NAIROBI CITY COUNTY

DRAFT GREEN BUILDING GUIDELINES

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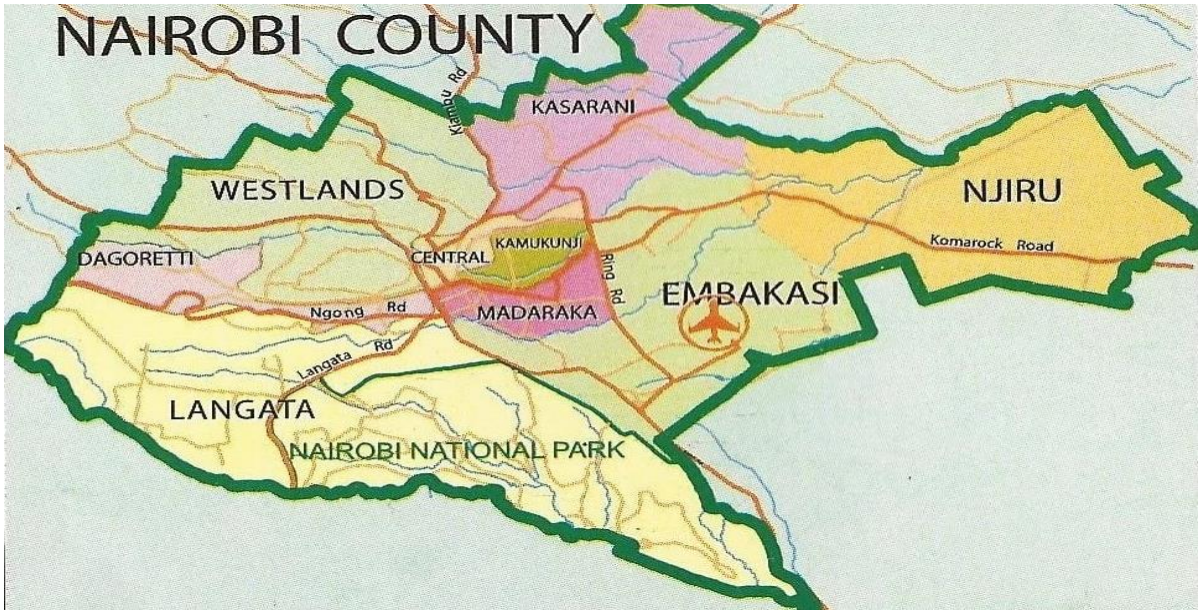
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1. INTRODUCTION: GREEN BUILDINGS AS AN INNOVATIVE APPROACH TO ACHIEVING SUSTAINABILITY

1.1. Background



Nairobi City County is one of 47 counties in the republic of Kenya. Nairobi City County is situated in South-Central Kenya.

The name “Nairobi” comes from the Maasai phrase ‘Enkare Nyrobi’, which translates to “cool water”.

Being Kenya’s capital, and the largest city in Kenya, Nairobi is well served by international airlines, and a regional road network linking it to other major East African urban centres including Mombasa, Kenya ‘s second largest city located on the shores of the Indian Ocean and Kisumu, the third largest city, located on the shores of Lake Victoria.

It is the most populous city in East Africa, with a current estimated population of about 5.3 million as at 2023, making it the 12th largest city in Africa and accounts for approximately 60 percent of Kenya’s GDP.

As a local government, the County is taking action to incorporate green building techniques into its planning and policy framework as a foundation for resource efficiency, a green economy, and sustainable development, and with KGBS’s technical assistance, has drafted these Green Building Guidelines (the “Guidelines”) order to identify the gaps and include proposals that are relevant and unique to Nairobi and guided by existing law, regulation, policies, strategies.

1.2. The Purpose of the Guidelines

The purpose of these Guidelines is to kick off the County's green building journey, and increase green building uptake in the County, by providing a central resource to the suite of regulatory and policy tools currently available to Nairobi City County to support and promote green building design and construction practices.

The aim of these Guidelines is to provide an easy-to-use reference document for the County and built environment professionals, developers, and users. It is not intended to be exhaustive, but rather to address the key issues that offer the most widespread benefits in terms of operating costs, user amenity and environmental sustainability.

Lastly, these guidelines are a platform and starting point from which policies and regulations on green buildings will be formulated to guide and support the County in defining, adopting and embedding a Low Emission Development (LED) pathway; and the integration of these guidelines into existing urban development policies, strategies, plans and processes.

Incorporating green building principles into a development may have little or no additional capital cost if such principles discussed below are incorporated from the onset. Other strategies can be retrofitted or added to a building as part of the normal maintenance cycle.

1.3. Building green, green building principles and why is it important to Nairobi City County?



1.3.1. What does it mean to build green

According to the World Green Building Council (WGBC), a green building is one that, in its design, construction and operation, reduces or eliminates negative impacts, while also having the potential to create positive impacts. Green buildings protect valuable natural resources while also improving the quality of life of communities that depend on them.

Green buildings are therefore buildings that are designed and constructed to:

- incorporate passive designs that promote better ventilation, lighting and through appropriate siting and orientation, optimize heating and cooling loads;
- incorporate energy efficient features (natural lighting and ventilation, good insulation, solar or geothermal heating, high efficiency lighting, cool roofs, etc.) and reduce occupant dependency on cars (by accommodating bicycle parking, showers for bicycle commuters, etc);
- incorporate water efficient features (harvest rainwater, use waterless urinals, low-flow faucets, showers and toilets and/or composting toilets, green roofs and walls, etc.);
- re-use and/or repurpose existing building structures and/or building materials; reduce and recycle waste materials;
- preserve natural vegetation and minimize disturbance to landscapes and habitats, in order to maintain biodiversity and preserve ecological integrity;
- incorporate sustainable, healthy, locally made or harvested non-toxic materials and features into buildings and furnishings (e.g., FSC or recycled wood, low VOC carpet, paint and composite wood products, previously used or recycled materials);

1.3.2. Principles guiding green buildings

Green building practices have been established that are organized around the life cycle performance of green buildings.

In exploring the practices further, the below principles guiding the practices encompass each of the green building phases, including planning and design, construction, operation, maintenance, and decommissioning (i.e., a “Whole Life” approach):

- ***Sustainable Siting***—this approach optimizes land use and development to reduce adverse impacts and minimize the building’s ecological footprint. Siting close to sources of public transport and promoting non-motorised transport is also encouraged. The principle focuses on minimising environmental impact, preserving natural habitats, and promoting biodiversity through thoughtful location selection and site planning.

    - ***Energy Efficiency***—this technique focuses on the establishment of performance targets for energy consumption that account for intended use, occupancy and other energy operations for new construction and renovation projects. It entails the use of high-performance building envelopes, efficient HVAC (Heating, Ventilation, and Air Conditioning) systems, and on-site renewable energy sources to reduce overall energy consumption and carbon emissions.

- ***Affordability*** – this is important, because for anything to be sustainable, it needs to be affordable to the local population and assist the government fulfil its objectives of delivering low-cost and socially conscious housing approaches in line with Kenya’s Affordable Housing Agenda.
  In this regard, it is very important to also consider a principle of ‘optimal size’ for buildings that rewards buildings that effectively use space rather than delivering larger spaces than necessary. This means promoting buildings with ‘optimal’ densities and sizes (it does not promote overcrowding or unsustainable densities). This is a key principle to integrate in definitions of green buildings so as not to penalise effectively sized homes which rely on public transport but are made of say concrete vs large homes which may consume ‘green certified fixtures and materials’ but have a higher carbon footprint per occupant.

- ***Water efficiency*** — this technique emphasizes the value of decreasing demands for fresh water and reducing the generation of wastewater through optimized landscaping, integrated rainwater catchments, grey/black water recycling, and wastewater treatment systems. Water conservation and efficient management, including the implementation of water-saving fixtures, rainwater harvesting systems, and innovative landscaping techniques to minimise water usage and protect local water resources.
- ***Building Materials*** — Sustainable material selection and resource efficiency, prioritizing the use of environmentally friendly, locally sourced, and recycled materials to reduce the building's carbon footprint and support circular economy principles. By encouraging the use of sustainable, recycled and/or alternative building materials such as cross laminated timber, the County can aid the reduction of extraction, processing, transportation, solid waste, and consumption in the built environment.
- Holistic and integrated design strategies that consider the entire building lifecycle, from construction to operation and eventual decommissioning, ensuring long-term sustainability and adaptability to changing needs and environmental conditions.
- ***Healthy Indoor Environmental Quality*** — these processes have enhanced the sustainable communities through ventilation and thermal comfort, moisture control, daylighting, environmental tobacco smoke control, and protecting indoor air quality during construction. Indoor environmental quality enhancement focuses on providing optimal air quality, thermal comfort, and natural lighting to improve occupant health, well-being, and productivity.
- ***Sustainable waste disposal*** – *this means ensuring that* suppliers for a building project either offer to take back excess materials and/or reuse or responsibly dispose the materials to avoid dumping and waste.
- ***Sustainable Urban Planning*** - In addition, the County bears responsibility for promoting principles of sustainable urban planning within which the green buildings will be delivered. This includes provision for green space and other recreational amenities for enjoyment of county residents, and adequate provision for non-motorised and public transport.
  The buildings emphasis on accessible architecture, public spaces, and educational activities contributes to sustainable community development and emphasizes its sense of community and social responsibility.

Green principles remain a critical component of sustainable development. Because the green building field is rapidly evolving, the county and national governments, will need to keep abreast of changes to green building practices as well as certification programs, rating systems, standards, and technology advancements.

1.3.3. The benefits of building green

Green building benefits in general include environmental, economic, and social advantages, however, in summary some of the benefits are:

- Carbon Footprint Reduction: which plays a significant part in the fight against climate change, and helping Kenya meet its obligations under the Paris Agreement.

- Durability and resilience for the green building owner, since the foundation is sustainability, green buildings are built to last longer.

- Lowering operating costs, since they maximise on energy and water efficiency.

- Improved health and comfort for residents.

- Reduced burden on local infrastructure, since they work with the environment and communities depending on them; and

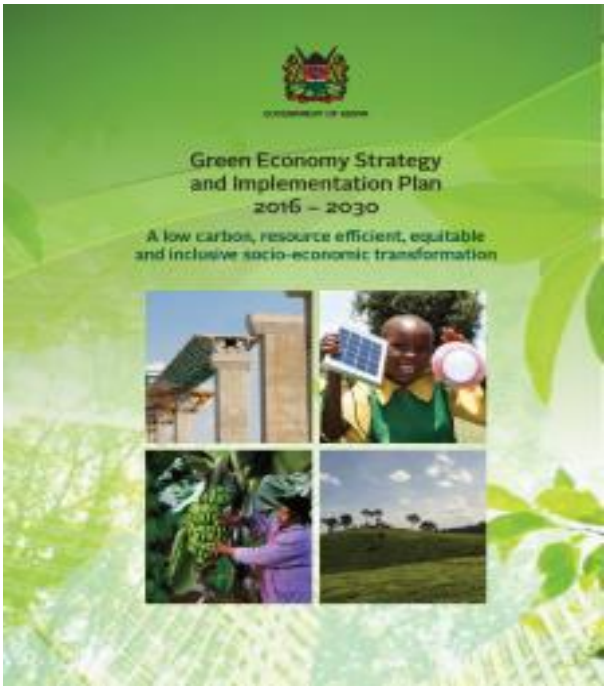
- Improved aesthetics.

Below are some proposals to green Nairobi, which have several benefits, including:

Benefit	Description
Reputation and branding of Nairobi as the leading green county in Kenya	Creates a green and healthy image for the county, that may attract other opportunities, such as investment, by ESG or sustainability focused investors. This may unlock financing, partnership and collaboration opportunities for Nairobi.
Increase in value or quality of real estate	Increases either from a rent perspective, or for a value perspective and better, healthier communities.
Increase in health and social benefits to communities	Provides opportunities for relaxation, social contact and recreation, and increases health and well-being
Improved aesthetics of County	Beautifies streets and neighbourhoods
Improved air quality	Less allergens means healthier communities. This is particularly important for children and the elderly.
Improved energy savings	Reduces the need for heaters in colder months and air-conditioning in hot months.
Mitigating effects of climate change	● reduces the greenhouse effect by absorbing CO2 ● regulates temperature extremes through shade and wind and humidifies the air, creating a cooler and more comfortable environment
Improves County's non-motorized transport and walkability aspects and supports public transport	Reduces the negative effects of traffic and industry
Improving water retention	Mitigates water scarcity

Figure 1: Benefits of building green

1.3.4. Greening the local economy



As the County continues on its path towards sustainability, it is important to identify and create employment opportunities in the local, green economy.

Many of the recommendations contained in various sections of these guidelines have associated benefits for the local economy. This can happen through the local production of clean energy from renewable sources, an increase in the construction of green buildings supporting local jobs and communities, and choosing locally-made rather than imported goods and products (use local labour while developing local skills).

The green economy also includes the promotion of the County's local and cultural identity through offering unique tourism opportunities, the promotion of green buildings, education and awareness and green business support structures and mechanisms.

1.3.4. The Role of the County Government

(a) As Regulator and Policy Maker

It is the role of the County Government as a regulatory authority to use regulations and policy to support and promote adoption of green building design and practices. This also fits within the county's broader strategy to find sustainable growth management solutions.

By reducing the footprint on air, land, water and energy resources at the site scale, green buildings can further the County's planning objectives for achieving sustainability on a county, and community-wide scale.

Broadly, the County aims at promoting sustainable growth by:

- promoting urban revitalization and a healthy working land base;
- incorporating green infrastructure into communities; creating compact, complete communities;
- increasing transportation choices;
- creating inclusive neighbourhoods; and
- making efficient use of expenditure of public funds/ public infrastructure.
- promoting a framework for data collection and sharing to help to make informed decisions on the upfront investment versus the operational benefits of green buildings

(b) As owners of Property and Infrastructure

Public projects led by county governments serve as exemplary models, incorporating green building principles in the design, construction, and operation of public buildings and infrastructure, demonstrating the feasibility and benefits of sustainable development. The County aims at becoming a green building leader in its capacity as the owner of property and County infrastructure, by leading by example towards this transition.

In addition, by building green, the County will develop direct experience with green designs and construction, which then presents an opportunity to inform the County government's understanding of the challenges and benefits, and enhances the ability of County government decision-makers to speak from experience, both when regulating and when advocating for needed reforms at County and national levels of government.

By taking up the mantle, the County can thereafter establish a green building policy and regulations. This would assist in implementing green building design and construction practices, which would also lead to significant savings for County and City operations as well as a better work environment for County/City employees, and position the County as an investment hub for green investors.

(c) As Partners and Educators

Collaboration and partnership with players in the private sector will increase awareness and acceptance of green building design and construction practices. The private sector can provide key green and sustainable infrastructure or programs and capacity building on targeted issues.

Some of the players in the private sector that the County Government intends to partner with include:

- Organisations such as the Kenya Green Building Society (KGBS), who can assist in building capacity of green building experts, through its EDGE Expert Training Program, or master classes for Greenstar. Separately, KGBS can also assist by assessing the County's real estate portfolio to give a high-level overview of the work required to transition the County's portfolio to one that is green and sustainable.

- Developers- to facilitate cutting edge innovation and ease the way for green projects by making them more affordable to undertake and enabling an easier operating environment.

- Lenders and other financial institutions to redefine green finance and address the mid- to low-income brackets, which would open up financing to a larger population set.

(d) As Incentive Providers

Currently, the challenge for green buildings is that they almost always involve innovations that are not contemplated by any laws, regulations, or the National Building Code and require "equivalency" approval by county government staff who may be unfamiliar with the proposed technologies and products.

For the uptake of green buildings to grow, the County Government can complement the national government's efforts by:

- Devoting staff and resources and some budget up front to review/design equivalencies, to help put a green building program in place and save time/money over the long term;

- Establishing policy that the county government supports green building standards and encourages applications seeking equivalencies for such standards;

- Providing tax incentives, shorter approval timelines and other incentives, that would drive investment into going green.

2. GREENING THE COUNTY: STEPS INVOLVED

2.1. Introduction

Whilst the focus of the guidelines is Green Buildings, the County needs to address how Green Buildings fit into the County's plan for a green Nairobi.

For this reason, green buildings should be part of a bigger strategy to green cities and towns, neighbourhoods, streets, infrastructure and buildings and involve intentional planning for the same in all stages.

The planning process needs to be at the County level, then trickle down, to neighbourhoods, streets and lastly buildings.

Alternatively, the planning process can start by focusing on what a building needs to have, what a neighbourhood has to have, what streets need to have and lastly, what the city need to have, which would then multiply to create a green county.

2.2. Greening the city

The County can use the Green Nairobi strategy to focus on improving the conditions of the urban (inner) city environment in order to create healthy, liveable city where people want to live and work.

By doing this, the County fulfils its social and environmental obligation to its citizens by providing green spaces where people can relax and exercise, green and walkable streets that help refresh the air, and green buildings that remind us of nature beyond the city limits.

Liveable urban neighbourhoods within city limits will make working in the city a desirable option. Furthermore, people who have no choice but to live within the confines of the city have the right to live in a healthy urban environment.

Incorporating walkable spaces reduces car usage which will then reduce background air pollution, carbon emissions, congestion, and the social problems associated with high levels of road traffic that cities are dealing with today.

2.2.1. Steps to a greener city

(a) Incorporating sustainability in the planning process

- Infrastructure projects should incorporate green early on in the design phase of new roads, transit facilities and other projects by assuring ample space (both above ground and underground, where applicable) and budget for sidewalks, trees and other green resources.

- The majority of the population either walk or use public transport in Nairobi City County, and Kenya as a whole. For this reason, spatial planning and development need to prioritize linkages with public transportation, other non-motorized transport and pedestrian walkways. The access to public transport nodes needs to be safe and easy and designed into the infrastructure, not an afterthought. The full ‘transit’ experience can be enhanced by incorporating functional green spaces and aesthetics.

- New development of residential and business areas should incorporate urban forests into the design and use green as a building block to build neighborhoods or office spaces.

(b) Consider effective Spatial Planning and Land Use Management

Spatial planning is a public sector activity with both regulatory and development functions which relies on established methods to influence the distribution of people and activities in spaces of various scales in order to improve the built, economic and social environments of communities.

Spatial planning aims to:

- create a more rational territorial organization of land uses,
- balance demands for development with the need to protect the environment,
- achieve social and economic objectives,
- coordinate and improve the impacts of other sectoral policies on land use
- promote long term capital appreciation of land assets across the county

As a key enabler of spatial planning, land is modified and transformed to support human activity and to enable residents, businesses, industry, agriculture and ecological systems to thrive. This includes building roads, railway lines, infrastructure, buildings, schools, health facilities, recreational open space, and farms. Where these are placed and how they interact is dependent on the natural environment, transport systems, demographics, socio-economic factors and policy.

Urban areas need to be made up of diverse, medium-density, safe neighbourhoods with a vibrant town centre and increased connectivity through a network of safe, well-designed public spaces and corridors.

2.2.2 considerations for greening at various levels

A. Buildings (Plot Level)

(i) Energy Efficiency

- Standards: Adopt standards like LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment Environmental Assessment Method) for new constructions to ensure sustainable building practices.
- Smart Building Technology: Implement IoT (Internet of Things) devices for efficient energy management, such as smart thermostats, lighting controls, and energy monitoring systems.

(ii) Renewable Energy

- Solar Panels: Install solar panels on rooftops to generate clean, renewable energy and reduce reliance on fossil fuels.
- Green Roofs: Use green roofs for insulation, stormwater management, and to combat urban heat islands. Green roofs can also enhance biodiversity and provide recreational spaces.
- Energy-Efficient Appliances: Encourage the use of Energy Star-rated appliances to reduce energy consumption and lower utility bills.

(iii) Compact Development at the Plot Level

- Vertical Building: Encourage the construction of multi-story buildings to accommodate more people within a smaller footprint, reducing the need for horizontal expansion.
- Efficient Land Use: Maximize the use of available land by promoting mixed-use buildings that combine residential, commercial, and recreational spaces within the same plot.

B. Neighbourhoods

(i) Sustainable Housing

- Affordable Green Housing: Develop affordable housing with sustainable materials and technologies, ensuring that energy-efficient homes are accessible to all income levels.
- Mixed-Use Development: Promote mixed-use development to reduce transportation needs and create vibrant, walkable communities with residential, commercial, and recreational spaces.

(ii) Community Spaces

- Green Spaces: Create parks, community gardens, and green corridors to enhance urban biodiversity, provide recreational areas, and improve mental and physical health.
- Waste Management: Implement robust recycling and composting programs to reduce waste sent to landfills and promote a circular economy.

(iii) Mobility

- Public Transport: Enhance public transportation options to reduce car dependency, lower emissions, and improve air quality. This includes expanding bus and rail networks and improving service frequency and reliability.
- Bike and Pedestrian Infrastructure: Develop bike lanes and pedestrian-friendly pathways to encourage active transportation, reduce traffic congestion, and lower greenhouse gas emissions.

(iv) Compact Neighborhood Design

- Transit-Oriented Development (TOD): Focus development around public transit hubs to reduce the need for car travel, making communities more accessible and sustainable.
- High-Density Housing: Promote the construction of high-density housing near key services and amenities to create more compact, walkable neighbourhoods.

C. Streets

(i) Green Infrastructure

- Street Trees: Plant trees along streets to improve air quality, provide shade, and reduce the urban heat island effect. Trees also enhance the aesthetic appeal of streetscapes.
- Permeable Pavements: Use permeable materials for sidewalks and streets to reduce runoff, improve water quality, and replenish groundwater.

(ii) Smart Street Lighting

- LED Lighting: Replace streetlights with energy-efficient LED lights to reduce energy consumption and maintenance costs.
- Smart Lighting Systems: Install motion sensors and dimming controls to optimize lighting levels based on usage and time of day, further conserving energy.

(iii) Sustainable Urban Drainage Systems (SUDS)

- Integrate rain gardens, bioswales, and other natural drainage solutions to manage stormwater, reduce flood risk, and enhance urban green spaces.

(iv) Compact Street Design

- Complete Streets: Design streets that accommodate all users—pedestrians, cyclists, and vehicles—to support active transportation and reduce car dependency.

- Narrower Roads: Implement narrower roads to calm traffic and increase space for pedestrians and cyclists.

D. Entire City

(i) Urban Planning

- Zoning Regulations: Update zoning laws to support sustainable development, encourage higher density, and protect natural areas.
- Green Belt Areas: Preserve and expand green belt areas to limit urban sprawl, protect natural habitats, and provide recreational spaces.

(ii) Renewable Energy Infrastructure

- City-Wide Solar Initiatives: Promote the use of solar energy across the city by installing solar panels on public buildings, providing incentives for residential and commercial installations, and developing solar farms.
- District Heating and Cooling Systems: Implement district heating and cooling systems for efficient energy use, reducing the need for individual building heating and cooling systems.

(iii) Compact Urban Form

- High-Density Development: Encourage the development of high-density, mixed-use areas to create compact, vibrant urban centers that are well-served by public transit.
- Infill Development: Prioritize the development of vacant or underutilized land within existing urban areas to prevent sprawl and optimize land use.

(iv) Policy and Incentives

- Incentives for Green Practices: Provide tax breaks or subsidies for businesses and residents adopting green practices, such as installing renewable energy systems, retrofitting buildings, and using energy-efficient appliances.
- Education and Awareness: Launch campaigns to educate the public on sustainability, energy conservation, and the benefits of green initiatives.

(v) Smart City Technology

- Data-Driven Decision Making: Use data analytics to optimize city operations, such as traffic management, waste collection, and energy usage.
- IoT for Sustainability: Implement IoT solutions to monitor and manage resources efficiently, including smart grids, water management systems, and environmental sensors.

(vi) Implementation Strategies

- Stakeholder Engagement: Involve local communities, businesses, and governments in planning and decision-making to ensure that green initiatives meet the needs and priorities of all stakeholders.
- Public-Private Partnerships: Leverage partnerships to fund and support green initiatives, combining resources and expertise from the public and private sectors.

- Monitoring and Evaluation: Regularly assess progress and make data-driven adjustments to strategies to ensure continuous improvement and accountability.
- Pilot Projects: Start with pilot projects to demonstrate benefits and refine approaches before scaling up city-wide initiatives.

E. Compliance with Laws and Regulations

- Legal Framework: Ensure that all green initiatives and compact development strategies comply with the Constitution of Kenya (2010), the County Governments Act (2012), and the Urban Areas and Cities Act (2011).
- County Planning Integration: Align compact development strategies with the County Integrated Development Plans (CIDP), County Sectoral Plans, County Spatial Plans (CSP), and Cities and Urban Areas Plans to ensure comprehensive, sustainable urban development.

3. THE GUIDELINES AND CATEGORIES CONSIDERED IN BUILDING GREEN

These guidelines have been designed to be used by everyone in the County: property owners, built environment professionals, construction contractors, property developers and County officials working in the built environment.

To gain the most benefit from these guidelines it's important to review them with the understanding that nothing can be considered in isolation.

Most actions or designs will have an impact, positive or negative, on something else. For example, window size and building orientation can impact on heat gain, lighting, glare, occupant perception of

comfort and energy requirements for heating and cooling. Built environment professionals are thus discouraged from viewing green features or initiatives in silos. That said, for ease of unpacking the various elements the guidelines have been structured across 11 main categories as illustrated in the figure below which will each



3.1 Format used to unpack the categories

Generally, the following format has been used to unpack the different categories, where applicable:

3.1.1. Introduction

Each category is introduced with an understanding of the system/resource in the county and the current challenges facing the County.

3.1.2. Changes needed

The change necessary to transition to low emission development and how the Guidelines aim to achieve this.

The detailed actions and initiatives included in these Guidelines have been organized into relevant scales of the built environment, because a green building needs to be connected to broader systems and infrastructure services.

The process is also broken down into the development phases of a building – from design and construction through to the building management.

The County has a key role to play in creating an enabling and supporting environment for the transition to low emission development.

This section has been compiled into a separate action plan to provide guidance on actions that can be undertaken by the County. This is to allow for reduced resource consumption and greenhouse gas emissions along with benefiting the natural environment and local socio-economic development.

3.1.3. What needs to be done at Pre-design and Design stages

Many short- and long-term environmental impacts of buildings can be reduced or potentially avoided with good green building decisions incorporated from the outset of designing a building. This is especially important when wanting to take hold of the no/low-cost initiatives presented in these Guidelines. This section of the Guidelines looks at green building initiatives and actions that can be undertaken in the first stages of a building's concept design and incorporated throughout the design and specification process.

3.1.4. What needs to be done during the Construction stage

Once a building design reaches site and construction begins, many direct environmental impacts are experienced. Green building decisions taken in this stage can help mitigate the impact of constructing the building on both the local and global environment. Good decision-making in this phase can have positive socio-economic benefits along with reducing the environmental impacts. This section of the guidelines details the green building actions that can be undertaken within the construction phase of a building.

3.1.5. What needs to be done during the Operations stage

The ongoing maintenance, operations and management of a building can have a significant environmental impact throughout the life of a building. Practices for monitoring and reduction of resource consumption are essential. When evaluating the total costs of a building's full lifecycle, the majority is spent in the occupation of a building. Green building practices applied here can therefore significantly reduce the environmental impact of the building, while at the same time reducing operational costs, especially in the long term. This section of the Guidelines details the green building actions that can be undertaken when managing and operating a building, whether existing or new. This section also details green building considerations for retrofits and refurbishments of existing building stock.

Lastly, where applicable, the guidelines also unpacks how we manage our precincts.

Moving up from the scale of a building and looking to broader systems, both natural and urban infrastructure, the Guidelines in this section indicate opportunities for green initiatives and interventions within a precinct. These are applicable to either existing or new precincts. These considerations also take advantage of economies of scale, which increase the feasibility and viability of green strategies as more people use them and there is more space to support them physically.

4. MANAGEMENT & GOVERNANCE



4.1. Introduction

Management involves practices for the design process and teams as well as the construction process and for the maintenance and upkeep of structures and systems.

Governance refers to the institutional make-up of the County, with regard to the local government partnering organisations (CBOs and NGOs), and business.

The management of buildings, infrastructure and public spaces is an ongoing responsibility that is vital to ensuring their sustainability through the full lifecycle; that is beyond the design and construction phases to include the operation and decommissioning or demolition stages as well.

The built environment's cost and environmental impact is mostly in the operational phase of its lifecycle. Being conscious of how the building will be managed and operated (and ultimately repurposed or decommissioned/demolished) as it is being designed and constructed ensures that the systems and infrastructure required to support good management practices are in place. Doing this well is important because it is difficult to implement environmentally sustainable management practices once the building is occupied.

4.2. What needs to be changed

Environmentally sustainable management practices affect every step of the building process from the design concept and building contracts, through to building operation and refurbishments or demolition. Each of these stages of building development need to include all team members working together in decision-making processes from start to finish. Good management and governance practices facilitate and enable proactive maintenance and sufficient monitoring and evaluation.

As a guideline:

1. any project must have a holistic approach with a multi-disciplinary team who have a shared vision for the outcome of the project is undertaken. It might require an independent peer review for building performance or appointing a responsible facilities manager who can monitor and evaluate performance.

2. occupants and users should be educated on green initiatives to encourage changes in behaviour that reduce resource demand and benefit the natural environment.

4.3. What needs to be done at Pre-design and Design stages

4.3.1. Provide for a holistic design approach with clear vision and team involvement

The successful implementation of green building principles begins at the conceptualization of the project. For optimal benefit to be gained from the holistic design approach, these principles should be understood and adopted by the whole team (town planners, architects, engineers, landscape architects, construction contractors, and the local community) which would facilitate green building principles and practices being implemented in all aspects of the design, construction, and management.

As a guideline:

1. Develop a clear vision of the project that represents the purpose and desired outcome.

2. Include an experienced green building specialist as part of the team to facilitate these discussions and engagements.

3. Encourage an independent peer review during the design phase to comment on the specifications and choices, especially with regard to optimization of equipment and design of the future systems, and during the building's first year of occupation as a means to verify a system's performance.

4. Enlist the services of an independent commissioning agent who can verify the appropriateness of the systems to be installed in the building and will prepare for and oversee their commissioning so that they operate as intended by the original design.

4.4. What needs to be done during the Construction stage

4.4.1. Adopt and implement good management practices

Good environmental management practices on construction sites include:

- **An Environmental Management Plan (EMP)** to stipulate controls and measures for environmental protection and reduced degradation of the site, especially with regard to water, soil, vegetation and pollution.
- **A Waste Management Plan (WMP)** to monitor waste streams on site and, where possible, to ensure that reuse and recycling of construction waste takes place. This is to reduce the amount of waste going to landfill.
- **A Demolition Plan** (where applicable) to allow for the reuse of building elements, such as windows and doors, and recycling of building materials, such as concrete and steel rebar.
- **Use of good Personal Protective Equipment (PPE)** on site to ensure the health and safety of construction workers.

4.5. What needs to be done during the Operations stage

The County should ensure that good maintenance practices are maintained to ensure that well-designed, well-constructed buildings also perform well, and that this enhanced building performance is maintained and even exceeded throughout the building's occupation and changes in functional use.

As a guideline:

(a) Appoint a qualified building / facility manager as a first step in implementing good facility management practices to take care of building operations and maintenance.

(b) Implement an integrated Building Management System (BMS). BMS is common to all smart buildings and refers to a host of monitoring and data collection devices and control systems that regulate and optimize the utilities and services, as well as equipment operations in a building.

(c) Allow for building tuning within the first year of occupation to ensure optimum comfort for the building inhabitants and resource efficiency for improved building performance.

(d) Incorporate green building guidelines when undertaking retrofits and refurbishments.

5. SPATIAL PLANNING AND LAND USE MANAGEMENT



5.1. Introduction

Spatial planning and land use management are critical frameworks for guiding the development and organization of urban and rural spaces. They ensure the efficient and sustainable use of land and resources, balancing economic, social, and environmental objectives.
Green building policies, which promote environmentally sustainable and resource-efficient building practices, are increasingly integrated into these frameworks to address climate change, reduce environmental impact, and enhance the quality of life.

Spatial planning involves the strategic organization of land use and the physical arrangement of infrastructure, services, and resources in a defined area with an aim to create functional, sustainable and aesthetically pleasing environments.
Key strategies for Integration of green building policies into spatial planning and land use management for integration include:

● Policy Alignment: Ensuring that spatial planning and land use management policies align with green building objectives to create a cohesive regulatory framework.
● Incentives and Support: Providing financial incentives, technical assistance, and regulatory support to encourage the adoption of green building practices by developers and property owners.
● Urban Density and Mixed-Use Development: Promoting higher density and mixed-use developments to reduce urban sprawl, enhance resource efficiency, and support sustainable transportation options.
● Green Infrastructure: Incorporating green infrastructure elements, such as parks, green roofs, and urban forests, into land use plans to enhance environmental quality and resilience.
● Stakeholder Engagement: Involving community members, developers, and other stakeholders in the planning process to ensure that green building initiatives address local needs and priorities.

5.2. What needs to be changed

In order to harmonize spatial planning and land use management with green policies, several critical changes need to be made:

- Revise and harmonize key policy documents like the Building Code, the Urban Areas and Cities Act, and the Environmental Management and Coordination Act (EMCA) to ensure that environmental sustainability is integrated into all aspects of urban planning and development.

- Incorporate green infrastructure as a mandatory component in spatial planning and land use management. This will help mitigate urban heat islands, manage stormwater, and enhance urban biodiversity, aligning with green policies.

- Strengthen land use regulations to protect these areas by clearly defining urban boundaries and enforcing zoning laws that promote compact, mixed-use developments, reducing the environmental footprint of urban expansion.

- Implement policies that require new developments to include renewable energy installations (e.g., solar panels) and meet energy efficiency standards. This approach reduces the carbon footprint of urban areas and supports the transition to sustainable energy systems.

- Engage the public and key stakeholders in the planning process to ensure that urban development projects are both environmentally sustainable and socially inclusive. This can be achieved through participatory planning approaches and transparent decision-making processes.

- Mandate the use of green building standards such as IFC EDGE, Green Star-Africa Kenya, and LEED for Communities in all new developments. This ensures that buildings are designed, constructed, and operated in an environmentally responsible manner.

- Prioritize the development of public transportation networks, non-motorized transit corridors, and pedestrian-friendly urban spaces. These measures not only reduce emissions but also promote a healthier, more sustainable urban lifestyle.

- Establish a robust monitoring framework that regularly assesses the impact of spatial planning and land use management on the environment. Use adaptive management strategies to modify policies and practices based on the outcomes of these assessments.

5.3. What needs to be done at Pre-design and Design stages

1) There needs to be an emphasis placed on development within a designated urban edge to reduce sprawl to allow for more efficient and less costly infrastructure provision as more people can be serviced in a smaller space with a reduced impact on sensitive ecological areas and high value agriculture land.

2) Urban areas need to be walkable, and made up of diverse, medium-density, safe neighbourhoods with a vibrant town centre and increased connectivity through a network of safe, well-designed public spaces and non-motorized transit corridors. The idea behind the concept is to build cities in such a way that most daily necessities and services are located within a 15-minute walk or bike ride. This is referred to as the “15-minute city” concept. Whilst it may take time to develop a 15-minute city, Nairobi can aim for a 30-minute city as it transitions to an intentional sustainable city.

3) Essential development in areas outside of the main urban areas should be guided by the National Building Regulations 2022 (the Building Code), the Urban Areas Cities Act, 2012, the Environmental Management & Coordination Act (EMCA), 2009, County Government Act, 2012 amongst others, and best practices found in green building rating systems like IFC EDGE, Green Star-Africa Kenya, LEED for Communities, Envision, among others.

4) The city needs to promote increased social and land use diversity by incorporating:

    - **mixed use buildings:** where possible include more than one use in the design of a building. The most successful uses to mix include residential, offices, retail and education, especially

where retail and other high- activity spaces are placed on the ground floor to improve security. This also enables provision of services in close proximity to where people live and work.

- **mixed income amenities/developments:** when designing residential or commercial units in particular, ensure that a variety of sizes and typologies are available to encourage owners/tenants from a range of income groups for inclusivity.

- **flexible base building designs:** consider floor heights and layouts which are common to most building typologies not just one to encourage future re-use/re-purposing rather than demolition of buildings when a new use is required. This is to allow for an easy future retrofit, which reduces the use of new construction materials and related greenhouse gas emissions.

5) Promote a permeable urban form by not obstructing pathways or service lots that are adjacent to or even on the site as they can be used by pedestrians or cyclists to increase accessibility.

6) Design for pedestrians by creating an interactive, walkable street façade within the commercial town centers of urban areas. Building function and space layout on the ground floor should be interactive and engage pedestrians, such as stores or public facilities e.g., libraries. The facades of buildings should be designed so that they promote activity on the ground floor (edge activation), ensure that development is at a human scale, and allow for interactive spaces.

7) Implement traffic calming measures (such as pinching a road to allow wider pavements for coffee shop tables or informal traders), thus slowing vehicular traffic while still allowing pedestrian movement, and planning in a manner such that parking garages are not located on the street-facing frontage.

8) Ensure pedestrian entrances have ease of access for pedestrians, including persons with disabilities (PWD), from surrounding walkways and transport stops to access a building or site (such as a shopping center).

9) Enhance the building's surroundings: where possible, look to providing appropriate seating furniture and bicycle racks along the street-facing edges of the buildings, plant trees and other appropriate indigenous vegetation and pave the walkways. Ensure that the same are adequately maintained over time.

10) Where possible choose sites for public open spaces which are adjacent to ecological systems, such as rivers, wetlands, hills and estuaries. This will allow these more ecologically sensitive areas to be used appropriately with little negative impact to these systems, thereby protecting them from future detrimental land use.

11) Design public spaces in a neighbourhood so that they form part of larger ecological networks and walking and cycling routes in the sub-counties and city.

12) Cluster community services, such as schools, crèches, clinics, libraries and community sports grounds, around public open spaces to increase the number of people watching and doing activities on the street or park (passive surveillance).

The principles of this spatial vision are:

Threshold density: Where density is increased to reduce the rate of urban expansion and sprawl, to support the efficiency of transport infrastructure and services, to reduce the cost of municipal service provision, and to protect valuable agricultural land and sensitive ecosystems.

Increased diversity and inclusivity: Where diversity and inclusiveness is increased to promote shared urban space for citizens who have different incomes, cultures and family structures.

Permeable urban form: Where towns and suburbs are laid out in such a way as to have easily navigable urban grids with many points of entry and exit. This increased choice of route improves accessibility and connectivity between different areas in the towns.

Pedestrian priority: Where citizens are encouraged to walk when needing to make short trips rather than use private vehicles. This can promote more active lifestyles and improved health, increased safety as more people are on the street and reduced greenhouse gas emissions.

Connected and safe public space: The increased provision and improved access to public open spaces (hard or soft surfaces) in urban areas that are safe and within a short walking distance from home or work for children to play safely and connect with nature and people.



Challenges and opportunities in a matrix

Challenges	Opportunities
Regulatory Complexity: Harmonizing green building policies with existing land use regulations can be complex and requires careful coordination among various government agencies.	Innovation and Technology: Advances in green building technologies and materials offer new opportunities for creating more sustainable and resilient built environments.
Economic Considerations: The initial costs	Public Awareness and Education: Increasing

associated with green building technologies and practices can be a barrier for developers and property owners, particularly in regions with limited financial resources.	awareness of the benefits of green buildings can drive demand for sustainable construction practices and support policy initiatives.
Capacity Building: There is a need for training and capacity building among planners, architects, and builders to effectively implement and enforce green building standards.	Global Collaboration: Sharing best practices and lessons learned from successful green building projects around the world can inform and inspire local initiatives.

6. ENERGY EFFICIENCY

6.1. Introduction

Energy efficiency is using less energy to provide the same service. This can be done through technical interventions, such as changing equipment, or through behaviour change, such as switching off equipment that is not required.

According to the Kenya Ministry of Energy, 91.9% of energy in residential households is used for lighting. This would indicate a huge opportunity for energy efficiency measures coupled with better design and building orientation, and with the KGBS as a partner this could be an opportunity for the county to explore rebates for lighting upgrades, program managed by KGBS.

Energy efficiency, is an important consideration in the green building movement, since, according to UNHABITAT, the building sector accounts for 40% of all fossil fuel consumption in developed countries.

Energy efficiency is important to the County since it is in the process of undertaking major developments that will require not only a substantial supply of electricity, but also, an efficient energy system that allows the County to save on costs.

To expound on the above, and taking the EAC as an example, the building sector consumes more than 60% of total final energy consumption. 80-90% of the energy consumed by a building is consumed during the use (or operational) stage of its life-cycle (for heating, cooling, ventilation, lighting, appliances, and so on), the remaining 10-20% is consumed during raw material extraction and processing, product manufacturing, construction, and demolition.

As a result, the Green Economy Strategy and Implementation Plan for 2016-2030 recognizes the enormous potential that energy efficiency in buildings provides for reducing greenhouse gases that cause climate change and achieving environmental sustainability. Separately, the recently launched National Cooling Action Plan, highlights the revision of building codes as one of its key proposals in initiating the process of mainstreaming passive cooling into building design, the analysis and revision of applying building codes for new and refurbished buildings.

6.2. What needs to be changed

(a) Simple measures to conserve energy can be implemented at no cost, and with a small increase in capital costs, large reductions in energy demand and increases in energy efficiency are possible

(b) Land use planning to have building massing models to guide the form and height of buildings in different locations during constructions to enhance natural lighting, natural ventilation and preserve open spaces.

(c) Align with the National Energy Efficiency and Conservation Strategy which provides a road map in five identified priority sectors: households, buildings, industry and agriculture, transport and power utilities –to realize the goal of sustainably transforming Kenya to an industrialized middle-income nation by the year 2030, as envisioned in Kenya Vision 2030.This will support the achievement of the country's commitments under the Paris Agreement on climate change and the Sustainable Development Goals. Separately, and in order to encourage private sector investments in renewable energy, the government has zero-rated the import duty and removed Value Added Tax

(VAT) on renewable energy equipment and accessories. It has also issued Feed-in-tariffs that allows power producers to sell renewable energy generated electricity to the off taker.

(d) Develop a localized county Building Code, and incorporate the provisions of the national one Building code which has incorporated provisions for mandatory resource and energy efficiency requirements as well as adopt energy conservation code with Minimum Energy Performance Standards for buildings.

6.3. What needs to be done at Pre-design and Design stage

(1) Compliance with mandatory requirements:

Energy efficiency and demand management in buildings is regulated by several laws and regulations, with the government's obligation to be energy efficient being mandated by the Constitution of Kenya, Article 69 (1) places this burden on the government and provides that the government shall ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources.

In support of the Constitution, the provisions of the below laws, and policy documents apply

- Energy Act 2019
- Energy (Energy Management) Regulations 2012
- Energy Management, Solar Photovoltaic and Solar Water Heating Regulations of 2012
- Energy (Appliances Energy Performance and Labelling) Regulations 2016,
- Vision 2030
- National Energy Efficiency and Conservation Strategy
- The Building Code.

(2) Including passive design elements considerations in all buildings from the planning stage.

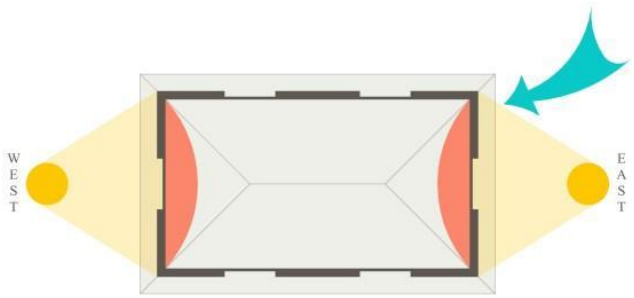
'Passive design' is design that works with the local climate to maintain a comfortable temperature in a building. For effective passive building design the following are considerations

- incorporates solar thermal performance and energy-saving measures, into the planning process early on.

- can also assist in maximizing the potential for heating and cooling, as well as solar-powered water heating, and can encourage natural lighting, reducing the need for additional heating or lighting during the day.

- capitalizes on the specific location and climate of a building and making key decisions about building orientation, floor plate dimensions, solar access, massing and air flow at the earliest design stages.

(3) considers the building orientation as illustrated below to maximize energy savings since this alone can generate estimated energy savings of 20% to 50% for a building.



(4) the building layout has to ensure proper ventilation and minimize thermal discomfort.

- includes shading devices or roof overhangs in all, if not buildings
- Shading devices assist with glare control and so contribute to a good indoor environmental quality of the space. It is possible to design a roof overhang so as to act as shading for windows below. This is especially useful in smaller commercial and residential buildings.

(5) incorporates wall and ceiling insulation to ensure better thermal comfort

- The above reduces the need for mechanical heating and cooling of the building, thus reducing overall energy requirements. Insulating the building envelope and glazing will improve thermal performance. In a home, carpets and thick curtains can improve the insulation of a room.

(6) increases the thermal mass in the building:

- the thermal mass of a building refers to the thickness of material in the walls and floor.
- buildings with higher thermal mass will absorb more heat during the day and release it slowly at night. This can help to keep the building warmer inside in colder periods and cooler in warmer period in and is especially appropriate in drier areas with large differences in daytime and night-time temperatures.

(7) maximizes natural light since natural light stimulates biological functions that are essential to human health.

(8) uses reflective or light-colored roof materials to reduce the building's cooling loads significantly as less heat is coming into the building.

(9) uses energy sub-meters to measure consumption This allows for quick identification of any excessive power so that it can be corrected, while flagging of large energy use areas or functions that can enable more accurate energy cost calculations.

(10) uses energy efficient lighting such as light emitting diodes (LED) lighting.

(11) An owner designing a building may conform to the sustainable design strategies derived from independent green building certification organisations, building code, 2024.

6.4. What needs to be done during the Operations stage

There are numerous initiatives which building managers and property owners can implement in order to reduce their energy load, and ensure the ongoing energy efficiency of a building.

Some of the best practice guidelines are discussed below.

(1) Energy efficiency through good operational practices

Implement good monitoring and management practices to improve energy performance, energy efficiency, use and consumption. This aims to reduce greenhouse gas emissions and other related environmental impacts and energy costs through the systematic management of energy.

Implement the four-phase cyclical action plan requiring building owners to:

- **Plan:** Conduct an energy review/energy audit of their operations and establish an energy baseline and retrofits that can be implemented as energy conservation measures (ECMs).
- **Do:** Implement the energy management action plans and ECMs.
- **Check:** Monitor and measure processes and key characteristics of operations that determine energy performance against the energy policy and objectives, and report the results.
- **Refine:** Take actions to continually improve energy performance and the Energy Management System.

(2) Energy meters and monitoring

In order to fully understand what a building's consumption is, it needs to be measured. This should work hand-in-hand with metering, monitoring and management. The facility manager should develop a thorough understanding of the energy flow in the building so as to reduce energy input without negatively affecting outputs.

(3) Energy Management Plan

Once the full picture is understood, an energy management plan can be drawn up to guide both maintenance and investment decisions going forward as buildings are transitioned towards greater energy efficiency and increased reliance on renewable energy sources.

(4) Consider formal or informal energy benchmarking

The ARC platform *www.arcskoru.com* is an online platform that measures, scores and benchmarks energy performance.

(5) Set energy consumption targets and monitor against meter reading.

(6) Use of thermostat set points

Allow the thermal and humidity set points to vary with the season and ensure that building managers align these more closely to outdoor conditions.

(7) Energy efficiency through retrofitting or refurbishing

Paint ceilings and walls light colours (especially soffits (ceilings) and walls of parking areas which should be painted white or off white) to reduce the amount of artificial lighting required as lighter

colours help to reflect natural light deeper in to the building. This should be in conjunction with painting the roof with light colored reflective paint, to minimize the amount of heat coming into the building and reduce the energy required for building cooling**.**

(8) Retrofit the installation of electrical sub meters to allow building owners to identify where energy is being used and flag and remediate inappropriate usage.

(9) Install timer switches on small equipment, thus allowing them to switch off automatically when not in use.

(10) Upgrade all motors to high efficiency motors which have the benefit of being both quieter and more energy efficient.

(11) Retrofit power factor (PF) correction units to keep the PF of the building as close to 1 as possible. This enables improved energy efficiency and lowers power costs for the building.

(12) Look to strategies for peak energy demand reduction, which involves reducing the daily peak power usage of the building by means such as thermal ice storage or co-generation.

(13) Domestic water and heating water can be upgraded through the installation of a new solar geyser to heat water, and a control and/or boiler upgrade.

(14) The HVAC can be upgraded to the more energy efficient variable air volume (VAV) HVAC system when the opportunity to replace the current one arises.

(15) Install internal blinds or external shading devices to reduce heat gain.

(16) Add solar film to existing glazing or replace single with double glazing to reduce heat/cold gain.

(17) Properly sized lighting zones: Office lighting zones should not exceed 100m², and all enclosed areas should have their own operable and clearly labelled light switch

7. WATER



7.1. Introduction

In Kenya, clean and accessible freshwater is considered a scarce resource. This means that more water is needed by agriculture, industry and the population than is available. This situation is made worse when drought reduces the amount of rainfall received and when floods inundate systems thereby polluting water and causing damage to infrastructure and housing.

Rapid urbanization of Nairobi County has stretched the capacity of the County to supply all of its residents' potable water, causing water shortages. Water usage in Nairobi is a critical issue, with the city's demand far exceeding its supply capacity. Nairobi's daily water demand stands at approximately 870 million liters, while the maximum production capacity from its treatment plants is around 525.6 million liters. This significant shortfall has led to ongoing water rationing in the city, with some residents receiving water only once a week. The water supply in Nairobi is also marked by stark inequalities. Wealthier neighborhoods generally have better access to piped water, while residents in lower-income areas often rely on communal taps or water kiosks. Research shows that residents in higher-income areas are much more likely to receive the World Health Organization's recommended 1,500 liters per person per month, compared to those in low-income areas.

With regard to sanitation, informal settlements in areas to the North, South and East of the County tend to have poor water borne sanitation, whereas the West is characterized by more formal residential areas.

Sustainable Water Management focuses on conservation, efficiency, and sustainability.
Green buildings use advanced technologies and strategies like low-flow fixtures, rainwater harvesting, and greywater recycling to reduce water consumption and waste.
Efficient water use in green buildings leads to economic benefits through reduced utility costs and aligns with environmental sustainability goals, promoting a more resilient built environment

Kenya has several acts, policies, and regulations aimed at supporting water management and addressing challenges related to water supply, distribution, and conservation. Some of the key policies and legal frameworks relevant to water management in Nairobi and Kenya as a whole include:

1. The Water Act, 2016
2. National Water Policy, 2021
3. The National Water Master Plan 2030
4. Water Resource Management Rules, 2007
5. The Water Services Regulatory Board (WASREB) Guidelines

6. Kenya Vision 2030

These policies and legal frameworks aim to ensure sustainable water management, improve access to water services, and protect Kenya's water resources for future generations.

7.2. What needs to be changed

There are linkages between water and energy use – with municipal water infrastructure using significant amounts of energy. Efficient water systems result in efficient use of energy too. Everybody has a responsibility to use water with care, both through reducing the amount of water used and through ensuring that water is not contaminated.

7.3. What needs to be done at Pre-design and Design stage

1. **Water metering**

Good design strategy dictates a well-designed and laid out water supply system with a network of water meters (including good sub-metering and leak detection). Water meters monitor the amount of water that is supplied to the building and then each floor, bathroom or major water-using system depending on the level of detail desired. Monitoring of leaks can significantly reduce water wastage- even a small drip can waste more than 200l of water a day.

2. **On-site stormwater management**

Methods of capturing, retaining and filtering stormwater on-site and releasing it slowing to County or ecological systems should be incorporated into the design of the building site and landscaping. This is known as Sustainable Urban Drainage Systems (SUDS). This is especially needed in Nairobi, where there is a large proportion of rainfall in short and hard bursts from thundershowers which can quickly inundate stormwater systems and cause flooding.

On-site strategies for stormwater management which can be designed by a civil engineer or landscape architect include (these are designed in accordance with the calculated amount of stormwater for average rainfall and storm events):

- Increased permeable paving and surfaces which allow for stormwater to infiltrate the ground.
- Soak-aways are usually excavated pits that are packed with coarse aggregate where water is directed to a specific permeable portion of the site where it is detained and slowly infiltrates the ground.
- Designing a green roof where the roof of a building is planted with low maintenance vegetation. Green roofs retain and filter rainwater thereby releasing cleaner water more slowly, which reduces the damage caused by flooding during large storm events.
- Filters and traps: When placed on-site at a point in the stormwater system before water is released from the building site, these help to reduce the amount of solid particle pollution, grease and oil released into the stormwater system which can clog pipes and harm rivers and wetlands and their wildlife. This can be especially important in vehicle parking lots, vehicle mechanic workshops and petrol stations where there is often a high concentration of toxic oils present on the paving surfaces.

3. **Building location and orientation on site**

If a land parcel chosen for development has either a wetland or river (seasonal or perennial) flowing through or present on the site, then great care must be taken not to disturb the water body and its surrounding ecology by locating the building too close to these systems. Along with the

recommendations provided through the environmental impact assessment process, the building location and orientation needs to comply with national and county laws and regulations on riparian zone requirements., A building should not be located within 30m of a water body or within a floodplain (1:100 year flood line). This is to reduce the likelihood of damage to the ecosystem or building.

Rainwater harvesting

Rainwater harvesting is a system which collects rainwater runoff from the roof(s) of buildings and stores it on-site. This untreated water can then be used for irrigation of plants or crops, the refilling of swimming pools, washing cars or other non-potable water uses.

Onsite wastewater treatment and reuse: The average suburban house can use between 200 – 300 liters of reusable water on a daily basis. Wastewater can be treated using wastewater treatment technologies and reused on site rather than releasing it into the sewerage system as it does not contain harmful pathogens.

Landscaping practices and drip irrigation: The average suburban household can use up to 37% of their total water consumption in watering their garden. This is a large proportion of potable water which could easily be saved through implementing the following:

- Use rainwater or greywater to irrigate plants.
- Plant vegetation that is indigenous and endemic to the region – these plants are best suited to the natural rainfall and climatic conditions and therefore will require less water.
- Plant landscapes that are made up of plants that only require watering for the first year, whereafter they rely solely on local rainfall (also known as xeriscapes).
- Specify drip irrigation for landscaped areas. This system allows water to be released where it is needed, with benefits including less weeds hence reduced maintenance costs. Whilst it is costlier initially, the benefits see a rapid payback. Note that drip irrigation can often not be used with greywater systems.

Swimming pool

It is essential that swimming pool design (be it commercial or residential) includes a settling and recycling tank for backwashed water (this has the added benefit of reusing chemicals) and pools should be required to have a pool cover over the pool when not in use.

Specify water-efficient fixtures and fittings

Specify fixtures and fittings in accordance with Green Star and EDGE rating tools - green Building rating tools like Green Star, EDGE and LEED provide limits on the expected water demand and flow rates for fixtures, fittings and appliances in buildings.

Fire management systems

The use of water-based systems for fire suppression in buildings such as sprinklers can be replaced with other non-water-based systems, which include carbon-dioxide and foam systems, either automatic or manual.

7.4. What needs to be done during the Construction stage

7.4.1. Implement water efficiency and demand management initiatives

As water is used on-site in the construction process and for operational functions of the site, it is also necessary to reduce water demand through the use of water-wise practices and water-efficient features. These strategies can include installing water-efficient and low flow rate taps and showers.

7.4.2. Implement on-site water management strategies

Adopt an environmental management plan which stipulates the following practices for water:

(a) No leaking taps or hoses on site.

(b) Sufficient, well-marked and enclosed waste holding areas (bins/skips) and toilet facilities to prevent the spread or leakage of waste from the site which could pollute local water bodies.

(c) Washing of cement mix and paint brushes to take place into designated settling tanks where the particulate matter can be separated and disposed of suitably. No cement water to be allowed to seep into the ground.

(d) Any groundwater pumped from site to be pumped into suitable settling tanks and the particulate removed before being allowed to enter the stormwater system.

(e) Ensure all hazardous wastes and materials (such as motor oil) are in sealed containers to prevent the spread or leakage of waste from the site which could pollute local water bodies.

7.5. What needs to be done during the Operations & Management stage

7.5.1. Encourage water efficiency through behavioural changes

An ongoing educational program should be run to teach building users how to maximize the benefits of the green building features installed, and to reinforce good behavior over time. This may include a dashboard (electronic screen or intranet based) showcasing savings due to good behavioral practices, and indicating ways to better improve or extend this to another environment (office to home or residential complex to commercial).

7.5.2. Improved water management and efficiency through good operational practices - Water use audit

As part of a full eco-audit or separately, building managers should undertake a water audit to understand where water is being used in the building and opportunities for reducing water consumption.

7.5.3. Water management plan

Once the water audit is completed and the building manager understands where water is being used, a water management plan can be adopted and implemented.

7.5.4. Water meters

Water consumption should be monitored regularly (monthly or quarterly) and be compared with the first water audit and management plan to see if the measures put in place to improve water efficiency and reduce demand are working.

7.5.5. Fire systems

Water-based fire suppression systems require that the pressure and water supply be checked regularly.

7.5.6. Irrigation practices and water conservation systems

During the hot months, perform irrigation in the early morning or late afternoon as this reduces water lost to evaporation (avoid watering between 10am and 2pm from October to March). Irrigate less during cold months as evaporation rates are lower and many plants are dormant therefore requiring less water. In the cold months, when the evaporation rate is lower, change the hours of watering to the warmer hours i.e., 9am to 3pm.

7.5.7. On-site stormwater management

Ensure that regular cleaning and clearing of the stormwater system is undertaken to prevent blockages that can cause on-site flooding.

7.5.8. Encourage water efficiency and demand management within the maintenance cycle leak detection

Ensure that all pipes in the building's water systems are maintained and replaced when necessary to prevent water leaks.

7.5.9. Install water flow inhibitors in all taps

Many taps can be fitted with flow inhibitors which reduce the flow rate of water and therefore reduce the amount of water used. This is a simple measure which can be done at low cost with large benefits to reduce water consumption.

7.5.10. Install cut-off switches

Install cut- off switches to houses and gardens or at least to bathrooms and public restrooms to ensure that water supply is automatically stopped should it be seen to be running constantly for a period of time.

7.5.11. Utilise precincts Water Strategies:

(a) **Identify areas prone to flooding and adopt measures to prevent flooding.**

(b) **Incorporate Water Sensitive Urban Design (WSUD) strategies like**

Filter strips: are vegetated areas or strips of land that are used to manage shallow overland stormwater runoff through filtration. These are most often located along pavements or cycle paths.

Bioswales are landscaped depressions used to manage stormwater runoff through several natural processes such as filtration, adsorption, biological uptake and sedimentation (Debo & Reese, 2003).

These are larger than filter strips and can be planted with larger vegetation such as trees and are often placed along roads or in parking lots.

Retention ponds are relatively large depressions that temporarily store stormwater runoff in order to reduce the downstream flood peak (Woods-Ballard et al., 2007).

(c) **Cluster activities for water reuse**

When designing a new city section or neighbourhood, consider activities which use water and how they can be clustered and located near one another for easy reuse of water. For example, a sports field that has shower facilities can reuse water from the showers for the field or for a local community garden once filtered.

(d) **Consider a precinct-scale blackwater treatment system**

Blackwater refers to water flushed down toilets and urinals, which may or may not also include greywater from other sources. Blackwater recycling refers to the treatment of this water to potable or non-potable water standards. This works best at a precinct scale, as the system requires a continual waste stream to work effectively, and has numerous benefits (economic and ecological) for a community.

8. WASTE



8.1. Introduction

Nairobi generates 2400 tonnes of solid waste every day, 20% of which is plastic waste;45% of it is recycled while the rest finds it way to Dandora dumpsite, the streets and Nairobi rivers. Waste management is a key priority for the County government, since it is responsible for the implementation of the devolved function, waste management. Consequently, the county is required to ensure county waste management laws conform with the Sustainable Waste Management Act, 2022.

Solid waste found in the County includes: Compostable waste such as garden trimmings, street sweeping, refuse from households and markets ; Recyclable waste such as glass, plastic, tin: Reusable waste such as construction rubble; non-hazardous solid waste from industrial, commercial and institutional establishments (including hospitals) and hazardous waste such as asbestos and motor oils.

This disposal facility, the Dandora Site, exceeded its lifespan in 2001 but continues to receive more garbage. A national Sustainable Waste Management Policy and the Sustainable Waste Management Act 2022 are in place and soon, the Extended Producer Responsibility (EPR) regulations will also come into force in order for the Country to adopt a circular approach to waste management. Implementation of Nairobi County waste management act 2015 and Waste management act 2022, will significantly reduce the amount of construction and demolition waste generated and sent to the dumpsite.

What the County is currently doing.

1. Regulatory Measures: Nairobi County has begun the process of aligning its local laws with the national Sustainable Waste Management Act.

2. Infrastructure Development: The County has been working on establishing the necessary infrastructure for effective waste management. This includes the development of

   - Material Recovery Facilities (MRFs) for sorting, segregation, composting, and recycling of waste, for example, Mukuru Integrated Waste Management Recycling plant in 2019 that was recommended by the Environmental and Natural Resource Consortium compromising of Nairobi County Government Environmental Department, SEI Africa Center, Sanergy, Slum Dwellers International, Muungano wa Wanakijiji and the University of California Berkeley.

   - Sanitary Landfills at Ruai- plans to construct a 45-megawatt power plant that will convert waste into electricity. The dumpsite project is expected to include not just waste disposal facilities but also a waste-to-energy plant. This plant will significantly reduce the volume of waste and provide a sustainable energy source for Nairobi.

3. Public Awareness and Education: The county , through Circular Economy, has launched Campaigns such as ‘ Taka ni Mali’ which translates to Waste is Wealth. These campaigns not only sensitise the public about waste management but also show through proper management, waste can become a huge resource to the County.

4. Partnerships and Collaborations: Nairobi County has been collaborating with the National Environment Management Authority (NEMA) and other stakeholders to implement the minimum standards for waste management as stipulated in the Act. This includes ensuring that waste collection vehicles are licensed and that disposal sites are properly managed and secured.

8.2. What needs to be done at Pre-design and Design stage

8.2.1. Reduce construction waste:

(a) Examining an existing building or designing a new structure so as to honour the existing building shell as much as possible, either retaining and building on to it, or reusing existing materials, such as roof tiles, ceiling trusses or bricks, in the new structure. Demolition waste can be crushed and reused as a base course of fill in a replacement structure.

(b) Where possible, teams should look to off-site construction of base materials, which can then be assembled on site. This not only reduces onsite construction waste but also reduces damage to the finished product during transport and storage, and hence less components being condemned.

(c) Design the building facade so that it can be disassembled and reused elsewhere. This allows for higher specifications to be used upfront so that the life of the panels can be guaranteed and re-use possible should the user wish to relocate.

8.2.2. Design for recycling and composting practices:

A dedicated storage area should to be provided for the separation and collection of waste consumables with good access for all building occupants and, where applicable, for collection by recycling companies. The storage area should allow for the collection and eventual recycling of, as a minimum, cardboard, paper products, glass, plastics, and metals.

8.3. What needs to be done during the Construction stage

8.3.1. Implement best practice construction strategies

The implementation of appropriate waste management strategies during the construction phase of a building can significantly reduce the amount of construction and demolition waste generated and sent to landfill. The client or developer can make it a contractual requirement that the contractor reuse or recycle a stipulated amount of demolition and construction waste.

Contractor should be required to implement a waste management plan which would detail how all waste generated during the construction process is monitored, which types and volumes of waste will be recycled, how this recycling will take place, and the responsibility of all on site towards contributing to the overall success of the plan.

8.4 What needs to be done during the Operations stage.

8.4.1 Alignment with the sustainable Waste management Act 2022 in the following areas.

1.Public education and sensitization of Reducing, Recycling and Reusing under Section 30-mandates public education and sensitization on reducing, recycling, and reusing waste. It outlines specific goals, methods, actions, and aims to create a comprehensive framework for public education and sensitization.

2.Sorting of waste at the source to facilitate proper management of the waste under section 23 - emphasises the importance of sorting waste at the source as a crucial step in effective waste management. It means separating different types of waste materials at the point where they are generated, such as homes, businesses, or institutions.

3.Ensure proper collection, transportation, and disposal of waste by licensed collectors.

4.Reporting and monitoring of the waste generated under section 28 - This section instils the importance of reporting and monitoring waste generation as part of a comprehensive waste management strategy. It will ensure that waste management practices are transparent, accountable, and capable of meeting sustainability goals.

5.Construction projects are encouraged to use materials with recycled content under Section 25 - This section encourages construction projects to use materials with recycled content, this initiative aims to promote sustainable building practices, reduce waste, and conserve natural resources.

9. INTERNAL ENVIRONMENTAL QUALITY



9.1. Introduction

Much of the building stock currently in use in Kenya and indeed in Nairobi consists of outdated or poor designs and building systems, and offers building occupants a poor internal environmental quality (IEQ). This includes high noise levels, stuffiness, poor levels of ventilation, bad internal space design and poor thermal comfort (that is heating and cooling controls, air quality, air tightness, daylighting and artificial lighting, and a lack of privacy). Health problems relating to poor indoor air quality have a major impact on staff productivity, and in the late 1980s the term “sick building syndrome” was coined to describe this.

Modern materials used in buildings are constantly off-gassing, and so the average building occupant is impacted by not only their own carbon dioxide emissions, but also pollutants such as volatile organic compounds from fittings and furnishings, and toxic emissions from the suite of IT equipment in offices and at homes.

9.2. What needs to be done at Pre-design and Design stage

9.2.1. Design for improved ventilation and fresh air provision

(a) Design to provide opportunity to maximize the provision of fresh air within a building. The three ways of providing this fresh air are via natural ventilation, mechanical ventilation or mixed mode ventilation, which is a combination of the two.
A design with natural ventilation should utilize cross-ventilation through operable windows and vents, with openings constituting at least 5% of the floor area in order to capitalizes on the local wind patterns and/or enhances air movement through the building’s form.
Mechanical ventilation systems must have energy-efficient fans and should recover at least 60% of energy from exhaust air or exceed the five litres per person per second or as stipulated by a national standard.

(b) Design of any HVAC (Heating, Ventilation and Air Conditioning) system to include systems which deliver sufficient quantities of fresh air to all occupants during the occupied time, and which monitor and trigger an audible alarm should pollutant levels (particularly Carbon dioxide) rise above a designated safe level (normally assumed to be CO_2 > 1,000ppm).
Heating, Ventilation, and Air Conditioning (HVAC) systems must be equipped with filters rated at minimum MERV 13 to remove particulates effectively. These filters should be inspected regularly to maintain air quality standards.

9.2.2. Provide sufficient fresh air

(a) Outdoor Air Intakes Placement, like the air intake vents, must be located at least 10 metres away from sources of pollution such as vehicle exhausts or industrial emissions.
(b) In instances where mechanical ventilation is used, the HVAC system should be designed in such a way that the majority of the useable area of that building is supplied with fresh air at rates which comply with or exceed the five litres per person per second or as stipulated by a national standard.

(c) A carbon dioxide monitoring and control system should be included with a minimum of one CO_2 sensor at all return points on each floor so as to provide constant adjustment of outside air rates to each level
(d) At rates expressed in litres per second (L/s) per person or as air changes per hour (ACH). These rates vary depending on the type of building and its occupancy.
- Residential Buildings: Fresh air supply rates might be around 5-8 L/s per person, ensuring that indoor air quality is maintained for comfort and health.
- Commercial Buildings: Office buildings and other commercial spaces often require a higher fresh air rate, typically around 8-10 L/s per person, to account for higher occupancy and activity levels.
- Industrial Buildings: The fresh air requirements in industrial settings can be much higher, depending on the nature of the work and the presence of contaminants. Rates can range from 10-15 L/s per person, with additional measures for local exhaust ventilation.
- Health Facilities: Hospitals and clinics have stringent requirements, often requiring 12-15 L/s per person in general areas, with higher rates (20-25 L/s per person or more) in critical areas like operating rooms and isolation wards to control airborne infections.

9.2.3. Design for good daylighting and electrical lighting

(a) Design the building to allow building users to capitalise on maximum access to natural daylight, whilst ensuring that glare is reduced and that the façade design does not encourage radiant heat build-up. Proper placement of windows and skylights ensures even distribution of daylight throughout the building, minimizing the need for artificial lighting.

(b) Project teams should specify light emitting diode (LED) lights, since they are highly efficient fittings that are now commonly available. They provide a “better” quality of light to the user than standard tubular fluorescent lamps and save significantly more energy (and money) than standard incandescent lights.

(c) Buildings should be designed with the lowest possible ambient lighting levels, and this should be supplemented with task lighting. Whilst the direct benefits of reduced lighting loads relate to lower electricity costs, reducing the amount of lighting also directly reduces heating loads and air conditioning requirements, therefore further reducing costs for the building operations.
(d) It is important to consider window size and positioning for deeper penetration of natural light into inner spaces. This is done by ensuring a minimum setback of at least 3 meters depending on the road the plot abuts.

(e) Consider Zoned lighting as a significant part of any demand reduction strategy and should be included in all new buildings. The most basic zoned lighting system allows users to switch off lights in areas that are not being used. More modern systems see zones linked to sensors that turn off lights automatically in unoccupied areas or in areas that are receiving enough daylight to not need lighting (these are termed “photometric sensors”).

9.2.4. Thermal Comfort

a) Building design should allow for individual thermal comfort control (either individually controllable ventilation openings in the case of naturally ventilated buildings or user control over air supply rate and air temperature in mechanically ventilated buildings). Office areas should be thermally zoned, with separate zones for core and perimeter areas.
b) Promote occupants' productivity, comfort, and well-being by designing for high quality thermal comfort and providing occupant controls. Projects have to meet the requirements for both thermal comfort design and thermal comfort control. For the design of the system there are two options:

- Option 1 is ASHRAE 55-2010
- Option 2 is ISO and CEN standards

c) To control Indoor Temperature and Humidity, Indoor temperature should be maintained between 20°C to 26°C with relative humidity levels between 30% to 60% for optimal comfort and health.
d) The use of appropriate building layout i.e place windows on opposite sides of the building to maintain a good cross air flow.
e) Materials and sun shading devices to prevent heat gain and enhance cooling. For example 10mm Roof Heat Insulation Polyethylene Roll
f) Using vegetation barriers also assists with maintaining indoor thermal comfort. Indoor landscaping improves air quality and is known for air purification properties in common areas to enhance IAQ naturally.

9.2.5. Reduction and monitoring of building-related emissions

A. Another aspect of indoor air quality relating to buildings is ensuring that building design should include the specification and installation of building systems which minimise the environmental damage from refrigerant leaks, hazardous fluids and gases used as refrigerants.

9.2.6. Universal access

A. All buildings should be designed to allow for universal access at all entrances to the site or building. Universal access allows for ease of entry to those who use wheelchairs, prams, walking sticks and other aids for mobility.
B. It allows optimal functioning of the building as every user especially those with disability are able to engage with the building functions as required herein.
C. Establish a minimum headroom requirement to ensure comfort and safety in interior spaces. For instance, the standard minimum headroom is around 2.7 meters (about 9 feet) for habitable rooms
D. Automatic doors and lighting systems not only provide ease of access and use but also reduce energy use through efficient control systems.

By incorporating universal access into green building design, we create environments that are not only sustainable and energy-efficient but also inclusive and beneficial for all members of society

The easiest available reference for this in Kenya is the National Building Regulations 2022 (Building Code) or green building rating tools (Green Star, EDGE, LEED).

9.3. What needs to be done during the Operations & Management stage

9.3.1. Opportunities for improved IEQ through good operational practices

(a) Implementing monitoring and control procedures to constantly assess and adjust systems to prevent and minimise the build-up of indoor pollutants in the building.

(b) The building manager or owner needs to establish a set of performance metrics for minimum indoor environment quality for the building based on green building best practice principles. Some common metrics are:

- Carbon monoxide levels in covered parking areas should not exceed 26ppm.
- Carbon dioxide levels in regularly occupied areas should not exceed 1000ppm.
- Levels of pollutants like CO_2, VOCs, particulate matter, and humidity.

(c) Engage a local engineering firm to perform quality checks on the HVAC installation.
(d) To verify that all systems are installed correctly and meet the specified Indoor Environmental Quality standards.
(e) Green Building Measurements: These measurements help assess and ensure that a building meets high sustainability standards, reducing its environmental impact while enhancing occupant health and comfort. They are essential for achieving green building certifications and maintaining long-term operational efficiency.

(f) Building managers should ensure that a good maintenance schedule is compiled and adhered to, that air filters are regularly inspected and replaced, and fresh air ducting cleaned. A quarterly schedule is recommended, but at a minimum annually.

(g) Indoor Air Quality (IAQ) best practice should include an environmental tobacco smoke policy for the building (to prevent and minimize exposure to environmental tobacco smoke prohibit smoking in the building, locate exterior designated smoking areas as least eight meters away from all building entries, outdoor air intakes, and operable windows).

Figure 15: Performance Measures for Buildings

Performance Measure	Excellent	Good
Thermal Comfort (AC)	-0.5<PMV<+0.5	-1<PMV<+1
Thermal Comfort (natural ventilation)	<1% operating hours exceed 28 °C	<2% operating hours exceed 28 °C
% Usable Area >2% Daylight Factor	>60%	30-60%

9.3.2. Encourage the use of green eco-friendly cleaning materials

(a) The building manager can use green cleaning techniques and materials to assist in reducing emissions exposure to cleaning teams and building occupants alike to potentially hazardous chemical, biological and particulate contaminants.

(b) A holistic implementation program should be implemented including:

- Green cleaning policy – cleaning products, cleaning equipment, standard operating procedures, hand hygiene, handling and storage of hazardous materials, feedback mechanisms, move to environmentally friendly products.

- Indoor integrated pest management system - manage indoor pests with the most effective, least risk and environmentally friendly options.

- Green purchasing and procurement.

- The specification and use of low irritant or non-chemical cleaning products.

9.3.3. Monitor outdoor air delivery

(a) retrofit buildings with ventilation system monitoring in order to help sustain building occupants' comfort and well-being. This should include the provision of carbon dioxide (CO_2) sensors in densely occupied spaces (particularly relevant to commercial buildings). It is desirable to keep CO_2 levels at under 700ppm at any given time.

(b) The IEQ management strategy for a building may include the desire to increase rates of natural ventilation. This can be done in part through the installation of openable windows for cross ventilation where these do not already exist. Another strategy used by some building managers is the supplementation of the mechanical ventilation systems with natural ventilation.

(c) Alarm Systems for Pollutant Levels;IAQ monitoring systems should have alarm capabilities to alert occupants when pollutant levels exceed safe thresholds.

9.3.4. Opportunities for improved IEQ within the maintenance cycle

(a) **Reduction of internal pollutants and mold**

Only no- or low-volatile organic compounds (VOC) and no or low formaldehyde products should be used in the internal spaces of a building. This includes but is not restricted to paints, adhesives and sealants, carpets and flooring, engineered wood products.

Check that the HVAC system maintains a humidity level of no more than 60% relative humidity in the space and no more than 80% relative humidity in the supply ductwork.

(b) **Reduction and monitoring of building-related emissions**

It is highly recommended that building managers implement a replacement policy for refrigerants and insulants, and in the medium-term work to replace all non-zero ozone depletion potential (ODP) refrigerants (or equipment) and insulants with less harmful modern ones. Associated with this would be the implementation of a plan to convert the refrigerant mass serving the building to low (<10) global warming potential (GWP) refrigerants.

(c) Use of CO_2 Sensors

Installation of CO_2 sensors in densely occupied spaces to adjust ventilation rates dynamically based on occupancy and activity levels.

Conduct routine maintenance to prevent system failures and ensure optimal performance.

(d) User feedback

Collect feedback from occupants on comfort levels to make necessary adjustments to the indoor environment.
Implement a digital feedback platform for reporting IEQ issues which would be responded to in 24 hours.

(e) Maintenance manual
Develop a comprehensive maintenance manual specific to the installed systems for guidance of maintenance staff on using and maintaining the new air purification systems.
Partner with local universities to provide ongoing training for maintenance staff on new IEQ technologies.

9.3.5. Opportunities for improved IEQ when retrofitting or refurbishing

A major building retrofit or refurbishment presents an ideal opportunity to make more significant changes which may have a marked positive impact on the indoor environmental quality.

(a) Identify and remove hazardous materials such as asbestos (many old ceiling tiles are asbestos and asbestos was also historically painted onto soffits as a fire retardant) should be embraced as a first step in any retrofit. For such hazardous materials use professionals for safe handling and disposal.

(b) Installation of properly zoned systems for lighting and HVAC should be considered, along with the introduction of opening windows where appropriate to allow for natural ventilation, and the introduction of internal or external screening and blinds to maximize daylight but minimize glare and radiant heat.

(c) Light fittings are another easy target, and all magnetic ballasts should be replaced with LED lighting.

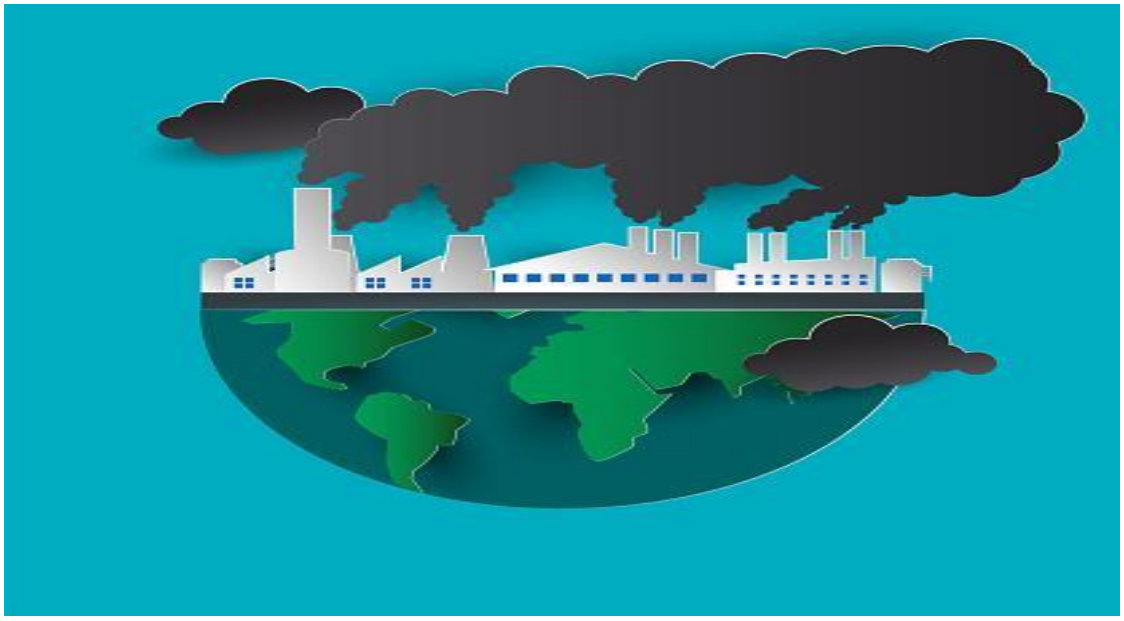
(d) In office buildings, any cellular offices should be in the middle of the floor, with transparent glass, and open desk areas should be at the perimeter. Open plan fit-outs provide the most daylight to the greatest proportion of floor area.

(e) In multi-unit residential buildings, living areas and bedrooms should be at the perimeter with kitchens, bathrooms and utility areas in the core.

(f) Internal layouts should be designed so as to maximize views to the outside for the majority of building users, and to cluster printers and photocopiers in an area which can be ducted.

(g) In larger buildings the opportunity may exist for the introduction of an atrium within the building, which will assist in improving natural daylight, ventilation and air quality.
(h) Flush-Out Procedures Before Occupancy;Buildings should undergo a minimum two-week flush-out with maximum outdoor air rates prior to occupancy to remove residual construction pollutants.
(i) Soundproofing; Some soundproofing materials, like certain acoustic panels, also have insulating properties that can help improve the building’s thermal efficiency and air tightness. This reduces the ingress of unfiltered outdoor air, helping to maintain better control over indoor air quality.

10. POLLUTION



10.1. Introduction

Rapid industrialization and urbanization have benefited humanity and improved the quality of human life. However, industrialisation and urbanization both have negative effects as well.

Air pollution in and around is referred to as urban air pollution. Urban air pollution is worse in areas with denser inhabitants and it is for this reason, that for the County in particular, pollution is a key area of concern.

10.2. What needs to be changed

Air quality and noise and light pollution can be managed and improved through a wide range of initiatives which reduce and control the activities associated with the generation of noise, dust, harmful chemicals and excessive light.

In Nairobi, to support the County's green and sustainable buildings journey, it is necessary to put measures in place to improve on current levels of air, noise and light pollution and reduce the urban heat island effect thereby creating a healthier and more comfortable external environment for County residents and building occupants with reduced impact on local ecosystems.

10.3. What needs to be done at Pre-design and Design stage

10.3.1. Reduce Air Pollution

a) **Green roofs and landscaping:** Plant more trees and design for more landscaped areas on-site to help reduce the amount of harmful greenhouse gas (GHG) emissions in the atmosphere. Trees and vegetation absorb carbon dioxide and release oxygen. They also help to settle out, trap and hold particle pollutants that are in the air (such as dust, smoke, pollen and ash) which would otherwise damage human lungs and cause breathing problems.

b) **Reduce harmful GHG emissions in air-conditioning**: good building design ensures that the harmful emissions from air conditioning and insulants are minimised. (See more in section on Internal Environmental Quality.)

c) Reduce the urban heat island effect:

Strategies to do so include:

- Reduce impermeable surface cover: Reduce the number of impermeable surfaces such as car parks, pavements and kerbs, and roofs which retain more heat for longer in comparison to permeable surfaces and contribute towards the heat island effect.

- Increase soft landscaping and shading: Create shaded areas on or around the site with trees or other structures and increase the site area designated for soft landscaping.
- Roof material and colour: Specify light-coloured roofing materials or install a green roof. Often buildings are left with roof areas painted black from the waterproofing. This absorbs heat and contributes to the heat island effect.

10.3.2. Reduce the effects of noise pollution design site layout for noise reduction

The arrangement of buildings on a site can be used to buffer and minimise noise impacts.

a) design site layout for noise reduction

Design building layouts that naturally buffer and minimize noise pollution, using structures or natural features to absorb or deflect noise away from sensitive areas.

b) Soundproofing Materials:

- Acoustic Insulation: Use sound-absorbing materials within walls, floors, and ceilings to minimize the transmission of noise between different spaces within the building. Insulation materials such as mineral wool, acoustic foam, or fiberglass can be effective.
- Acoustic Panels and Baffles: Install acoustic panels on walls and ceilings to absorb sound and reduce echo within rooms. These panels can be designed to fit the aesthetic of the space while improving acoustic performance.
- Double-Glazed Windows: Use double or triple-glazed windows with air gaps between the panes to significantly reduce the amount of external noise entering the building. Laminated glass can also enhance noise reduction.
- Acoustic Doors and Seals: Install solid-core doors with acoustic seals around the edges to prevent noise from leaking through gaps around doors. Acoustic doors are particularly important for rooms requiring high levels of sound isolation, such as offices, conference rooms, or residential bedrooms.
- Flooring Solutions:Floating Floors: Use floating floors, which are decoupled from the building's structure, to reduce impact noise transmission from foot traffic or machinery. These floors can include resilient layers that absorb vibrations.
- Carpets and Rugs: In areas where sound reduction is essential, use carpets, rugs, or underlay materials that can absorb sound and reduce noise from footsteps.
- Acoustic Ceilings: Install suspended acoustic ceiling systems with sound-absorbing tiles. These systems are particularly effective in large open spaces or buildings with high ceilings, helping to reduce overall noise levels and improve speech intelligibility.

c) Vegetative Buffers and Green Walls: Incorporate green walls or vegetative buffers around the building to absorb and deflect noise from outside sources, such as traffic or nearby industrial activities. Plants naturally help reduce noise pollution and provide added aesthetic value.

d) Isolation of HVAC Systems: Mount HVAC systems on vibration isolators to prevent the transmission of mechanical noise through the building's structure. Use sound-attenuating ductwork and enclosures to minimize noise from air handling units.
e) Enclosures and Barriers: Enclose noisy mechanical equipment, such as generators or pumps, in soundproof barriers or rooms to contain noise and reduce its impact on surrounding areas.

10.3.3. Prevent and eliminate light pollution

Reduction of lights shining outwards from the building: When designing internal and external lighting for the building ensure the design prevents light from being emitted from the building and/or the site, especially at night.

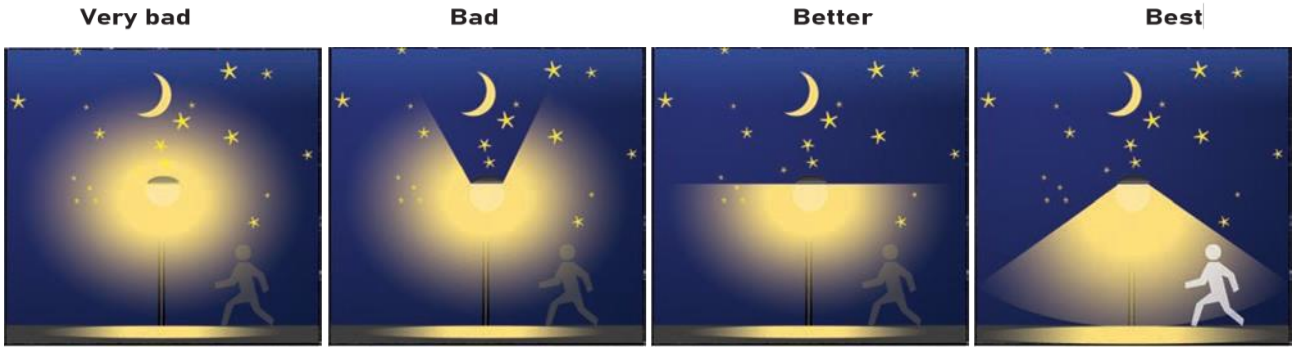
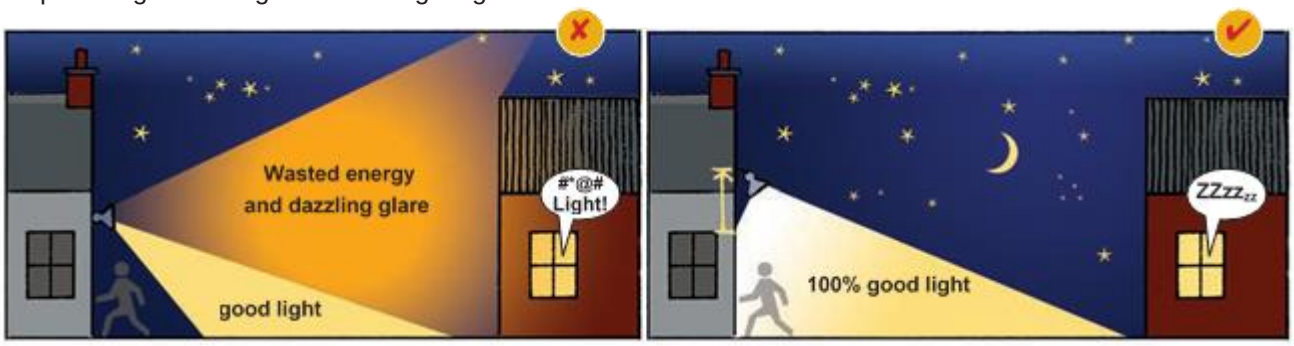


Figure 16: Good street and building lighting to minimise light pollution

Lighting for streets, walkways and parks: The provision of public lighting should prevent the emission of direct light into the night sky.

- To prevent this, street and pathway lighting must be angled so that it points where light is needed and not upwards.
- Design factor is the placement of lights where lights are evenly distributed to prevent overlap of lighting. The use of light emitting diode (LED) lamps can help reduce light pollution through providing more targeted street lighting.



Badly aimed 500W halogen floodlight Well aimed 100W floodlight

Source: http://kerrydarksky.com/light-pollution/)

Monitoring and Compliance

It is important to monitor conditions throughout a building's life cycle to check on the efficacy of measures adopted to prevent/ reduce pollution. For this reason building managers should have in place regular air, noise, and light pollution monitoring systems to ensure that buildings comply with the guidelines.

There is need to establish a clear process for reporting and addressing violations

11. BIODIVERSITY



11.1. Introduction

Biodiversity is the variety all living things and their interactions. The diversity and quantity of life in a city is known as urban biodiversity. Urban nature includes all forms of life found in a city, such as gardens, green roofs, street trees, birds, and other species that can be found there. It also includes large, comparatively untamed green and blue regions

Currently, due to population growth, urban sprawl, rapid urbanisation and harmful land use practices, biodiversity and the ecosystems are being damaged and undermined.

Healthy and well-functioning local ecosystems can provide services “free of charge” to support the city,urban areas and neighbourhoods and have a positive effect on curbing climate change. This includes supporting soil formation and agricultural and resource production, providing fresh water, food and fuel sources, regulating the climate, mitigating floods and disease, and providing cultural value for aesthetic, spiritual, recreational and educational purposes.

This, in turn, can benefit the well-being of residents in the County by improving security and ecological resilience, providing for basic human rights, improving and sustaining health and promoting good social relations.

11.2. What needs to be changed

The foundation of a city’s plan for preserving urban biodiversity and ecosystem services is the amount and spatial distribution of area devoted to urban green and blue spaces.

Urban green spaces refer to open space areas reserved for parks and other “green spaces” including plant life.They include closed parks,urban parks,public sports gardens ,overpasses to pedestrians and squares of public buildings. Blue spaces refer to blue infrastructure and areas dominated by surface water bodies or watercourses.They include rivers,lakes,bays etc.They are found to provide physical and mental health benefits. These are essential components for livable sustainable cities.

The baseline of urban nature can be best measured using two metrics. The County can first assess the proportion of its terrain that is now made up of green or blue area. Second, planners within the County team along with key stakeholders can determine how much of this space is permanently preserved by zoning or law. The County can ensure the conservation and reintroduction of biodiversity in public spaces including road medians and parks instead of leaving them undeveloped or not assigned any use. This ensures there is deliberate use of land in a sustainable manner therefore ensuring there is limited pollution and encroachment.

11.3. What needs to be done at Pre-design and Design stage

11.3.1. Choose development sites with limited ecological value to limit effects on biodiversity

A critical element to green building is site choice, as this is something which cannot be changed later. Preference should be given to sites within the urban edge which have been previously developed (brownfield sites), or which have been deemed to have no ecological value. This includes not building on wetlands or too close to watercourses, avoiding land within the riparian reserve of rivers, and preserving sites which are home to protected red data species. Red data species include all endangered species of animals, plants and fungi.

11.3.2. Improve the ecological value of a site

Every effort should be made to affect some form of ecological restoration, thus improving the ecological value of the site through development. This can be done through the removal of existing contaminants, the planting of local endemic species, and using a green spine on the property to allow the continuation of an ecological corridor across the site to link to other green buffers on adjoining properties.

Sensitive ecological sites should be preserved and conserved.This includes also preserving the wetlands and introduction of Bioswales that help in reducing water surface runoffs as it slowly directs water to an area where it can soak off.Bioswales could be used for enhancing greening by allowing trees and plants of various species to build their habitats therefore enhancing biodiversity.

Introduction of green roofs and green walls as a requirement for buildings in urban areas will help create a habitat for living organisms thus help to enhance biodiversity. Green roofs include living vegetation installed on roofs. This can achieved by giving provisions on:

(a) species diversity and richness,

(b) substrate type and depth,

(c) plant species selection,

(d) connectivity to natural environment,

(e) green roof ratio

(f) ecologically responsible development

All these can be assessed on the basis of whether the roofs promote diversity,provide habitat and if the roof are vegetated.

Green roofs provide green spaces, mitigate urban heat island, reduce air quality problem, contribute to stormwater management and enhance biodiversity.They also provide new wildlife habitat,replace the habitats lost through development and connect isolated habitat pockets especially if located near fragmented ground level habitats.

Green walls help reduce UV damage to surfaces and can protect a building from wind, weather and temperature fluctuations, prolonging the life of the structure.

11.3.3. Well-informed site layout and building location

As with the initial site choice, site layout and building location tend to be fixed at the onset of a development and remain static for the rest of that building's life. It is important that due care is taken in this siting. Efforts should be made to restore ancient wetland areas through construction of berms to control flooding by directing storm water,act as buffers.Therefore, it may be possible to work around existing wetlands or direct storm water runoff in such a way as to restore ancient wetland areas.

11.3.4. Existing mature trees on a site should be identified and preserved, while the built fabric should be designed so as to honour or celebrate these.

Where they cannot be retained, they should be carefully removed and relocated by a suitably qualified person or provide designs that integrate them

11.4. What needs to be done during the Construction stage

11.4.1. Implement a construction environmental management plan (EMP)

Ensure the engagement of the relevant professional status as provided by law and that the development is done in an ecologically sensitive way.

11.4.2. Protect ecologically sensitive areas

Top soil is a valuable resource. During development care should be taken to conserve as much of the existing top soil as possible. This can be stockpiled and reused on site later (preferred) or it can be carefully harvested and used on a different site (rather than sending it to landfill).

11.4.3. Rehabilitate damaged land

The very nature of construction means that it is a high impact activity. And even the most careful contractor is going to have some negative impact on the site through construction activities. Time and budget should be allocated to enable rehabilitation of the damaged land once construction is complete.

11.4.4. Consider biodiversity corridors and linked viable open spaces

The design should best encapsulate ways to create, or link up with, ecological corridors on the site, which can be both ecologically and socially beneficial. This may include a planted ribbon with a path,

which can double as a running, pedestrian or cycling track, whilst allowing natural movement of fauna and flora along it.

11.4.5. Implement good landscaping practices

Property owners or managers are encouraged to contribute positively to enhanced biodiversity in the long term through implementing good landscaping practices. A site management plan should be implemented for the landscaped areas with a focus on water-wise, endemic (or edible) plants.

11.4.6. Implement an integrated pest management plan

Integrated pest management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks. An IPM plan should be established for both indoor and outdoor pests and invasive species, and should detail recommendations for both monitoring and management. This approach emphasizes the reduction of pesticide use and the implementation of preventative and alternative control methods.

11.4.7. Rehabilitate and enhance local green spaces to increase biodiversity

An important aspect of this is recognizing that through decades of non-management, many potentially viable biodiversity areas have been degraded or functionally changed. These need to be rehabilitated. This can be a very good community building exercise, promote short- and long-term job creation, and through the buy-in of the community ensure better preservation of the space into the future.

11.5 What needs to be done during decommissioning stage

Decommissioning a building in a manner that ensures biodiversity conservation and preservation requires careful planning and execution

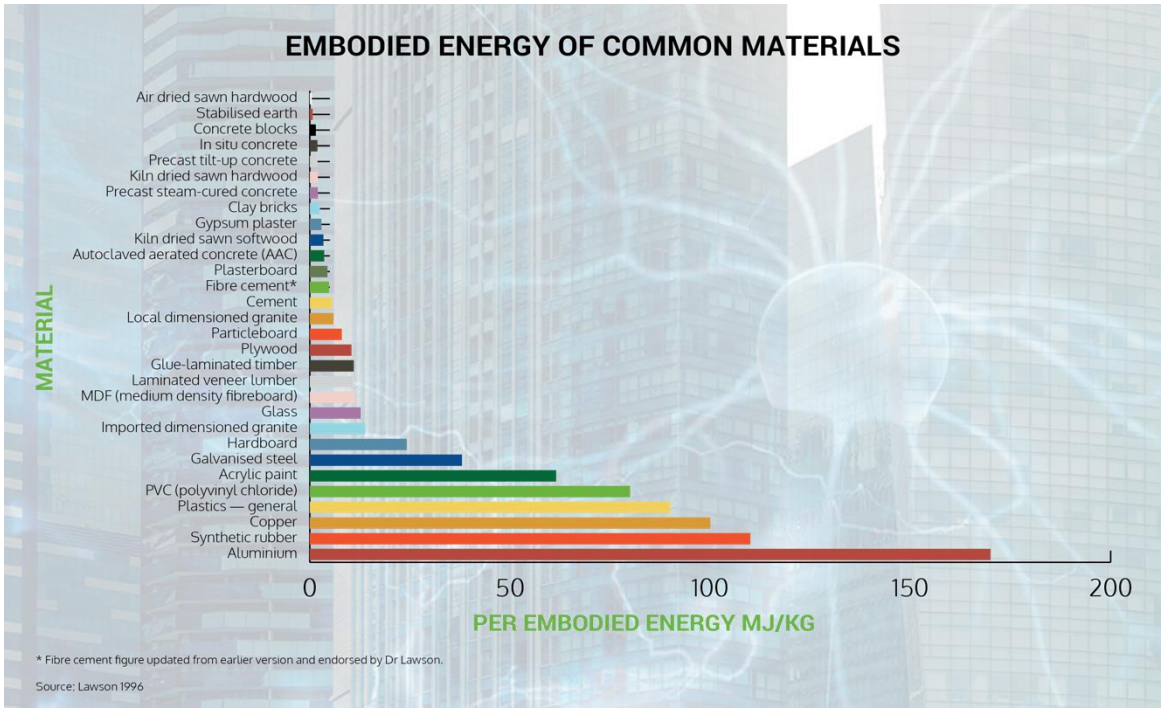
11.5.1 Provide a deconstruction plan and a monitoring plan.

One should provide a plan that prioritizes reuse and recycling of materials to minimize waste and reduce habitat disturbance. Also use methods that minimize noise, dust, and vibrations to reduce the impact on surrounding environment. One should also take into consideration the timely restoration of disturbed habitats as soon as possible after decommissioning. This could involve replanting native species, creating new habitats, and removing invasive species.Also provide a monitoring plan to track the recovery of biodiversity in the area. Adjust management practices as needed based on monitoring results.

11.5.2 Soil conditioning or remediation if there was soil contamination

Soil conditioners, also referred to as soil amendments, help improve soil structure by increasing aeration, water holding capacity, and nutrients. They help break up compacted clay soils, which lack sufficient space for air and water, both of which are important for microorganisms to thrive and for plant roots to grow.Soil remediation involves the strategy for managing soil to control salinity and sodicity, in order to reduce plant stress and improve productivity

12. BUILDING MATERIALS AND GREEN PROCUREMENT



12.1. Introduction

Building materials and construction (typically referred to as embodied carbon), are responsible for 20% of CO2 emissions' annually.

For this reason, ensuring that building materials align with green building principles is important, and a key tool to help the County reduce CO2 and help with Kenya's commitments under the Paris Agreement.

All materials require energy, water and other natural resources to be produced and transported to where they are marketed to consumers. This results in materials having embodied energy and water even before they are used. The higher the embodied energy and water of a material, the less sustainable it is considered to be.

However, the advantage that green or sustainable building materials have is that they embrace circularity, in that they can either be reused, repurposed or recycled easily.

For this reason, implementing green procurement practices means choosing materials that compliment local and global environment and socio-economic factors.

A green material has few additives (such as stone or wood rather than plastic); does not off gas or release toxic fumes (such as formaldehydes in many composite wood products do), and is made locally. The aim of these Guidelines is to promote green procurement practices that encourage and specify the use of locally sourced building materials that have low embodied energy and water.

12.2. What needs to be changed

12.2.1. Implement green procurement policies

During operation and management of a building or facility, new products and materials should be sourced locally to ensure the ongoing functioning and upkeep of premises. This policy would stipulate the conditions against which products and materials are chosen for use in the building. The green procurement policy would include the following:

a) Incentive to source for locally sourced materials and products

b) Incentive and direction to source for low embodied energy and water products

   Products that use less energy and water in the harvesting and manufacturing process have a more positive impact on the environment as resource use is reduced. Where possible, make use of products and materials that have a low embodied energy and water. This can be as simple as choosing to use sustainably sourced wood rather than plastic for tenant fit-outs.

c) Incentive to use environmentally-friendly cleaning products

d) Incentive to use alternative building materials such as sustainable mass timber, or CLT.

12.2.2.Develop a directory of local services and products

The County can also work with identified industry players such as the Kenya Green Building Society, to help consumers source products from local suppliers and manufacturers or services from residents of the county, it is necessary to provide some form of reference guide to highlight the services and goods available locally.

The materials and services directory dubbed the Jenga Green Library is a free and active tool that aims to:

a) Reduce waste and pollution during the delivery of the built environment by encouraging the use of low-carbon materials.

b) Assist developers and homeowners in selecting products and materials that perform well over time and do not degrade, which is an important aspect of circularity/sustainability in the building sector.

c) Advise policymakers on how to implement a circular model in the building and construction industry.

The County can consider incorporating the Jenga Green library as a tool in helping the supply chain in the uptake of sustainable products and green buildings by businesses and individuals in the local market.

12.3. What needs to be done at Pre-design and Design stage

12.3.1. **Design for dematerialization**

Dematerialization refers to designing a building in such a way as to reduce the net amount of material used without compromising its strength and functionality. This can focus on the reduction of material

used in the structure of the building, where less concrete and steel is used, and in the use of less material for piping, ductwork and internal finishes.

12.3.2. **Specify the use of recycled content**

Recycled material is a valuable resource as it offers renewable access to non-renewable resources. This reduces the overall environmental impact of construction materials as lower quantities of new materials need to be extracted. This, in turn, lowers the energy and water used and carbon emissions of building materials, and reduces the amount of waste going to landfill unnecessarily.

Common building materials which are recycled and reused include concrete, steel and timber.

- **Concrete:** New concrete mixes can use recycled and crushed concrete as aggregate in place of stone.

- **Steel:** Structural steel components and steel rebar used in reinforced concrete can contain high proportions of post-consumer recycled steel without undermining the strength of the material for construction purposes.

- **Timber:** When choosing timber products, either use recycled wood, reused wood or wood which is from sustainably managed sources and certified by the Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC).

12.3.3. **Specify the local sourcing of materials and products**

Sourcing materials locally is beneficial to the environment as it reduces greenhouse gas emissions associated with transport and is beneficial to the economy as it creates local jobs as demand drives growth in the materials sector. Building materials are considered to be sourced locally if they are extracted, harvested, recovered and manufactured within 400km of the construction site. To ensure even greater environmental benefits, the materials should be sourced within 50km of the site.

12.3.4. **Consider alternative building materials**

Alternative building materials, those other than concrete, timber and steel which are most commonly used, are increasingly being considered in building construction for their improved environmental benefits over conventional materials.

These can include:

- reduced volume of material.

- lower embodied energy and water.

- lower greenhouse gas emissions with improved thermal performance.

In Kenya, Cross-Laminated Timber CLT is an emerging technology where the material rivals concrete in structural integrity and is considerably lighter than its concrete counterpart that the County can consider. 3D printing is another emerging technique that is worth noting in Kenya.

When using alternative building materials and delivery ensure that they are approved by Kenya Bureau of Standards (KEBS) to credit their quality and strength for the safety of occupants.

Consider the Building's Whole Lifecycle: This involves selecting materials that are long-lasting and require minimal maintenance.

Research on new and sustainable building materials

What needs to be done during during decommissioning

End-of-Life: Opt for materials that can be recycled or are biodegradable at the end of their use.

Deconstruction: Prioritizing deconstruction over demolition to systematically and carefully dismantle the building. This approach allows for the recovery and reuse of materials, reducing waste and conserving resource

13. URBAN AGRICULTURE



Green Economy Enabler

Urban agriculture

The provision of food from within urban areas holds opportunities for job creation and economic development throughout the supply chain. This begins with the provision of seeds and seedlings, equipment, the manufacturing of organic fertilisers and compost, and the making of structures to support farming practices. This is followed by the need for food markets, especially informal trading stalls, and transport operators to access consumers on a regular basis. Informal trade is more labour intensive with lower start-up and operational costs therefore giving economic opportunity to a wider group of residents in the municipality.

13.1. Introduction

The built environment can play a key role in increasing food security by incorporating urban food gardens and through the planting of edible landscaping. Land can be allocated for shared urban agriculture projects or allotment to farms. High-value agricultural land along the urban edge can be used for food production thereby preventing urban sprawl through improved urban management practices.
Animal husbandry

Animal husbandry, traditionally associated with rural settings, is an increasingly significant aspect of urban life, particularly in rapidly urbanising cities like Nairobi. In these urban environments, a notable number of city dwellers maintain livestock and pets within their residential compounds. This practice, while contributing to household nutrition and economic resilience, also intersects with environmental concerns, especially in the context of green building initiatives. Recognizing the role of animal husbandry in urban settings is crucial for developing comprehensive green building guidelines.

These guidelines seek to address the environmental impacts and opportunities associated with urban animal husbandry, such as waste management, water use, and biodiversity.

By integrating considerations for urban livestock and pet management, the green building guidelines can more effectively promote sustainable living practices that align with Nairobi's unique urban dynamics.

(i) Waste Management, Odours, and Noise Control: It is essential to consider the issues of waste, odours, noise, and animal welfare both during the design phase and throughout the operational life cycle of green buildings. Effective strategies should be implemented to mitigate these potential nuisances, ensuring that they do not negatively impact building occupants or the surrounding community.
(ii) Establishment of Minimum Standards for Livestock Barns and Shelters: Implementing minimum standards for the construction and maintenance of livestock barns and shelters is crucial. These standards should promote the health and well-being of the animals while also minimising their environmental impact. This includes considerations for ventilation, space allocation, and materials used, which should align with green building principles.
(iii) Design of Efficient Waste Collection Systems: Developing and integrating efficient waste collection systems is necessary to manage animal byproducts effectively. These systems should be designed to handle the specific types and volumes of waste generated by urban livestock, reducing the risk of contamination and promoting sanitation.
Proper Siting and Orientation: Careful attention must be given to the siting and orientation of livestock barns and shelters. Proper placement can prevent odours, noise, and other nuisances from affecting building occupants and neighbouring properties, thereby enhancing the overall quality of urban living.
(iv) Utilisation of Animal Waste for Composting and Energy Generation: The exploration of sustainable uses for animal waste, such as composting or energy generation, should be a priority. These practices not only reduce waste but also contribute to the creation of circular economies within urban areas, aligning with broader environmental sustainability goals.

13.2. What needs to be changed

The need to make healthy food affordable and accessible to residents in the County is essential to improving the livelihoods of residents and offers an opportunity to reconnect with local ecological systems.

These Guidelines provide ideas and guidance for building owners and developers to establish and support small-scale agriculture, from tiny window box vegetable gardens to larger allotments or whole properties given over to vegetable farming.

13.3. What needs to be done at Pre-design and Design stage

(a) Include useful plants in the design of landscaping and roof gardens

Building owners and developers are encouraged to plan the landscaped areas of a site so as to provide the opportunity for planting of edible and medicinal plants. This could take place along common verges and areas of general public accessibility, on balconies, podiums, roof gardens and in courtyards, or through innovative green edible walls.

(b) Consider opportunities for on-site food production

Taking this one step further, larger developments would do well to consider the formal allocation of space for communal or managed food gardens. This can be done through allocated space for allotment farming, or carefully managed and planned hydroponic schemes and hothouses.

(c) Design space and systems for composting organic waste

All retail, residential and commercial buildings should consider how best to manage their organic waste, specifically restaurants and retailers. This can be done through arranging for collection by a specialist company, through on-site composting, bokhasi or establishing a worm farm (vermiculture). Compost and worm juice produced from these processes can then either be used locally or sold. (Also refer to the section on waste management.)

13.4. What needs to be done during the Operations stage

(a) **Consider edible plants when planting on site**

The seasonal planting of planters and flower beds presents the facilities manager or building owner with an opportunity to rethink the landscaping philosophy, and to introduce edible or medicinal plants into the area. Building managers should consider the introduction of organic composting and vermiculture if they are not already practised on site.

(b) **Implement an organic waste management system**

The diversion of organic waste from landfill can contribute to a closed-loop system where this is used to make compost for feeding the soil. This can either be done on site and contribute to the composting used for plants, or can be collected by a service provider and managed off site.

(c) **Innovation**

Consider different ways in which urban agriculture can be promoted, such as acting as a distribution point for local “vegetable boxes”.

(d) **Enhancing our surroundings**

Fantastic opportunities exist at community scale for the introduction of edible landscaping.
Areas suitable for allotment gardening, community gardens and greenhouses need to be identified by both private developers and the municipality. Space should be provided for local food markets and fresh produce grocery stores, so as to stimulate and promote this sector.

e) Efficient use of water
Water is a vital resource in urban agriculture, particularly in cities where scarcity is a growing concern. Building managers should incorporate strategies to ensure that water is used efficiently in urban agriculture. One key approach is using rainwater harvesting systems for irrigation.

The use of portable tap water provided by the county in irrigation should also be highly discouraged.

14. CONCLUSION

The County Government of Nairobi is committed to promoting sustainability through three key roles as a regulator and policymaker, owner of civic buildings and Infrastructure partner, promoter, and sponsor of good practices.

Each of these roles provides opportunities for leadership and proactive, facilitative action. The County Government can ensure that new civic buildings are designed to be cutting-edge, or they can collaborate, promote, and fund infrastructure, educational, or other programs that support green building technologies. In the long run, such initiatives pay for themselves because green building design and practices make both environmental and economic sense.

In applying these guidelines, the County, and other key stakeholders, need to consider the context in which green buildings exist. They form or are found within, streets and neighbourhoods and eventually, a series of buildings and structures form a town. In this regard the County should ensure that along with green buildings, there must be:

- Safe routes for pedestrians and bicycles to and from work, home, schools, shopping and health centres, and recreational facilities including play and sports facilities.

- Larger network of habitats for small animals.

- Less car use for daily short trips, since safety means more citizens either walk or can depend on public transport.

- Neighbourhood recreational facilities, such as playgrounds should be available for children to support outdoor physical activity.

- Encourage movement within neighbourhoods by ensuring safe and well-lit green spaces.

- There are trees in parking areas, and public transport stations to keep cars cooler and reduce the amount of hydrocarbon vapour emissions from parked cars.

To create a sustainable County, the County must create incentives, and practices that support and promote green development, aid and encourage stakeholders to incorporate greener building design and practices.

Lastly, in taking up the proposals under the Guidelines, it is our recommendation that the County should also promote the use of sustainable materials in order to promote circularity, by using the Jenga Green App by the KGBS. The App, is a one stop shop that helps a consumer utilise sustainable building materials and address a supply chain issue with a view of promoting circularity and reducing waste.

GUIDELINES AND CATEGORIES TO BE CONSIDERED IN BUILDING GREEN	DIOGNOSTIC QUESTIONS
1.GOVERNANCE	
1.ORGANIZATION OF BUILDING INDUSTRY PROFESSIONALS **Professional associations play a key role in driving green building implementation by convening industry experts, disseminating knowledge, setting standards, and promoting best practices.**	• Is there an accreditation or licensing system for Professionals involved in green building? • Is there engagement of the appropriate professionals?
2. PROVISION OF AN ENABLING ENVIRONMENT FOR SUSTAINABLE BUILDING **The government must provide incentives for adoption of sustainable materials or technology in the market.**	• Is there market penetration of construction materials that aid in green and sustainable building? - Masonry (e.g., lightweight cavity blocks, autoclaved aerated concrete blocks) - Roofs and slabs (e.g., reinforced cement concrete with ground granulated blast furnace slag or fly ash, insulated sheet metal) - Windows and glazing (e.g., high-performance glass such as double-glazed units, low-e glass) - Insulation (e.g., expanded polystyrene, polyurethane foam) - Solar water heaters - Solar photovoltaic panels - High-efficiency HVAC systems - Low-flow faucets

	- Sewage treatment plants with recycling facilities - Rainwater harvesting technologies • What is the status of the green buildings in the country? - Are there examples of green certified buildings? - Are there organizations (public or private) or individuals that are actively promoting green building?
2.SITE CONTEXT AND SPATIAL PLANNING	
1.MICROCLIMATE AND OUTDOOR COMFORT **Buildings near each other can alter the microclimate of the outdoor spaces between them, which could result in such things as inadequate solar access and wind tunnels. For example, if a new building is built too close to an existing building, it can cast shadows that will limit daylight in the existing building. In addition, buildings close together may create a "tunnel effect," increasing wind speed and causing discomfort for people using the space between the buildings**	• Are there measures that address minimum distance from neighboring buildings or abutting streets? If yes, please specify: Between buildings Between building and streets • Are there measures that prescribe minimum distances between buildings? For example, certain codes stipulate that the distance between two buildings may be 1/2 or 1/3 of the height of the taller of the two buildings.
3.PROXIMITY TO PUBLIC TRANSPORTATION **Access to the property in terms of public transport connectivity is an important aspect of site selection. It will reduce the carbon footprint of those who use or visit the building. Ideally, public transport systems such as bus, metro, and light rail will be within walking distance of the proposed development, which will reduce private vehicle use to access the building**	• Are there public transportation transit points such as bus stops, bus rapid transit system stops, and metro or railway stations?

4.PREFERENTIAL PARKING FOR ELECTRIC VEHICLES **Electric vehicles reduce vehicular pollution. Preferential parking for electric vehicles makes it easier for drivers of electric vehicles to use the building. An example of a preferential provision may be that parking spots for electric vehicles are closest to the building entrance.**	Are there electric charging stations in the parking area?
4.BUILDING CLASSIFICATION **Building classification sets benchmark criteria for specific requirements (e.g., based on population, size, and primary activity of building). Different building uses and occupant characteristics present different energy and water consumption patterns and therefore require different approaches.**	• Are the guidelines classified according to the climate of the region?
5.BUILDING ORIENTATION **Building orientation affects building heating and cooling loads. Orienting a building optimally considering geographic location and local climate can reduce cooling load in warm climates and heating load in cold climates.**	• Are there measures that address or prescribe building orientation? • Are there measures that specify orientation for different types of buildings?
3.ENERGY EFFICIENCY	
1.SHADING **Horizontal shading reduces solar radiation on windows and glazing when the sun is high in the sky. Vertical shading reduces solar radiation on windows and glazing when the sun is low in the sky. A combination of vertical and horizontal shading is usually recommended to reduce solar radiation from various sun angles.**	• Are there measures that provide guidance on various types of shading implements? • Are there instructions on how the shading must be designed? • Are there measures that specify shading implements for different orientations? • Are there instructions on which orientation of walls must be provided with horizontal, vertical, or combined shading?

	• Are there measures that specify formulas for shading? • Are there measures that specify the Vertical Shading Angle (VSA)? • Are there measures that specify the Horizontal Shading Angle (HSA)? • Are there measures that provide an illustrative cross-section drawing to explain VSA & HSA?
2.THERMAL TRANSMITTANCE OF GLASS (U-VALUE) **Thermal transmittance is the amount of heat that a material transfers from outdoors to indoors to raise the temperature by 1°Kelvin. This is also called U-value. The lower the U-value, the greater the insulating properties of the material. The SI Unit of U-value is Watts per Square meter Kelvin(W/SqM. K)The inverse of U-value is R-value, which is the measure of how well an insulation resists the flow of heat**	• Are there measures that specify U-value requirements for glass? • Are there measures that outline different U-value requirements for different orientations?
3.GLASS SOLAR HEAT GAIN COEFFICIENT (SHGC) **SHGC is the amount of heat that glass admits from direct solar radiation incident on the surface of the glass. It is expressed as a fraction or a percentage (e.g., 0.1=10%,0.65=65%). Shading the window reduces the SHGC, as does tinting the glass.**	• Are there measures that specify SHGC requirements for glass? • Are there measures that outline different SHGC requirements for different orientations? • Are there measures that give provisions for adjusted SHGC by combining this measure with shading?
4.COMBINED GLAZING ASSEMBLY PROPERTIES **Combined glazing properties include the SHGC and the U-value of the glass and the frame. Some codes require that the opening properties be seen holistically with U-values, SHGC, shading, and orientation.**	• Are there measures that provide guidance on combined glazing assembly properties
5.AIR INFILTRATION	• Are there measures that outline strategies for preventing air infiltration?

Air infiltration is the phenomenon of air leaking from one space to another, reducing cooling or heating effectiveness of the space. **A well-sealed door or window will minimize air infiltration. Joints of pipes and ducts entering the walls must also be effectively sealed, which may be done by caulking, skirting, or architraves at various joints.**	• Are there measures that prescribe specific joints for mitigating air infiltration? • Are there construction details in the form of figures or sketches as guidance?
6.DAYLIGHTING **Abundant daylight in a building reduces the need for artificial lighting, reducing energy use during the daytime.**	• Are there measures that specify day lighting requirements, for example that a certain percentage of habitable building area must be adequately lit through daylight for a certain percentage of the day? If yes, has a formula or an explanatory diagram has been provided to define adequate daylighting for a given space
7.NATURAL VENTILATION **Natural ventilation occurs in a building without use of artificial systems such as fans and air conditioning, reducing reliance on artificial ventilation. Usually there is a standard that stipulates that the openable portion of a window must be at least 5% (or similar figure) of the usable floor area of the space.**	• Are there measures that specify openable window,glazing, or perforation area with respect to the room's usable floor area?
8.THERMAL TRANSMITTANCE OF WALLS (U-VALUE) **A low U-value for a wall helps keep the building cool or warm. This can be achieved by choosing the right wall assembly material or insulating the wall surface. The SI Unit of U-value is Watts per Square meter Kelvin W/SqM. K). The inverse of U-value is R-value, which is the measure of how well something resists the flow of heat**	• Are there measures that specify U-value requirements for the walls? • Are there measures that prescribe different U-value requirements for different orientations? If yes, have guidance U-values been provided for the most common masonry assemblies used in the country?
9.WALL REFLECTIVITY **Heating/Cooling of a wall through direct solar radiation is a function of its color and texture. Using walls with high reflectivity in warm climates reduces the heat gain of the**	• Are there measures that specify a SRI for walls

building. The higher the solar reflectance index (SRI), the greater the reflectivity of the surface.	
10.THERMAL TRANSMITTANCE OF ROOF (U-VALUE) **A roof with a low U-value helps keep a building cool or warm. This can be achieved by choosing the right roof material or insulating the roof surface.**	• Are there measures that specify U-value requirements for the roof? If yes, have guidance U-values been provided for the most common roof assemblies used in the country?
11.THERMAL TRANSMITTANCE OF FLOOR (U-VALUE) **Floors with a low U-value that touch the earth or are exposed to the outside (e.g., stilted floors) helps keep the building cool or warm. This can be achieved by choosing the right floor material or insulating the floor surface.**	• Are there measures that specify U-value requirements for the floor? If yes, have guidance U-values been provided for the most common floor assemblies used in the country
12.ROOF REFLECTIVITY **Heating/Cooling of the roof through direct solar radiation is a function of its color and texture. Using roofs with high reflectivity in warm climates reduces heat gain. Reflectivity is measured according to a solar reflectance index. The higher the index, the greater the reflectivity of** **the surface.**	• Are there measures that stipulate a certain SRI solar reflectance index for the roof
13.DAYLIGHT SENSORS **Daylight sensors are used on light fixtures that are close to windows. In large-occupancy spaces, they switch off lights when sufficient daylight is available, reducing energy use. They are usually found in large, open-plan offices, classrooms, and lecture halls, where workstations near windows receive adequate daylight.**	• Are there measures that specify daylight sensors? • Are there measures that provide measurements for the depth (perpendicular to the window opening) up to which the spaces should be fitted with daylight sensors? • Are there daylight sensors available in the local market?

14.OCCUPANCY SENSORS **Occupancy sensors switch lights that are not used regularly off and on and can be used in spaces such as corridors and office areas where low levels of light are sufficient for one to enter the space. When someone enters the space, the remaining lights switch on for full functionality. The extra lights then switch off after the occupant exits the space**	• Are there measures that specify occupancy sensors? • Are there measures that prescribe minimum lighting levels for different types of spaces?
15.ELEVATOR AND ESCALATOR EFFICIENCY **Most countries require that elevators and escalators adhere to minimum efficiency prescribed in national or International standards.**	• Are there measures that prescribe minimum energy efficiency standards for elevators and escalators? • Are there measures that address use of elevators with regenerative brakes?
16.PIPE AND DUCT INSULATION **An insulated pipe or duct will ensure that heat loss or gain is minimized, reducing the load on the heating or cooling system. Most with HVAC system manufacturer have made it mandatory to insulate pipes and ducts to increase energy efficiency, even in the absence of regulation.**	Do the building regulations require insulation of pipes and ducts? · Is there another provision that addresses insulation of HVAC pipes and ducts?
17.WINDOW-TOWALL RATIO (WWR) **Windows and structural glazing provide light and ventilation, but in warm climates, they also bring in unwanted heat, increasing the load on air conditioning systems and thus increasing energy use. Having the optimum window-to-wall ratio (WWR) helps balance the two opposing requirements.**	• Are there measures that address a minimum or maximum WWR? • Are there measures that prescribe different WWR for differently oriented walls? • Is there a provision for the formula for calculating WWR?
18.USE OF SMART SYSTEMS TO MONITOR AND CONTROL ENERGY USE **Building management systems (BMS) monitor use of various resources in the building and provide data that can be used to reduce energy use.**	• Are there measures that address Building Management Systems? • Are there measures that recommend for certain aspects of data be collected, for example, how much energy the HVAC system or the lighting consume?
4.WATER	

1.WATER EFFICIENT FEATURES **Water efficiency is measured according to flow rate, expressed in liters per minute. Water use can be reduced by using the most water efficient fixtures available.**	• Is there a measure to address water-efficient fixtures? • Is there a measure to specify flow rates for each type of fitting? I. Faucets II. Showers III. Single-flow flush toilets IV. Dual-flow flush toilets
2.WATER EFFICIENT IRRIGATION SYSTEM **Use of drip irrigation instead of conventional systems such as sprinklers and planting native and drought resistant species of plants increase water efficiency.**	• Is there a measure to address water-efficient Landscape irrigation systems? • Is there a measure that prescribes water-saving species or native species for landscaping
c) SWIMMING POOL COVERS **Covering pools when they are not in use prevents water from evaporating.**	• For proposed developments with swimming pools,are there strategies in place for swimming pool Covers and other water saving measures?
D)WATER AUGUMENTION MEASURES AND PROVISION OF ALTERNATIVE SOURCES **Harvesting rainwater and using recycled water enables developers generate their own water supply hence reducing over reliance on existing sources that are already limited.**	• Are there any water augmentation strategies in place? • Does the developer prescribe the proportion of roof area to be dedicated to rainwater harvesting?
E) WASTE WATER TREATMENT **About 80 to 85% of water consumed in a building is ejected as wastewater that must be treated for hygiene and safety before it can be disposed off.Most cities and towns have a centralized facility or require that buildings larger than a certain size have their own sewage treatment plants (STP).**	• How does the developer intend to address on-site wastewater treatment. This should be informed by the size of development in terms of gross floor area, number of room, dwellings or use.

E) WATER USE SUB METERING **Sub-metering enables the water consumption of various components of the building to be measured, for example, Sinks, toilets, showers. Supply-side inlets such as water from the city, town, and water from rainwater harvesting treated water from a sewage treatment plant can also be sub-metered. Sub-metering provides data that can be used to increase water efficiency.**	• Are there measures for water sub metering in place?
5.WASTE	
1.SOLID WASTE **Responsible solid waste management is extremely important for local ecosystems. Spaces within a building that provide for safe segregation and storage until disposal are important. Wet waste can be composted on site and used as fertilizer for landscaping**	• Are there measures for solid waste segregation and management?
6.INTERNAL ENVIRONMENTAL QUALITY	
1.INDOOR AIR QUALITY **Carcinogenic volatile organic compounds (VOCs) in paints, carpets, and adhesives used for fixing wood and wood products decrease indoor air quality. Low VOC materials are widely available.**	• Are there measures and indication of use of low VOC materials?
2.CO2 SENSORS **For fresh air supply in spaces with a high concentration of people (e.g., offices, auditoriums), CO2 concentrations can build above safe limits. CO2 sensors connected to the HVAC system will signal the AHU to increase fresh air intake**	• Do the building regulations address CO2 sensors in large assembly spaces
3.INDOOR LIGHTING **Adequate indoor lighting is important for physical and mental health.**	• Are there measures for indoor Lighting?

4.NATURE CONNECTED SPACES AND VIEW **Spaces connected with nature (windows overlooking a garden or the city skyline) help occupants have a sense of connection with the outdoors, which improves overall well-being.**	• Are there measures that ensure nature-connected views?
5.ACOUSTICAL COMFORT AND CONTROL **This is important as it prevents undue amounts of noise from coming inside. Prolonged exposure to loud noise is harmful to health.**	• Are there measures for allowable noise inside?
6.CARBON MONOXIDE (CO) SENSORS FOR GARAGES **Enclosed garages usually have exhaust systems that run continuously to prevent concentration of CO from vehicle exhaust. A CO sensor ensures that the fans switch on only when CO concentrations exceed the prescribed limit.**	• Are there measures that require CO sensors for enclosed garages? • Are there measures that address fresh air requirements for enclosed car parking spaces
7.NATURAL VENTILATION FOR GARAGES **It is best that garages be naturally ventilated, which will ensure that CO concentrations do not exceed prescribed limits.**	• Are there measures that require that the car parks be naturally ventilated?
7.POLLUTION	
1.CONSTRUCTION WASTE MANAGEMENT **Construction sites generate considerable waste. For example pieces of tile, cardboard, polystyrene foam, paper, all types of plastics, leftover insulation, and scraps of steel must be segregated, stored temporarily, and disposed of responsibly. Waste generated during construction goes into landfills, but with proper management, it can be recycled for other uses.**	• Are there measures on handling of construction waste and demolition waste?
8.BIODIVERSITY	
INTEGRATION OF PROJECT'S WITH LOCAL ECOSYSTEM **This assesses if the design of building or property respond appropriately to ecological factors such as flora, fauna, presence of water bodes (lakes, rivers, sea). For example:**	• Are there specific protection or buffer zones set aside for water bodies, forests, etc.? If yes, please indicate:

Leaving adequate buffer zones near water bodies to ensure that the water bodies' catch basins are not harmed. **Ensuring that only native tree and shrub species are grown so that local fauna habitats are not damaged.**	- For water bodies [enter linear distance] - For forests or nature reserves [enter linear distance] - Other, please indicate • Are there measures that address on-site tree cutting? • Are there measures that require native landscaping? • Are there measures that specify a certain amount of open space allocation in the project?
9.CLEAN CONSTRUCTION PRACTICES/BUILDING MATERIALS	
1.BUILDING MATERIALS WITH LOW EMBODIED ENERGY **(Energy used for building material production)** **Using materials with less embodied energy reduces the carbon footprint of a building. As a thumb rule local materials have lesser embodied energy as transportation adds to the embodied energy of a material. This also has an added advantage of encouraging local economy**	• Are there measures that prescribe the use of low embodied energy materials?
2.RECYCLED BUILDING MATERIALS **Many buildings components, such as steel, can be recycled and reused, reducing dependence on virgin resources**	• Are there measures that specify a percentage of Building materials to be made of recycled materials?
3.DESIGN BUILDINGS TO OPTIMIZE BUILDING MATERIAL USE **Buildings can be designed to optimize use of materials.** **For example, a cantilevered structure usually consumes more steel than a structure supported with columns at the end.**	• Are there measures that provide guidance for Optimizing building material use?
4.NET-ZERO AND NET-POSITIVE BUILDINGS **A net-zero building produces all the energy that it uses. A net-positive building produces more energy than it needs.**	• Are there measures for achieving net-zero or net-positive energy consumption?

10.URBAN AGRICULTURE	
1.GREEN ROOFS **Green roofs have vegetation on them, along with structural and waterproofing safeguards reducing the transfer of heat into and out of the building. Green roofs also increase biodiversity in densely built urban environments.**	• Are there measures that require the construction of green roofs? • Is there a minimum standard for such roofs in terms of area covered by vegetation?