairobi City County residents, visitors and its neighbors. Although air quality measurement conducted in Nairobi City County are few and most are short-term and thus not comparable to WHO guidelines for ambient air quality, they clearly point to the need to address the serious impacts of air pollution. Air pollution has been linked to numerous illnesses including asthma, strokes, heart disease and dementia. The upsurge in children respiratory illnesses in parts of Nairobi City County is also attributed to increasing levels of air pollution. Some of the worst pollution levels, have been shown to be in economically disadvantaged communities where exposure to water, soil, noise and air pollution are a daily reality. Exposure to fine particulate matter in Kenya contributes to over 18,000 premature deaths annually from both indoor and outdoor sources and was estimated to cost USD 2,244 million per year. Nairobi makes large contribution to the national GDP generating over 60% of Kenya's GDP. Thus, although the social-economic impacts of air pollution to Nairobi City County have not yet been estimated, the County Government is cognizant that the biggest health and financial burden of air pollution in Kenya is borne by Nairobi. For this reason, taking steps to permanently address and resolve air pollution brought about by human activities is important.

The development of the Nairobi City County Air Quality Policy forms part of the strategy development to reduce the growing challenge of air pollution through support of enabling factors and identifying priority key sectors. The priority sectors identified are: transport, waste management, industry, housing, energy, road construction and agriculture. The Air Quality Policy has been developed together with an Air Quality Action Plan. The Action Plan outlines various interventions that the Nairobi City County Government will undertake in the first action-planning period (2021-2025) in order to tackle the growing problem of air pollution in the County. The development of this Policy is one of the key actions outlined



under objective 3 of the Action Plan, that is, develop effective approaches for air quality management in Nairobi City County. The Policy establishes the foundation for future development of legislative and regulatory options for Air Quality Management in Nairobi City County as envisaged by the Action Plan.

This Policy is organized into 9 Chapters starting with the Introduction under Chapter 1. Chapter 2 contains the Goals, Objectives and Guiding Principles of the policy while Chapter 3 provides a comprehensive Legal and Regulatory Framework for air quality in Kenya. Chapter 4 details the Emission Reduction Measures in Transport, Waste Management, Housing, Agriculture, Energy sector and Industrial sector. Chapters 6,7,8 and 9 deal with Research and Technology, Education and Public Awareness, the Implementation Framework and Resource Mobilization respectively.

## CHAPTER 1 INTRODUCTION

### 1.1. Background

Air pollution is a growing threat with adverse effects on human health, climate change and crop yield [1]. Globally, over 3 million premature deaths per year can be attributed to fine particulate matter (PM<sub>2.5</sub>) pollution. Exposure to fine particulate matter (PM<sub>2.5</sub>) is especially deleterious to human health [2], responsible for respiratory and cardiovascular diseases as well as premature births and deaths. Furthermore, it is estimated that approximately 10 million annual asthma emergency room visits globally may be attributable to Ozone (O<sub>3</sub>), Nitrogen Dioxide (NO<sub>2</sub>) and PM<sub>2.5</sub>. In Kenya, over 18,000 premature deaths occur annually from both indoor and outdoor sources, estimated to cost the country USD 2,244 million per year [3].

According to the Kenya National Bureau of Statistics (KNBS) Economic Survey, 2020, respiratory system diseases was the leading cause of morbidity at 39.3 per cent of all disease incidences reported at public health facilities in Kenya in 2020. Being the capital city of Kenya, Nairobi has the highest number of those affected by such incidences due to its population. The other effects of air pollution include; cardiovascular diseases, ischemic heart disease, asthma, stroke, chronic obstructive pulmonary disease, lung cancer, acute lower respiratory infections in children. The number of diseases of the respiratory system reported increased by 63% over a four-year period from 12.2 million in 2012 to 19.9 million in 2016 according to the World Health Organization Database. Greenhouse gas (GHG) emissions, short-lived climate pollutants (SLCPs) and air pollutants such as black carbon (BC) also influence both global and regional climate [4].

Nairobi City County is one of the fastest growing cities in Africa. The growth however has also seen an increase in unsustainable activities which increase emissions of fine polluting particles and gases such as in open waste burning, increased motorization, domestic use of biomass and kerosene, back-up diesel generators, unpaved road and construction dust, unregulated industries, and poor solid waste management. In addition, most of the urban poor in Nairobi City County live in informal settlements with poor sanitary conditions, near roadways, with poor access to clean energy and with congested housing with poor ventilation. Therefore, they are worst affected by air pollution. Thus, in the absence of interventions, the impact of air pollution on health, environment and the economy in Nairobi City County is disproportionate and has an added element of increasing inequality.

Targeted interventions that inform urban development, encourage greener policy actions to mitigate the effects of air pollution on human health and environment are needed for Nairobi City County. This should align with the existing policy framework, the County Integrated Development Plan (CIDP) [5] and the Nairobi County Integrated Urban Management Development Plan (NIUPLAN) [6].

The Air Quality Policy seeks to address the problem of air pollution in Nairobi City County by providing guidance for implementation strategies to minimize air pollution. The absence of a policy and legislative framework to target reduction of air pollution in Nairobi threatens the livelihoods, health, wellbeing and social economic status of its residents and environs. Thus, this Policy seeks to fill the gap created by lack of an adequate policy and legal framework to address air pollution at county level, and at the same time domesticate, align and contextualize the frameworks that already exist at national level.

## **CHAPTER 2 GOALS, OBJECTIVES AND GUIDING PRINCIPLES**

### **2.1. Goals**

The goal of this Policy is to ensure the protection of the right to a clean and healthy environment for residents of Nairobi City County and its environs through the promotion of measures for clean air by all stakeholders. Domestication of rights of people of Nairobi through the institutions such as the Nairobi Metropolitan Service whose aim is to work for the county.

### **2.2. Objectives**

The objectives of this Policy are to:

- (1) Provide a framework for an integrated approach in all sectors and institutions to air quality management in Nairobi City County;
- (2) Strengthen the legal and institutional framework for effective coordination and management of air quality in Nairobi City County;
- (3) Promote education, communication and public awareness on air quality by all stakeholders;
- (4) Promote participation of key stakeholders, including the civil society, the Nairobi Metropolitan Service, private sector and industry, and local communities, in air quality management in Nairobi City County;
- (5) Promote and enhance research and use of science and technology in policy decisions for clean air and environmental management in Nairobi City County;



- (6) Provide the policy framework to facilitate the development and effective implementation of a scientifically informed and periodically updated County Air Quality Action Plans;
- (7) Support capacity building as needed for all stakeholders in air quality management; and
- (8) Ensure that air pollution is avoided and where it cannot be avoided minimized to the least harmful quantities.

### 2.3. Guiding Principles

The governance and management of quality air in Nairobi City County Government will be informed by the mandatory national values and principles of governance set out in Article 10 of the Constitution, together with principles stipulated in Articles 43, 60, 69 and 232 of the Constitution. More specifically, the following provisions apply:

- (1) **Environmental Right:** Under the 2010 Constitution, every person in Kenya has a right to a clean and healthy environment and a duty to safeguard and enhance the environment. Air quality regulation seeks to safeguard the right to a clean and healthy environment.
- (2) **Public Participation:** A participatory and consultative approach to air quality management and environmental protection will be enhanced to ensure that all actors, including County government departments, private sector and industry, civil society and city residents are involved in planning, implementation and decision-making processes as per the existing laws.
- (3) **Precautionary Principle:** Where there are credible threats of serious or irreversible damage to key environmental resources, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- (4) **Polluter Pays Principle (Extended Producer Responsibility):** The polluter and users of environmental and natural resources shall bear the full environmental and social costs of their activities.
- (5) **Good Governance and transparency:** Rule of law, effective institutions, transparency and accountability, respect for human rights and the meaningful participation of citizens will be integrated in air quality management and environmental protection.
- (6) **Mainstreaming climate change:** Section 19 of the Climate Change Act, 2016 requires county governments to mainstream climate change actions and the National

Climate Change Action Plan across various sectors. Air quality management should be integrated in County Integrated Development Plans as a priority.

- (7) **Human Rights:** The right to a clean and healthy environment in Article 42 of the Constitution is a fundamental right that should be protected at all levels of government.
- (8) **Intergenerational Equity:** The Constitution of Kenya 2010 embodies the principle of Intergenerational Equity in Article 42 by requiring that the environment be protected for the benefit of present and future generations. The same is also provided in the Environmental Management and Coordination Act of 1999.
- (9) **Consultation and Cooperation between governments:** Air quality regulation cuts across both levels of government and in accordance with Article 189 of the Constitution, governments at each level are required to cooperate in the performance of functions mandated by the Constitution.

## CHAPTER 3 LEGAL AND REGULATORY FRAMEWORK

### 3.1. THE CONSTITUTION OF KENYA

- a. The Constitution has addressed the issue of air pollution through provisions on environmental management and sustainability. Its promulgation in 2010 marked an important chapter in Environmental Policy legislation as it contains elaborate provisions on environmental management. The **Preamble** recognizes the environment as a heritage which should be respected and sustained for the benefit of future generations. **Article 10** of the Constitution highlights Sustainable Development as one of the principles of governance. Governments, including county governments should strive to ensure sustainability in every project they undertake to address issues affecting citizens and air pollution is one such issue.
- b. Kenya is party to international treaties and protocols relating to protection of the environment and control of air pollution which by virtue of **Articles 2 (5) and 2 (6)** of the Constitution, form part of the laws of Kenya.
- c. The Constitution, **Article 42** guarantees the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures.
- d. The Bill of rights in the Constitution provides for enjoyment of economic and social rights under **Article 43 (a-f)** which include the right to the highest attainable standard of health and to reasonable standards of sanitation. In the provision of these basic rights, the issue of inequalities in distribution of wealth and resources should be addressed.
- e. The Constitution, **Article 21** places an obligation on the State to take legislative, policy and other measures including setting of standards, in order to achieve progressive realization of these fundamental rights provided for in Article 43. Counties should ensure the implementation of these basic rights.
- f. The Constitution has championed the protection of the environment through provision for environmental and natural resources principles in **Article 69** which impose a duty on the state to maintain a tree cover of at least 10% and eliminate processes and activities that are likely to endanger the environment. Every citizen has a duty to cooperate with state



organs and other persons to ensure that natural resources are used in an ecologically sustainable manner.

- g. The Constitution recognizes the distribution of functions and powers between the national and county governments under **Chapter 11**.
- h. The County Assemblies are empowered under **Article 185** to make any laws that are necessary for the effective performance of the functions and exercise of the powers of the county government under the Fourth Schedule, control of air pollution being one of them. The Assemblies may also receive and approve policies and plans that relate to the exploitation of the county's resources.
- i. In relation to air quality, **Part 2** of the **Fourth Schedule** provides that county governments shall be responsible for the Control of air pollution, noise pollution, other public nuisances and outdoor advertising and county transport including county roads, street lighting, traffic and packing and public roads.

### 3.2. CURRENT POLICY AND LEGISLATION

Air quality standards in Kenya are guided by the following legislation both at the national and county level;

- (a) **The Environmental Management and Coordination Act, 1999** which has the following provisions in relation to air quality:
  - Section 29 establishes the county environment committees that are responsible for proper management of the environment within the county. This mandate extends to the proper management of air quality standards within the respective counties.
  - The Cabinet Secretary has powers pursuant to section 78 of the Act in accordance with recommendations from the National Environment Management Authority (NEMA) to establish criteria and procedures for the measurement of air quality, set air quality standards, and take other measures to control air pollution such as issuance of guidelines to minimize emissions of GHG and the application of suitable technology.
  - Section 79 of the Act further empowers the Cabinet Secretary to gazette controlled areas and prescribe the air emission standards in respect of such areas.

- Section 147A empowers the county to legislate on matters permitted under the Constitution which air quality is part of.
  - Section 101 provides for standards of noise and recommends to NEMA minimum standards for emission of noise and vibration pollution into the environment as are necessary to preserve and maintain public health and the environment.
  - Section 102 establishes an offence for emission of excess noise as per the emission standards.
- (b) **The Forest Conservation and Management Act, 2016** provides that county governments are to establish and maintain arboreta and green zones for utility by persons residing within their jurisdiction. In order to improve air quality, the Act requires all county governments to cause housing developers to establish green zones covering at least 5% of the total land area developed.
- (c) **The County Governments Act, 2012** sets out functions of the county governments which include the responsibility to legislate in accordance with Article 185 of the Constitution, exercise executive functions in accordance with Article 183 and perform its functions as provided for in the Fourth Schedule of the Constitution.
- (d) **The Climate Change Act, 2016** under Section 19 requires county governments in performance of their functions to integrate and mainstream climate change actions and duties set out in the act and in the NCCAP into various sectors.
- (e) **The Intergovernmental Relations Act, 2012** under Section 3 provides for a framework for consultation and cooperation between national and county governments and amongst county governments in all matters of governance including management of environmental resources.
- (f) **The Public Finance Management Act, 2012** requires the counties to adhere to the principles of public finance set out in Chapter 12 of the Constitution and the national values set out in Article 10 of the Constitution. The implementation of this policy must adhere to such provisions.
- (g) **The National Environment Policy 2012** recognizes that human life is dependent on a clean and healthy environment and that air pollution is a leading cause of morbidity. The



policy also emphasizes the need for community involvement in the implementation of measures to reduce air pollution.

- (h) **The Kenya Climate Change Policy** requires the county government to integrate climate change policy strategies and actions into county planning and management strategies. The policy also domesticated the National Climate Change Response Strategy (NCCRS) which seeks to integrate information regarding climate into Government policies.
- (i) **The National Land Use Policy** recognizes poor air quality as a key challenge facing the optimal and sustainable use of land in Kenya.
- (j) **Kenya National Adaptation Plan 2015-2030** requires County Governments to integrate and mainstream climate change actions, duties and interventions into County Integrated Development Plans (CIDPs) and appoint a County Executive Committee member responsible for coordination of climate change affairs, Air pollution being one of them.
- (k) **The Kenya Vision 2030** with regards to the environment seeks to have a clean and sustainable environment by 2030 with improved pollution and waste management, improved capacity to adapt to global climate change and the harmonization of environmental laws for better environmental governance and planning.
- (l) **The Environmental Management and Coordination (Air Quality) Regulations, 2014** provide for the prevention, control and abatement of air pollution in order to ensure a clean and healthy environment. The Regulations also prohibit certain forms of air pollution while giving guidelines on pollution levels that are permissible. The Regulations further set out controlled areas where pollution is prohibited. The Regulations apply to:
  - All internal combustion engines
  - All premises, places, processes, operations or works
  - Any other appliances or activities the cabinet secretary may by order gazette
 The Regulations also define the controlled areas and list other sources of interest such as emission from demolition, waste incinerators, open burning and cross-border pollution.
- (m) **The Nairobi City County Solid Waste Management Act, 2015** imposes a duty on every person within the county to safeguard the environment because everyone is entitled to a clean and healthy environment.



- (n) **The Nairobi City County Integrated Urban Management Plan (NIUPLAN)** identifies citywide air quality program as one of the priority programs under the environment management sector.
- (o) **The Green Economy Strategy and Implementation Plan 2016-2030** guides both the national and county government to adopt development pathways with higher green growth and a clean environment.
- (p) **The Kenya Building Research Centre Strategy** that advocates for green building standards and practices including the GreenMark Standard for Green Buildings. This provides guidelines for assessing the extent to which the development of new and existing buildings address climate change and degradation of the environment. The Standard also seeks to abate Green House Gas emissions.
- (q) **Nairobi City County Government Urban Agriculture Bill, 2014** encourages environmental sustainability in Nairobi City County by defining environmental standards for urban agriculture in order to protect public health, food safety and the environment.
- (r) **Nairobi City County Transport Bill, 2019** in Part VIII proposes that the County Executive Member may designate any area of the county to be a low emission zone.
- (s) **The Nairobi Non-motorized Transport Bill** that seeks to ensure that non-motorized facilities and areas are not encroached by the motorized modes of transport and other street users.
- (t) **The Nairobi City County Urban Agriculture Promotion and Regulation Bill, 2014** that seeks to promote urban agriculture, provide necessary regulatory framework for the practice of agriculture and establishment of the Nairobi City County Urban Agriculture Promotion Advisory Board.
- (u) **The National Climate Change Action Plan 2018-2022** Guides the climate actions undertaken by both levels of government in order to facilitate transition to a low-carbon climate resilient development pathway. It also provides a framework for mainstreaming climate change into sector functions at both levels of government in order to deliver Kenya's Nationally Determined Contributions.

### 3.3. INSTITUTIONAL ARRANGEMENTS

#### 1. Ministry of Environment and Forestry

It is created by Executive Order No. 1 of 2018 and it is mandated to undertake protection and conservation of national environment including pollution control. It is also committed to facilitate the enabling policies and legal and regulatory reforms for promoting environmental sustainability and mitigating the effects of climate change. The Climate Change Directorate under the Ministry is mandated to support counties in delivery of climate change interventions and implementation of the National Climate Change Action Plan 2018-2022.

#### 2. The National Environment Management Authority

It is established by the Environmental Management and Co-ordination Act, 1999 (EMCA) as the principal institution for the implementation of all policies relating to environment. Section 9(i) of EMCA mandates the Authority to exercise general supervision and coordination over all matters relating to the environment and to be the principal instrument of the Government of Kenya in the implementation of all policies relating to the environment.

#### 3. The Nairobi Metropolitan Service

An interim arrangement established by the office of the President.

#### 4. Kenya Meteorological Department

The mandate of the Department includes measuring the air quality and in particular the organization and administration of surface and upper air meteorological observations within its area of responsibility.

#### 5. The Kenya Bureau of Standards

The Bureau is involved in development of standards and quality control for goods and services, metrology, conformity assessment, training and certification services.

#### 6. The National Environment Tribunal

The Tribunal is established under Section 125 (1) of EMCA with a mandate to review administrative decisions made by NEMA relating to issuance, revocation or denial of licenses and the conditions of issuance of these licenses.

**7. The National Climate Change Council**

The Council is established by the Climate Change Act, 2016 to perform among other functions, ensure mainstreaming of climate change functions by the national and county governments and oversee the implementation on the National Climate Change Action Plan (NCCAP). The Council also ensures that climate change functions are mainstreamed into National and County budgets, plans and programs. A critical role of the Council is to set targets for the regulation of greenhouse gas emissions.

**8. The Environment and Land Court (ELC)**

The ELC is established by Section 4 the Environment and Land Court Act, 2011 and has jurisdiction to hear and determine all disputes in accordance with Article 162(2) (b) of the Constitution or any other law applicable in Kenya relating to environment and land. Section 13 (3) further grants the ELC jurisdiction to hear applications relating to infringement of, or threat to, rights or fundamental freedom relating to a clean and healthy environment under Articles 42, 69 and 70 of the Constitution.

**9. County Environment Committees**

Section 29 of the Environmental Management and Coordination Act (EMCA) empowers county Governors to constitute County Environment Committees with the responsibility for the proper management of the environment within the county and the development of county strategic environmental action plan every five years.

**10. Sectoral Committee on Environment and Natural Resources**

This Committee is established pursuant to the Third Schedule to the Nairobi County Assembly Standing Orders and is mandated to implement specific national government policies on natural resources and environmental conservation, including air pollution control.



## CHAPTER 4 EMISSION REDUCTION MEASURES

The County Government will put in place measures and interventions to promote clean air and reduce emissions of different pollutants as per the existing national and county laws, and in particular the Environmental Management and Coordination Act, 1999 (EMCA) that provides the framework for the overall management of the environment in Kenya, including the compliance and monitoring of air quality across all sectors such as transport, energy, and waste management, among others. The proposed measures will follow the Environmental Management and Coordination (Air Quality Regulations) 2014 that include provisions to reduce impacts of air pollution, guidelines to reduce greenhouse gas (GHG) emissions, and recommendations of appropriate air pollution control technologies that apply to all internal combustion engines, premises, places, processes and operations from which emissions may occur.

Priority actions to target the following sectors, conscious of the *informality* of the major sectors that are key sources of both stationary and mobile pollutants in Nairobi City. The Climate Change Act 2016, Section 19 requires the county governments to integrate and mainstream climate change actions and the National Climate Change Action Plan (NCCAP) in all sectors. The NCCAP 2018-2022 seeks to ensure that Kenya achieves her Nationally Determined Contributions to the Paris Agreement, reduction of GHG emission being one of them. NCCAP therefore distributes the emission targets across different sectors in order to achieve the mitigation targets set.

### 4.1. TRANSPORT SECTOR

1. Rapid motorization in Kenya coupled with poorly maintained and unpaved roads has made transport a significant and increasing source of outdoor air pollution. Nairobi accounts for over 60% of vehicles in Kenya with motorcycles surpassing the number of private cars.
2. Most vehicles are old, poorly maintained and often overloaded which increases tail-pipe emissions resulting in increased air pollution. Traffic-related emissions account for approximately 39% of fine particulate matter emission. The transport sector in the city is the highest emitting sector accounting for 45% of greenhouse gas emissions in Nairobi. Another cause of air pollution is the use of poor quality or adulterated fuel due to lack of regulation or implementation of vehicle and fuel standards.

3. Diesel and unleaded petrol emissions produced by vehicles contain hydrocarbons, carbon monoxide and carbon dioxide which are leading causes of lung cancer and other respiratory conditions.
4. As a result of this the Nairobi City County Transport Bill, 2019 part VIII proposes that the County Executive Member may designate any area of the county to be a low emission zone. Petroleum or diesel-powered vehicles will therefore be prevented from accessing these zones. Failure to which such persons driving the vehicle will be liable to a penalty of fifty thousand shillings, an imprisonment not exceeding a year or to both.

### **Policy Statements**

The County Government will:

- a) Update pre-existing air quality standards and strengthen enforcement capacity;
- b) Enforce regulations that promote non-motorized, non-polluting and efficient infrastructure for mass transport system;
- c) Enforce regulations that promote non-polluting modes of transport and clean mobility, carpooling;
- d) Invest in development of infrastructure that support alternative means of transport;
- e) Develop and expand road networks to include cycling paths and safe walking paths;
- f) Enhance monitoring and enforcement of compliance with sets fuel quality standards for petrol, diesel fuels, and any biofuels used in road vehicles as well as for gas oil used in non-road-mobile machinery;
- g) Develop incentives and disincentives for use of fuel-efficient vehicles; and
- h) Expand private sector partnerships to speed up investments and technology in public transport.

## **4.2. WASTE MANAGEMENT SECTOR**

1. Nairobi City County is experiencing economic growth, increased population and rapid urbanization making urban waste management a major challenge. For instance, more than 70 percent of Nairobi's population lives in unplanned settlements and this makes waste collection in such areas difficult.
2. This leads residents to practice uncontrolled burning of waste, especially plastics which are a major contributor of particulate matter emission. Alternatively, they resort to dumping

of household garbage along rivers or roads. Open drains carrying human waste potentially contribute to high ammonia levels. To compound this problem, there are a few sanitation facilities in Nairobi especially in the informal settlements. Many residents of Nairobi are therefore forced to find alternative ways to properly dispose of their waste.

3. There are opportunities to use sustainable practices that could turn the organic household waste collected into energy which will reduce burning and dumping and consequently minimize air pollution.
4. Medical waste management in most hospitals does not meet the World Health Organization standards on medical waste management. Most incinerators are not up to the required standard and this potentially contributes to air pollution through toxic emissions.

### **Policy Statements**

The County Government will:

- a. Update pre-existing air quality standards and strengthen enforcement capacity;
- b. Prohibit open burning of waste and invest in infrastructure to control and reduce emissions;
- c. Organize and carry out campaigns to raise awareness on the risks related to poor waste management and the resulting effects;
- d. Advancerethinking, reduction, re-use, recycling and recovery of waste;
- e. Invest in infrastructure suitable for effective waste management;
- f. Encourage public-private-partnership in waste management;
- g. Undertakepublic awareness and education campaigns in waste management techniques;
- h. Facilitate training in proper waste management practices and disposal systems (Reuse,Reduce,Recycle); and
- i. Develop a policy framework for medical waste management in compliance with international emission standards.

### **4.3. HOUSING SECTOR**

1. The housing sector is a major contributor of both indoor and outdoor air pollution. Airborne particles of dust from construction sites and unpaved roadscause severe health



impacts including asthma and heart disease. These emissions are experienced throughout the building process from construction to demolition.

2. The process of creating concrete, results in the production of silica dust which poses a health risk to human beings. The process of excavation and transportation results into air pollution as well. There is need for dust production during construction to be properly managed and contained.
3. Furthermore, during construction, diesel emissions can be produced as a result of using machines such as cranes and bulldozers which are heavily used in the construction of buildings. These emissions produce hydrocarbons, carbon monoxide and carbon dioxide which affects human health.
4. Air pollution can also occur during the demolition of buildings. Most materials used in the construction of buildings are released into the atmosphere when such buildings are demolished as various types of dusts that gravely affect the health of people in that area.
5. In order to accelerate sustainable development, an integrated Urban Master Plan has been prepared to guide infrastructural developments such as transport network, sewerage and energy reticulation.

### **Policy statements**

The County Government will:

- a. Implement energy efficiency in buildings by raising building standards with an aim to reduce operational emissions;
- b. Ensure indoor air quality standards for workplaces, schools and hospitals are upheld as per the national occupational, health and safety standards.
- c. Invest in clean energy for use in cooking, cleaning and lighting and support renewable energy networks in construction;
- d. Develop incentives for safe and sustainable methods of construction;
- e. Invest in local sourcing, reusing or recycling of building materials in order to minimize pollution that results from construction processes;
- f. Partner with the private sector to support sustainable financial initiatives for green buildings;
- g. Monitor outdoor air quality and publicly publish the data in order to raise awareness on the effects; and

- h. Monitor indoor air quality and publicly share data in high occupancy areas for example informal settlements such as Mukuru kwa Njenga, Kibera, Juja, Dandora among others.

#### 4.4. AGRICULTURAL SECTOR

1. Crop production and value addition is one component of urban Agriculture in Nairobi that addresses food and nutrition insecurity in addition to supplementing household incomes.
2. Most of the crop production is to a large extent small-scale, market oriented and subsistence farming where farmers have small portions of land.
3. Horticulture farming takes lead in crop production in the County. The main vegetables grown include tomatoes, kales, spinach, cabbage, local vegetables, onions, capsicum and carrots. Fruits grown include passion fruits, mangoes, bananas and avocado.
4. Several varieties of herbs and spices are also grown. The main food crops grown are maize, beans and potatoes on small-scale basis especially in peri-urban Sub counties of Dagoretti South, Langata, Westlands, Kasarani and Roysambu.
5. Emissions from nitrogen rich fertilizers, pesticides, herbicides and animal waste such as ammonia ( $\text{NH}_3$ ) combine with the air to form particulate matter which causes air pollution. These emissions then combine with other emissions arising from industries and the transport sector to form solid particles that lead to respiratory diseases and deaths of residents of Nairobi County. The use of pesticides and fungicides that contain Hex chlorobenzene (HCB) also causes formation of particulate matter.

#### Policy statements

The County Government will:

- a. Ensure burning of agricultural residue and waste is limited by educating people on alternative waste management practices;
- b. Prohibit free surface spreading of liquid manure and encourage shallow injection instead;
- c. Encourage improved housing design for cattle to reduce ammonia emissions;
- d. Encourage the use of low emission mineral fertilizers;

- e. Train farmers on safe and best available agricultural practices that require minimal reliance on pesticides and herbicides;
- f. Conduct campaigns on the harmful effects of emissions from agricultural practices and their alternatives; and
- g. Encourage the adoption of smart agricultural practices such as the use of high quality seeds and planting materials that focus on adaptation mechanisms while simultaneously lowering GHG emissions.

#### 4.5. ENERGY SECTOR

1. Use of fossil fuels such as coal, diesel and petrol to generate power is a source of air pollutants such as nitrogen oxides, sulphur oxides, particulate matter, carbon monoxide and heavy metals.
2. Use of biomass and paraffin in most households in Nairobi City County produces high levels of both indoor and outdoor pollutants. These fuels are used in both heating and lighting as most families cannot afford clean fuels such as solar and liquid petroleum gas.
3. Approximately 70% of Kenyans rely on biomass fuel (wood and charcoal) energy for cooking as of 2018 mainly because of the non-affordability of cleaner fuel alternatives such as liquid petroleum gas and electricity. Burning of these biomass fuels and kerosene is a major source of indoor and outdoor air pollution especially in most households including the informal settlements where residents and street vendors cook outside due to lack of space and poorly ventilated house structures.
4. Communication, awareness raising and advocacy on the benefits of using clean energy for cooking and lighting will help the population transition from using harmful biomass fuels and kerosene. The county government should collaborate with the private sector to come up with solutions that ensure affordability of clean energy.

#### Policy Statements

The County Government will:

- a. Update pre-existing air quality standards and strengthen enforcement capacity;
- b. Promote the use of alternative and best available technologies including improved cooking stoves that are non-polluting;



- c. Collaborate with the private sector to provide incentives and flexible payment plans for clean energy such as solar panels and gas;
- d. Promote the use of alternative sources of energy that are less polluting like solar energy;
- e. Create awareness on the all-round affordability of clean energy alternatives;
- f. Enact a policy that promotes the construction of energy efficient buildings with less reliance on artificial lighting through improvement of building insulation and lighting systems; and
- g. Collaborate with the private sector to facilitate transition towards a more sustainable and low carbon energy model.

#### 4.6. INDUSTRIAL SECTOR

1. The industrial sector in Nairobi County is largely comprised of small to medium enterprises and a thriving informal and unregulated sector, known as Juakali.
2. The small to medium enterprises are dominated by food-processing industries such as grain milling, beer production, and sugarcane crushing, and the fabrication of consumer goods, e.g. vehicles body building.
3. A large proportion of this sector is unregulated, but this offers opportunities to work associations such as Kenya Association of Manufacturers to identify quick wins and long-term strategy that leads to cleaner production.
4. Due to the inadequate legislation in this sector, heavy metals emanating from leather and electroplating industries are found in rivers in the city. Such pollutants pose a danger to the residents living alongside rivers such as the Nairobi River as the water gets polluted. This polluted water is usually used to irrigate crops which when harvested and consumed exposes consumers to a myriad of diseases.

#### Policy statements

The County Government will:

- a. Develop and promote economic incentives for investment in more efficient, clean and environment-friendly production technologies;
- b. Promote corporate and social responsibility and accountability;

- c. Ensure compliance for all industrial sectors with at source emission and ambient air quality limits. Through the use of capacity tools such as monitoring station in Mukuru, Kimathi Avenue;
- d. Plan the County effectively by positioning industries away from residential areas to limit the effects of toxic emissions on human health;
- e. Enforce industrial emission limit values based on the Best Available Techniques (BAT); and
- f. Train the relevant actors in proper industrial waste management including treatment of waste before disposal to minimize air pollution.

#### **4.7. CROSS CUTTING SECTORS**

- 1. The risks posed by air pollution are systemic and interlinked, with major effects on human health, education, finance, urban planning and the general environment.
- 2. Air pollution is one of the physical determinants of health. Residents of the County are more likely to develop severe health problems from exposure to outdoor and indoor air pollution. This in turn puts a strain on the health budgets of households and the County health infrastructure that has to support the increased disease incidents.
- 3. In the education sector, physical learning environments have to be free from air pollution. County budgetary allocations have to accommodate provisions for upgrading learning infrastructure to limit exposure to air pollution.

#### **Policy statements**

The County Government will:

- a. Mainstream air pollution into the County fiscal policies to support implementation measures for air quality standards.
- b. Ensure coordination across all its departments to ensure the integration of information and harmonizing responses to air pollution, data sharing and consultation on mutual issues.





## CHAPTER 5 GOVERNANCE AND REGULATIONS

1. The Nairobi City County Government will put in place governance mechanisms and regulations to promote cleaner air in Nairobi City and will do so in close collaboration with the National Government and counties within the Nairobi Metropolitan Region.
2. In line with Article 10 of the Constitution which identifies public participation as a binding national value during the implementation of any public policy or decision, or in the making or implementation of any law, the County Government recognizes the importance of developing strong partnerships with the different stakeholders, including residents, local communities, private sector and industry, NGOs and the wider public to ensure effective action for realizing clean air and improved health of Nairobi residents.

### Policy statements

The County Government will:

- a. Develop an Air Quality Legislation for the County;
- b. Put in place an appropriate institutional coordination mechanism within the County Government structure to enhance inter-sectoral coordination of air pollution mitigation measures across all sectors;
- c. Put in place an appropriate institutional coordination mechanism within the County Government structure to enhance coordination with other counties;
- d. Mainstream air quality into county planning processes, including the County Integrated Development Plans (CIDP), and the short to medium term budget making process;
- e. Regularly review and amend relevant sectoral laws and policies in order to integrate air pollution control measures and actions in respective sectors;
- f. Develop a framework and invest in tools for air quality monitoring;
- g. Put in place mechanisms for public consultation and participation in air quality management;
- h. Promote and support residents' associations, community groups and consumer organizations to create public awareness on the challenge of air pollution;
- i. Partner with the Nairobi Air Quality Unit to enhance institutional governance and assist in the coordination of issues relating to air pollution;

- j. To develop tools that capture real time evidence, credible and reliable evidence to avoid corruption.

## CHAPTER 6 RESEARCH AND TECHNOLOGY

1. Innovation of new technologies through support of science and technology strive to provide at affordable cost emission controls to reduce exposure to and levels of air pollution concentration.
2. Poor air quality is detrimental to human health and environmental sustainability and for this reason the Nairobi County Government should invest in measures to address air quality management in close collaboration with research institutions and private organizations.
3. Policy decisions in this case directly influence emission levels and the Government should encourage and support the use of new technology that seeks to minimize or mitigate the effects of harmful emission.
4. Research and technology may provide sustainable solutions to the air pollution challenges faced by the county. Air quality monitoring networks using emerging technologies have provided innovative, efficient and effective ways of measuring the levels of particulate matter, sulphur dioxide, nitrogen dioxide and carbon monoxide in the air. These measurements have been used to establish whether the city's air quality meets the WHO guidelines. A review of the results show that the pollution levels surpass the WHO guideline limits by a factor of 5 to 10.

### Policy statements

The County Government will partner with the research institutions and private sector to:

- a. Identify research and technology needs for effective air quality management, including technology development and diffusion;
- b. Enhance the capacity of the public and private sectors, civil society and research institutions to develop and utilize technological innovations for Air Quality Management;
- c. Identify and implement incentives for the private sector and institutions of higher learning to undertake Research and Development to support Air Quality Management measures;
- d. Promote the development of improved emission-tracking mechanisms in order to ascertain the risk and measure progress of pollution control strategies;



- e. Develop air purification mechanisms in industries and develop modern incinerators fitted with gas-cleaning equipment;
- f. Promote the use of open source and best available technologies including satellite imagery to identify pollution hotspots and guide decision making;
- g. Promote public awareness by disseminating near to real time air quality information through live streaming in public areas including on billboards and mobile phone platformsand;
- h. Partner with research institutions and the private sector to establish a data management center led by the County which will promote public awareness through the dissemination of information.

## CHAPTER 7 EDUCATION AND PUBLIC AWARENESS

1. Air quality communication involves understanding the status of air quality, the emission sources and impact on environment and human health. It is dependent on other components of air quality management. This information can be used to raise awareness of air pollution issues and foster voluntary behavioral change among key stakeholders.
2. In Nairobi County, there is a low level of awareness among various stakeholders [19]. The County Government of Nairobi should emphasize community ownership of air quality issues in order for its citizens to understand the effects.
3. When ownership arises from the community itself it creates a sense of individual responsibility for the air quality in Nairobi and this generally impacts on overall pollution levels. It will also make it easier to accept policies coming from the government as the community already understands the effects of air pollution.

### Policy statements

The County Government will:

- a. In partnership with the private and public sector and research institutions, develop and maintain a publicly accessible air quality management database;
- b. Put in place a strategy for identifying, refining and disseminating air quality information and data to the public and other stakeholders in user-friendly formats;

- c. Ensure information on air quality is accessible to all citizens by having it in popular versions, translated into Kiswahili and also coded in a manner accessible to the visually and hearing impaired persons.
- d. Collaborate with private sector and civil society in disseminating air pollution information and knowledge through advocacy and public awareness raising programs;
- e. Promote campaigns for clean air, including car free days, regular tree planting and promotion of green and open spaces in urban areas including the restoration and revitalization of degraded areas;
- f. Partner with educational institutions within the County to promote green initiatives such as organizing tree planting campaigns in schools to educate children on the importance of tree planting as carbon sinks and their role in ensuring clean air and mitigating the effects of air pollution;

## CHAPTER 8 IMPLEMENTATION FRAMEWORK

1. Implementation of Air Quality Policy priorities and other actions will require significant planning, including detailing the full cost to determine budgetary and other economic implications. This Policy will be implemented through specifically developed and fully costed Air Quality Action Plans commencing with the Nairobi City County Action Plan 2021 - 2025 and continuing through new and amended action plans developed in at least five-year intervals. In addition, the Policy will be implemented through enactment of a Nairobi City County Air Quality Bill and a Nairobi City County Air Quality Regulations.
2. To facilitate air quality management mainstreaming and realization of the overall policy objectives, the current and future Air Quality Action Plans will be fully aligned with and integrated into the regular Nairobi City County Integrated Development Plan.
3. Implementation of this policy should emphasize the results through the process laid out. The success of this policy requires cooperation and capacity building to strengthen implementation. Public awareness is important to bring residents on board and instill individual responsibility in air quality management.

### Policy statements

The County Government will:

- a. Enact a Nairobi City County Air Quality Bill to provide for a comprehensive legal framework for air quality;
- b. Enact a Nairobi City County Air Quality Regulations to operationalize the Nairobi City County Air Quality Bill and related national frameworks on air pollution;
- c. Prepare and implement comprehensive, fully costed and periodically reviewed Air Quality Action Plans under the framework of this Policy;
- d. Ensure that climate related interventions in the Air Quality Action Plan (2019-2023) and the CIDP are aligned with the Air Quality Policy to facilitate its implementation;
- e. Enact policies and programmes to tackle climate change through the reduction of carbon dioxide emissions and effective management of County resources;
- f. Undertake programs to raise awareness on climate change and air pollution and promote behavioral change;



- g. Adopt measures to move towards more sustainable energy sources through decarbonising the County's energy supply, reducing the energy consumption and supporting measures for moving towards zero emission transport;
- h. Facilitate continuous consultations and public awareness across all sectors, interest groups and the public;
- i. Develop emission inventories that show what pollutants are emitted into the air, the peak period and their sources as well as their dispersion;
- j. Establish sampling stations across the city that take regular measurements of emissions, to constitute the air quality monitoring network with a capacity for real to near real time data flow; and
- k. Build capacity by working with experts across scientific and policy implementation fields.

## CHAPTER 9 RESOURCE MOBILIZATION

1. A clean air quality action plan is necessary for Nairobi air quality management because it will enable the government as well as wider stakeholders to mobilize resources in the most effective and efficient manner to achieve air quality objectives.
2. The National Climate Change Action Plan (NCCAP) establishes the County Climate Fund which is designed to finance adaptation in local climate change issues.

### Policy statements

The County Government will:

- a. Allocate resources for air quality management actions in the county budgetary processes;
- b. Build capacity to mobilize and enhance absorption of resources for air quality management interventions;
- c. Mobilize finances to fund implementation of this Policy and the associated Air Quality Action Plans from internal and external sources; and
- d. Promote the use of green investments by establishing funds such as a Green Bond through a private public partnership arrangement to facilitate funding of air quality management processes across the County.
- e. Ensure the policy maximizes the opportunities of the climate finance fund/policy (Climate Fund Policy 2017) to fund the implementation of this policy.

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## CHAPTER 11 ANNEXES

### 11.1. Institutions and participants in the drafting of Nairobi County Air Quality Policy document

<u>Institution</u>	<u>Nominated Representative</u>
1. Nairobi City County Government (NCCG)	<p><b>NCCG-Environment</b></p> <p>Mrs. Margaret Kariuki</p> <p>Mr. Lawrence Mwangi</p> <p>Ms. Maryvine Nyanchoka</p> <p><b>NCCG-Health</b></p> <p>Mr. Sammy Simuyu</p> <p><b>NCCG-Transport and Infrastructure</b></p> <p>Mr. Kigen Samson</p>
2. National Transport and Safety Authority (NTSA)	<p>NTSA-Motor Vehicle Inspection Unit (MVIU)</p> <p>Engineer Opere Nyaroya</p>
3. National Environment Trust (NETFUND)	Dr. George Mwaniki
4. Kenya Meteorology Department (KMD)	Ms. Johanna Mitei
5. National Environment Management Authority (NEMA)	Mr. Mwai Maitungi
6. University of Nairobi (Institute of Nuclear Science)	Mr. Simon Bartilol
7. Environment Compliance Institute	Mr. Gerry Opondo

(ECI)

8. **Kenya Association of Manufacturers (KAM)** Ms. Georgina Wachuka
9. **Kenya Alliance of Residents Association (KARA)** Mr. Vincent Amwoi
10. **Kenya Medical Association (KMA)** Dr. George Rae
11. **UN Environment - Mobility and Air Quality** Ms. Soraya Smaoun  
Mr. Victor Nthusi
12. **Stockholm Environment Institute-Africa Centre** Dr. Philip Osano  
Dr. Aderiana Mbandi  
Mr. William Apondo
13. **Ministry of Environment and Forestry** Climate Change Directorate/Focal Point  
for Climate and Clean Air Coalition  
Mr. Peter Omeny
14. **C40 Cities** Philip Dinga

## 11.2. Mapping of Institutions

It is expected institutions that participated in the drafting of the Nairobi Air Quality Policy document together with the institutions listed below will be some of the key institutions to be consulted for their input.

### Manufacturers

1. Kenya Association of Manufactures (KAM)
2. Bidco industries
3. Bell industries Kenya
4. Crown Paints
5. Chandaria Group of companies

6. Kenya Vehicle Manufacturers\*
7. Karatasi Industries
8. KEPSA
9. Bamburi Cement
10. PIEA
11. National Jua Kali Association
12. Ruaraka business Community (RUBICON)

**Government Policy Institutions and Parastatals**

9. Council of Governors (COG)
10. National Environment management authority (NEMA)
11. National Environment Trust Fund (NET Fund)
12. National Transport Authority (NTSA)
13. Kenya Forestry Research Institute
14. Kenya Forest Service
15. Kenya Agriculture and Livestock Research Organization (KALRO)\*
16. Law Society of Kenya/Attorney General's office
17. Kenya National Cleaner Production Center (KNCPC)
18. National Construction Authority
19. Kenya Energy Generating Company
20. Kenya Human Rights Commission
21. Geothermal Development Company
22. Agriculture and Food Authority
23. Energy Regulation Commission

**Lobby Groups and NGOs**

24. Center for Environment Justice and Development
25. Kenya Environment and Waste Management Association
26. Architectural Association of Kenya
27. Pan African Climate Justice Alliance
28. Institute for Law and Environmental Governance
29. Kenya Meteorological Society
30. Kenya Institute of Planners
31. Matatu Owners Association



32. Kenya Car Importers Association

### **Health Sector**

- 33. Kenya Medical Practitioners and Dentists Board
- 34. Kenya Medical Association
- 35. Kenya Association for Prevention of TB and Lung Diseases
- 36. Kenya Medical Research Institute
- 37. National Nurses Association of Kenya

### **International NGOs and Research Institutions**

- 38. IntraHealth International
- 39. International Livestock Research Institute
- 40. GIZ Kenya
- 41. Africa Population Health Research Center
- 42. Veterinaries Sans Frontiers (VSFG Kenya)
- 43. Greenpeace Kenya

### **Local Universities and Research Institutions**

- 44. Nairobi University
- 45. Kenyatta University
- 46. Technical University of Kenya
- 47. Egerton University
- 48. Moi University
- 49. South Eastern Kenya University (SEKU)
- 50. Strathmore University
- 51. Kenya Industrial Research and Development Institute (KIRDI)\*

### **Labor Unions**

- 52. Kenya National Union of Nurses.
- 53. Union of Kenya Civil Servants
- 54. Federation of Kenya Employers
- 55. Central Organization of Trade Unions - Kenya
- 56. Kenya Petroleum Oil Workers Union
- 57. Kenya Quarry and Mine Workers Union

58. Fair Trade Kenya\*

**\*Line Ministries**-Ministry of Environment and Forestry, Health, Energy, Transport, Industry, Agriculture Livestock and Fisheries, Petroleum and Mining

### 11.3. Types of air pollutants

**Carbon Monoxide (CO):** CO is an odourless, colourless, flammable and toxic gas, is an intermediate product of incomplete combustion due to fuel-rich conditions with insufficient O<sub>2</sub> available but can also be a product of CO<sub>2</sub> dissociation at high temperatures in an internal combustion [21]. CO is one of the 6 major air pollutants regulated in ambient air and the main source of CO is inefficient combustion of fossil fuels, the other regulated pollutants in ambient air are Pb, NO<sub>2</sub>, O<sub>3</sub>, PM<sub>10</sub> and SO<sub>2</sub>.

**Carbon Dioxide (CO<sub>2</sub>):** CO<sub>2</sub> is a colourless, odourless non-toxic gas which occurs as a result of complete combustion. The impact of CO<sub>2</sub> is not directly to health but rather globally which includes warmer global temperatures, altered weather patterns, changes in ecosystems and melting ice, as summarised in the 5<sup>th</sup> assessment report from Intergovernmental Panel on Climate Change (IPCC) [22].

**Hydrocarbons (HC):** HC is a collective term representing a broad range of hydrocarbon species and their presence in the exhaust is due to incomplete combustion due to fuel-rich mixture or due to evaporative lubricating oil compounds [21]. The composition and the quantity of HC is very broad and depends on the nature of the fuel rates of oxidation [23]. Polycyclic aromatic hydrocarbons (PAH) are of particular concern as many of them are known carcinogens [24] and they are formed in extremely fuel-rich regions where HC polymerization reactions are favored over oxidation [23]. Hydrofluorocarbons (HFCs) were developed to replace stratospheric ozone-depleting substances that are currently being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer. Gasoline and diesel are both sources of PAH; heavy duty diesel trucks were the major source of lighter PAH, whereas light-duty gasoline vehicles were the dominant source of higher molecular weight [25],[26].

**Particulate Matter (PM):** Incomplete combustion creates PM which consists of a complex mixture of condensed liquid or solid particles of organic and inorganic substances suspended in the air. The major components are: sulphates, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water [27], minor components may be heavy metals such as arsenic, selenium, cadmium, and zinc [28]. PM is formed in both the combustion cylinder and in the exhaust system of the vehicle [21].

PM is categorised by particle size and further characterised by mass, particle number. PM<sub>10</sub> refers to particles with a diameter of 10 microns or less and PM<sub>2.5</sub> refers to particles with a diameter of 2.5 microns or less. Particles ( $\leq$  PM<sub>10</sub>) are the most health damaging as they can



penetrate and lodge inside the lungs, and chronic exposure increases the risk of developing cardiovascular and respiratory diseases [27]. Exposure to  $PM_{10}$  and  $PM_{2.5}$  increases mortality or morbidity in short- and long-term exposure and it is for this reason  $PM_{10}$  is regulated in most developed countries.

**Nitrogen Oxides (NO<sub>x</sub>):** Nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>) are the most important nitrogen oxide air pollutants and they are jointly referred to as NO<sub>x</sub> [23]. Nitric oxide is a product of combustion process through the high temperature reaction of nitrogen (N<sub>2</sub>) and oxygen (O<sub>2</sub>). NO<sub>x</sub> emissions are presented as NO<sub>2</sub> as they are calculated as if all NO is converted to NO<sub>2</sub>, however of the two nitrogen oxides, NO<sub>2</sub> is the toxic and irritating compound with multiple air pollution roles often difficult to distinguish [29]. NO<sub>2</sub> in the presence of volatile organic compounds (VOC) and ultraviolet light is the main source of tropospheric ozone therefore considered an ozone precursor in addition to a main source of nitrate aerosols which form a major component of  $PM_{2.5}$  mass. Nitrogen oxides also deposit into water bodies causing eutrophication, nitrification and acidification.

**Sulphur Dioxides (SO<sub>2</sub>):** Sulphur dioxide is a colourless gas with a sharp odour formed from combustion of fossil fuel and smelting of minerals containing sulphur in fuel [27]. SO<sub>2</sub> jointly with other oxides of sulphur formed such as sulphur trioxide (SO<sub>3</sub>) are called SO<sub>x</sub> or oxides of sulphur. The convention is to express SO<sub>x</sub> emissions on the basis of the molecular weight of SO<sub>2</sub>, simply referred to as SO<sub>2</sub> [30].

SO<sub>2</sub> contributes to eutrophication of soil and water and acid deposition [28]. Exposure to SO<sub>2</sub> can cause irritation of the eyes, affect the respiratory system and the functions of the lungs, this aggravates asthma and chronic bronchitis, exacerbates lung infection, cardiac diseases and increases mortality [27].

The amount of SO<sub>2</sub> emitted is directly proportional to the amount of sulphur in the fuel. Due to modern efficient emission reduction devices such as 3-way catalytic converters and reduction of sulphur content in fuel then petrol fueled engines are not considered major sources of SO<sub>2</sub> [31]. For diesel vehicles with no emission controls the amount of sulphur in the exhaust is directly proportional to the sulphur in the fuel, in addition, there exists a linear relationship between sulphur content and PM emissions. There is a linear relationship between sulphate emissions ("PM related to sulfur") and fuel sulphur content [31].

**Non-methane volatile organic compounds (NMVOCs):** NMVOCs are evaporative organic chemical compounds excluding methane, that under normal conditions can vaporize and

enter the atmosphere [21]. NMVOCs include such compounds as benzene, xylene, propane and butane. NMVOCs are mainly emitted from transportation, industrial processes and use of organic solvents. Low level ozone is harmful to the health of humans, animals, trees and plants. High quantities also contribute to acid rain and the greenhouse effect, as well as being partly responsible for photo chemical smog

