Steve Tshwete
Local Municipality

Green Building Guidelines

of

STEVE TSHWETE LOCAL MUNICIPALITY

The development of these Green Building Guidelines has been made possible through the Urban-LEDS Project. The Urban Low Emission Development Strategies project, implemented by ICLEI Africa in partnership with UN-Habitat and funded by the European Commission, has the objective of enhancing the transition to low emission urban development in emerging economy countries by offering selected local governments in Brazil, India, Indonesia and South Africa a comprehensive methodological framework (the GreenClimateCities methodology) to integrate low-carbon strategies into all sectors of urban planning and development.

URBAN LEDS
URBAN LOW EMISSION DEVELOPMENT STRATEGIES

Implemented by *in Partnership with* *Funded by*

ICLEI Local Governments for Sustainability

UN HABITAT FOR A BETTER URBAN FUTURE

This project is funded by the European Union. The views expressed in this document can in no way be taken to reflect the official opinion of the European Union.

These guidelines were developed and written by Conscious Property Solutions, MCA Urban and Environmental Planners and Steadfast Greening. This document was published by Dogstar Design Studio.

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MASAKHANE

Steve Tshwete

Local Municipality

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Our journey towards implementing a low emission future is integrated into being the best community-driven local municipality, through the provision of sustainable services and development programs. While we recognise the importance of providing infrastructure, we also realise that buildings have a significant negative impact on our natural environment.

The compilation of these Green Building Guidelines will assist the residents, business owners and investors to review their planning applications through a "green lens". Working with ICLEI Africa we have developed these guidelines to provide practical guidance on what is required and how it can be done.

I am looking forward to seeing more green buildings in Steve Tshwete in the near future and encourage everybody to use these guidelines and supporting documentation.

Mayor Mike Masina

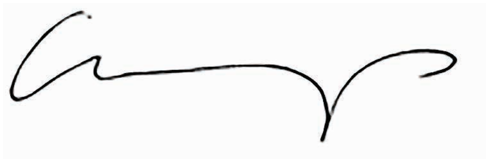
As a global membership organisation, ICLEI – Local Governments for Sustainability supports over 1000 member local and other sub-national governments to chart their own unique journeys towards sustainable urban development.

ICLEI works with our members on diverse topics such as water and sanitation, climate change, low-carbon development, the green economy and biodiversity protection. We promote an integrated approach to urban planning which aims to strengthen service delivery to citizens while enhancing and sustaining local and global natural resources. The greening of urban infrastructure and of buildings in particular, presents an ideal avenue for ICLEI to partner with our members to make progress on a number of these topics in tandem.

Through our Urban-LEDS (Urban Low Emission Development Strategies) project, funded by the European Commission, and in partnership with UN Habitat, we have been able to assist two rapidly growing cities, by working with them to develop their green building guidelines. To this end we are grateful to have brought on-board the expert team of MCA Urban and Environmental Planners, Steadfast Greening and Conscious Property Solutions, to assist us with this task. We are confident that the thorough outputs produced by this partnership will be of use to other municipalities in South Africa, and also to cities and sub-national governments further afield.

ICLEI-Africa encourages our member cities to adopt and adapt these guidelines in local contexts, and update them over time. We will also continue to support cities in their endeavours to implement the guidelines in a way that transforms their urban environments to be more liveable, prosperous, climate friendly and resilient.

Kobie Brand



Regional Director

ICLEI – Local Governments for Sustainability – Africa

> *"Do your little bit of good where you are; it's those little bits of good put together that overwhelm the world."*
>
> Desmond Tutu

1 Introduction

1.1 Background

Today, it is widely accepted that human activities are contributing to climate change. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) estimated that between 1970 and 2004, global greenhouse gas emissions due to human activities rose by 70% (IPCC, 2007). As the majority of the global population now lives in urban areas, with this proportion rising to above 60% in South Africa (World Bank, 2015), cities have become areas of strategic focus to address climate change.

Cities are defined by their built environment. The built environment is made up of the roads and pathways used for mobility; the physical infrastructure which provides services, such as water, electricity, transport, sewerage and waste removal; the buildings which act as homes, offices and shops; and the governance structures which manage the relationships between these features.

South Africa currently faces a series of challenges, especially prevalent in urban areas, that have resulted in harm to the environment and to people. The challenges include:

- More people are demanding more space and consuming more resources;
- Low density development has led to urban sprawl in this municipality and other areas;
- The development of buildings on prime agriculture land has led to irreversible soil damage;
- Large scale monoculture has led to biodiversity destruction;
- Urban sprawl has lead to disconnected communities, reliance on private vehicles, habitat and biodiversity loss.

As cities continue to grow in population, physical size and density, increasing stress is placed on the built environment to carry the urban systems and associated processes that people depend upon. Consequently, climate change adaptation and mitigation measures need to be strategically focused on reducing the greenhouse gas emissions from activities associated with the growth and development of the built environment. This will enable the transition to a more sustainable development path.

The Green Building Council of South Africa highlights that, worldwide, buildings account for:

- 39% total energy used
- 70% electricity
- 40% CO^2 emissions
- 40% material consumption
- 65% municipal waste
- 12% water
- 25% timber harvested
- 50% ozone depleting CFCs

Green buildings offer the opportunity to significantly reduce these figures through implementing good design, construction and management practices at the building and precinct scales.

The Steve Tshwete Municipality has committed itself to the path of Low Emission Development (LED). A key component of this is the creation of an enabling and educational framework to assist players in the urban environment in the development and management of ‘green’ buildings. Green buildings are those that are resource efficient, benefit their occupants and contribute positively to the environment and their communities. Green buildings are the result of numerous processes, methods and technologies coming together at once. They inherently involve multiple stakeholders, interests and areas of expertise.

The aim of these guidelines is to provide an easy to use reference document for the municipality and building professionals 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 the environment.

> ***"The destruction of the earth's environment is the human rights challenge of our time."***
>
> Desmond Tutu

Incorporating green building principles into a development may have little or no additional capital cost if such principles are incorporated from onset. Other strategies can be retrofitted or added to a building as part of the normal maintenance cycle of the building, with no appreciable additional capital requirements. It should be noted, however, that some of the features that have the most lasting positive impact on a building, its resilience and future operating costs and internal quality can't be 'reverse engineered' into the design and their absence will have lasting consequences on the environment and on building operations (for instance base building orientation or location).

Ultimately, this set of Green Building Guidelines is one of the tools needed and available to achieve better buildings and better spaces for people to live, work and play – to restore and enhance the environment, society and the economy.

1.2 The financial case for green buildings

While there is increasing development of green buildings in South Africa, there have been many misconceptions about the costs associated with this type of building when compared with conventional construction costs. The perceived cost of entry has been a major perceptual impediment to the widespread adoption of green building technologies. Many developers and private homeowners have been put off by fears of high costs and long pay-back periods where the value is realised by tenants and not the landlords. However, initiatives necessary to reduce resource consumption within the built environment are now gaining traction due to the rising costs of water and energy and a growing understanding of the need for environmental protection and restoration.

While not all green initiatives will add cost to the development of a building or precinct, all will contribute to the overall value of the building and a greater return on investment for the developer, building owner or investor. Certain aspects of green building, such as passive design, are the result of good decision-making and processes that allow for innovation while using the same budget needed for the construction of a conventional building.

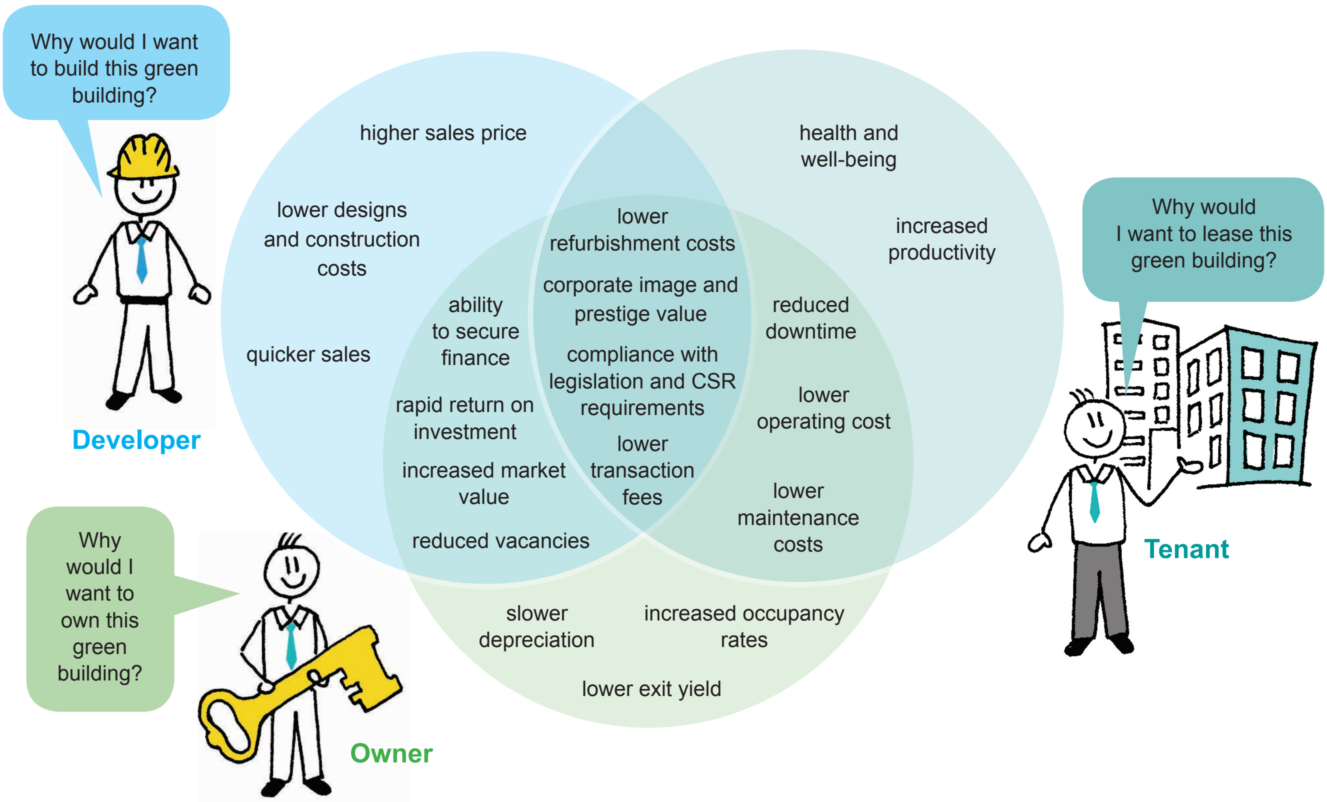
Where green features or initiatives do require increased upfront costs, this is referred to as a 'green premium'.

Some of the advantages now commonly agreed for green buildings include:

- Lower operating costs (particularly energy and water)
- Higher rentals and overall returns on assets
- Better marketability ("smart buildings", differentiated in the market)
- Lower risk, future-proofed buildings
- Increased ability to attract and retain talent (staff) and major desirable tenants (including government departments)
- Increased productivity, better retail sales, higher student pass rates, quicker hospital recuperation
- Responsible investing

Savvy developers are thus leaning towards buildings which are resource efficient, boast modern technologies and offer a good indoor environment for employees.

Figure 1: Reasons for developing, renting or owning a green building rather than conventional building



Source: The Business Case for Green Buildings, http://www.worldgbc.org/files/1513/6608/0674/Business_Case_For_Green_Building_Report_ WEB_2013-04-11.pdf)

1.3 Different shades of green

So what does this mean for you? Should all buildings be certified and can only certified buildings be considered green?

There are many shades of green and, in South Africa, traditional construction methods (such as mud huts with clay and dung floors) embody many of the principles which green building does today, such as the use of sustainable local materials and labour, climate appropriate design, and correct orientation. At a minimum no building should be constructed in South Africa any longer which does not take cognisance of its location (in terms of not developing on high-value ecological land, and the proximity to places of work or residence and local transport), orientation (to maximise morning sunlight but reduce penetration of harsh afternoon sunlight), and the ability to be reused over time. In addition, all buildings should demonstrate sensitivity to the limits of energy and water availability experienced in South Africa.

With this as a base, there are more elements that can be incorporated, such as natural ventilation, appropriate mechanical ventilation, energy efficient lighting and equipment, thermal mass to reduce heat loss and gain. Buildings need to be well managed, with ongoing waste minimisation and separation at source. On-site energy generation and water collection and recycling should be implemented where possible. It is thus clear that there is not a single "green" prerogative, but a scale of greenness and a wide range of elements and practices which can be incorporated into any building at any stage of its lifecycle.

The South African government and local municipalities continue to develop and improve upon policies to guide well-informed and sustainable development. This has both led to and been enabled by an increased voluntary buy-in to the need for sustainable building practices by private developers. This is evident in the rapid uptake of green building certification in the private sector. Most of the green building certifications in South Africa have been through the Green Building Council South Africa (GBCSA), which offers third-party verification of design, new buildings, operational performance and interior fit-outs for a wide range of building types and communities.

A decade ago much debate existed in South Africa and the international community as to whether there was a real advantage in formal green building certification. It is now commonly accepted that the rigorous process of independent third party validation and accreditation holds extensive merit, and the uptake of formal certifications is increasing and no longer only associated with flagship developments.

1.4 How to use these guidelines

These guidelines have been designed to be used by everyone in the Steve Tshwete Local Municipality – property owners, built environment professionals, contractors, property developers and municipal officials working in the built environment.

These guidelines are aligned with the five focus areas as identified in the Low Emissions Development Strategy Transition Documents:

- Institutional transition: Including both management and government
- Spatial transition: Spatial planning, land use management and transport
- Energy transition: Energy efficiency and renewable energy
- Ecological transition: Resource management
- Economic transition: Economic development

These documents provided guidance with regard to the key topics that needed to be addressed within the municipal area, to focus on actions that enable change and transition towards a greener economy and low emission development.

Within these focus areas, 12 categories were identified that specifically relate to green buildings and community-focused living environments. These categories are outlined below:

Figure 2: Green Building Guideline Categories

INSTITUTIONAL TRANSITION	SPATIAL TRANSITION	ENERGY TRANSITION	ECOLOGICAL TRANSITION	ECONOMIC TRANSITION
Management and Governance	Spatial Planning and Land Use Management	Energy	Water	Building Materials and Green Procurement
	Transport		Waste	Urban Agriculture
			Internal Environmental Quality	
			Pollution	
			Biodiversity	

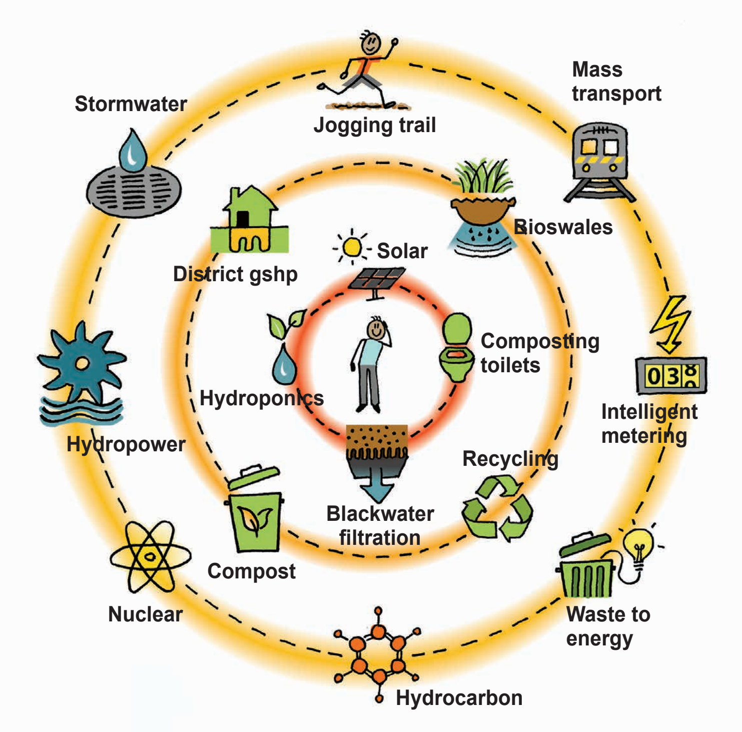
The following format is used to unpack the different categories, where applicable:

Introduction - Each category is introduced with an understanding of the system/resource in the municipality and the current challenges facing the municipality.

What changes do we need? – The change necessary to transition to low emission development and how the guidelines aim to achieve this is identified.

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

Figure 3: Scales of intervention in the Built Environment



Source: http://www.holcimfoundation.org/Projects/energy-water-and-waste-efficient-military-installation-fort-le)

The different scales used in this guideline includes:

- a building
- a precinct or the local community

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

The municipality 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 municipality. This is to allow for reduced resource consumption and greenhouse gas emissions along with benefiting the natural environment and local socio-economic development.

How do we design our buildings? – 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.

How do we construct our buildings? – 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.

How do we manage our buildings? – The ongoing maintenance, operations and management of a building can have a significant environmental impact throughout the life of a building; where 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 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 a building, whether existing or new. This section also details green building considerations for retrofits and refurbishments of existing building stock.

How do we enhance 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.

1.5 Greening the local economy

As Steve Tshwete moves towards low emission development, 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 municipality'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.

The green economy is not a subset of the current economy. It must be understood as a paradigm where economic growth can have environmental and social benefits by creating jobs while reducing risk and scarcities. The aim of this economic framework is to reduce, and possibly even reverse, the negative environmental and social impacts of unrestricted development. The green economy is enabled and supported by changing technology, evolving awareness and the rise of a social consciousness leading to the emergence of many new opportunities and ways of approaching human well-being (environmentally, economically and socially sustainable activities).

There are many opportunities to green the local economy through the design and construction of green buildings and precincts. Where applicable, these opportunities are identified in each category of these Green Building Guidelines which offer the opportunity for everyone in the municipality to contribute to growing an economy that benefits the environment and improves the livelihoods of residents.

2 Management and Governance

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 too. 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.

__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, while __governance__ refers to the institutional make-up of the municipality with regard to the local government, partnering organisations (CBOs and NGOs), and business.

2.1 What changes do we need?

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.

These practices include engaging in a holistic approach with a multi-disciplinary team who have a shared vision for the outcome of the project. It might require an independent peer review for building performance or appointing a responsible facilities manager who can monitor and evaluate performance. Good management should also include educating occupants and users on green initiatives to encourage changes in behaviour that reduce resource demand and benefit the natural environment.

2.2 How do we design our buildings?

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

The successful implementation of green building principles begins at the conceptualisation 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.

It can be useful to develop a clear vision of the project that represents the purpose and desired outcome. Where possible, this should be done with the involvement of all team members to ensure the team's ongoing commitment throughout the project's lifecycle. It is advisable to include an experienced GBCSA Accredited Professional (AP) as part of the team to facilitate these discussions and engagements. This is to ensure the incorporation of green building practices throughout the building process, and provide input and guidance when weighing up the various green initiatives that would be best suited to the project (climatically, socially and economically).

2.2.2 Encourage an independent peer review

Independent peer review is encouraged during the design phase to comment on the specifications and choices, especially with regard to optimisation 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. An independent review can be conducted by an experienced sustainability consultant who reports directly to the client and, although part of the design phase of the building, is not part of the design team and can therefore remain impartial and unbiased. An experienced sustainability consultant can help ensure that the green building principles incorporated in the design and construction of a building result in measurable performance improvements and cost savings, especially with regard to the energy efficiency of mechanical and lighting systems.

2.2.3 Enlist the services of an Independent Commissioning Agent

An independent commissioning agent 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.

2.3 How do we construct our buildings?

2.3.1 Adopt and Implement good management practices

During the planning phase it is necessary to consider how the negative environmental impacts of construction can be reduced or remediated. This can be done by ensuring that good management practices are included in the contractual requirements of both the main contractor and related sub-contractors and then implemented on site.

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.

2.4 How do we manage our buildings?

Good maintenance practices are essential 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.

2.4.1 Appoint a responsible building / facility manager

The first step in implementing good management practices is to ensure that a responsible and knowledgeable building or facilities manager is appointed to take care of building operations and maintenance. This person should preferably also have a prior knowledge of green building principles and practices or be willing and able to learn about these principles and their implementation. Depending on the building size and use, a designated or shared resource may be most appropriate.

2.4.2 Implement an integrated building management system (BMS)

Integrated building management is common to all intelligent buildings, and refers to a host of monitoring devices and control systems that regulate the utilities and services in a building. They include both manned and automated systems, and may be either passive or mechanical systems for lighting, ventilation, heating, cooling, security and communications. A Building Management System (BMS) incorporates the use of sensors and meters to monitor water and energy use and thermal comfort in the building and relays this information to a central computerised system. This allows for timeous responses to faults or unaccounted for surges in resource use which in turn improves the building's efficiency and performance.

A BMS is used to improve building performance through measuring and reporting on the resource use of the building. This can then be used as baseline measurements against which progress can be measured.

2.4.3 Allow for building tuning within the first year of occupation

Within the first year of a building's occupation, it is beneficial to undertake monthly and quarterly monitoring to report on the various mechanical systems in the building, such as lifts, irrigation systems, automated water systems, the air conditioning system and automated lighting systems. At the end of this first year, the sub-contractors responsible then return to re-commission these mechanical systems in accordance with the quarterly reports that stipulate any changes needed to ensure optimum comfort for the building inhabitants and resource efficiency for improved building performance.

2.4.4 Incorporate green building guidelines when undertaking retrofits and refurbishments

Retrofitting and refurbishing is a necessary part of a building's lifecycle as the building ages or changes tenants and use. Retrofitting involves replacing or making changes to the systems within the building or the building structure to fit a new function. Refurbishments predominantly involve improving the building aesthetically to fit the requirements of new tenants but can also include upgrades to certain building systems. Both of these processes offer the opportunity to improve an existing building's water and energy efficiency, indoor environmental quality, and building management. Ultimately, this can lead to reduced environmental impact.

To undertake a green retrofit or refurbishment, consider applying the strategies included in these guidelines. Designing major renovations and retrofits for existing buildings to include sustainability initiatives will reduce operation costs and environmental impacts, and can increase building adaptability, durability, and resilience.

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Fast Fact:

Building Tuning

Green building is a process and not a single event. Building tuning allows the building systems to be adjusted to ensure that they perform optimally under the operational conditions they find themselves, and are correctly set for the climate and occupancy.

case study

Kirstenhof Office Park, Johannesburg
– Existing Building Retrofit

Kirstenhof Office Park is a multi-tenanted office park consisting of four blocks, each two stories high, connected by a core quad area which sits over a single, shared basement. The following sustainable building features were included in the retrofit:

- Energy efficient lighting that includes fluorescents fitted with high frequency ballasts.
- Flow restrictors on all taps & water efficient toilets with dual-flush functions.
- Occupant, thermal & transport mode surveys were conducted during the performance period.
- An operational waste & materials management plan that aims to decrease the amount of waste currently being sent to landfill.
- A stormwater management plan was developed to limit disruption to natural hydrology, minimise pollution & site deterioration.

Source: https://www.gbcsa.org.za/hub/local/uploads/Project-study-392/kirstenhof-building-case-study-updated.pdf

Green Economy Enabler

Green building retrofits

Retrofitting buildings to improve resource efficiency and reduce demand is vital to transition to low-emission development. This creates the opportunity for local jobs as building owners seek to improve their building's energy and water efficiency through installing new fixtures and fittings that use less and therefore save them money in the long term. As the market for improved energy efficiency in buildings grows, it will be necessary to continue to develop the knowledge and skills of the local labour market in this sector through short practical courses and apprenticeships

2.4.5 Establish an awareness and education programme for building users

Affecting and changing the behaviour of building occupants is vital for improved resource efficiency and thermal performance. For example, if occupants are made more aware of dressing appropriately for the season, the heating and cooling system can be adjusted to be warmer in summer and cooler in winter therefore saving energy and reducing greenhouse gas emissions.

A **Building Users Guide** can be generated by the building manager, architect or green building consultant to educate occupants about green features included in the building's design and systems and how occupants can help these design features and systems to perform well. This guide can include information regarding energy and water usage in the building, the recycling and/or composting system in place, green materials used in the building and management practices which have been put in place to enhance the occupants' comfort and experience in the building.

3 Spatial Planning and Land Use Management

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.

As a large percentage of the municipality's population live in towns, the ways in which urban areas are planned, designed and built can impact life in Steve Tshwete. Currently, urban settlements are spreading out and encroaching on valuable agricultural land and ecologically sensitive areas. This is known as sprawl. A pattern of sprawl creates traffic problems as people have to travel further, it negatively impacts the local ecology, and overburdens local resources, services and infrastructure. This, in turn, can put strain on the local economy and municipal finances.

3.1 What changes do we need?

In response to national policy, municipalities throughout South Africa are encouraging higher density new development and the densification of existing areas. One strategy to do this is by placing emphasis on development within a designated urban edge to reduce sprawl. Increased urban density and a compact urban form allows for cheaper 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. To aid the transition to low emission development in Steve Tshwete, urban areas need to be made up of diverse, medium-density, safe neighbourhoods with a vibrant town center and increased connectivity through a network of safe, well-designed public spaces and corridors.

The principles of this spatial vision are:

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

Increased diversity:
Where diversity 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.

The following guidelines indicate voluntary best practice which, when implemented, can work towards seeing these principles manifest in the municipality.

3.2 How do we design our buildings?

3.2.1 Design to enable density thresholds

Choose a previously developed site within the urban edge, i.e. select a brownfield site rather than a greenfield site. This is called infill development and building within the urban edge increases urban density to support efficient and more sustainable infrastructure provision while reducing the harmful effects of development on the natural environment and high-value agricultural land.

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Fast Fact:

Difference between brown and greenfield site

A brownfield site is a plot of land that has been used previously, as a building, car park or other urban uses. A greenfield site refers to an unused, still naturally vegetated plot of land.

Appropriately maximise building height, bulk and set-backs: Design buildings to make use of the maximum bulk and height permitted by the land use zoning scheme. Place the building as close to the site's street edge as is allowed by the zoning scheme. This helps to create a dense urban form and maximises the use of land within the urban edge to prevent unnecessary sprawl.

3.2.2 Promote increased social and land use diversity

Mixed use: 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 and provide services in close proximity to where people live and work.

Mixed income: 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.

Flexible base building designs: Consider floor heights and layouts which are common to most building typologies not just one (such as parking garages) to encourage the reuse 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 materials and reduces greenhouse gas emissions.

3.2.3 Promote a permeable urban form

Increase accessibility: Do not obstruct 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.

3.2.5 Design for pedestrians

Design an interactive street facade: Within the commercial town centers of urban areas especially, 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. Other interventions which can have a marked positive impact are the treatment of shop fronts, implementation of traffic calming measures (such as pinching a road to allow wider pavements for coffee shops tables or informal traders), thus slowing vehicular traffic while still allowing pedestrian movement, and building design such that parking garages are not located on the street-facing frontage.

Design pedestrian entrances: Ensure that there is ease of access for pedestrians from surrounding walkways and transport stops to access a building or site (such as a shopping centre). It can be unsafe and deter pedestrians when the only access point is shared with motor vehicles.

3.2.6 Create safe and connected public open spaces

Enhance the building's surroundings: Where possible, look to providing appropriate seat furniture and bicycle racks along the street-facing edges of the buildings, plant trees and other appropriate vegetation and pave the walkways in front of the building.

Figure 4: An interactive facade in Middleburg's Town Centre

Building or site boundary fences and walls: Boundary walls and fences fronting onto public streets, parks and other open spaces are highly visible and directly affect the character and visual amenity of neighbourhoods. For the building to have a more positive aesthetic impact and safety benefit on surrounding public open space, design the perimeter boundaries so that they are visually permeable and are not too high (1.8m on street boundaries and 2.1m on lateral boundaries).

3.3 How do we enhance our precincts?

3.3.1 Design for enabling density thresholds

Human-scaled density: Higher density living can have many benefits for residents and contribute to better performing urban environments. Medium/ high density housing can be accommodated in 3- to 6-storey buildings.

Transit-orientated density: Match areas of planned higher density on primary connection routes through an area or along roads that have a higher transit capacity. Denser areas need greater transit capacity to prevent congestion.

3.3.2 Promote increased social and land use diversity

Mixed-use developments: Ensure that there are a variety of uses within each neighbourhood. This can be provided for in separate buildings, which are close to one another or within the same building. This can include residential, retail, offices, education and public open with high activity uses, such as retail, on the ground floor with commercial, residential or hotels on the floors above.

Mixed income housing: Allow for a variety of housing typologies (apartments, townhouses, detached and semi-detached housing) and employment opportunities within a neighbourhood to promote a community with a variety of incomes.

A regular grid pattern: Designing and implementing a regular grid pattern can allow for flexibility over time. This is because the town layout is not designed for any particular sector (residential, commercial or retail) and therefore the buildings can easily change function without disrupting movement routes and the urban environment.

3.3.3 Promote a permeable urban form

Increased accessibility: Reduce the number of cul-de-sacs in neighbourhoods as these inhibit accessibility by creating deadends with little choice of route and movement. This can create unnecessary congestion and increase the use of cars rather than active transport options thereby increasing the municipality's greenhouse gas emissions from motor vehicles.

Connectivity: Ensure that all new planned areas or townships are well connected to the existing urban form, structure and roads to improve the connectivity between areas in a town (the more points of entrance/exit there are, the higher the connectivity and accessibility). This can happen through joining up and aligning new streets with existing ones.

A networked grid: Using a grid pattern as the structure for an urban layout can offer increased connectivity and accessibility as it increases the choice of route available to move from one place to another and increases the ease by which this is done. A networked grid, which has a hierarchy or roads, allows for less congestion on smaller roads and gives multiple options for all types of traffic (NMT, public transport, private vehicles and freight).

3.3.4 Design for pedestrians

Increased accessibility: Give priority to pedestrians or cyclists for accessibility. The design of precincts should include well-connected pathways to allow for ease of access by pedestrians in urban centers. These pathways should be wide enough to accommodate pedestrians walking in both directions.

Local connectivity: Having a variety of uses accommodating a variety of daily activities within each neighbourhood facilitates pedestrian priority by having these facilities in close proximity to one another and where people live and work so that people can choose to walk rather than drive their cars. These activities include a food market, pharmacy, medical center/doctors' rooms, crèche, bank or ATM, library, school, restaurants and fitness center.

Design settlements using perimeter blocks: Place buildings on the outside, street edge of urban blocks where a semi-private courtyard can be created for residents. This provides a well-defined edge to the street which can improve safety, walkability and the experience for people on the street.

Good walkways are defined by sufficiently wide pavements along streets that have few obstructions (such as parked cars or unmanaged informal trade) and include benches, the provision of shade and sufficient street lighting.

Urban design for safety: Ensure that infrastructure provision and public space design is done in accordance with the best practices for urban safety. This includes:

- Clear boundaries and collective ownership of public space
- Increased surveillance and visibility
- Safe access and movement
- Positive relationships and layered spaces
- Good urban management and monitoring

3.3.5 Create safe and connected public open spaces

Well-located public open space: Where possible choose sites for public open space 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 of these systems, thereby protecting them from future detrimental land use.

Connected open space systems: Design public spaces in a neighbourhood so that they form part of larger ecological networks and walking and cycling routes in the town and municipality.

Accessible open space systems: Public open space (whether a soft or hard surface) is to be interspersed within neighbourhoods to allow all citizens easy and regular access (within a 5 - 10 minute walk from all homes or places of work).

Clustering of services: 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). Clustering can also reduce the amount of space that many services require as they can share spaces during different times of the day.

Case Study

Cornubia Urban Development
Umhlanga

Cornubia is a 1300ha integrated human settlements project, which forms part of the extension of Umhlanga, just outside Durban. The total cost is estimated to be R25 billion with a development time span of 25 years. Through this public-private partnership the developers have taken a sustainable city approach with housing, retail, public open space, community facilities, schools, clinics and light industry being accommodated within the settlement. These functions are to be connected via non-motorised transport routes within the settlement and with the Integrated Bus Rapid Transport System to areas beyond its boundary. The key spatial and land use planning practices employed include: increased diversity (in function, income and opportunity), increased residential density to reduce sprawl, the inclusion and connectivity of public space, emphasis on public transport and walking, and a zero unemployment policy.

Source: *van Zandvoort, F. 2015. Changing the Umhlanga Skyline. Earthworks. 24: 70 - 80*

4 Transport Planning

Transport is a vital system for a functional city. It brings people, goods and services together when and where they are needed. Urban transport systems are made up of public buses, minibus taxis, private motor vehicles, freight trucks and trains, passenger trains, walking and cycling. This system also includes the roads, railways and pavements, which carry these modes of transport.

A cause of the problems experienced in towns and cities is private motor vehicles being given priority over public transport and active transport options. This has contributed to sprawl and to residents being located in suburbs far from their places of work and daily activities, rather than being close enough to walk or cycle. This has had a negative effect on the health and well-being of residents and damaged the local environment (for example by suburbs encroaching into agricultural areas). These problems intensify as towns grow leading to further congestion, time wasted travelling or in traffic, urban sprawl, air and noise pollution, loss of open space, and an increased demand for fossil fuels.

Fast Fact:

Greenhouse gas emissions and transport

The transport sector accounts for approximately 17% of greenhouse gas emissions in Steve Tshwete. Therefore reducing the number of cars on the road can significantly reduce the municipality's effect on global climate change.

Source: Greenhouse Gas Inventory 2012 Report, Urban-LEDS, ICLEI Africa

It has become clear that municipal transport planning needs to be innovative to address the current challenges.

"Active Transport" is a new phrase in South Africa and has been identified as a priority area at national, provincial and local government. Previously, the phrase non-motorised transport (NMT) was used. This includes all forms of movement that are human-powered and do not rely on engines or motors for movement, such as walking, cycling (and a host of related modes such as rickshaws, wheelchairs or even skateboards). Making use of active transport to get to work not only benefits the environment but can have significant positive health and economic benefits too.

The overall goal of the Low Emissions Spatial Transition in the Steve Tshwete Local Municipality is the establishment of a compact, efficient, integrated, liveable and affordable city, in which there is good and equitable mobility, and transport related emissions are minimised. This should include an improved public transport network. According to the Nkangala District Municipality CITP (2012/12), approximately 25 000 households in STLM have no car, and there is thus a pressing need for an improvement to the non-motorised transport network, as well as to promote cycling as an inclusive mode of transport and commuting.

> *"South Africa is such a car-orientated country, as success is often equated with the ability to buy and drive a motor vehicle. But we have to start thinking of ways to decrease the effect of carbon emissions on our environment. This requires an efficient and practical transport system that encourages people to use NMT and BRT systems instead of cars"*
>
> **Sekadi Phayane**
>
> **Manager**
>
> **SMEC roads and highways Gauteng South**
>
> Source: Mavuso, Z. NMT 'greening' public transport. Engineering News. (http://www.engineeringnews.co.za/article cycling-brings-environment-friendliness-to-public-transport-2013-11-01).

4.1 What changes do we need?

Sustainable transport practices include planning for, and supporting, movement patterns that increase the use of non-polluting energy sources, as well as the number of transport modes available to urban residents. It encourages walking, cycling and public transport use instead of private vehicle use (especially in the journey to and from work, school and recreation), freight carried over rail rather than road, and it supports integrated planning approaches. This includes providing the appropriate infrastructure for various modes of transport such as foot paths, cycle lanes, and bus lanes and stops. Public transport plays a vital role in providing all citizens and visitors with access to opportunities and facilities, whether for economic, education, health, recreation or social purposes.

4.2 How do we design our buildings?

4.2.1 Consider transport during site selection

Developments that are within close proximity to good public transport nodes and routes with frequent service can encourage building occupants to use public transport. The building location and design should also favour active transport (pedestrians and cycling). This helps to provide a variety of transport options for staff (building occupants) and visitors alike to access the property without needing to use private vehicles.

4.2.2 Design for on-site facilities

Wherever possible, the design of buildings should include the provision of on-site facilities (such as banking, laundrette, coffee shop, hair salon) so as to reduce the need for additional trips by building users for basic amenities. This has the additional advantage in many instances of activating the building edge, and so making it safer and more pedestrian friendly.

There is a growing trend both in South Africa and internationally for commercial and retail developments to provide good cyclist facilities that encourage and enable the use of bicycles as a means of transport. Adequate undercover, safe bicycle parking should be provided, both for staff and building visitors, along with lockers and shower facilities. This doubles as a functional facility for staff who wish to exercise at lunch time.

Many professionals undertake unnecessary flights around the country on a monthly or more frequent basis – the incorporation of good video conferencing facilities into the building goes a long way to reduce the need for flights, and should be encouraged.

4.2.3 Provide preferential parking

Clever building design can incentivise and help to enforce good decision-making within the transport sector. Building design should make it as attractive and convenient as possible for users to use energy efficient and renewable energy powered modes of transport. This should be while simultaneously discouraging the use of large single occupancy vehicles (SOVs), such as 4x4s, which consume large amounts of fuel and emit higher levels greenhouse gases than smaller vehicles. A simple way to impact behaviour is through parking provision. Priority, easy access parking closest to building entrances should be reserved for the desired classes of vehicles, such as carpooling and shared vehicles, mopeds, motorcycles and scooters, and hybrids or alternative fuel vehicles. This should be in addition to the parking bay requirements for the disabled.

During the initial design of the building it may also be prudent to consider the installation of wire-ways for the future retrofit of some bays with electric charging points, as it is anticipated that the use of electric vehicles will increase in the future.

4.2.4 Reduce parking ratios

Design buildings with fewer parking bays than the local planning allowances permit. Whilst the municipal minimum ratios will need to be adhered to, every effort should be made not to exceed them where they do exist and a reduction of these should be considered by the municipality, especially where existing public transport facilities exist.

4.2.5 Design for accessibility

Buildings should be designed for universal access, including the needs of disabled persons. The National Building Regulations stipulate specific standards which need to be adhered to by all building designers in SANS 10400-S. To improve upon these standards, universal accessibility should also be given priority throughout the building, and clearly indicated at building and site entrances. Wheelchair ramps and suitable slopes should be designed at all building entrances, and clearly designated safe paths need to be made available for pedestrians and cyclists.

4.3 How do we construct our buildings?

4.3.1 Co-ordinate staff transport requirements

Contractors and developers can actively encourage construction staff to lift share or carpool. Such behaviour can be facilitated through the use of a noticeboard for lifts to be advertised or shared, and a designated meeting or collection area identified, and rewarded through the allocation of parking to carpool vehicles. Gauteng's Department of Rural Development has recently created an internal staff car-pooling system and website through a tailor made online version of www.findalift.co.za.

4.3.2 Plan and co-ordinate material delivery

Good preparation and planning can reduce unnecessary transport requirements around materials to be delivered during the construction phase of the project. Large developments can also benefit dramatically from the use of a concrete batch plant instead of the need to bring in large volumes of cement at one time. Not only does this prevent stress on the traffic grid at peak times, but also results in fewer harmful pollutants and greenhouse gases being released from large trucks especially concrete mixers waiting in lines with their engines idling.

4.4 How do we manage our buildings?

4.4.1 Implement an eco-mobility plan

Travelling requirements can be reduced through better co-ordination and suitable infrastructure, as outlined below in a few simple steps to set up an eco-mobility plan:

Do a transport survey: The first step in the proactive management of a building in order to promote active transport and a move away from single occupant private vehicles is a review of the current practices. This would help to develop an understanding of how staff or building occupants and visitors currently access the building, as well as when and why they leave. One way to do this is to develop and administer a transportation management survey for all staff and visitors.

Compile a transport strategy: Thereafter, a formal strategy should be drawn up which allows key interventions and strategies for improvement to be planned and prioritised. A green travel or transport management plan should be developed and implemented to encourage alternative commuting to single occupant private vehicles and promote travel by modes that produce lower emissions per passenger-kilometre. Central to the success of this is buy-in from building occupants, and it is recommended that executive or body corporate buy-in is obtained to the green travel plan.

Encourage innovative alternatives: In the case of corporates and where appropriate, employers should be encouraged to allow staff to work flexi-time or to work from home. Office design should incorporate more hot desks and less permanent ones. Lift sharing and carpooling should be encouraged and facilitated – businesses could offer dedicated or preferential parking bays or free parking to carpooling or lift share vehicles, and the company intranet be used to connect staff coming in from similar areas. Another option, which has been embraced by some corporates, is the use of one or two hire cars, which are available to staff during the day for work-related travel, and thus allows staff to use public transport to commute and leave their private vehicles at home.

Promote public transport: Major public transport routes in the close vicinity should be identified and regularly communicated to residents and/or staff and building visitors alike. This can be done via notice boards or information screens in the foyer, as well as social media platforms (e.g. WhatsApp groups) or the company intranet. Staff can often get a petrol allowance, but not a public transport allowance – consider how this can be negotiated as an innovative policy within your business.

Provide suitable infrastructure: Minor changes to the basement or entrance could allow for the installation of lockable bike racks in secure areas for staff and visitors to use when they commute by bicycle. Provision of staff changing rooms and shower facilities also encourages active mobility.

The eco-mobility strategy should also promote the use of alternative fuel vehicles, which can be done via the identification of priority parking areas and the provision of refuelling or recharging stations (whilst not yet in huge demand, building owners should place this on their medium term capital expenditure list).

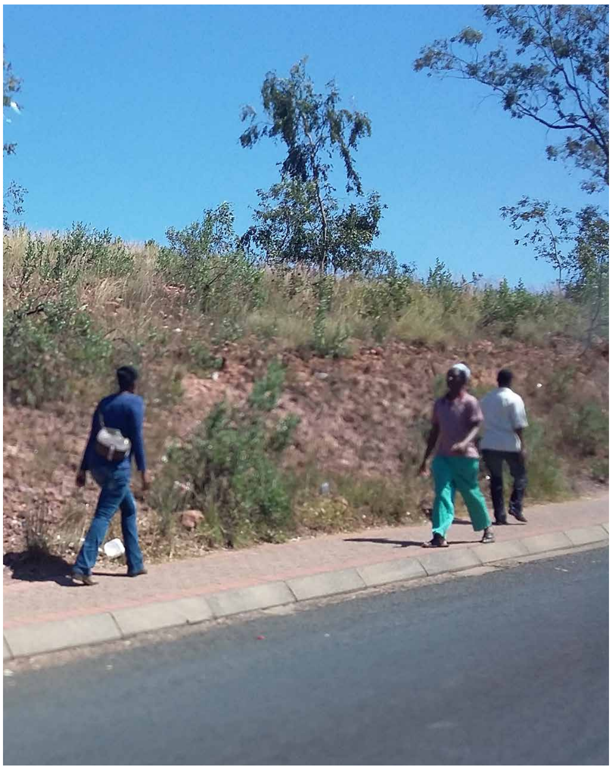
Reduce unnecessary travel: The final two aspects of the plan should be to actively reduce the need for building occupants to move around via private vehicle for short trips on one end of the spectrum and flights on the other. Complementary facilities should be developed in, or near, the building (such as a convenience store, ATM, pharmacy, hairdresser, gym, library, crèche), and the building should be equipped with video conferencing facilities which have been demonstrated as having the potential to dramatically reduce the need for business travel (especially flights).

4.5 How do we enhance our precincts?

4.5.1 Design for people, not cars

Transport and mobility planning at a precinct or neighbourhood scale, and broader, offers the opportunity to create a network of well-connected and well-located cycling and pedestrian routes. These need to be safe, clearly demarcated and well maintained. Pedestrian-friendly neighbourhoods do not develop overnight, and need planning and suitably phased intervention that reflect the needs of the people. Part of the design of walkable neighbourhoods involves minimising street widths, hard and soft landscaping (such as the provision of trees and benches), encouraging appropriate retail activities such as coffee shops on the ground floor of commercial buildings and ensuring that store fronts are at a pedestrian scale. In a nutshell, think of towns or villages designed for people not cars, and where the streets can come alive as meeting places.

Another proposal is the provision of bike-sharing facilities, where people can “hire” or borrow a bike for a designated period of time, and either return it to where it was collected or to another drop-off point in the municipal area. This promotes a sense of community, reduces private transport dependence, and can also assist in stimulating new jobs and economic activity.



Case Study

Bike Share Programme

eThekwini Municipality

As part of a broad Non-motorised Transport programme rolled out by the eThekwini Municipality, a bike share programme for staff members was piloted in 2013. This involved the provision of approximately 150 bikes dedicated for trips in and around Durban's central business district (CBD). The initiative was intended to encourage staff and councilors to use bicycles when commuting in the CBD, while raising the profile of cycling in the city and encouraging people to use bicycles to commute to and from work and to run errands.

The municipal bike share system operated along similar lines as the COP17 project whereby staff had access to a pool of bicycles located at municipal buildings within the inner city. Staff members wishing to make use of the bikes will be required to register their details on a bicycles tracking system, which is the same tracking system deployed for the COP17 bike share system. Registered staff can use any of the available bikes at the various share points, and can return the bike at a different location to where it was picked up, provided the drop-off destination has scanning facilities installed.

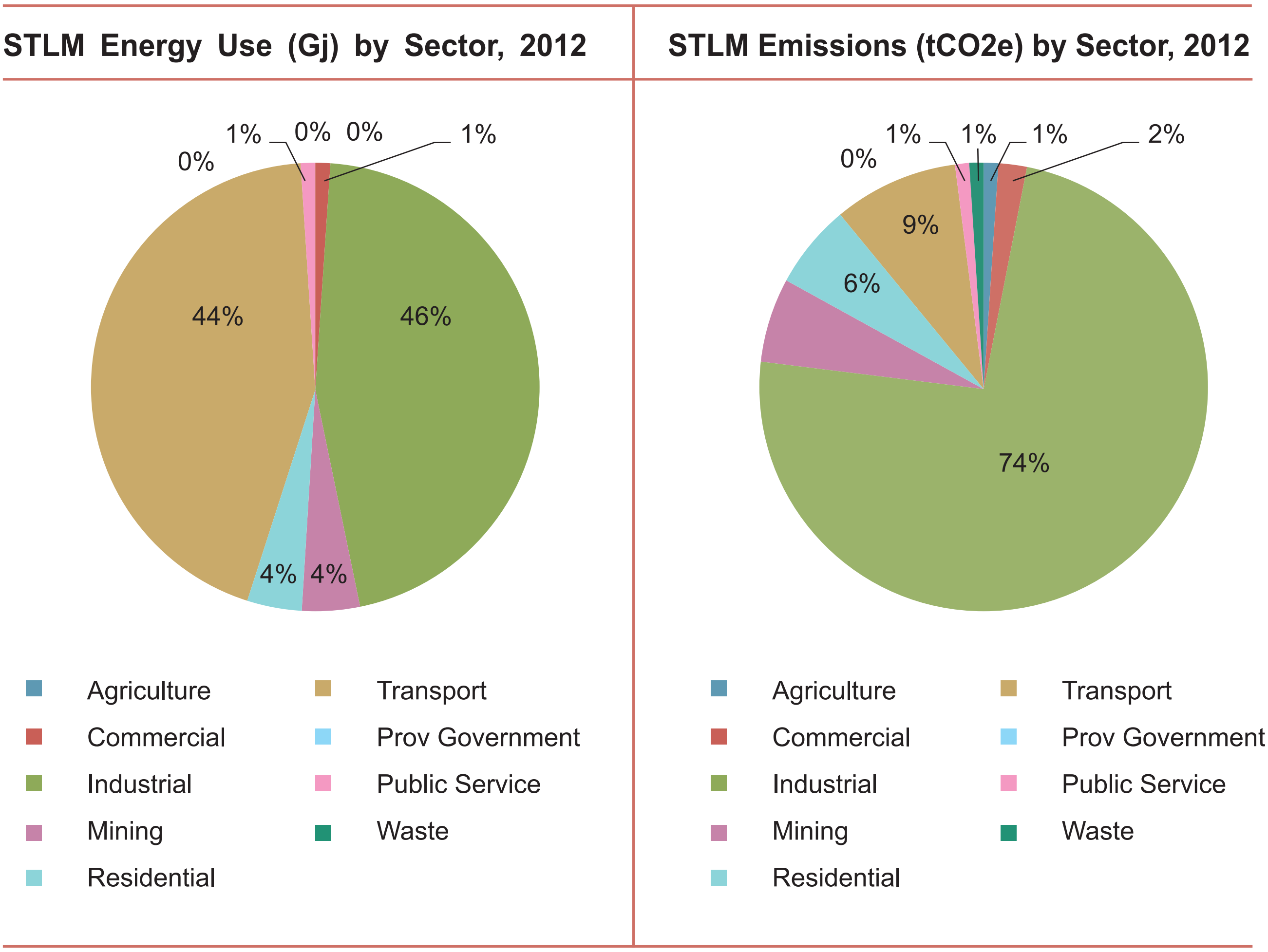
Source: :http://urbanearth.co.za/articles/ethekwini-bike-share-system-raises-cycling-awareness-durban

5 Energy

Energy is vital to the daily activities undertaken in homes, getting to work, in offices, shops, hospitals, libraries and industry. Energy is predominately used in the form of electricity, but also includes liquid fuel (petrol, diesel and paraffin), gas, wood, and coal. The majority of South Africa's energy supply comes from the burning of fossil fuels, especially coal. Electricity generation in South Africa is both a major emitter of greenhouse gases and a serious hurdle for development as demand is exceeding supply.

In Steve Tshwete, as seen in the image below, the largest energy user is industry, which also accounts for almost three quarters of all greenhouse gas emissions, followed by closely transport. While the transport sector predominantly relies on liquid fuel for energy, the industrial sector relies predominantly on electricity. Hence, there is an opportunity for significant demand reduction in industry through energy efficiency in their buildings and processes and for the use of energy generated on site or shared between a few industrial sites in the municipality. In the residential and commercial sectors (which jointly account for 5% of energy use), electricity used in buildings is the predominant energy used. This indicates the opportunity for demand reduction and energy efficiency measures through implementing "green" building principles and practices.

Figure 5: Percentage distribution of energy use and greenhouse gas emissions in the municipality



Source: Greenhouse Gas Inventory 2012 Report, Urban-LEDS, ICLEI Africa

South Africa's energy challenges can be tackled with a drive to reduce demand through the implementation of strong energy efficiency initiatives, and through the promotion and roll out of renewable energy sources.

Green Economy Enabler

Renewable energy

Renewable energy is key to the green economy as it offers an alternative supply of electricity to businesses and industry that emits no greenhouse gases through the production process. The renewable energy sector can stimulate local jobs in areas that do not have fossil fuel resources available, and tends to be more labour intensive per gigawatt produced than fossil-fuel based electricity. Jobs can be created throughout the process of renewable energy production; from the design and manufacture of parts to the construction of power farms, to the production of energy and the ongoing maintenance and operations of these farms.

5.1 What changes do we need?

Buildings can account for up to 40% of total energy consumption and contribute 20% of global greenhouse gas emissions, but also provide an opportunity for improvement. 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. This can occur by encouraging and implementing passive design and energy efficient lighting, heating and cooling systems in buildings, energy efficient processes in industry and municipal infrastructure provision, and through the promotion and rolling out of alternative energy sources, namely investment in the renewable energy market.

Fast Fact:

Energy Efficiency

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

5.2 How do we design our buildings?

When designing a building, the following needs to be taken into consideration:

- Ensure compliance with mandatory requirements
- Include passive design elements
- Include energy efficiency and demand management features
- Consider on-site electricity generation

5.2.1 Compliance with mandatory requirements

Energy efficiency and demand management in buildings is regulated through national policy and standards. The purpose of these guidelines is not to provide a summary of these regulations. Rather, as it is essential to a full understanding of the current regulatory environment which frames and provides a base for these green building guidelines, to provide a brief overview and highlight sections of the **SANS 10400-XA Energy Usage in Buildings (what needs to be done)** while touching on the associated **SANS 204 Energy Efficiency in Buildings (how it should be done).**

Effective from May 2012, all new buildings and building extensions must comply with the energy usage and energy efficiency standards as detailed in the amended National Building Regulations.

Fast Fact:

SANS 10400-XA

The SANS 10400-XA regulations include aspects such as orientation towards north, window sizing and positioning, shading, choice of materials with regards thermal and insulation properties, solar heating, natural cooling and daylighting.

Non-compliance with the SANS 10400: XA poses the risk of penalties under the National Building Regulations and Building Standards Act. It is also anticipated that over time these standards will become more stringent, and may become incorporated into existing and not only new buildings. It is thus critical that developers and building managers heed these requirements in both design and operation of buildings so as to future proof their portfolios.

A quick overview of SANS 10400-XA

SANS 10400-XA is presented in three sections:

- XA1 – Energy efficiency standards in buildings
- XA2 – Energy efficiency in water heating
- XA3 – Three routes to illustrate compliance with SANS 10400 XA

XA1 – Energy efficiency standards in buildings

The focus is to design the building in an energy efficient manner that still provides adequately for the needs of the users, its function and geographical location. This excludes garages, storage areas, equipment and plants that are required for conducting the business.

XA2 – Energy efficiency in water heating

At least half of the water, 50% (by volume) , that is required to be heated shall be provided by solar heating, heat pumps, heat recovery or fuel from renewable energy (sun, wind, geothermal, biomass, etc.). A typical geyser with resistance heating is discouraged.

XA3 – Three routes to illustrate compliance with SANS 10400-XA

There are three ways in which the property developer can show compliance with regards to the design and construction of the building:

- **Compliance Route 1 – The prescriptive route** where all the requirements are met as stipulated in the regulations.
- **Compliance Route 2 – The reference building route** is where a competent person can demonstrate the energy usage of the building is equivalent to or better than a "reference building", which would have been achieved through the prescriptive route.
- **Compliance Route 3 – The performance route** is where the building has a theoretical energy usage performance, determined using certified thermal calculation software, less than or equal to that of a reference building in accordance with the regulations.

Fast Fact:

Key SANS10400-XA definitions

A competent person is defined as "a person who has the necessary education, training, experience and contextual knowledge to make a determination in terms of a functional regulation". A competent person will typically be a mechanical engineer or architect, who has completed appropriate courses pertaining to the SANS 10400–XA 'Energy usage in buildings' regulations. Most multidisciplinary engineering consultancies should offer this service.

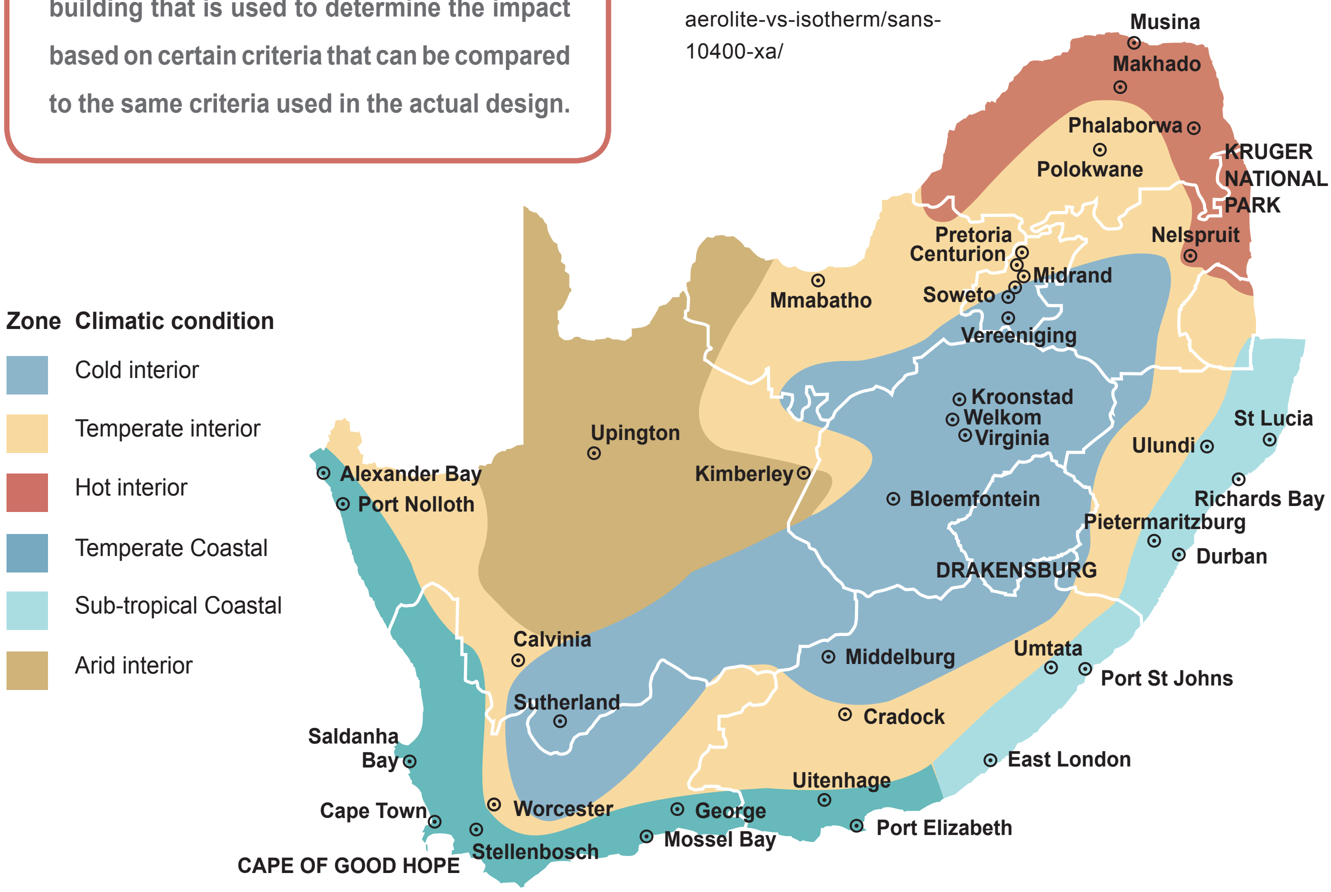
A reference building means a hypothetical building that is used to determine the impact based on certain criteria that can be compared to the same criteria used in the actual design.

5.2.1.1 A quick overview of the different climatic zones:

Essential to the implementation of SANS 10400-XA is the differentiation of South Africa into natural climatic zones. Due to the varied climatic conditions in South Africa, SANS 10400-XA sets different requirements for thermal insulation, and other aspects of building design. As seen in the image below (taken from SANS 10400-XA), there are a total of six climatic zones, which are labelled and referred to throughout the regulations as Zone 1 to 6.

Figure 6: Climatic Zones in South Africa used by SANS 10400XA

Source:
http://aeroliteinsulation.co.za
aerolite-vs-isotherm/sans-
10400-xa/



Steve Tshwete Local Municipality is located in Zone 1, which is the cold interior climate. This climate is characterised by a lower humidity with colder temperatures, and large temperature variance from day to night, and between seasons. Insulation is thus critical to maintain a steady indoor temperature.

5.2.1.2 A quick overview of the key SANS 10400-XA requirements:

Confirmation by a competent person: Where a competent person is responsible for compliance, they need to submit the relevant form to the local authority on completion of the construction and commissioning of the building (form 4 as contained in SANS 10400-A).

Windows and overhangs: Where glass areas are larger than 15% of the net floor area, shading devices or performance glazing is required. Whilst double glazing or treated glass are options, it is expensive and can equally be achieved through overhangs or shading over the windows. It is best used in conjunction with internal blinds or curtains, which in summer should be drawn in the early afternoons to keep the heat out, and in winter can be closed around dusk to retain the heat.

Fast Fact:

Measuring the performance of insulation

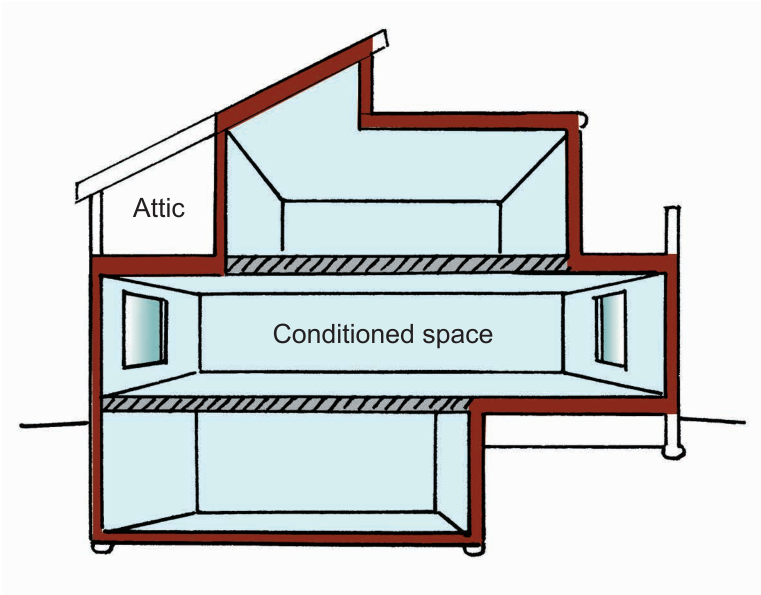
R-value: An R-value is a measure of thermal resistance in materials used in buildings. The higher the thermal resistance of a material, the harder it is for heat to move through it. If a building is built with high R-value materials, this means the building will stay cooler for longer in summer and will stay warmer for longer in winter. This makes the building more comfortable to be in. It is important in green buildings to reduce the amount of energy used to heat or cool a building, so the use of material with a high R-value is encouraged.

The U-value is always used within building regulations and indicates how much heat is lost through a given thickness of a particular material. It includes the three major ways in which heat loss occurs – conduction, convection and radiation. The lower the U-value is, the better the material is as a heat insulator, so the use of material with a low U-value is encouraged.

Figure 7: Building envelope description

The building envelope consists of:

- Fenestration
- Ceilings
- Walls
  - Above grade
  - Below grade
  - Mass walls
- Floors
- Slab
- Crawl space



Source: http://www.greenrushenergy.com/building-performance/

Provision of suitable building insulation: This serves to minimise temperature fluctuations within the buildings to reduce or eliminate the need for energy to be used for heating and cooling, as well as improve the indoor environmental quality of the building. The smaller the building is, the greater the effect the envelope will have on the internal environment. This is because in a smaller or narrower building, the building envelope is a greater proportion of the building's volume and therefore has more influence over the total internal space.

A minimum thermal resistance of R-value 3.7 as prescribed by SANS 10400-XA for the Steve Tshwete Local Municipality in climatic zone 1 (cold interior) which translates into 135mm of insulation required by SANS 10400-XA Deemed-to-Satisfy criteria.

Note: This insulation can take place via roof insulation alone, or be adapted as per insulating properties of the roofing materials. Hence the actual R-Value of building insulation will be less than the stipulated value and determined by roof type. Furthermore, when following the rationale design route for compliance with SANS 10400-XA, the insulation requirement may be less due to the use of good walling materials and shading.

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Fast Fact:

Insulated ceilings

Research has shown that indoor air temperatures can be managed much more effectively through installing a ceiling and insulation than by a coal stove or an electric heater, fans or air-conditioning.

Source: Energising SA Cities and Towns, SEA, 2003

- **All exposed hot water pipes** are to be insulated. Exposed hot water pipes with a diameter of less than or equal to 80mm should be insulated with a minimum R-value of 1.00. Exposed hot water pipes with a diameter of greater than 80mm should be insulated with a minimum R-value of 1.50.
- **Floors:** If an underfloor heating system is provided for in the design, then insulation with an R-value of no less than 1 must be provided for below the installed heating system.
- **Walls:** Wall insulation is required for non-masonry external walls. The requirements refer to the external walls of the habitable portions of the building fabric only.
    - For zone 1 the minimum R-value required for walls is 2.2.

The following types of masonry walling comply with the R-value requirements:

- Double-skin masonry with no cavity, plastered internally, or rendered externally (Note: The cavity and grouted cavity walling systems exceed the minimum R-value of 0.35); or
- Single-leaf masonry walls with a nominal wall thickness greater than or equal to 140mm (excluding plastering and rendering), plastered internally and rendered externally.

Building sealing: Insulation works best when there is little infiltration of air through gaps in windows, walls and roofs. SANS 10400-XA therefore stipulates that ceiling voids should be designed so as to minimise air infiltration. Accordingly, wall plate and roof junctions shall be sealed. The joints in sheeted roofs shall be sealed.

Fast Fact:

Sealing windows

Old windows that don't seal well allow the warm air escape during the winter, so it is advisable to get self-adhesive weather stripping to seal the gaps around doors and windows. This is cheap and easy to do, while it can show a remarkable improvement of the heat retention during winter.

Insulation of hot water pipes: Exposed hot water pipes with a diameter of less than or equal to 80mm should be insulated with a minimum R-value of 1.00. Exposed hot water pipes with a diameter of greater than 80mm should be insulated with a minimum R-value of 1.50.

Provision of hot water: The regulation is fairly prescriptive with regard to hot water supply requirements. More than half of the annual hot water must be provided by means other than electric resistance heating (geyser) or fossil fuels. Various options exist, including solar heating, heat pumps, geothermal heat, renewable combustible fuel or heat recovery from alternative systems and processes.

The functional requirements of the provision of hot water (sub-regulation XA2) shall be satisfied when:

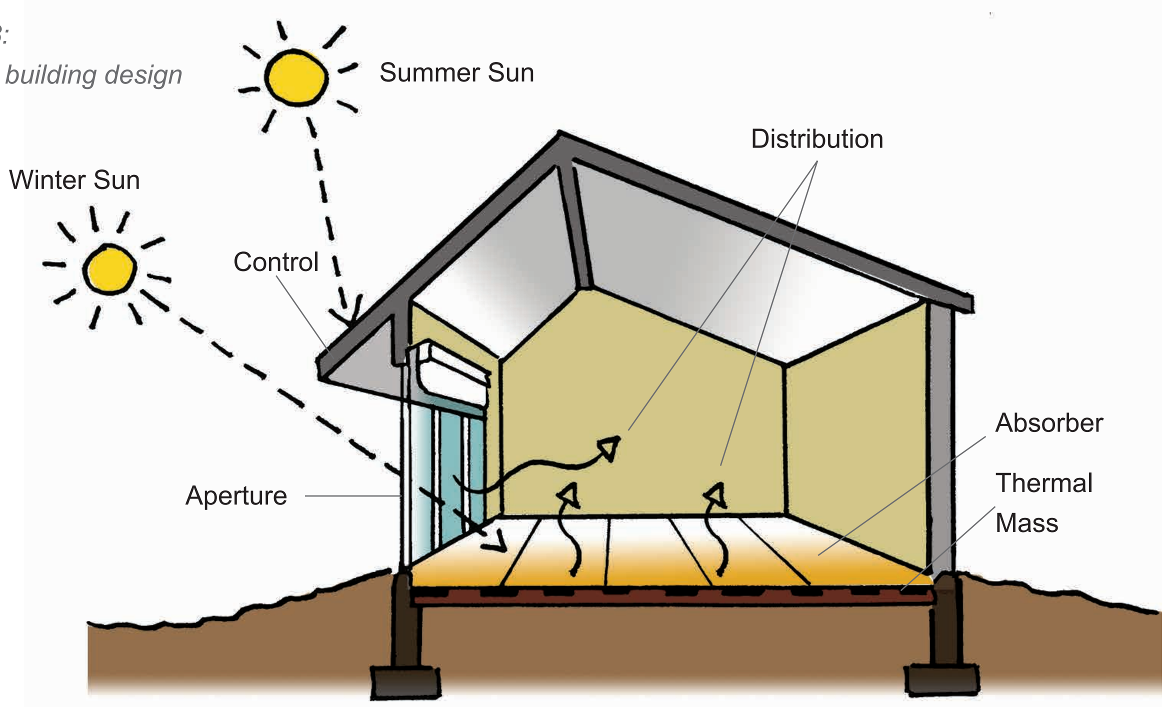
- The population for which such building is designed is determined in accordance with Regulation A21.
- The hot water demand is determined in accordance with table 2 and table 5 of SANS 10252-1:2004.
- The storage requirement is based on maintenance of a hot water temperature of 60°C.
- Solar water heating systems shall comply with SANS 1307, SANS 10106 and SANS 10254 based on the thermal performance determined in accordance with the requirements of SANS 6211-1 and SANS 6211-2.
- All exposed hot water service pipes (SANS 10252-1) shall be clad with insulation with a minimum R-value in accordance with SANS 204. (see section on insulation above).
- Thermal insulation, if any, shall be installed in accordance with the manufacturer's instructions.

Note: It is important that all buildings are designed in accordance with the existing national and local legislation and building standards. Whilst some of these key features have been highlighted, it is the responsibility of all who work in the built environment to ensure that they have a good working knowledge of existing legislation and where to confirm the detail as applicable to their current project.

5.2.2 Include passive design elements

Effective passive building design, which incorporates solar thermal performance and energy conserving measures, can only be achieved through incorporating the appropriate design principles into the planning process at an early stage. A building with good passive design is not more expensive to design or build than any other building, but is likely to save money throughout the life of the building, and is therefore considered a quick win in designing a green building.

Figure 8: Passive building design



Source: http://www.ecohome.net/news/ latest/saskatchewan-birthplace-high-performance-buildings-pasive-solar-home-design

Fast Fact:

Passive Solar Design

Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces. In this approach, the building itself or some element of it takes advantage of natural energy characteristics in materials and air created by exposure to the sun

Good passive design and orientation can also assist to maximise the potential for heating and cooling, solar water heat heating, as well as encourage natural lighting and so reduce the need for additional heating or lighting during the day.

Successful passive design is about capitalising 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. Unlike many other energy efficiency measures, these cannot be retrofitted later, and hence suitable foresight and planning upfront are essential.

5.2.2.1 Building orientation

Maximising the passive solar performance of a building requires careful building orientation and layout taking the surrounding environment conditions such as prevailing wind into consideration. An ideal building would be long and narrow and oriented on an east-west access, with the longest side of the building facing north. Such an orientation would allow the building to capitalise from heat gain in the morning, but minimise late afternoon solar gain when the sun is at its hottest and ambient temperatures are higher. It has been proposed that good orientation alone can generate estimated energy savings of 20% to 50% for a building.

5.2.2.2 Building layout

The service areas (i.e. the kitchens and bathrooms) in residential buildings should ideally be on the south/east facade, and the bedrooms and living areas on the north/west. In large public or commercial buildings, circulation spaces and non-living areas can be placed on the west or south periphery as these areas will have the greatest thermal discomfort and can shield thermally sensitive areas like offices from harsh glare and solar radiation or cold darker environments.

5.2.2.3 Shading devices or roof overhangs

At different times of the year the sun is located in a different position in the sky (higher or lower) and it may be good to use shading devices to control the heat coming into the building. These shading devises can either be fixed or automated to follow the seasonal patterns. Shading devices should block mid-summer sun, which is high in the sky, but allow the cooler lower winter sunbeams to penetrate the space. Shading devices will also 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.

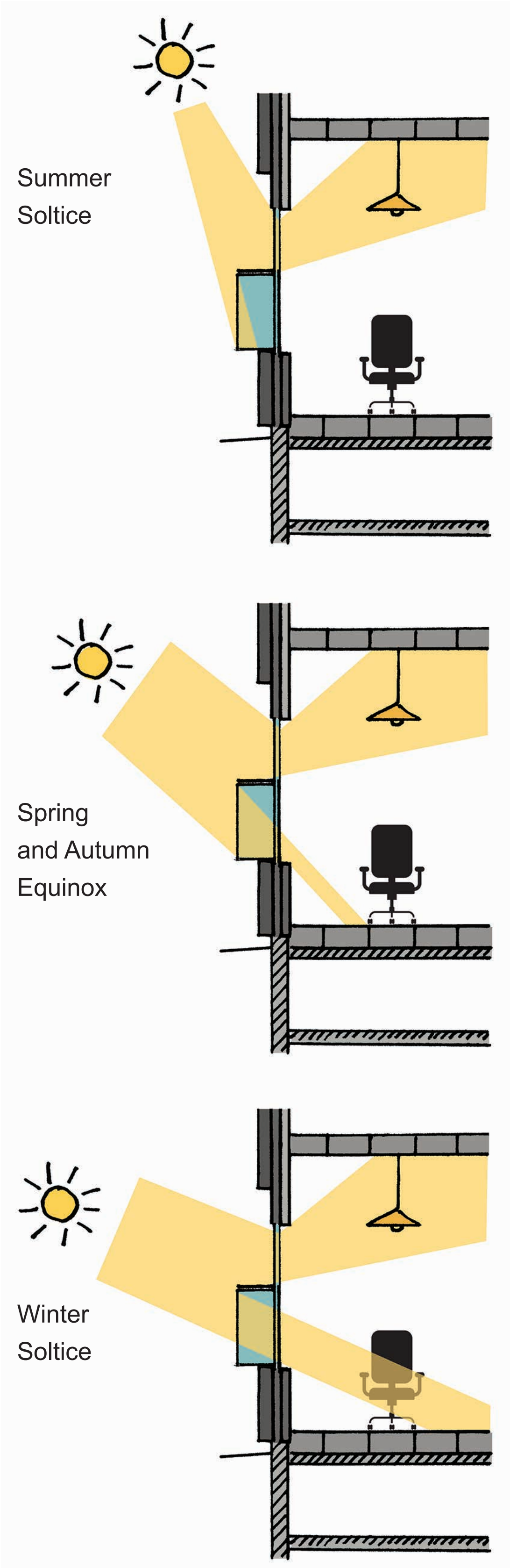


Figure 9: Good building design to minimise seasonal variations

Source: http://www.wbdg.org/resources/daylighting.php

5.2.2.4 High performance glass

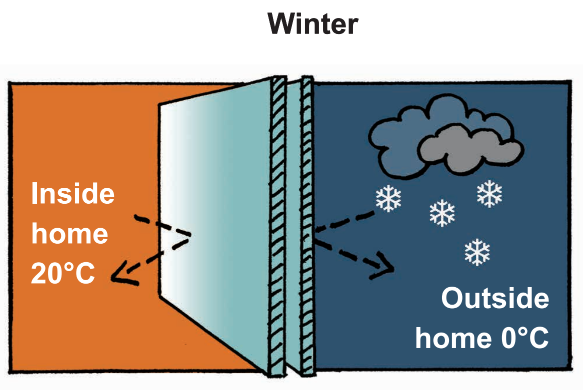
The thermal property of glass is not as good as walls, so a lot of the building's internal winter warmth and summer coolth is gained or lost through the windows. This negative impact can be reduced through the use of double glazing, high performance glass and glass with special coatings. It aims to reduce the build-up of radiant and convective heat, manage the loads on the air conditioning system and thus keep energy requirements down.

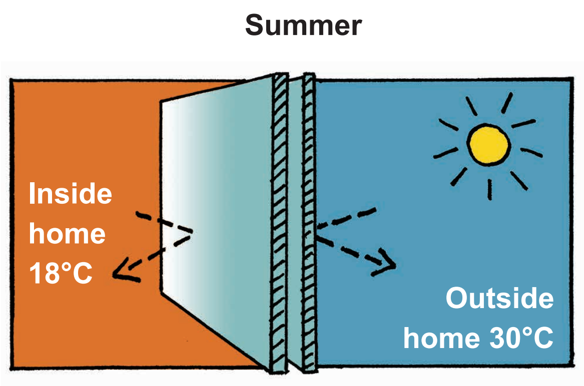
Building glazing, particularly on the north-facing facade, should have a low solar transmittance to reduce the heat coming in through the windows. **Low-E coating** on glazing can reduce the heat, while letting in useful light for daylighting. **Double glazing** acts as insulation and is appropriate for most climates, particularly those that require heating during part of the year and for areas where it is necessary to reduce the impact of external noise pollution. Triple glazing is commonly used in Europe where they experience cold winters.

However, this can be expensive and can equally be met by well-designed **overhangs or shading** over the windows. It is best used in conjunction with internal blinds or curtains, which in summer should be drawn in the early afternoons to keep the heat out, and in winter closed around dusk to retain the heat.

Fast Fact:

How double glazing works





Double glazing is made from two pieces of glass sealed together with an air space between. A double glazed window sits in your frame just as single glazing would, but provides a number of extra benefits. It keeps the space warmer in winter, cooler in summer, offers building owners a saving in utility bills due to less heating and cooling needed, acts as a security feature (more difficult to break), reduces noise from outside (acoustic attenuation), and dramatically reduces condensation on the inside of the glass. Clear glass accounts for less than 5% of a windows insulation, the rest is being supplied by the air layers on either side of the glass.

Since the heat flow resistance of still air is much greater than that of glass, a glass unit made from two panes, enclosing an air space will have about twice the insulation value. Double glazed units provide insulation to windows and doors of a building like fibreglass batts insulation to a wall, helping you to maintain a consistent internal temperature throughout the year.

Source: http://www.wellingtondoubleglazing.com

Fast Fact:

How high performance glazing works

One way in which to achieve the low U-values required by the building regulations is through the installation of high performance glazing such as low-emissivity glass (low-E glass), because it will:

- **Reduce heat loss, saving energy by maintaining a comfortable environment at lower thermostat settings.**
- **Reduce cold spots and downdraughts near windows, improving comfort and increasing usable floor space.**
- **Increase inner glass surface temperatures to reduce condensation inside the window.**
- **Reduce capital and running costs of heating systems, thus saving money.**

Low-E glass incorporates a very thin layer of metallic coating on one surface. To protect it from wear, the low-E coated surface is positioned in the outer face of the inner pane in a double or triple glazing layer. The coating allows heat from the sun to enter the building but significantly reduces heat loss from inside the building by reflecting radiant heat back into the room. In most instances, the transparency of the glazing is not significantly affected by the low-E coating although a very slight tint is discernable in certain circumstances, particularly from the outside.

Source: http://www.lowenergyhouse.com.

5.2.2.5 Wall and ceiling insulation:

Insulation contributes to better thermal comfort, which 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.

In any climate, insulation will not be effective without reduced air infiltration. South African buildings are notoriously leaky due to unsealed windows and doors and unnecessary air vents in walls. In more extreme climates, where there is a greater difference between internal and external temperatures, commissioning of the building envelope and even airtightness testing should be considered (this also helps for mould prevention).

5.2.2.6 Increasing 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 winter and cooler inside in summer and is especially appropriate in drier areas with large differences in daytime and nighttime temperatures.

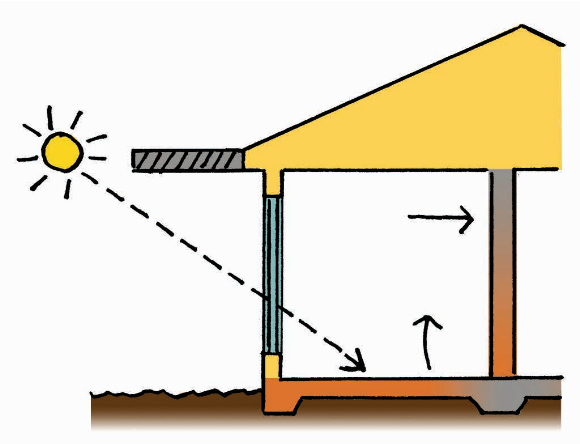
Fast Fact:

How thermal mass works

Thermal mass is an important component of passive solar design and refers to the material's resistance to change in temperature. Thermal mass works to regulate and reduce temperature fluctuations in buildings so that the building structure can retain and release heat. Dense materials such as concrete, rammed earth and bricks all have good thermal mass properties and could be used as walls, dividers or floors.

Thermal mass in winter

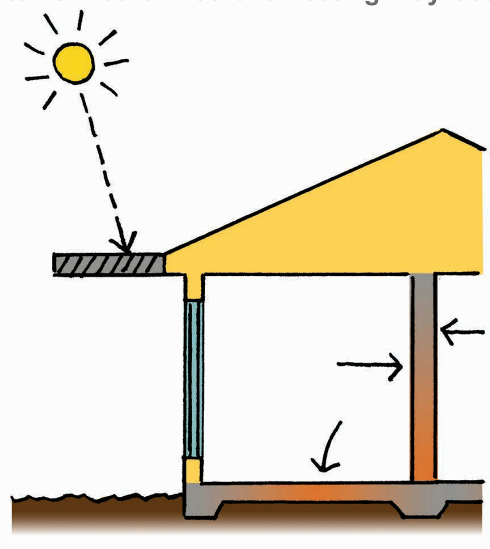
In winter, let the sun in and thermal mass will absorb heat from the sun during the day. The floors and walls store the warmth, releasing it back into the home at night and on cloudy days. It helps if carpets and other insulating materials do not cover floors exposed to the sun.



Source: http://www.level.org.nz

Thermal mass in summer

In summer, the thermal mass of a building can "soak up" excess heat from within the building. At night, the house can be ventilated to allow any excess heat to be lost into the cooler night air. Ideally, direct sunlight and excess solar gain should be prevented from entering the house by use of blinds, sails, a pergola, eaves or other external shading systems – otherwise overheating may occur.

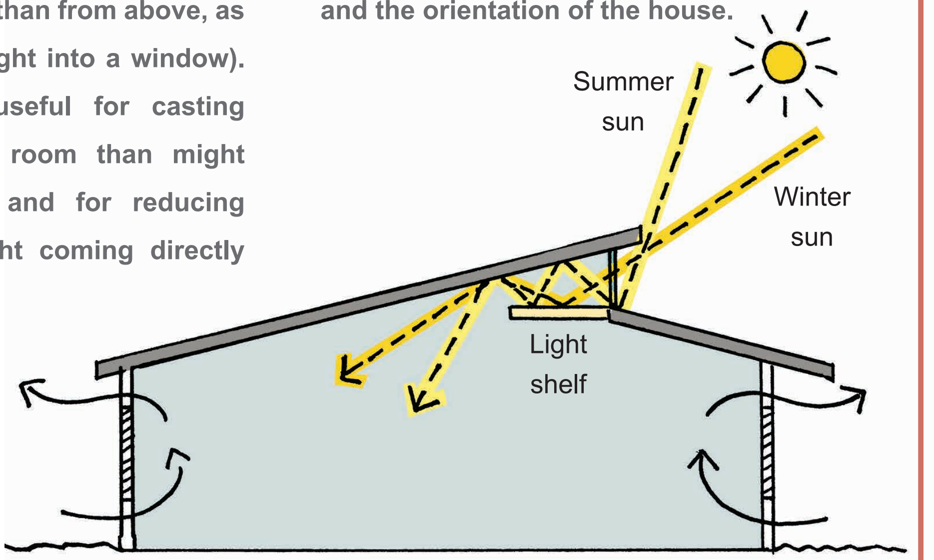


A building with incorrectly used or little thermal mass can experience large internal temperature fluctuations over a 24-hour period; heating up during the day and cooling down overnight. A building with well designed thermal mass would experience smaller temperature fluctuations over the same period in the same location. It would stay cooler during the day and warmer overnight.

Fast Fact:

How a light shelf works

Light shelves are placed horizontal next to windows and bounce light upwards into a room from below (rather than from above, as is the case with direct light into a window). They are particularly useful for casting daylight further into a room than might otherwise be possible and for reducing shadows caused by light coming directly through a window. The distance that light is cast depends on the time of day and year, and the orientation of the house.



Source:
xbananasplitx.blogspot.com

5.2.2.7 Maximising natural light

Most of the windows can be on the northern side of the building, if suitable overhangs or shading is provided. Windows on the east and west should be reduced to avoid glare and heat gain. Windows on the south can provide diffused light, but will require additional high performance glazing to avoid heat loss through windows in the winter.

If the regulations are implemented (i.e. the window area is 15% of the floor area), then adequate natural light should be provided. Natural lighting can also be maximised through the use of light shelves to bounce light into deeper spaces – careful design is needed to ensure effective maintenance of reflective plane.

Daylight should become the primary light source in building for health, productivity and sustainability reasons. Natural light stimulates biological functions that are essential to human health, and has been observed to increase staff productivity and retention, to lead to higher retail sales, better school grades, and in the healthcare sector a reduction in the average length of hospital stay, quicker post-operative recovery; and reduced requirements for pain relief to name but a few of the myriad benefits.

5.2.2.8 Roof materials

Using reflective or light coloured roofing materials or installing a roof garden can reduce the building's cooling loads significantly as less heat is coming into the building.

5.2.2.9 Roof design for the installation of solar water heater (SWHs)

Roofs should ideally be tiled at 25 degrees to the horizontal for maximum solar energy collection with the best orientation for roofs bearing SWH being north facing, although this can vary between 15 degree east and 45 degree west. This will allow for maximum solar water heating and so reduce or omit the need for electrical backup or top up for most of the year. Even if SWHs are not included in the design at the time of construction, it is beneficial to design the pitched roof in such a way so as to allow for the easy installation of SWHs during a retrofit or refurbishment.

5.2.3 Include energy efficiency and demand management features

5.2.3.1 Energy sub-meters

If you can't measure it, you can't manage it! Sub-metering with a suitable monitoring system should be provided for all energy uses in a building of 100kVA or greater. Most modern building management systems (BMS) are able to perform this monitoring function.

Where practical it is advisable to provide separate sub-metering for lighting and power on each floor or tenancy (whichever is smaller) and ensure that appropriate mechanisms for monitoring are in place. 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 costs linked to actual consumption instead of floor space. Some of the common loads which need to be measured are car parks, chillers, air handling units, lifts (individually or as a bank), and common area lighting and power.

5.2.3.2 Building Management System (BMS) and building tuning

Building management systems (BMS) are an essential part of any modern building, and are used to measure and manage building performance. The effective control of building services and equipment, lighting and water, has a direct impact on operational costs and indoor environment quality. Electricity and water meters should be connected to the BMS, enabling the building manager to charge tenants for their use, but also to find leaks and to ensure that equipment and systems are running properly. Large and small buildings can all benefit from monitoring systems, and even well-designed building systems can get out of tune. It is recommended that full commissioning be done at practical completion with a re-commissioning after one year of occupation, followed by ongoing building tuning and a regular re-commissioning scheduled as part of the management regime.

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Fast Fact:

What is commissioning?

Verification that the building's energy related systems are installed, calibrated and perform according to the intended design and based on construction documents.

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Fast Fact:

What is building tuning?

Building tuning is the process of assessing and adjusting all building systems to ensure that they function correctly during all weather seasons and adapt correctly to the building use and heat loads. This includes a period, normally 12 months, of trouble shooting and adjustment, and is required in order to ensure that a building achieves maximum energy performance.

5.2.3.3 Lighting in buildings

Use of energy efficient lighting: The use of energy efficient lighting is critical, specifically if it is solar powered. It is recommended that only light emitting diodes (LED) lighting be used, as the slightly higher upfront costs are soon balanced and superseded by the longer life spans and much lower energy requirements, allowing these to be powered by solar energy and save money on operational costs.

Design for lighting power densities of the lowest possible levels: Lighting power density refers to the total power consumed by lamps excluding ballasts in an area, and reflects good lighting design where artificial lighting with minimal energy consumption is specified. It is expressed as a function of the **nominal wattage of all lamps in the space divided by the floor area of that space.** In offices this should never exceed 3W/m2 per 100lux (measured at 720mm above finished floor level with the default maintenance factor of 0.8), but it is deemed desirable to target lower than this. Lux = Total Lumens ÷ Area in Square Meters

Various strategies can be used to achieve the goal of energy efficient lighting systems, including the use of electronic ballasts, efficient luminaires, metal halide lamps, designing to the correct lighting level (this is discussed in more detail in the section on Indoor Environmental Quality), and the efficient use of lighting control zones and daylighting.

Lighting power density worked example

A residential bedroom of 4m x 5m, has two 30 watt lamps.

- Determine total lamp capacity:
  30 Watt x 2 = 60 Watt
- Determine room area:
  4m x 5m = 20m²
- Determine lighting power density:
  60Watt/20m² – 3W/m²

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Fast Fact:

Energy used for lighting

Only 10% of the energy used by an incandescent light bulb provides light. The other 90% is released as heat, which uses 30% of a buildings cooling energy.

5.2.3.4 Lighting zoning to promote energy efficiency

Older buildings often have a central switch for lights per floor, so that all the lights are on even if it is not needed. When the light requirements are designed in different zones it allows specific lights to be switched on where required, thus reducing the energy demand. This can result in enhancing the versatility of the space and promoting ongoing energy efficiency for the building. All individual or enclosed spaces should have individual switches, and the size of individually switched lighting zones should not exceed 100m². All lighting zones and switches should be clearly labelled and accessible by building users.

5.2.3.5 Motion occupancy and daylight sensors

It is becoming increasingly common for developers to specify motion occupancy sensors as part of the base build, and many tenants now require this as part of their fit-out. Daylight sensors, which are also becoming more common, allow for the automatic dimming of lights in peripheral zones that have greater natural daylighting, and the ramping up of lights in core zones which may have less natural light. A combination of the two may be used in parking garages, ensuring regular placement of lights thus providing orientation and safety, but with the remaining lights been zoned and motion controlled.

5.2.3.6 Peak energy demand reduction

Energy supply is most constrained at residential peak demand times between 07:00 to 10:00 and from 18:00 to 20:00. Project teams are encouraged to actively explore ideas to ensure that a building can reduce its peak electrical demand load on the grid by at least 15%. Alternatively, project teams can look to flatten loads so that the difference between peak and average demand does not exceed 40%.

5.2.3.7 Swimming pools

When designing a residential home it might also include a swimming pool. Natural swimming pools recreate pristine ponds and mountain pools found in nature. The water is kept sparkling clean by circulating it through an ecosystem of water plants. No salt, chemicals, or sterilisation equipment is needed, and thus it is very energy efficient.

If a standard pool is built, then ensure that a suitable pool pump is installed as per the size of the pool. A variable speed drive allows the pump to adjust to the requirements at any specific stage and is very efficient. Ensure that the pool pump is on a timer and set to optimum use depending on the seasonal conditions. If practical, consider running the pool pump during the daytime using solar power.

Case Study

My Green Home
– swimming pool pump
Pinelands
Cape Town

A family in Pinelands worked with the Green Building Council of South Africa to “green” their home. The swimming pool pump used to be their second highest electricity consumer (after the geyser), but they slashed its energy use by more than 80% by switching to an efficient variable-speed pump and reducing operating hours.

Source: www.mygreenhome.org.za

5.2.3.8 Good design of HVAC system

Mechanical heating, ventilation and air conditioning (HVAC) systems are typically responsible for about 40% of a building's energy use. Combining good base design principles (orientation and layout) with an efficient and suitably sized HVAC system can dramatically reduce energy consumption in the building

5.2.3.9 Use efficient and climatically appropriate mechanical cooling systems

A variable air volume (VAV) HVAC system uses water for cooling and has a building management system that controls the air volume and fan speeds. This allows for the targeted cooling of specific areas thereby increasing the energy efficiency of the overall system. The VAV system has sensors that open or close air valves as demand requires, causing fans with variable speed drives (VSD) to adjust their speed, resulting in a more efficient system than one that has a static volume of air. Energy is saved when the cooling and ventilation mechanisms are split as only the volume of air needed for ventilation is circulated. Also, in this system water rather than air is used as the temperature regulating mechanism. This system also enables different parts of the building to respond to different heating and cooling needs. Experience has indicated that the installation of a VAV system may show motor energy savings of up to 50%. Air-cooled systems are the least energy efficient HVAC systems and are only acceptable for small-scale uses such as in a small office in an industrial building

5.2.3.10 Design buildings with raised floors to allow for underfloor air displacement systems

Underfloor air displacement systems allow air to be introduced from vents in the floor rather than being blown down from vents in the ceiling above

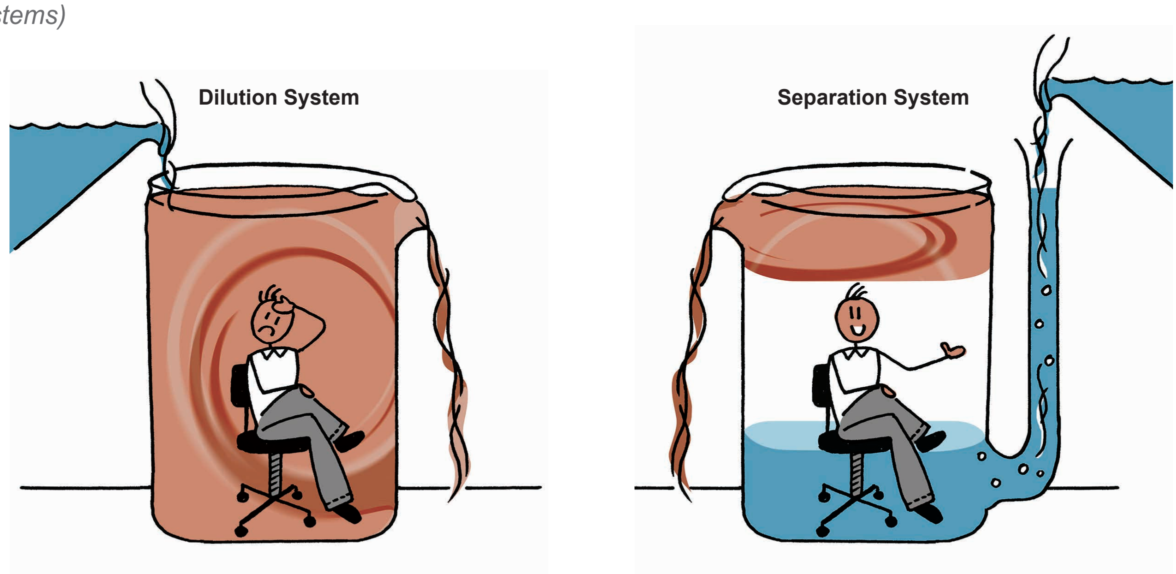
as conventional HVAC systems do. Through these systems, the air released can be at a slightly higher temperature than when using conventional mechanical ventilation. This is both energy saving, and will have a positive impact on the indoor air quality as it displaces stale air upwards, instead of just diluting it. Warm air will naturally rise as cooled air from the top of the room moves down, also creating a healthy air exchange rate. Energy savings from displacement ventilation systems are estimated to be from 30 to 60% over standard systems.

Fast Fact:

How underfloor air displacement systems work

An underfloor air displacement system introduces low velocity fresh air at a lower temperature than the ambient room temperature via an underfloor plenum or void. This filters into the open plan space via grills in the floor. This air warms and rises, pushing the layer of stale hotter air and impurities upwards where it can be vented at a higher level. The image below clearly indicates the difference between the dilution system commonly used (where cold fresh air is introduced from above and mixes with the warmer air) and the underfloor displacement system which introduces air from below results in a separation and displacement of stale air.

Figure 10: Office stale air dilution (conventional HVAC systems) vs separation (underfloor air displacement systems)



Source: http://www.dnw.com.cn/dnw/show.php?itemid=4653&page

5.2.3.11 Design to include passive or active chilled beams

Chilled beams refer to a network of pipes located in the ceiling that circulate cool water to create passive (non-mechanised) conductive cooling – the cool air drops towards the floor and hot air rises to the top and is cooled again. This system is most appropriate in drier climates, such as in the interior of South Africa, as more humid climates, along the coast, can reduce the effectiveness of the system and lead to increased visible condensation of the beams.

This system saves energy as water is more efficient at cooling than air, water can be pumped in directly from the cooling tower, and less air needs to be supplied. This also allows smaller equipment to be sized, with additional reduced lifecycle energy costs.

Active chilled beam systems (also known as chilled ceilings) use the same cooling mechanism of chilled water running through pipes in the ceiling, but also include active air distribution systems, typically in the form of displacement ventilation systems where air is introduced through vents in the floor.

5.2.4 Consider on-site electricity generation

To reduce the reliance and demand on the national electricity grid and to reduce the greenhouse gas emissions associated with coal-fired power stations, it is possible to generate electricity on site using renewables such as the sun, wind, from agricultural waste products or through industrial processes. Local or on-site power generation also results in transmission losses being negligible whereas 8% of electricity is lost in transmission and distribution when using the national grid to transport electricity far from points of electricity generation.

The most appropriate solution will be determined by the following factors:

- The amount of electricity required
- The time of day that the electricity is required
- The space or site area available
- The presence of sufficient and accessible renewable resources

5.2.4.1 Design for on-site energy generation through renewable sources or co-generation: PVs (photovoltaics) are well suited to single buildings. PVs are panels placed on the roof and are designed to generate energy from sunlight, which is then transformed to usable electricity and stored in a battery until used. PV panels must be placed to be north-facing and at an angle of approximately 23° (in South Africa, with a latitude greater than 25°) to receive the greatest amount of direct sunlight to perform optimally and generate the maximum amount of electricity.

Co-generation is a method of electricity production that is more suitable for industrial plants. This process generates both heat and electricity. It can be a means of sharing heat as a by-product from one industrial process to another where heat is needed as an input to the process. This can reduce the amount of electricity required by industry.

5.3 How do we construct our buildings?

5.3.1 Implement site energy efficiency and demand management initiatives

Good construction practice will contribute towards a reduction of energy demand during construction and result in operational cost savings to the contractor.

The following strategies can be implemented on site to help ensure an on-site energy demand reduction:

- Ensure that all distribution boards are clearly labelled and metered to monitor and manage energy use.
- When working at night or in darkened areas of the building such as fire escapes, only light those sections which need to be illuminated for work or safety reasons by using targeted lighting. Installing motion detectors in site offices can be a useful tool to prevent wasteful use of lighting.
- Use energy efficient light fittings and equipment on site and in site offices.

5.4 How do we manage our buildings?

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. When undertaking a retrofit, the first step is to consider any of the design initiatives mentioned in the sections above which had not been included in the base build.

5.4.1 Energy efficiency through good operational practices

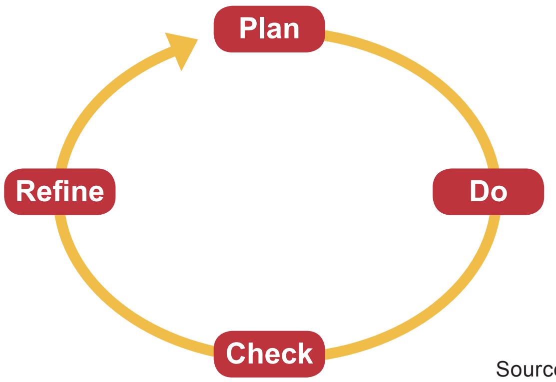
5.4.1.1 Brief overview of the energy management standards

SANS 50001:2011 provides for the implementation of the voluntary international ISO50001 standard by organisations in South Africa in order to improve their 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.

It outlines a four phase cyclical action plan requiring companies to:

- Plan: Conduct an energy review/energy audit of their operations and establish an energy baseline and retrofits that can be implemented.
- Do: Implement the energy management action plans.
- 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.

Fgure 11 : The four-phase cyclical action plan for improved energy management in buildings



Source: SANS 50001:2011

Various voluntary standards are now incorporated into legislation in order to assist the government in achieving its energy efficiency targets. As time goes by, individuals and industry wishing to remain competitive and relevant are likely to comply with these standards. In particular, those wishing to obtain tax benefits through energy efficiency savings will need to comply with the requirements set out in ISO50001.

5.4.1.2 Energy audit and benchmarking

It is recommended that a full building energy audit be undertaken, in order to develop an understanding of the building's performance and to determine which areas should be targeted first for maximum gain at minimal cost. It is important to drive both energy efficiency and improved system performance. The intention is first to make existing systems as energy efficient as possible, and then to explore opportunities to supplement them with alternative forms of energy.

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Fast Fact:

What is an energy audit?

An energy audit is an analysis of the energy consumption of a specific building. The aim is to determine what could be done to improve energy efficiency in the building through technical interventions or behavior change. It will typically require a summary of the actual consumption of the various lights and appliances, while also taking into account the overall consumption (KWh), apparent demand (KVA) and related cost.

5.4.1.3 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. This can take the form of a visual inspection, coupled with metering (to provide energy use information to support energy management and identify energy saving improvements) and monitoring (to provide information to support the ongoing accountability and optimisation of building energy performance and identify opportunities for additional energy saving investments).

5.4.1.4 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.

5.4.2 Energy efficiency through maintenance planning

Some of the low or no cost initiatives that can be employed to promote energy efficiency are:

Consider formal or informal energy benchmarking: The GBCSA Energy and Water Benchmark Tool allows for free self-assessment of energy and water use in a building.

Energy consumption targets and monitoring: Set consumption targets and monitor against meter reading.

Change 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. Modify thermostat set points towards the upper (24°C in summer) and lower (20°C in winter) thermal comfort boundaries. Research indicates that even a 2°C to 4°C increase in the temperature setting can save energy use by a factor of three.

Make use of a daytime cleaning service: This means that additional lighting is not required at night, and reduces the risk of energy waste through lights been left on in unoccupied zones.

Clear and easily understood light switch labelling is an effective way to reduce energy consumption especially after hours. This allows staff to only switch on those lights that they require.

Appliances: Select only energy efficient appliances for rental or purchase.

Case Study

Energy efficiency retrofits are affordable and shows returns

The V&A Waterfront, Cape Town, has managed to implement a 15% annual energy saving through retrofitting and refurbishment, with an anticipated payback period of less than three years

Source: Colin Devinish, V&A Waterfront

5.4.3 Energy efficiency through retrofitting or refurbishing

When considering a retrofit or refurbishment of a building it is advisable to "start from a clean slate" and review the initial design principles as outlined in the section "How do we design our buildings".

Some initiatives that show a rapid rate of return and could be argued easily for retrofit:

5.4.3.1 Repaint surfaces

Paint ceilings and walls light colours to reduce the amount of artificial lighting required as lighter colours help to reflect natural light deeper in to the building (especially soffits (ceilings) and walls of parking areas which should be painted white or off white). This should be in conjunction with painting the roof with reflective paint, to minimise the amount of heat coming into the building to reduce the energy required for building cooling.

5.4.3.2 Electrical lighting

An upgrading of the electrical lighting systems would include the replacement of inefficient fixtures, ballast upgrades, the phasing in of energy efficient lamps, luminaires and ballasts, and addressing over-lit spaces, especially parking garages

Fast Fact:

Impact of light replacement

"If we replaced all the incandescent light bulbs in the world with existing compact fluorescents we could close 705 of the world's 2400 coal plants."

Lester Brown

Founder, Earth Policy Institute

Lighting controls to incorporate the installation of motion sensors and zone lighting controls, sweep functions and photocell installations (timer with photocell to override if cloudy dark conditions outside).

Retrofit occupancy sensors as part of a lighting control system. As a minimum these are required in areas that are occupied less often such as libraries, meeting rooms, print areas and toilet blocks.

Retrofit daylight sensors to respond to current natural ambient light levels and so dim down or switch off lights.

Retrofit the installation electrical sub meters to allow building owners to identify where energy is been used and flag and remediate inappropriate usage.

Install time switches on small equipment, thus allowing them to switch off automatically when not in use.
Upgrade all motors to high efficiency motors which have the benefit of being both quieter and more energy efficient.

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 operating costs for the building.

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Fast Fact:

What is power factor?

Power factor is the ratio between the actual power load (kW) and the apparent power demand (kVA) drawn by an electrical load. It is a measure of how efficiently the load current is being converted into useful work output. More specifically, it is a good indicator of the effect of the load current on the efficiency of the supply system.

A power factor of 1 would mean 100% of the supply is being used efficiently. A power factor of 0.5 means the use of the power is very inefficient or wasteful.

So what causes Power Factor to change? In the real world of industry and commerce, a power factor of 1 is not obtainable because equipment such as electric motors, welding sets, fluorescent and high bay lighting create what is called an "inductive load" which in turn causes the amps in the supply to lag the volts. The resulting lag is called Power Factor.

By installing suitably sized switched capacitors into the power distribution circuit (also referred to as power factor correction), the Power Factor is improved and the value becomes nearer to 1 thus minimising wasted energy, improving the efficiency of a plant, liberating more kW from the available supply and reducing operating costs.

The purchase cost of the installation is usually repaid in less than 1 year's electricity savings.

Source: http://www.kwsaving.co.uk

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.

Specific green or renewable energy initiatives include the retrofitting of PVs to roofs, shading elements or facades, and the inclusion of on-site cogeneration of energy.

Domestic water and heating water can be upgraded through the installation of a new solar geyser to heat water, and a controls and or boiler upgrade.

Airside systems such as air handling and rooftop units and terminal units can also be upgraded.

Chiller plants should be considered for replacement or upgrade and control improvements. The ability to purge a building with fresh air before the chillers are started up should also be enabled.

The **heating plant** would benefit from an upgrade or replacement and control improvements (especially heating water supply temperature setpoint reset and review circulating pumps operation schedules)

The HVAC can be upgraded to the more **energy efficient VAV HVAC** system when the opportunity to replace the old one arises.

Install **internal blinds** or external shading devices.

Add **solar film** to existing glazing or replace single with double glazing.

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

Fast Fact:

The decreasing cost of renewable energy

The cost of renewable energy sources is coming down. In 2008 the cost for solar was about R40 million per MW, but by 2013 the cost had reduced to R18 million per MW.

5.5 How do we enhance our precincts?

The economies of scale for renewable energy generation and district heating or cooling plants (central heating or cooling for groups of buildings) are possible at a precinct or community scale. This is because with a group of buildings relying on a system to provide electricity, or to heat and cool the buildings, there is less wasted energy and the capital, operational and maintenance costs are then shared between the users. Systems such as these can also make use of time-based sharing where some buildings use the energy during the day while others use it at night.

5.5.1 Consider local energy production

Generating power within a precinct can be more viable than on a single building site as there is more space to be used to generate electricity, whether on the ground or on building rooftops. The most common and viable types of renewable energy production possible within a precinct include:

- Photovoltaics
- Wind power
- Geothermal
- Biomass

There are many incentives that can help to promote these, and the municipality and private developers should look at how best to harness these.

6 Water

Water is essential for life. Water is used in agriculture, industry, buildings and gardens to water plants and crops; to drink; for daily hygiene; to clean homes and wash cars; to prepare and cook food; and to flush the toilet. While water might appear to be an abundant resource, less than 1% of water on earth is freshwater available in rivers, lakes and wetlands for the benefit and enjoyment by people, plants and animals.

Fast Fact:

Water used in buildings

Approximately 25% of global water is consumed in the production of materials for buildings, construction and occupation of buildings.

Source: UNEP, http://www.unep.org/sbci/About SBCI/Background.asp

Fast Fact:

Potable and non-potable water

Potable water is water from rivers and dams that is treated and safe to drink. This water should be used at times when people ingest water, such as when drinking it, preparing food, and washing. Non-potable water is directly from boreholes, rainwater harvesting, rivers and dams or even from water reuse strategies such as greywater harvesting. This water is not treated and could be unsafe to drink. However, this water can be used safely to irrigate landscapes and crops, wash clothes, in the construction of buildings, for the flushing of toilets and in cooling towers.

In South Africa 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.

6.1 What changes do we need?

To aid the transition to low emission development, measures need to be taken to protect rivers, dams and wetlands from pollution and harmful surrounding land uses and to reduce the amount of water used in everyday activities to allow sufficient and ongoing access to clean water. 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. Simple measures to conserve water can be implemented at no cost, with well-informed site layout and landscaping, and with a small increase in capital costs, large amounts of potable water can be saved and reused through water-efficient fittings and on-site water harvesting systems.

Water as a resource

Besides potable water, we need to consider alternative types of water which can be used as a resource in buildings and in the municipality such as:

Rainwater includes water collected from roof runoff or other structures after rain. This water can be used as drinking water, if not left stagnant for too long.

Greywater includes water that has been used for showering, bathing, hand wash basins and laundry. Kitchen sink and toilet water is excluded. This water is, however, usually combined with blackwater unnecessarily as it can be a valuable resource for landscape irrigation or for flushing toilets.

Stormwater includes any rainwater that touches the ground and flows across the surface of the ground (roadways, parking surfaces, gullies, creeks, streams, etc.). This water is channeled into the municipal stormwater system which discharges the water into rivers, lakes or the sea unfiltered or treated.

Blackwater (also referred to as sewage) includes water that has been used to wash dishes and to flush the toilet, which contains harmful contaminants. This water is usually disposed of through the municipal sewer and treated at a wastewater treatment plant. This water can be recycled by treating it to the level of greywater or even to potable water to supplement drinking water sources.

Acid rain: South Africa is generally blessed with good drinking water, but in some regions this becomes compromised at certain times of the year or under prevailing climatic conditions when rain falling at times of heavy smog becomes acidic. When sulphur dioxide and nitrogen oxide gases come in contact with clouds in the atmosphere, these gases can make rain more acidic. This acid can be deposited in the form of snow, fog or rain, with serious effects on the environment. Acid rain contaminates drinking water, damages buildings by corroding cement, and causes metals to rust. It poisons soils, affects plant growth, and destroys plant leaves. It also harms animals, aquatic life, and other wildlife.

6.2 How do we design our buildings?

The way in which a building is designed can have lasting effects on the resource efficiency of building systems and can limit the extent to which occupants can implement improved systems later on in the building's lifecycle. The design of buildings refers to both the initial design process prior to construction and when a refurbishment or retrofit occurs.

6.2.1 Design for on-site water management strategies

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. These meters must be connected to a system whereby water consumption can be monitored and evaluated by the building's facility manger or occupants. Water meters can bring points of excessive consumption to the attention of building managers and occupants who can then fix the problem or change their behaviour to reduce water use in the building.

On-site stormwater management: How a building is designed can have a negative effect on its surrounding environment. With regard to water this can occur through building in flood plains or riparian buffers which degrades local water courses, increasing the flow rate and volume of water from a building site, and an increased pollution flow into water bodies.

In the site's natural state, most stormwater would infiltrate and be absorbed by the vegetation and soft, open ground. However, as water flows along hard, paved surfaces the water can no longer infiltrate which increases the flow rate and quantity of stormwater being released from a site. This can cause or exacerbate flooding and the associated damage, especially in properties near to rivers. Methods of capturing, retaining and filtering stormwater on-site and releasing it slowing to municipal 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 the Steve Tshwete Local Municipality, where there is a large proportion of rainfall in short and hard bursts from thundershowers that 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 allows for stormwater to infiltrate the ground.
- Soak-aways are usually excavated pits that are packed with course 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.

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, a building should not be located within 100m 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.

With regard to how a building is orientated, often urban water systems can be neglected, misused and polluted as a negative environment is created between a building and the water body. This should be prevented by orientating an active part of the building towards the river and by allowing for a good interactive facade between the building and the river or wetland, where people can overlook and/or interact with the water system.

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. This reduces the demand of potable water for many activities in urban areas and too often is a neglected source of this precious resource. Rainwater harvesting is a survival strategy that has been around for thousands of years. This strategy is especially appropriate in Steve Tswete as most rainfall is received in summer when increased temperatures drive a higher demand for water. These systems can be installed by home owners or experienced contractors.

Greywater reuse: The average suburban house can use between 200 – 300 litres of reusable water on a daily basis. Greywater is water that has been used for showering, bathing, hand wash basins and laundry, excluding water from the kitchen sink and toilet. This water can be captured and reused on site rather than releasing it into the sewerage system as it does not contain harmful pathogens. It can therefore be reused, without being treated, for non-potable water uses (as is done with rainwater). Again, this reduces the demand for potable water in buildings and is a source of water that is available all year as it is not dependent on the weather and cliamte. Note that phosphate free washing powder needs to be used.

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 more costly initially, the benefits see a rapid payback. Note that drip irrigation can often not be used with greywater systems.

Swimming pools: Swimming pools are regarded as significant users of water. Traditional backwashing wastes vast amounts of water, which is often also inappropriately disposed of into the stormwater system. Furthermore, water is lost through evaporation. It is thus 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.

Case Study

My Green Home
Swimming Pool backwash tank

A family in Pinelands worked with the Green Building Council of South Africa to 'green' their home. In order to save water they installed a settling tank into which the pool backwash water now flows. Within 24 hours the majority of the water can be pumped back into the pool, thus saving on water and chemicals!

Source: www.mygreenhome.co.za

6.2.2 Specify water-efficient fixtures and fittings

Specify fixtures and fittings in accordance with National Regulations: National Building Regulations provides limits on the expected water demand and flow rates for fixtures, fittings and appliances in buildings. Adhering to these is mandatory but building design should strive to exceed these through specifying water-efficient and low flow fixtures and fittings.

Mandatory Requirements for Water Demand in Buildings

SANS 10252-1: 2004: Stipulates the hot and cold water daily demand provision permitted in buildings according to typology (for detail refer to SANS 10252-1: Table 1).

SANS 10252-1: 2004: Stipulates the average water consumption of hot and cold water per appliance (for detail refer to SANS 10252-1: Table 2)

SANS 10252-1: 2004: Stipulates the design flow rates for water fittings in buildings (for detail refer to SANS 10252-1: Table 3)

Water-efficient fixtures and fittings: The easiest way to reduce potable water consumption, requiring no change in building delivery and design nor in occupant behaviour, is the installation of water-efficient toilets, urinals, taps and appliances. In the design specifications, the water services engineer/architect should only specify fittings that have flow inhibitors or low flow rates, which are for example:

- Washroom Taps: 6 litres per minute aerator or a 1.7 litre per minute spray
- Kitchen Taps: 6 litres per minute aerator
- Showerheads: 6 - 10 litres per minute
- Toilets: 3.6 litres per flush (when low and high flush flows are combined) dual flush system
- Urinals: either waterless or a maximum of 1.9 litres per flush
- For residential and commercial kitchens and laundry rooms, water-efficient dishwashers and washing machines should be included as part of the base building.

Fast Fact:

Water use in the home

Water fittings are the conduits of consumption for approximately 40% of water used in high income homes and approximately 92% of water used in low income homes.

Source: *Jacobs, H; Geusteyn, L and Loubser, B. 2005. Water - How is it used at home. http://www.ewisa.co.za/literature/files/220%20Jacobs.pdf*

Provision of hot water: Hot water can be provided for by electrical resistance heaters and solar hot water geysers. While it is good practice to turn down the temperature of the geyser in a building to save energy, take note that the risk of legionella, a potentially fatal type of pneumonia, occurs at water temperatures between 20°C - 45°C and can no longer live above 55°C. Make sure your geyser is set to reach 55/60°C to avoid concerns regarding legionella.

Mandatory Requirements for Hot Water in Buildings

SANS 10400-XA refers to SANS 10252: At least half of the annual average hot water heating requirements shall be provided by means other than electrical resistance heating. The alternative means could be via but not limited to heat pumps, solar water heating, heat recovery from other processes or heating via gas.

Hot water installations need to comply with further SANS requirements as provided in section 4.1 of SANS 10400-XA:

- All hot water pipes must be clad with insulation, in accordance with Table 1 in SANS 10400-XA section 4.1.
- Solar hot water systems must comply with the following standards which govern the quality and functioning of these systems: SANS 1307, SANS 10106, SANS 10254 and SANS 10252-1.

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.

6.2.3 Consider alternatives to waterborne sewerage systems

The largest use of water in residential buildings is for the flushing of the toilet. This water use is also predominant in other building types, such as retail, commercial and educational. Alternatives, such as greywater captured on-site, need to be considered for the use of non-potable water for waterborne sewerage systems or to do away with waterborne sewerage within the design. Non-waterborne sewerage systems include:

- Waterless urinals, which are increasingly becoming more common in retail and commercial buildings.
- Composting toilet systems using a ventilated pit, which have been used in schools and residences. These systems breakdown the collected waste into harmless matter which can be used as fertiliser and compost.
- Vacuum toilets use a suction technology to remove waste within a closed system which can then also be treated on-site with the little water that is used being recycled for use as greywater. This vacuum system uses 80% less water than conventional waterborne sewerage systems (typically used on airplanes, but also implemented at the Table Mountain Cable Car Station to reduce water consumption and wastewater production).

6.3 How do we construct our buildings?

6.3.1 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 waterwise practices and water-efficient features. These strategies can include installing water-efficient and low flow rate taps and showers (this is discussed in greater detail in the section on how we the design our buildings) and ensuring the water is used only when needed – hoses and taps are not left to run unnecessarily.

6.3.2 Implement on-site water management strategies

The construction of buildings can cause damage to local water systems through dumping waste in or next to rivers and wetlands, bulldozing or using hydrologically sensitive areas for construction purposes, and from runoff from the site containing excess pollutants.

It is therefore necessary to adopt an environmental management plan which stipulates the following practices for water:

- No leaking taps or hoses on site.
- 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.
- Washing of cement mix and paint brushes to take place into designated settling tanks where the particulate can be separated and disposed of suitably. No cement water to be allowed to seep into the ground.
- Any groundwater pumped from site to be pumped into suitable settling tanks and the particulate removed before being allowed to enter the stormwater system.
- 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.

6.4 How do we manage our buildings?

Good building design is one thing, but in order for water efficiency to be maximised and proper savings enjoyed, a building needs to be well maintained and managed, and the building users educated so that their actions are in line with best practice.

6.4.1 Encourage water efficiency through behavioural changes

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

6.4.2 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. Building services or features which are found to be using a disproportionate amount of water should be investigated as there might be a leak to be fixed or certain changes needed in occupant behaviour.

Water management plan: Once the water audit it completed and the building manager understands where water is being used, a water management plan can be adopted and implemented. This water management plan can span a few years and include measures to reduce the building's total water consumption with measurable targets indicated to track consumption trends. This plan can also identify actions for improved education and awareness of water use in the building for occupants.

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. If there are spikes in water use, as registered by the water meters which have been installed, it is necessary to investigate what it was caused by. This could be from behavioural change in occupants, from water leaks or from burst pipes. These must then be attended to appropriately, through engaging with occupants or fixing the leaks.

Fire systems: Water-based fire suppression systems require that the pressure and water supply be checked regularly. When undertaking the Main Drain Test, ensure that the water is left running for no longer than needed (approximately 1 minute) so that water is not unnecessarily wasted.

Irrigation practices and water conservation systems: In summer, water in the early morning or late afternoon as this reduces water lost to evaporation. (Avoid watering between 10am and 2pm from October to February.) Water less during winter as evaporation rates are lower and many plants are dormant therefore requiring less water. In winter, when the evaporation rate is lower, change the hours of watering to the warmer hours – 9am to 3pm. Furthermore, consider installing a drip irrigation system to apply water only where it is directly needed. Automatic watering systems should also be connected to a moisture reader, to ensure that landscaped areas are not watered when there is sufficient moisture already in the soil.

[More information at: http://www.waterwise.co.za/export/sites/water-wise/gardening/water-your-garden/downloads/Water_Wise_Watering.pdf]

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. This flooding could then carry pollutants that otherwise would have been trapped by the site's filters to rivers and wetlands, thereby causing damage to surrounding ecosystems.

6.4.3 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.

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.

Install cutoff 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.

Landscaping: As vegetation needs to be replaced on-site, consider planting vegetation native to the local area which will contribute towards a xeriscape (where no irrigation is needed after the first year of growth).

6.4.4 Opportunities for improved water efficiency when retrofitting or refurbishing

Water-efficient fixtures and fittings: During a retrofit or refurbishment it can be necessary to replace sanitary fittings in the bathrooms and taps in the kitchens. This offers the opportunity to replace high-water-demand fixtures with low-water-demand fixtures. This is discussed in greater detail in the section on how we design our buildings.

6.5 How do we enhance our precincts?

6.5.1 Identify areas prone to flooding

Rivers and wetlands that flow through or next to the towns in the Steve Tshwete Local Municipality benefit the municipality as areas of recreation and beauty. However, due to harmful planning practices, many properties are built either on or too close to these water bodies. In times of excess rainfall, flooding often occurs in these areas leading to damage to property and people's livelihoods. Flooding is expected to get worse as climate change causes increased rainfall in shorter time periods. It is therefore necessary to identify these areas and adopt measures to prevent flooding. These strategies could include rehabilitating riparian buffers, which help to slow and absorb flood waters, and moving harmful structures from these sensitive areas.

6.5.2 Incorporate Incorporate Water Sensitive Urban Design (WSUD) strategies

Stormwater management at the scale of a community or grouping of buildings can protect rivers and wetlands from being degraded and polluted in times of rainfall, drought and flood. This is due to larger scale interventions which reduce the volume and velocity of runoff from building sites by filtering and cleaning water and allowing water to infiltrate permeable areas (and potentially recharge aquifers). This is especially important if not all the buildings in an area have incorporated on-site stormwater management measures and with regard to runoff from public areas and roads.

The following stormwater management tools are appropriate for intervention at the preciinct scale and can also be used to add green areas to a neighbourhood:

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.

Figure 12: Bio-swale to enable stormwater filtration and infiltration

Detention ponds: are relatively large depressions that temporarily store stormwater runoff in order to reduce the downstream flood peak (Woods-Ballard et al., 2007). These could be multi-functional areas that in the dry season act as a sports field.

6.5.3 Cluster activities for water reuse

When designing a new city piece 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.

6.5.4 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 have numerous benefits (economic and ecological) for a community. Although it is standard practice in some countries, blackwater treatment and reuse is not yet common practice in South Africa, in part due to our historically cheap potable water and the large numbers of the population who were not supplied with waterborne sewerage. As a greater proportion of the population is provided with waterborne sewerage, and the costs of potable water increase and water scarcity worsens, municipalities will increasingly need to actively encourage alternatives such as blackwater recycling.

Case Study

Wastewater Reuse for Municipal Drinking Water – George, Western Cape

The town of George in the Western Cape has re-engineered one of their largest wastewater treatment works (WWTW) to allow for the abstraction and reuse of water from the plant. The project was fast-tracked last year due to the worst recorded drought experienced on the Garden Route in 133 years. George was severely affected, with the dam dropping to an historic low of 16.9% in February 2010. The reuse plant will supply 10Ml/day of high quality treated water into the Garden Route Dam, which is the only source of raw water supplying George with its water requirements. Not only is it a reliable water resource in times of water shortage, but is an excellent example of water demand management and environmental responsibility. The project also created job opportunities for residents living along the pipeline route, who worked 7000 labour days at a cost of R630 000.

Source: http://www.southafricaonline.co.za/george-mun-first-in-sa-to-implement-indirect-reuse-of-treated-effluent_article_op_view_id_5680


sappi
Inspired by life
Proudly sponsored by sappi
recycle
metal
glass
plastic
paper
Glass
Plastic
Paper

7 Waste

Although waste management in South Africa is well-regulated at both national and municipal level, this linear consumption process has led to environmental damage through the release of toxic emissions, and has become a growing economic concern. Landfills are costly to construct and manage, rapidly filling up due to increasing population and the related waste production. Also, the rise of illegal dumping in public open spaces and road verges is harming the natural and urban environment by polluting rivers, streets and parks and poses a health and safety risk, especially to children and youth.

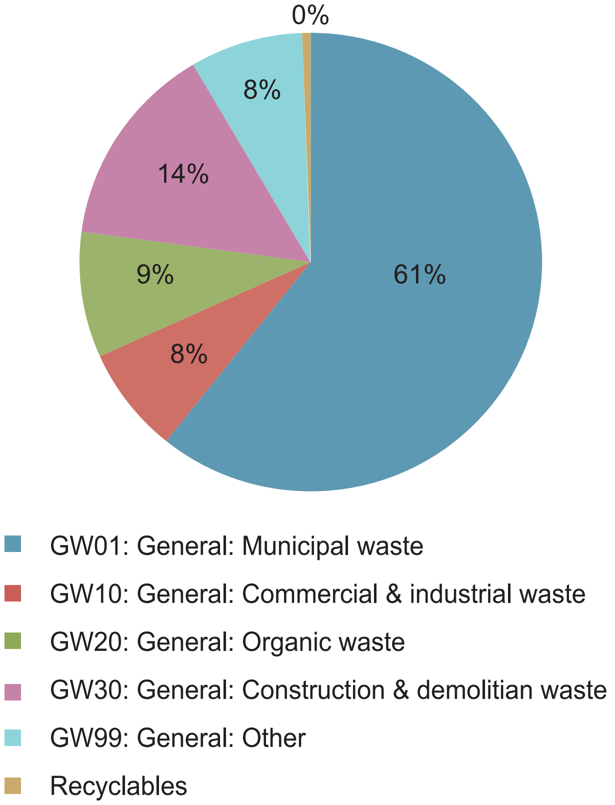
Municipal solid waste includes refuse from households, non-hazardous solid waste from industrial, commercial and institutional establishments (including hospitals), market waste, yard waste and street sweepings. It thus includes compostable waste such as garden trimmings and vegetable and fruit peelings, recyclable waste such as glass, plastic and tin, reusable waste such as construction rubble, and hazardous waste such as asbestos and motor oils. Most of this solid waste is currently sent to municipal landfill sites.

In the Steve Tshwete Municipality, waste disposal is centralised through the use of one landfill site and eight transfer stations. The municiplaity manages to reclaim approximately 200 tonnes per month from the general waste at the landfill site (2.5%). The current landfill is nearing capacity. Due to a new landfill site being needed sooner than expected, and the lack of an appropriate site for a new landfill, a project for the extension of the landfill site is currently underway at a cost of R24m. It currently costs the municipality around R3m per year to run the existing landfill site.

Landfill management is costly, and the closure and rehabilitation of landfill sites is even more so. Due to the build-up of landfill gas and leachate as the site matures and decomposes over time, management requirements are ongoing. This has severe financial implications for municipalities, but also offers opportunities to design associated activities with it for final waste reclamation, such a landfill gas to energy projects.

Figure 13: Waste generated in STLM and deposited in the landfill

STLM Waste Generation 2012

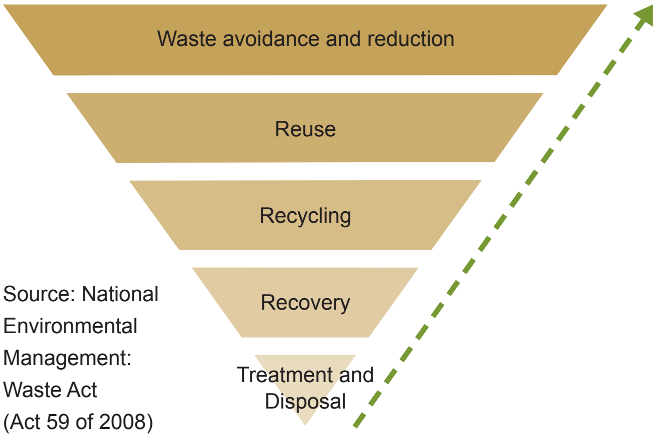


Source: Greenhouse Gas Inventory 2012 Report, Urban-LEDS, ICLEI Africa

7.1 What change do we need?

To transition to low emission development in Steve Tshwete, sustainable waste management practices need to protect the environment from harmful emissions and pollution and to reduce the amount of waste going to landfills. This would occur through prioritising action in terms of the waste management hierarchy, as seen in the figure on the next page.

Figure 14: The waste management hierarchy



Source: National Environmental Management: Waste Act (Act 59 of 2008)

Green Economy Enabler

Sustainable waste management

Sustainable management of municipal waste streams offers the opportunity for new markets to develop and for job creation. This is through the collection, sourcing and processing of recyclable products and materials that is labour intensive with low-skilled work opportunities available. New markets then need to be supported to buy and use the products and materials made from recycled resources. This step is critical to the success of any waste separation and recycling initiatives, and should be given priority assistance by the municipality.

Effective waste management has important economic and social impacts in addition to environmental benefits. Furthermore, the waste management sector can play an important role in the emerging green economy through creating green jobs and contribute to local economic development and growth. Waste, more perhaps than any of the other sections in these guidelines, cannot be dealt with effectively on a piecemeal basis. Whilst these guidelines are not an attempt at a formal waste management strategy, the aim is to create awareness amongst building owners. These owners need to deal with waste that comes into and out of a building at any stage of its lifecycle in the context of broader systems designed to enable this.

7.2 How do we design our buildings

7.2.1 Reduce construction waste

A large amount of waste material is generated by building construction, and whilst a degree of waste is unavoidable, much of what currently goes to landfill can be prevented, reclaimed or used elsewhere. The first and most obvious design component to this is examining an existing building or designing the new structure so as to honour the current 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.

In many cases unnecessary waste is created by assembling building components off-site, and then finding that they not suitably sized. Where possible teams should look to off-site construction of base materials, which can then be assembled on site. This also reduces damage to the finished product during transport and storage, and hence less components being condemned. Including standard sizes into the design of the building will also reduce construction waste.

Another key design element, which is rapidly gaining traction in South Africa due to the long-term economic benefits, is to design the building facade so that it can be disassembled and reused elsewhere. This allows for higher specifications to be used upfront, as the life of the panels can be guaranteed should the tenant wish to relocate. A flexible building design is also recommended, which allows for the primary use of the building to change relatively easily over time.

7.2.2 Design for recycling and composting practices

Good management of the waste stream begins at source. As such, the base design of any building must include adequately sized and easily accessible recycling storage facilities. A dedicated storage area should to be provided for the separation and collection of 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.

- In a **residential** context, the space could be as little as an additional dedicated cupboard in a single residential unit, to a large formal area in a complex or block of flats.
- In a **commercial** context, the space needs to be placed within easy access of all office areas. This can be achieved by positioning it within 20m of the base of the lift core/principal vertical circulation core serving all floors; or within 20m of the exit used for recycling pick-up; or within 3m of the shortest route connecting the lift core serving all floors and the exit used for recycling pick-up. The location and layout of the storage and collection area must be safely and easily accessible by recycling collection service providers and their vehciles and vehicles.
- In a **retail** context, a holding area for items to be reused or recycled should be next to the general waste facilities, but spatially distinct. It should be adequately sized and properly designed to handle a broad range of waste streams including paper, cardboard, plastic, glass, metal, cooking oils, compostable organic materials (many retail centres now have their own earthworm farms), fluorescent and CFL lights, batteries and motor oils.

7.3 How do we construct our buildings?

7.3.1 Implement best practice construction strategies

The implementation of appropriate strategies during the construction phase of a building can significantly reduce the amount of construction and demolition waste generated and sent to landfill. There are various initiatives that can be deployed, spread across the different role players. The client or developer can make it a contractual requirement that the contractor reuse or recycle a stipulated amount of demolition and construction waste.

In turn the contractor should 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 this. Wherever possible waste materials generated from site clearance or demolitions should be reused on-site, and wooden pallets should be stacked, protected and reused, or returnable plastic pallets used. The role and services of both informal and bulk recyclers should be acknowledged and can be included in the plan.

Fast Fact:

Strategies for a Waste Management Plan

The implementation of a waste management plan can save a project money and be beneficial to the environment. The Green Building Handbook, an annual publication by the CSIR, highlights some strategies which could be included in this plan (Page 139-141, Green Building Handbook Vol 6):

Prevention

- Rethink traditional design and use a modular design approach based on materials to be used in construction
- Consider prefabrication
- Favour standardised components and avoid one off product design
- Specify asphalt paving with recycled content
- Specify concrete mix containing fly ash
- Specify materials which do not require a finish where possible
- Accurate estimating and ordering of material quantities to reduce waste on-site
- Reduce packaging or sent it back to supplier

Minimisation

- Implement material saving construction techniques
- Prepare a waste management plan for each construction project
- Carefully store of materials to reduce loss through damage
- Utilise excess concrete for parking stops, gutters, sign bases etc.
- Use PVC offcuts for use as drainage pipes in retaining walls
- Order materials which have a recycled content

Re-use

- Source salvaged materials wherever possible
- Do work for alterations through deconstruction not demolition
- Reuse bricks, crushed concrete and asphalt as aggregate, subbase material or fill
- Use untreated processed wood for mulch, composting bulk agent, and fuel
- Carpets and underlay can be reused in the furniture industry as stuffing for sofas and chairs

Recycle

- Implement an in-house waste recycling program based on waste separation
- Make subcontractors responsible for their own waste
- Separate and recycle asphalt and concrete
- Separate and recycle rebar and other materials

Disposal

- Make disposal the last resort for waste management

Source: The Green Building Handbook Vol 6

7.4 How do we manage our buildings?

Whilst the reduction of initial waste to landfill during the demolition and construction process is critical, so too is the ongoing management of the building.

7.4.1 Improved waste management through good operational practices

The first step in the war against waste is an understanding of the types of waste generated and how this can be reduced. A waste audit should be conducted on a building or residential complex, and a comprehensive waste management plan drawn up in response to the findings. Waste reduction is the smart approach to saving money and natural resources.

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Fast Fact:

A Waste Audit

A waste audit records the total waste that a building and its occupants generate, normally by weight, and examines how much is recycled, how much goes to landfill, and normally how much could be composted

Common to residential, commercial and retail premises is the opportunity to reduce on-site waste volumes through the well-informed procurement of goods. This would include, where possible, procuring wholesale goods to reduce packaging waste and to procure goods that can be reused rather than discarded, such as stainless steel rather than plastic cutlery. Furthermore, a dedicated on-site space for recycling storage and composting should be identified and allocated, with bins clearly marked, and a responsible and reliable collector for recyclables contracted.

Within the **residential** context, consumers are encouraged to take reusable shopping bags to the stores instead of purchasing plastic ones. Where possible carrier bags should be avoided, along with over-packaged products and consumables. An easy way to do this is by supporting local organic grocers and purchasing loose fruit and vegetables. Consumers can buy in bulk to avoid additional packaging (this also often amounts to a lower unit cost).

Within the house, the **residential** consumer should implement recycling and composting strategies, and introduce a separate bin system. This is made easier through the allocation of dedicated space or bins within the home for recycling storage and composting, and contracting with a responsible and reliable collector for recyclables.

Commercial offices also have a role to play in the reduction and recycling of waste. Printers should be set to print double-sided pages, staff encouraged to only print when essential, and user codes issued to employees to release the print job only at the printer. The provision of a microwave, refrigerator and area for dish washing will encourage waste reduction at the office, but ensure that suitable recycling bins are provided.

The very nature of the retail environment offers considerable opportunities for both the implementation of recycling practices and the education of shoppers. Shopping centres should provide clearly labelled bins for recyclables in all areas, particularly in food courts, as well as a clean and well laid out recycling storage area in the back of house where recycling can be sorted, baled and collected by the appropriate companies. Almost every household needs to visit a retail environment at some stage during the month, and so these also form ideal locations for community or precinct recycling schemes. There is also an opportunity to offer incentives for a branded reusable glass or mug to be purchased and reused.

Manufacturing and **industry** are required to prepare and implement industry waste management plans (IndWMP). IndWMPs apply to a waste stream or an individual company, including both mandatory and voluntary plans. This includes the evaluation of the company's processes and products to determine whether raw materials can be used more efficiently, less hazardous or recycled-content materials can be substituted, and whether there are new technologies available to recover and reuse wastewater. Clean scrap materials can be salvaged and reprocessed in house or a recycler can be found. Overstock should be reduced and inventory controlled more tightly by methods such as "just-in-time" manufacturing. Manufacturers are encouraged to take responsibility for their products throughout the products' lifecycles, and to establish systems and facilities to take back and recycle waste at the end of their products' lifecycle. Where possible cleaner technology practices should be instituted and waste generation minimised.

Much of the onus for the development and implementation of a good waste management policy falls on to the **building operations and facilities managers**. They are responsible for setting up systems, monitoring waste generation targets, and the establishment and operation of a waste management plan. The building or facilities manager needs to maintain the centralised waste handling facilities and waste compaction plant where such exist. A good waste management strategy should promote and encourage the ongoing separation of waste and recycling materials and be the champion for organic waste composting. They should provide tenants with clear guidelines on expectations for recycling, and could look to the application of a surcharge for unsorted waste removal from tenant premises.

7.4.2 Improved waste management and reduction when retrofitting or refurbishing

The same principles as applied to new building construction would apply to works involved in retrofitting or refurbishing a building or tenant space. An on-site construction waste management plan should be implemented for the works, and should specify a methodology for the safe disposal of all waste, including any hazardous waste identified or generated. The core principles of salvage, reuse and recycle should be applied to all building elements and construction waste, and useable materials not required on-site (old doors or windows) can be sold or donated to relevant organisations (like disaster management) that may require these. Through a co-ordinated waste-efficient procurement strategy waste associated with excess construction materials can be greatly reduced.

7.5 How do we enhance our precincts?

When designing a **precinct,** community or large residential complex, thought should also be given to whether bioreactors (which use standard waste streams to produce energy), composting toilets, or blackwater treatment plants (for the treatment of sewerage) would be appropriate. These work best at a precinct scale, as they require a continual waste stream to work effectively, and have numerous benefits (economic and ecological) for a community.

7.5.1 Implement waste management strategies

A well-managed and holistic waste management process will be of social, economic and environmental benefit. It can create jobs (green economy) and provide income for marginal communities involved in informal recycling. Economies of scale for recycling initiatives only take effect when sufficient numbers of households and business contribute on a regular basis, and need to be supported by new industries to collect and process the recycled materials.

Although the scale is different, the process is the same at precinct or community level as for an individual property. The first step is for a responsible person to conduct a waste audit, after which a waste management plan needs to be drawn up and implemented. This should include a strategy and roll-out plan for the local storage, collection and management of reusable, recyclable and composting material.

Figure 15: Decomposition of pollutants in the ocean

Source: http://www.activeseakayaking.ca/how-long-until-its-gone/

8 Internal Environmental Quality

Much of the building stock currently in use in South Africa and indeed in Steve Tshwete have outdated or poor designs and systems, and offer 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 emissions from the suite of IT equipment in offices and at homes.

Studies indicate that continued reliance on, and exposure to, artificial lighting has a detrimental effect on occupant health and well-being. Increased access to natural lighting assists with human circadian rhythms, which in turn affects productivity, happiness and overall health. At the same time, the provision of sufficient natural lighting can lead to glare or reflective problems, particularly at certain times of the day or year.

8.1 What changes do we need?

This set of green building guidelines looks to address this historic legacy, and improve the well-being of occupants in both newly built buildings as well as retrofitting older building stock. The guidelines offer suggestions to establish a good quality internal environment by describing how building designers and managers can eliminate, reduce, and manage the sources of indoor air pollutants, lighting, and maximise comfort factors such as external views, individual climate control and noise levels, provide for occupant connection to the outdoor environment, and prevent or reduce health issues (including the minimisation of indoor volatile organic compounds, asbestos and formaldehyde emissions as well as mould prevention). Small changes like increasing the amount of fresh air circulating in a building have been demonstrated to hold significant benefits to the health of occupants through the dilution and reduction of indoor pollutants.

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Fast Fact:

Benefits from an improved IEQ

Small changes to the indoor environmental quality can have large impacts on users. For instance, daylighting is known to improve productivity in offices, improve test scores in schools, reduce recovery times in hospitals and increase sales in retail stores.

8.2 How do we design our buildings?

8.2.1 Design for improved ventilation and fresh air provision

Good building design provides the opportunity to maximise the provision of fresh air within a building. Fresh outside air is used to dilute the build-up of indoor pollutants as experienced by building users.

There are three ways of providing this fresh air: via natural ventilation, mechanical ventilation or mixed mode ventilation, which is a combination of two. A design with natural ventilation capitalises on the local wind patterns and/or enhances air movement through the building's form. Some of the common design features used for natural ventilation include openable windows, thermal chimneys, atria and courtyards.

Statutory requirement as per SANS 10400-O:

Buildings require a minimum of 5% openable areas to qualify for natural ventilation.

Air movement creates a sense of comfort for building occupants, meaning a higher temperature setpoint can be used and less cooling is required from buildings that also use supplementary mechanical systems (mixed mode systems). It should be highlighted that the SANS regulations prescribe minimums which are considered required for liveable or useable space; green buildings would exceed these standards and seek to push that boundary.

The design of any HVAC (Heating, Ventilation and Air Conditioning) system should 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).

8.2.2 Provide sufficient fresh air

Statutory requirement as per SANS 10400-O:

Commercial Buildings are to be supplied with outside air at a rate not less than 5 litres/second/person).

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 stipulated requirement of SANS 10400-O.

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.

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Fast Fact:

SANS 10400-O

SANS 10400-O sets minimum permissible ventilation rates for buildings, giving consideration to health and ventilation amenity. However, these minimum rates are purely intended to maintain general contaminants at levels below those with the potential to cause harm, and tend to be far lower than international standards.

In order to isolate, contain and allow maximum removal of noxious fumes from printers and other centralised office equipment, these should be located in a room next to the core that is serviced by an independent Tenant Exhaust Riser, which removes the fumes and exits these outside the building.

8.2.3 Design for good daylighting and electrical lighting

A well-designed building allows 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. The design of the building should promote a direct line of sight to the outdoors or large atria for as much of the office space as possible. This needs to be carried through in office space design, so as to locate cellular offices around the core and the open space areas on the periphery. The use of narrow floor plates in buildings increases the proportion of occupants near a glazed perimeter section who are thus able to benefit from natural light and views. A similar result can be obtained by the use of atria. In retail and residential buildings, additional natural lighting can be introduced into deep spaces using skylights.

It is necessary to be aware that maximising natural lighting and views risks increased glare and reflective stress from sunlight. This can be reduced by deploying fixed shading devices in the base build, or the addition of internal or external blinds. For years this meant losing the view, with heavy opaque blinds cutting out all the light – and views. Newer blinds tend to be almost transparent from the inside, so able to maintain views whilst significantly reducing glare.

A new trend is towards the use of automatic blinds or screens, which are controlled by a sun-sensitive monitor, and where the angle of the blind or screen changes accordingly at different times of the day or different seasons.

Case Study

My Green Home
Introduction of a Staircase Skylight
Pinelands

A Pinelands family, chosen in 2014 by the Green Building Council SA to receive a full home retrofit and behavioural training as a showcase for the energy and water savings possible for an average suburban family, highlighted the significant impact that the installation of a skylight can have. As part of the installation process, a skylight was installed above the dark staircase of the double story home. The positive effect was dramatic, not only requiring no artificial lighting at times of the day (and during the full moon!) but also dramatically changing the feel of that part of the house.

For more information please see http://mygreenhome.org.za/

Electronic high frequency ballasts for fluorescent lighting systems have fast become the standard in the industry and should be specified over the old magnetic ballasts technology for numerous reasons. Electronic ballasts tend to be at least 15% more efficient than magnetic ballasts, run at lower temperatures, and thus have lower direct and indirect operating costs. Importantly, they do not create the visible flicker commonly associated with fluorescent lighting.

Project teams should specify light emitting diode (LED) lights, or as a second option compact fluorescent lamps (CFLs) where possible, as both 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.

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Fast Fact:

The disposal of CFLs

CFLs contain mercury vapour and must absolutely be disposed of properly. All buildings should have a dedicated storage area (in the same area for storage of waste and recycling) for disposal of CFLs. If a CFL breaks it is advisable to ensure that the room is well ventilated to avoid inhalation of mercury vapour.

8.2.4 Appropriate lighting levels and zones

Much of the existing building stock has lighting which has been overdesigned. 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.

Zoned lighting is considered 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").

8.2.5 Design for improved thermal comfort – heating and cooling

Traditionally, buildings and HVAC systems have been designed to be able to maintain specific temperature ranges. Set points were selected during the commissioning of a building, and often never revisited or reviewed. There is a growing trend nationally and internationally to revisit this practice. With a growing awareness that occupant comfort is key, the focus has switched to thermal comfort as part of this. This means finding a balance between humidity, ambient temperature, draughts and radiant heat, and acknowledging the prevailing seasons. This is because such temperatures should be set to reflect seasonal variations in what building occupants are likely to be wearing (warmer indoor ambient temperature in summer and cooler in winter).

The HVAC/ventilation system needs to allow for occupant control over ventilation rates. 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.

Whilst the actual settings will differ from building to building, some of the norms recommended for a comfortable indoor environment are:

- a predicted mean vote of between -1 and +1 for commercial buildings and PMV levels between -1.5 and +1.5 inclusive for retail buildings
- a dry bulb temperature between 20 and 24°C
- mean radiant temperatures between 20 or 27 °C
- relative humidity within the range of 40-60%

8.2.6 Design for occupants comfort and satisfaction

Various other factors also impact on perceived occupant comfort in a building, which in turn has been demonstrated to have a direct effect on productivity levels (office and education) and recovery rates (hospitals). People are shown to thrive if they have some form of connection to nature, and hence buildings which are able to make this linkage are encouraged. This could include active planting, landscaped atriums, green walls, or even just maximising external views for all building occupants. The simplest way to maximise views is to work with relatively shallow floor plates, and to locate all cellular offices and meeting rooms along the core or within the deeper space, so allowing the movement and open plan areas to take place closest the perimeters.

People are very noise sensitive, and even though they may not consciously be frustrated by noise, the louder the ambient environment, the louder people have been demonstrated to talk, so increasing the ambient sound levels further. Green buildings are designed for lower ambient noise control, and have features in place to further control this in an occupied building.

Statutory requirement for maximum internal noise levels as per SANS 10103:2004:
SANS 10103:2004 sets various statutory maximum design levels for noise in different buildings:

1.1.1.1

COMMERCIAL BUILDING	Building Services noise	Overall ambient sound level
General office	40dB(A)eq	40dB(A)eq
Open plan space (>50m^2)	45dB(A)eq	45dB(A)eq
RETAIL SPACE	55 dB(A) eq	55 dB(A) eq

Although there are currently no statutory requirements governing the residential market in South Africa, national good practice recommends the following maximum design levels:

	Bedroom (night)	Other Habitable Rooms
RESIDENTIAL	35 dB (A) eq	40 dB (A) eq

Modern offices often include the use of overhead baffle panels, carpeting, acoustically treated meeting rooms, floor to soffit dividers and plants as means of reducing and controlling ambient noise levels.

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Fast Fact:

Health implications of Formaldehyde fumes

Formaldehyde is a widely used industrial chemical, present in almost all composite wood products, and is found by many people to be an irritant to mucous membranes and eyes, can increase the risk of cancer and have negative impacts on an unborn child.

8.2.7 Reduction of internal pollutants and mould

All interior finishes should be specified to minimise the volatile organic compound (VOC) and formaldehyde levels or emissions. Over the past few years, paints, adhesives and sealants, and carpets and flooring with low or no total VOC levels have all become readily available to the market at no cost premium and should be specified for use.

Mould is a form of fungi, and the spores are floating through indoor and outdoor air and water at almost all times. Mould spores need three things in order to grow – moisture, nutrients and warm temperatures. The drier climate of Steve Tshwete Municipality acts as a natural mould retardant, which can be supported by the design of the HVAC system such as to maintain indoor relative humidity levels of between 30 and 60%.

It is recommended that building design avoids the use of evaporative cooling towers or other evaporative cooling systems as these may harbour Legionella. Other design features which can be used in HVAC systems to minimise Legionella growth include hot water delivery at 50°C or higher, cold water distribution at 20°C or lower, keeping pipe work as short and direct as possible, adequately insulating pipes and tanks, using materials that do not encourage the growth of Legionella, and preventing contamination (by fitting tanks with lids and insect screens).

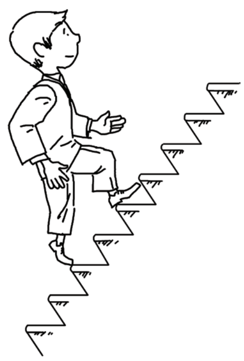
The dangers of cigarette and pipe smoke have long been documented, and the country has strong anti-tobacco legislation which must be adhered to. Taking this one step further, it is recommended that all buildings be declared smoke-free zones. This requires that the developer, landlord and tenants buy into the concept, and that in the design (and indeed operational phase) or the building, no provision should be made for smoking inside the building (via a smoking room, decks assigned for smoking areas or other special smoking areas).

8.2.8 Reduction and monitoring of building-related emissions

Another aspect of indoor quality relating to buildings is ensuring that hazardous fluids and gases used as refrigerants, insulants and for fire and leak suppression are well-managed. In essence, this entails the preferential specification of insulants, refrigerants and other gases that do not contribute to the long-term damage of the earth's stratospheric ozone layer theough the release of harmful gases. Building design should include the specification and installation of building systems which minimise the environmental damage from refrigerant leaks. Other building emissions that should, and can, be addressed through good building design are discussed elsewhere in these guidelines, but are highlighted here for clarity. These include:

- Building design should minimise stormwater run-off to, and pollution of, the natural watercourses.
- Building design should minimise discharge to the municipal sewerage system.
- Building design and lighting layout should be such as to minimise the light pollution into the night sky.

Where boilers or generators are specified, ensure that all gas boilers have NOx emissions of <100mg/kWh (at 0% excess O2) and generators comply with the Tier 3 emission standards as defined by the United Stated Environmental Protection Agency (USEPA) or similar.



8.2.9 Promote the use of stairs

Multi-story buildings should be designed with prominent trafficable staircases providing connectivity between floors. This reduces the demand on lifts and escalators, and also contributes positively to the health and well-being of building occupants.

In buildings where this is not possible, the fire escape stairs could be designed so as to allow them to be used by daily traffic, and should be afforded a higher level of finish to make them more user-friendly.

8.2.10 Universal access

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. The easiest available reference for this in South Africa is SANS 10400_S (Facilities for persons with disabilities). Architects are encouraged to design residential buildings which would allow for universal access to and within the individual dwelling units, so as to meet the needs of different occupants and the needs of existing occupants. All dwelling units and common properties should be designed to comply with this and have at least one toilet at the entry level of the unit which is accessible to wheelchairs.

8.2.11 Reduction and safe removal of hazardous materials (e.g. asbestos)

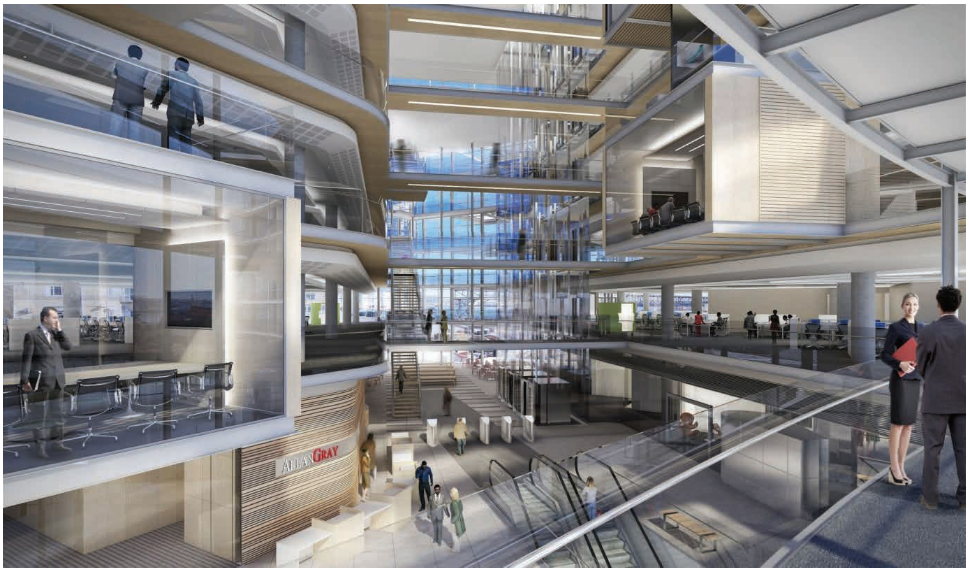
A hazardous materials survey should be conducted by a suitably qualified professional before any demolition works for existing structures commence or when an extension or alteration to an older building thought to contain such is planned. Should hazardous materials such as asbestos, lead or polychlorinated biphenyls (PCBs) be identified in the existing structure, they should be removed by a suitably qualified and experienced company in accordance with the relevant standards or legislation, in order to mitigate risks to contractors and future building occupants alike.

8.3 How do we construct our buildings?

Good construction practice calls for the establishment and adherence to an environmental management plan to guide construction activities. This has the advantage of providing a means to detail and monitor correct procedures so as to safeguard the health of construction workers during a project. Some of the areas where this links back to the indoor environmental quality are: adequate toilet facilities on site (accessible within a few minutes from anywhere on site); separate and designated eating areas; regular damping down of site to reduce excessive dust; enforced use of proper personal protective equipment (especially dust masks when chasing into walls or sweeping debris, and goggles for welding or skimming soffits), proper labelling and regular inspection of portable distribution boards and extension leads.

8.4 How do we manage our buildings?

Good building management is essential to ensure the maintenance of a quality indoor environment. This requires both the ongoing monitoring of the indoor air quality of a building and the systems which impact on this. Where necessary this also requires the implementation of appropriate remedial actions to ensure that the systems and quality of the indoor environment is retained. In addition, when tenant churn or the natural lifecycle of the building determines that a major overhaul or renovation is due, the building manager or owner should consider the introduction of green features and initiatives that can further improve the quality of the indoor environment of the building. The first step is to conduct a detailed audit of what is in place and the current practices, and then to develop a phased implementation plan based on that. Many of the initiatives can also be included in the annual operational and natural replacement cycle of the building.



8.4.1 Opportunities for improved IEQ through good operational practices

In recent years, there has been an increase in operational practices which support good indoor environmental quality. Firstly, by understanding the activities taking place in the building, one can begin with implementing monitoring and control procedures to constantly asses and adjust systems to prevent and minimise the build-up of indoor pollutants in the building. Secondly, a building manager or owner needs to establish a set of performance metrics for minimum indoor 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.
- Green Building Measurements:

Given the focus on occupant comfort and necessary adjustments, regular occupant surveys of both staff and visitors to the building should be conducted to inform these adjustments. In larger buildings or portfolios, it is proposed that a dedicated and suitably qualified Indoor air quality manager be appointed.

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.

Indoor Air Qulaity (IAQ) best practice should include an environmental tobacco smoke policy for the building (to prevent and minimise exposure to environmental tobacco smoke; prohibit smoking in the building, locate exterior designated smoking areas as least eight metres away from all building entries, outdoor air intakes, and operable windows. This area needs to have a visible butt disposal area to prevent cigarette butts landing up on the streets).

Figure 16: 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%

8.4.2 Encourage the use of green cleaning materials

The building manager can use green cleaning techniques and materials to assist in reducing exposure by cleaning teams and building occupants alike to potentially hazardous chemical, biological and particulate contaminants. As with most interventions, the first step should be a review of the current practices, including the building, tenant or corporate cleaning policy, purchasing and procurement decisions, cleaning equipment, indoor pest management protocols. It is deemed desirable that all of these are "greened". 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 option).
- Green purchasing and procurement.
- The specification and use of low irritant or non-chemical cleaning products.

8.4.3 Monitor outdoor air delivery

Buildings may be retrofitted 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. As discussed in the design section, there are significant benefits for building occupants from increased fresh air, and the levels of fresh outdoor air supplied can be increased fairly easily.

8.4.4 Give preference to natural ventilation

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. It has been observed that significant energy savings can be achieved from night purging of the building space using natural ventilation.

Fast Fact:

Indoor Planting

Mother-in-law's tongue, or Sansevieria trifasciata, is a popular indoor plant as it is tolerant of low light levels and irregular watering; and is commonly regarded as one of the best plants for improving indoor air quality by passively absorbing toxins such as nitrogen oxides and formaldehyde.

Figure 17 : Mother-in-law's tongue in an office

8.4.5 Opportunities for improved IEQ within the maintenance cycle

8.4.5.1 Promote health and wellbeing of building occupants

Good office space planning and the procurement of suitable furniture is also important. The use of ergonomic equipment (such as standing desks or laptop stands) and the clever design of tenant space can promote occupant well-being, efficiency and effectiveness.

When considering internal areas of a building, use should be made of plants and greenery to further improve the indoor air quality. Indoor plants have the ability to reduce airborne concentrations of VOCs, as well as assist in reducing CO² and dust levels, baffling noise, and stabilising humidity and temperature in the space. Furthermore, research has shown that the presence of indoor plants in an office space tends to lead to healthier and happier staff.

8.4.5.2 Reduction of internal pollutants and mould

Only no or low 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.

Where possible all photocopy and print equipment should be located in a dedicated room close to the core and connected to a dedicated exhaust riser or ducted exhaust system. It is further recommended that a service level agreement be signed with a supplier of photocopy and print equipment who has low emission certified equipment available.

Another action which can be taken relatively easily is to 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.

8.4.5.3 Reduction and monitoring of building-related emissions

There are various actions which can be taken to assist in the reduction of building-related emissions. Once again adequate planning and monitoring is key. 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.

Regular leak testing should take place on all refrigerant mass which is not composed of zero ozone depletion potential (ODP) refrigerants, and if possible a leak detection system connected to the building management system should be installed for all non-zero ODP refrigerant equipment with mass more than 3kg refrigerant (unless 100% zero ODP).

8.4.5.4 Generator / boiler maintenance programme

Whilst few South African buildings make use of boilers, an increasing number are installing emergency generators to run critical systems and ensure business continuity during electrical load shedding. A regular generator and/or boiler maintenance program should be implemented in order to minimise excessive NOx, CO and CO^2 emissions.

8.4.6 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. It allows for several measures to take place simultaneously, instead of having to wait for the maintenance cycle or obsolescence, and often comes with a capital budget of its own.

Through reconfiguration of the internal spaces and a few changes to the external envelope and systems, dramatic improvements can be achieved. The opportunity for the identification and removal of hazardous materials such as asbestos (many old ceiling tiles are asbestos, and it was painted onto soffits as a fire retardant) should be embraced as a first step in any retrofit. Thereafter, the installation of proper zoned systems for lighting and HVAC should be considered, along with the introduction of opening windows where appropriate, and the introduction of internal or external screening and blinds to maximise daylight but minimise glare and radiant heat. Light fittings are another easy target, and all magnetic ballasts should be replaced with the high frequency electronic ones. A move to LED lighting should also be considered.

The layout of the interior fit-out will also impact how much light reaches the core of the building. 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. In multi-unit residential buildings, living areas and bedrooms should be at the perimeter with kitchens, bathrooms and utility areas in the core.

Internal layouts should be designed so as to maximise views to the outside for the majority of building users, and to cluster printers and photocopiers in an area which can be ducted. In buildings where a single tenant may occupy multiple floors, or where there are many tenants on a floor and hence a common shared passage, the introduction of useable staircases between the floors can be considered (in many cases structural engineers will approve the punching of a hole into the slab to allow this).

In larger buildings the opportunity may exist for the introduction of an atrium within the building, which will assist in improving natural daylight and ventilation.

9 Pollution

Buildings, vehicular transport, agriculture and industry can affect the external environmental quality, the health and safety of residents and the natural environment by causing air, noise and light pollution and by increasing the urban heat island effect.

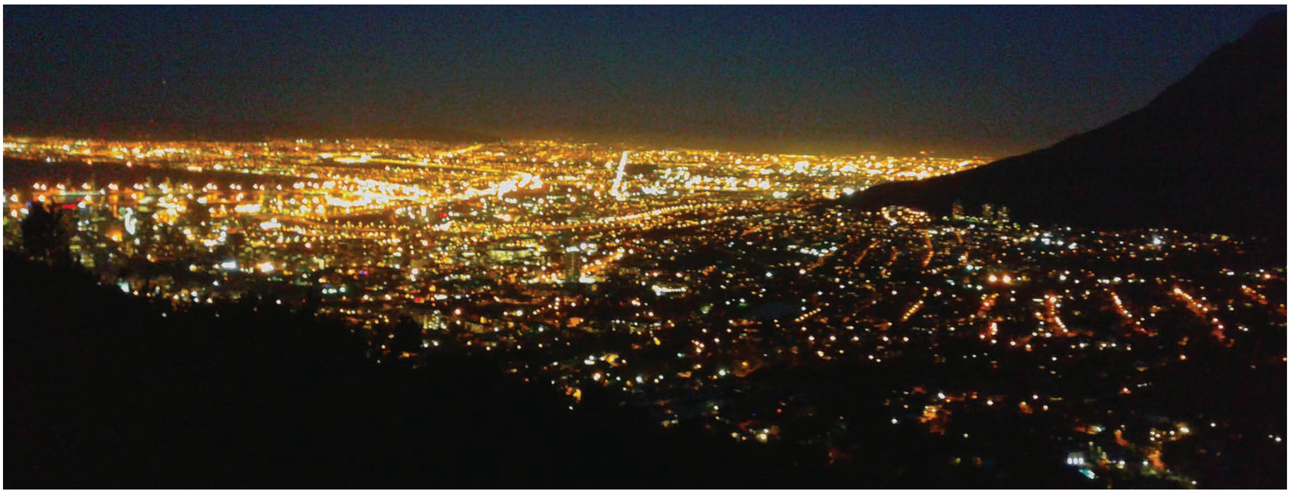
Noise pollution is classified as excessive noise from trucks, industry, motor vehicles and machinery which disturbs work and sleep causing undue stress. Noise pollution may also impact the occupants of a building and this is discussed further in the section on Indoor Environmental Quality.

Air quality refers to the level of smoke, dust and harmful chemicals in the air which come from vehicle exhausts, smelting metals, burning wood and agriculture by-products, open cast mines and power plants. This can then be made worse by naturally occurring weather events such as fog from the coast or in a basin between mountain ranges which traps this pollution. Constant exposure to poor air quality can be dangerous to residents, especially the young, elderly and pregnant, as breathing these air pollutants is known to cause respiratory problems and other health risks. This can, in turn, put extra strain on the provision of health services.

Light pollution is classified as light from electrical lighting that spills upwards into the night sky or on to neighbouring properties. This can be harmful to the natural environment by disturbing nocturnal ecosystems such as disorientating migratory birds which use the stars for navigation, disrupting biological rhythms of animals and insects, and depriving the public of views of the night sky. Light emitted upwards is considered as wasted light and is therefore a waste of electricity too, and can pose a hazard to air traffic and impact on avian activity.

The **urban heat island effect** refers to a change of the microclimate in urban areas where temperatures are higher than in rural areas. This is due to the increased cover of dry, impermeable surfaces and an increase in the thermal mass in urban areas from buildings, roads and other infrastructure which holds on to heat for longer periods of time and releases it at night rather than absorbing it as occurs in rural areas.

Figure 18: The visual effect of light pollution from urban areas



Fast Fact:

Impact of air pollutants on health

An average South African breathes in 7.6 litres of air per minute which means around 12 870 litres of air each day.

Pollutants that are released into the air, as opposed to land and water pollutants, are the most harmful.

People who live near high traffic roads face greater risk of cancer, heart disease, asthma and bronchitis as these places contain more concentrated levels of air pollution.

Source: : http://www.conserve-energy-future.com/various-air-pollution-facts.php

9.1 What changes do we need?

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 Steve Tshwete, to aid the transition to low emission development, 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 residents with reduced impact on local ecosystems.

9.2 How do we design our buildings?

9.2.1 Reduce Air Pollution

Green roofs and landscaping: Trees and other vegetation absorb carbon dioxide and release oxygen. Thus planting more trees and designing for more landscaped areas on-site can help to reduce the amount of harmful greenhouse gas emissions in the atmosphere. Trees and vegetation 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.

To help this, increase the amount of the site that is covered by trees and soft landscaping, including consideration of designing a green roof.

Reduce harmful emissions: GHG emissions in air-conditioning: Good building design ensures that the harmful emissions from air conditioning and insulants are minimised. This is discussed in more detail in the section on Internal Environmental Quality.

9.2.2 Reduce the urban heat island effect

By reducing the heat islands caused by buildings and impermeable surfaces, there is a reduced impact on microclimates, enabling cities to become cooler and more comfortable. 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 colour and material: 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. Painting these a lighter colour will have a major impact on the air conditioning load (and hence energy usage) of the building. The use of a green roof has the additional benefit of increasing the usable area for a commercial building, as it can create additional staff resources.

9.2.3 Reduce the effects of noise pollution

Site layout for noise reduction: The arrangement of buildings on a site can be used to minimise noise impacts. If incompatible land uses already exist, or if a noise sensitive activity is planned, acoustical site planning often provides a successful technique for noise impact reduction. Many site planning techniques can be employed to shield a residential development from noise. These can include:

- Increasing the distance between the noise source and the receiver.
- Placing non-residential land uses such as parking lots, maintenance facilities, and utility areas between the noise source and the receiver.
- Locating barrier-type buildings parallel to the noise source (such as a busy road).
- Orienting the residences away from the noise.

Noise barriers: A noise barrier is an obstacle placed between a noise source and a receiver which interrupts the path of the noise. These can be made out of many different substances which include sloping mounds of earth, called berms; walls and fences made of various materials including concrete, wood, metal, plastic, and stucco; regions of dense plantings of shrubs and trees; and combinations of these techniques.

Materials for noise management within buildings: Certain building systems, such as generators and HVAC systems, can emit high volumes of noise and disturb surrounding residents and other buildings, especially when placed on the outside or on the roof of the building. To minimise this it is therefore necessary to specify the use of noise reduction materials that are able to absorb the noise sufficiently to prevent the noise disturbance.

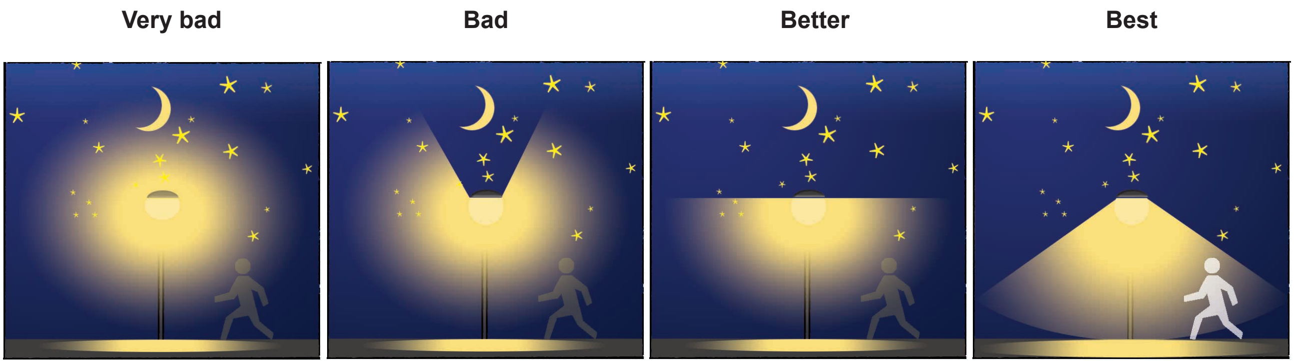
9.2.4 Prevent light pollution

Reduction of lights shining outwards from the building: When designing internal lighting for the building ensure the design prevents light from being emitted from the building, especially at night. This can be incorporated through the provision of targeted lighting options available for use by occupants at night and by ensuring that the lighting levels for each floor are not excessive. This is beneficial to the indoor environmental quality too, as noted in that section of the guidelines.

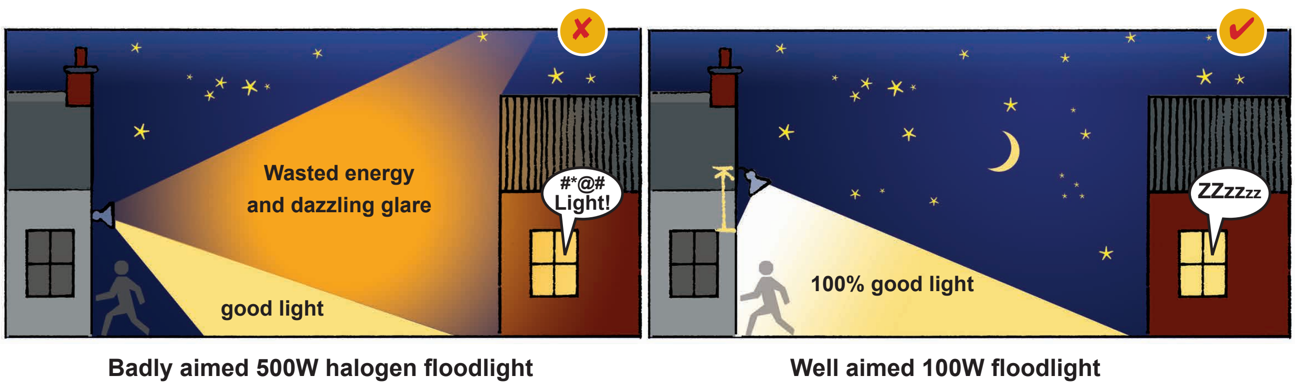
No internal lighting shining upwards into the night sky: Ensure that all internal lighting from offices and atrium spaces in the building is prevented from being emitted outwards directly into the night sky. This can be done through either aiming the light downwards or by ensuring that the light's full beam angle is reflected off a surface or shaded by the light fixture.

No external lights shining upwards into the night sky: External lighting can include lighting for balconies, parking lots, decorative facade, signage and landscape lighting, walkway lighting, and garage, building and site entrance lighting. To ensure that no light is directed upwards into the night sky and into surrounding buildings, ensure that the full beam angle for each light is positioned to aim downwards or is reflected off a surface or light fixture.

Figure 19 : Good street and building lighting to minimise light pollution



Source: https://www.jmu.edu/planetarium/light-pollution.shtml



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

9.3 How do we construct our buildings?

9.3.1 Reduce air pollution

Cover and damp down construction materials: Dust particles from the storage and use of materials on construction sites can easily become a harmful pollutant to surrounding residents if they are not properly managed. To prevent this ensure that all piles of sand and other small particles of construction material, wood and concrete dust, are dampened and covered with a textile that prevents wind blowing it off the site.

9.3.2 Reduce noise pollution

Restrict loud construction activities to working hours: Loud noises are disturbing to surrounding residents therefore ensure that loud construction activities are only undertaken during working hours of the week.

The use of sound meters can be used to track levels of noise generated by different activities and the reach of such sound, and this information can be put back into the construction programme to ensure the least impact on surrounding areas of the works.

9.3.3 Prevent Light pollution

Ensure site lighting does not emit light upwards or into surrounding buildings: Site lighting is necessary for safety and security. However, it is necessary to ensure that the site is not lit up excessively and that lighting is angled downwards and away from neighbours' windows. This is to prevent light pollution emitted to surrounding neighbours and upwards into the night sky.

9.4 How do we manage our buildings?

9.4.1 Conduct an Emissions Audit

Conduct an audit to evaluate the level and source of emissions from the building with regard to air, light and noise pollution. Adopt and implement a pollution management plan as part of the operations and maintenance programme to identify opportunities and strategies to reduce emissions and to track progress.

Eliminate noise pollution: All generators which are installed as part of the operational or maintenance process, or were not previously adequately installed, should be fitted with noise attenuation to prevent them causing noise pollution to neighbours or neighbouring areas.

During major retrofits and alternations, noise meters should be used to assess the actual levels of noise generated and the reach thereof, and the activities correctly scheduled accordingly to be of least impact.

9.5 How do we enhance our communities?

9.5.1 Reduce air pollution and the urban heat island effect

Tree planting and soft landscaping: As mentioned, tree planting and soft landscaping helps to filter pollutants from air while producing oxygen. These benefits can be increased at the scale of a community and precinct as it offers the opportunity to plant trees and soft landscaping in public spaces and pathways between buildings. This also helps to compensate for building sites which have not got sufficient space on site for viable areas of landscaping.

>>

Fast Fact:

One soccer field planted with trees can:

- **absorb the same amount of carbon dioxide released from 42 000km of driving a car in a year**
- **provide enough oxygen for 20 people to breathe every day**

Source: http://urbanforestrynetwork.org/benefits/air%20quality.htm

Cooling areas: The urban heat island effect can be reduced by shading impermeable surfaces such as roads, parking lots and pathways with trees and constructed shading devices. This helps to prevent heat absorption and retention by these surfaces. Other cooling areas can be provided by public open spaces which are covered by permeable surfaces, such as grass and other vegetation, and public water fountains, dams or lakes.

9.5.2 Reduce the effects of noise pollution

Precinct layout: When designing a new precinct, ensure that noise compatibility is taken into account. Residents or building typologies that are more sensitive to noise should not be located near to areas of high noise pollution.

Noise buffers: At the scale of a community, larger noise buffers (such as a tree cluster or hedge) can be used to shield a group of buildings from a harmful noise source, such as loud industry or mining. Consider the opportunity for these buffers to work as multi-functional spaces for public open space in the community too.

9.5.3 Prevent and eliminate 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. Another 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.

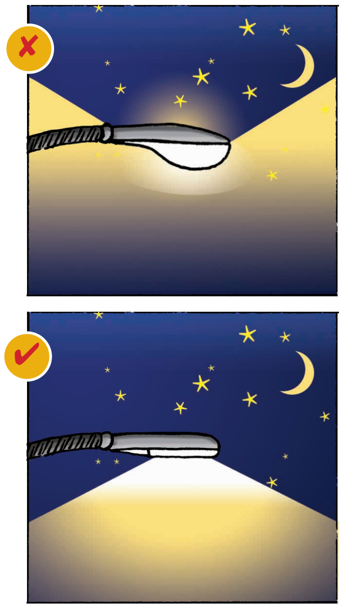


Figure 20: Street lighting design to prevent light pollution.

Source: http://physics.fau.edu/observatory/light-pol-prevent.html

10 Biodiversity

South Africa is home to rich terrestrial and marine biodiversity. Biodiversity refers to the variety of life which includes the number of different species of plants, animals and birds and the relationships between them that are found in an area of land or ocean. Rich biodiversity is supported by healthy ecosystems where land, water and air systems are functioning well.

Healthy and well-functioning local ecosystems can provide services "free of charge" to support the municipality that have a positive effect on curbing climate change. This includes supporting soil formation and agricultural and resource production; providing freshwater, food and fuel sources; regulating the climate, 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 municipality by improving security and ecological resilience, providing for basic human rights, improving and sustaining health and promoting good social relations. Therefore, building sites and the municipality can reduce the cost of service provision by using ecosystem services to support and supplement the use of engineered infrastructure solutions.

The Steve Tshwete Local Municipality is an important biodiversity region, with large parts of the municipal area being classified as irreplaceable and highly significant. In total Steve Tshwete hosts 79 threatened species, 18 of those being red data flora species. The Giant Bull Frog is the only red data frog species to have been recorded in the Nkangala District Municipality and it is found within the municipal boundaries of Steve Tshwete.

Key areas in respect of biodiversity and environmental sensitivity in Steve Tshwete are The Loskop Dam Nature Reserve (mammals, birds, reptiles); the grasslands between Middelburg and Loskop Dam Nature reserve (Flora); and the ecological corridor traversing the western boundary between Middelburg and eMalahleni in a north-south alignment towards Vandyksdrif.

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

Green Economy Enabler

Natural resource management

Natural resource management involves the conservation, restoration and maintenance of natural resources in the municipality such as biodiversity corridors, rivers and wetlands with their associated riparian buffers, coastal dune systems, and the removal of invasive vegetation. Already there are national projects supporting these activities for job creation such as Working on Water, Working on Fire and Working on Wetlands. These form part of the Expanded Public Works Programme and can be used as mechanisms by the municipality to fund decent green jobs.

10.1 What changes do we need?

As Steve Tshwete transitions to low emission development, there will be an increasing reliance on ecosystem services. These require healthy and well-functioning ecosystems. These guidelines promote the conservation and enhancement of natural systems on individual building sites and throughout the larger municipal area. This includes promoting biodiversity by protecting and planting indigenous vegetation, the conservation of nutrient-rich topsoil, managing invasive species, rehabilitating high-value ecological areas that are degraded and adhering to national guidelines with regard to Critical Biodiversity Areas in the municipality to promote ecological connectivity and areas for wildlife in natural, undisturbed habitats.

10.2 How do we design our buildings

Well-informed and thoughtful building location and design can assist in both slowing the speed of ecological degradation and assist in reversing it. We need to both protect prime agricultural land from loss due to development, as well as develop a network of protected interlinked spaces of undisturbed or untransformed vegetation. Wherever possible, wetlands should be protected or reinstated, due to their important role in maintaining water quality, reducing the impact of floods, in controlling erosion and sustaining river flows.

10.2.1 Choose development sites with limited ecological value

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 100m flood line of rivers, and preserving sites which are home to protected red data species.

10.2.2 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 and so link other green buffers on adjoining properties. Where appropriate, consideration should be given to the planting of water-wise or edible plants as part of the landscaping for the site.

10.2.3 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 design. Therefore, it may be possible to work around existing wetlands or direct stormwater runoff in such a way as to restore ancient wetland areas.

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 trained person.

A good way to ensure that a landscaped or planted area is valued in the long term as a key element of the site, is to ensure that it has multiple uses. For instance, an edible garden could be planted in a quiet corner of the site, and with a little screening double as a meditation or quiet space for staff. A green roof is also an innovative way to manage heavy rainfall and stormwater runoff, prevent the heat island effect and add thermal insulation to the building, while creating an attractive and useable space on top of the building (an area all too often lost to hard surfaces for HVAC plant rooms and inaccessible to building users).

Case Study

New Sisonke District Office

KwaZulu Natal

New Sisonke District Office is a provincial government office building in Ixopo, KwaZulu Natal. The building is on a site that was previously developed and full of alien vegetation. Through development the site was cleaned up and a green roof (shown in the image) both contributes to the thermal performance of the building and increases the ecological value of the site. This planted area boasts a variety of water-wise endemic vegetation, and provides both an aesthetically pleasing space and a habitat for insect and bird life.

Figure 21: Rooftop Garden at the new Sisonke District Office, KZN

Source: https://kzniajournal.wordpress.com/2013/06/10/sisonke-district-offices/

10.2.4 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. A green space with carefully chosen plants can provide habitat to reptiles, amphibians, birds and insects and make actual physical links between existing habitats, known as ecological corridors. As global warming changes the range of more and more species, these corridors will become increasingly valuable to allow the free movement of animals to more suitable places, thereby improving resilience.

10.3 How do we construct our buildings?

10.3.1 Implement a construction environmental management plan (EMP)

The appointment of an **ISO14001 contractor** ensures that the development is done in an ecologically sensitive way. This is, however, not always practical as many contractors in South Africa have not yet attained this accreditation, but it should be encouraged wherever possible.

An alternative would be for the client to appoint an **environmental officer** for the development, who would draw up such a plan and track and enforce its implementation with the contractor. An environmental management plan would include strategies for how to manage water, waste, topsoil, leaks and contact with hazardous materials such as oil or asbestos, the provision of toilet and washroom facilities and the protection/incorporation of flora and fauna on site.

10.3.2 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).

Part of the development strategy should also revolve around the **protection of existing flora** on site. In particular, the site's environmental plan should include a strategy for the protection of all existing mature trees on site which are to be retained. The advice of a horticulturalist may be obtained, who can make recommendations as to how best to protect the areas under the tree's drip zone, and to ensure that soil compaction, particularly within this area, is kept to a minimum (no storage). This advice would also extend to the best watering and mulching protocols for the tree type and area.

10.3.3 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.

10.4 How do we manage our buildings?

The ongoing and correct management of fauna and flora on site will contribute to improved biodiversity over time.

10.4.1 Manage invasive vegetation on site: compliance with NEM:BA AIS

The Department of Environmental Affairs manages alien and invasive species in South Africa under the National Environmental Management: Biodiversity Act (NEM:BA), Act 10 of 2004. The Alien and Invasive Species Regulations for this Act were published on 1 August 2014 and put into effect on 1 October 2014, and can be found at http://www.invasives.org.za/legislation.html.

The regulations control **both alien and invasive fauna and flora**, and require landowners (including the public sector) to manage invasive species on their land. The onus is on the landowner to check for the presence of these species on their site, and take the appropriate action. Furthermore, homeowners selling their property must notify potential buyers of any listed invasive species on their properties. This should take the same form as getting a beetle, electrical or plumbing certificate from the relevant contractor.

10.4.2 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. Preference should be given to drip irrigation regulated by a timer or water sensors in the soil, to ensure watering takes place in the cooler hours and prevent unnecessary watering if it has rained.

Where possible the on-site shredding of prunings is encouraged, which can then be composted on site with other garden waste like leaves or grass cuttings, or used as mulch. Regular mulching of garden beds can help control evaporation and prevent topsoil removal from heavy rains.

A further element of good landscaping practices is the use of organic not chemical fertilisers.

10.4.3 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 minimises 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 emphasises the reduction of pesticide use and the implementation of preventative and alternative control methods.

A first step would be the choice of a variety of plants that are endemic to the area and hence more likely to be resistant to weather-related stresses and local diseases. Regular observation and monitoring allows for early intervention in the case of pests, and wherever possible these should be controlled primarily through physical and biological control methods (such as the encouragement of local predators such as birds for aphids, crop rotation, companion planting or the use of physical barriers).

Fast Fact:

Irrigating drought-tolerant plants

The benefits of drought-tolerant plants are not achieved unless they are watered through a water-conserving irrigation system. Plants and trees watered through standard sprinklers will develop shallow root systems and therefore lose their drought-tolerant qualities.

10.5 How do we enhance our precincts

10.5.1 Identify and conserve critical biodiversity areas in the precincts

In order to make a real difference to biodiversity via impacts on individual properties, it is essential that these be linked and managed in a cohesive and holistic fashion. The critical biodiversity areas as identified in the spatial development framework need to be respected and celebrated. Depending on the nature of each space, it may be best suited to a low impact activity, such as the establishment of a small nature reserve (which could be as small as a single residential erf fenced and preserved as a wetland or fauna or flora sanctuary), or be able to handle contained traffic (a biodiversity ribbon with a path for active movement) or even heavy traffic (such as a water body designed for water sports and an associated picnic area).

10.5.2 Rehabilitate and enhance local green spaces to increase biodiversity

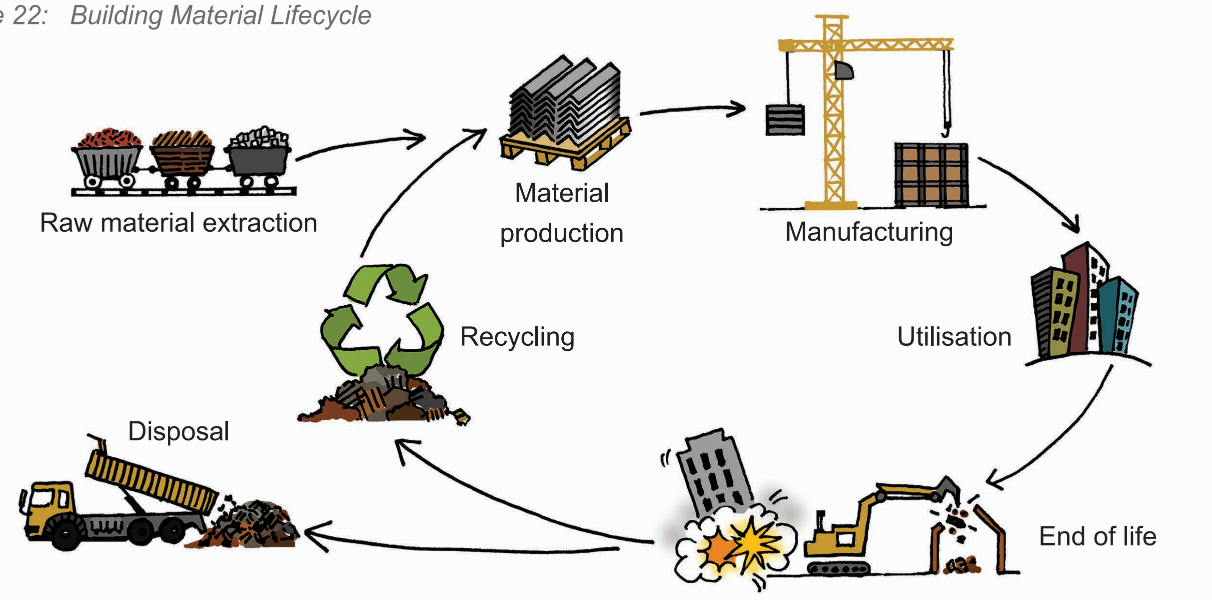
An important aspect of this is recognising that through decades of non-management, many potentially viable biodiversity areas have been degraded or functionally changed. These need to be rehabilitated. This can be a very good community building exercise, promote short- and long-term job creation, and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

11 Building Materials and Green Procurement

When considering building materials we need to think about both permanent fixtures (such as roof tiles), and items used in the construction of the building (like wooden scaffold boards), because the selection of building materials has upstream and downstream environmental impacts. The lifecycle of a material or product begins at extraction and harvest of the material components. Materials and products can also impact occupant health and the environmental performance of the building.

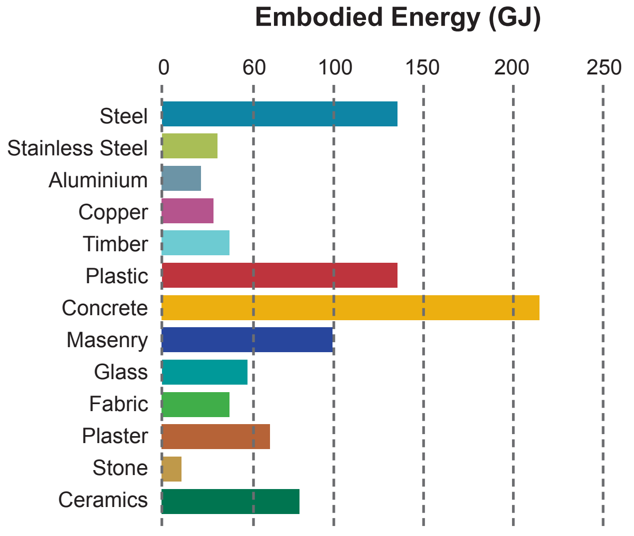
All materials require energy, water and other natural resources to be produced and transported to where they are marketed to consumers. This results in materials having an embodied energy and water even before they are used. The higher the embodied energy and water of a material, the less sustainable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

Figure 22: Building Material Lifecycle



Source: http://www.byggalliansen.no/dokumenter_14/mars/Temamote/Vannbaarne-anlegg_Berget.pdf

Figure 23: Embodied energy of common building materials



Source: http://www.yourhome.gov.au/sites/prod.yourhome.gov.au/files/images/M-Embodied-EEC-SIRO-02_fmt.png

Fast Fact:

Embodied energy and water

Embodied Energy: the energy consumed by all of the processes associated with the production of a building, from the mining and processing of natural resources to manufacturing, transport and product delivery.

Source: www.yourhome.gov.au/materials/embodied-energy)

Embodied Water: This is the amount of water used during the growing, processing and transportation of the goods we use or consume, or the services we use.

Source: http://www.savewater.com.au/research-and-resources/why-save-water/embodied-water)

Common procurement practices for building materials and products include criteria such as cost, availability, functionality, aesthetics, and client and project team preferences. With the implementation of green procurement practices, materials are chosen using additional criteria with regard to their effect on the local and global environment and socio-economic issues. A green material has few additives (such as stone or wood rather than plastic); does not offgas or release toxic fumes (such as formaldehydes in many composite wood products), is made locally (sometimes even produced or sourced on site), and may offer an opportunity to involve local community members, create employment, and develop and transfer valuable skills. When thinking about green materials, it is also necessary to consider the lifecycle of a product especially with regard to disposal or disassembly. Green materials can either be reused, repurposed or recycled easily.

11.1 What changes do we need?

In Steve Tshwete, to aid the transition to low emission development, the aim of these guidelines is to promote green procurement practices that encourage and specify the use of locally sourced building materials that have a low embodied energy and water. This aims to reduce the negative effect that buildings have on the natural environment, while encouraging local job creation and economic development within the municipality.

11.2 How do we design our buildings?

11.2.1 Design for dematerialisation

Dematerialisation 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. This can also be achieved where cladding is multifunctional, such as a green roof that acts as insulation, stormwater management system and roof cover material.

11.2.2 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. It is important to consider the use of recycled aggregate when an existing building on site is going to be demolished.
- **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. Therefore look to increase the percentage of recycled steel used in steel products, such as reinforcing bar, structural beams, window and door frames, etc. through specifying steel with a minimum post-consumer recycled content of 60%.
- **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). This helps to protect natural forests and promote sustainable wood harvesting practices for this renewable resource.

11.2.3 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. A further benefit can be the creation of a unique aesthetic identity specific to the local culture and context. 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.

11.2.4 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 and lower greenhouse gas emissions with improved thermal performance. This is most common in residential buildings which have fewer structural constraints, such as large widths to span and fewer floors to support. Alternative building materials can include straw bales, sandbags, mud bricks, reused shipping containers, and reinforced expanded polystyrene. Alternative building delivery methods such as prefabrication are often adopted along with the use of alternative building materials. When using alternative building materials and delivery ensure that they are approved by Agrement South Africa to credit their quality and strength for the safety of occupants.

Fast Fact:

Agrement South Africa

Agrement South Africa is a government body that assesses and certifies innovative non-standardised construction products, systems, materials, components and processes, which are not fully covered by a South African Bureau of Standards regulation or code of practice. This is to support and promote the process of integrated socio-economic development in South Africa as it relates to the construction industry by facilitating the introduction, application and utilisation of satisfactory innovation and technology development, in a manner which will add value to the process.

Source: http://www.agrement.co.za/

11.3 How do we construct our buildings?

11.3.1 Sustainably sourced, reused or recycled shutterboard

When choosing timber products, such as shutterboard as formwork for concrete, 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).

11.3.2 Consider the use of local skills and labour

While the building materials are chosen and specified in the design phase of a building, the construction phase offers the opportunity to use local skills and labour. These local skills can accompany the use of local building materials so that local knowledge is used and beneficial to the project. This in turn is beneficial to the local economy through job creation.

Case Study

Vele Secondary School

Limpopo

This high school for 640 learners in northern Limpopo has been designed, built and is still managed on the basis of sustainable practices. With regard to the use of materials in particular, this school's walls were constructed in part with stone found on site that otherwise would have been discarded in a landfill. Using this stone lowered the building's embodied energy and water by reducing the number of bricks and the amount of plaster needed to be brought in from far away. Using this stone also helped to create the building's unique and local identity by connecting it physically to its site and context. To construct the building using local stone, local community members were taught the skills of stone masonry thereby creating employment and providing community members with new skills. This also allowed the community to be intimately involved in the building which led to an increased sense of ownership of the building thereby ensuring a positive ongoing relationship between the community and the school.

Source: http://www.eastcoastarchitects.co.za/projects-vele.html

11.3.3 Identify opportunities for skills transfer and training

Where the skills required for the construction of a building might not yet exist in the local community, identify opportunities to develop these skills. This will enable the project to make use of local labour to benefit the local economy and allow the building to have a lasting impact.

11.4 How do we manage our buildings?

11.4.1 Implement green procurement policies

During the operation and management of a building or facility, new products and materials will need to be sourced to ensure the ongoing functioning and upkeep of the premises. To ensure that the building can continue to be green throughout its lifecycle, it is helpful to adopt and implement a green procurement policy. 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:

Locally sourced materials and products: Sourcing materials and products locally has positive environmental and economic benefits as greenhouse gas emissions are reduced from limiting transport needs and it creates jobs locally through developing the local economy. 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. This is especially important when considering the retrofit or refurbishment of a building.

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.

Environmentally-friendly cleaning products: The production and use of manufactured chemicals for cleaning products can be harmful to the environment. This is through the heavy industrial processes used to produce them which require high energy input with potentially toxic emissions. Environmentally friendly cleaning products are those that do not cause harm to the health of cleaners and building occupants and those that can be easily broken down to harmless substances through ecological processes.

11.5 How do we enhance our precincts?

11.5.1 Develop a directory of local services and products

To help those in the community, precinct and town to source products from local suppliers and manufacturers or services from residents of the municipality, it is necessary to provide some form of reference guide to highlight the services and goods available locally. This could take place as part of a monthly newspaper insert or as a brochure or flyer made available to all residents. While increasing connectivity and local knowledge, this could also help to boost the local economy.

12 Urban Agriculture

Food is vital to life. A well-balanced diet made up of fresh fruit and vegetables, protein and dairy is essential for the continued mental and physical development of children, teenagers and adults. Currently, many communities globally and within the Steve Tshwete Local Municipality are facing food insecurity and poor access to affordable fresh vegetables and fruit. This means that residents do not have sufficient food to prevent hunger either on a daily basis or at certain times of the month and year when a family's income is reduced. Food insecurity also refers to residents not having sufficient access to healthy food through urban food markets or from local food gardens, whether in their own gardens or shared within a community.

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 farms. High-value agricultural land along the urban edge can be used for food production thereby preventing urban sprawl through improved urban management practices. The way in which food is produced can also impact the environment. Farms that reduce or omit the use of harmful fertilisers and pesticides reduce the negative effects of agriculture by preventing the pollution of rivers, soil and air. Urban farms can therefore also serve to enhance local ecosystems and biodiversity. The use of chickens or ducks for pest control provides an innovative and reliable source of protein and manure.

In Steve Tshwete, 9% of households are agricultural households with the poultry, livestock and vegetable farming being the most common. The vast majority of these agricultural households earn less than R40 000 annually and therefore can be considered subsistence farmers.

12.1 What changes do we need?

The need to make healthy food affordable and accessible to residents in the Steve Tshwete Local Municipality 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. This can in turn offer new employment opportunities because the benefits of 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.

12.2 How do we design our buildings?

12.2.1 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. Plants such as strawberries, herbs and nasturtiums all grow well in vertical planters. Such produce could be harvested by the building occupants, sold or donated to local community groups/NGOs.

12.2.2 Consider opportunities for on-site food productions

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.

12.2.3 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.)

12.3 How do we manage our buildings

12.3.1 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 practiced on site.

12.3.2 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.

12.3.3 Innovation

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

12.4 How do we enhance our precincts?

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. South Africa, along with the other countries around the world, is witness to a growing trend towards residents seeking out locally grown organic food, and it is something that all communities should have access to.

The establishment of a neighbourhood organic composting program can generate employment and economic activity in an area, but dedicated areas should be demarcated for this. Organic waste can be collected from surrounding properties, composted and sold.

Case Study

Waste to Food

Closing the Loop

Roger Jaques

Pick n Pay and the City of Cape Town have a "Waste to Food" project, which was started in Philippi. Food waste and organic waste are mixed to produce compost. It is used to feed earthworms, for pest and disease control, as liquid fertiliser and to grow crops. This project is creating jobs, as it is structured as enterprise development, and operates as a franchise, and Pick 'n Pay is now buying the compost back. The people working on this project can obtain a second franchise, manage it and repay their loan.

Source: Sustainable Settlements Innovation Summit, 2015, Western Cape Provincial Government

Source: http://wtf.waste-to-food.co.za

Case Study

Farm-to-Fork

Buy Local Campaigns

Abalimi Bezekhaya and Harvest of Hope

Abalimi Bezekhaya ("Farmers of the Home") is a non-profit development organisation based primarily in township communities like Nyanga and Khayelitsha. Residents in these townships are encouraged and supported to grow their own organic vegetables to feed their families. Vegetables are now grown in hundreds of gardens in the townships, sustaining thousands of individuals and families. Some of the micro-farmers are now producing more than enough to feed their families, even after giving to needy neighbours and selling "over the fence". However, in the past there was little or no access to markets outside the immediate neighbourhood to sell the high quality organically grown produce.

Abalimi's "Harvest of Hope" project provides a much-needed outlet for excess produce by selling this produce on behalf of the farmers in the form of a weekly organic box scheme. Harvest of Hope contracts with the farmers in advance, guaranteeing to purchase their produce and thus giving them some income security. Members of Harvest of Hope sign up for the box scheme and pay for their weekly delivery of vegetables in advance. Thus Harvest of Hope is a community supported agriculture scheme (CSA) that facilitates the commitment between the micro-farmers and the consumers/members. This has become so successful that even the CTICC and Mount Nelson Hotel are procuring some of their vegetables from Harvest of Hope.

Source: http://harvestofhope.co.za/about-us/our-story/

Steve Tshwete Local Municipality

For more information consult the green building information portal on the municipal website.

URBAN LEDS
URBAN LOW EMISSION DEVELOPMENT STRATEGIES

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