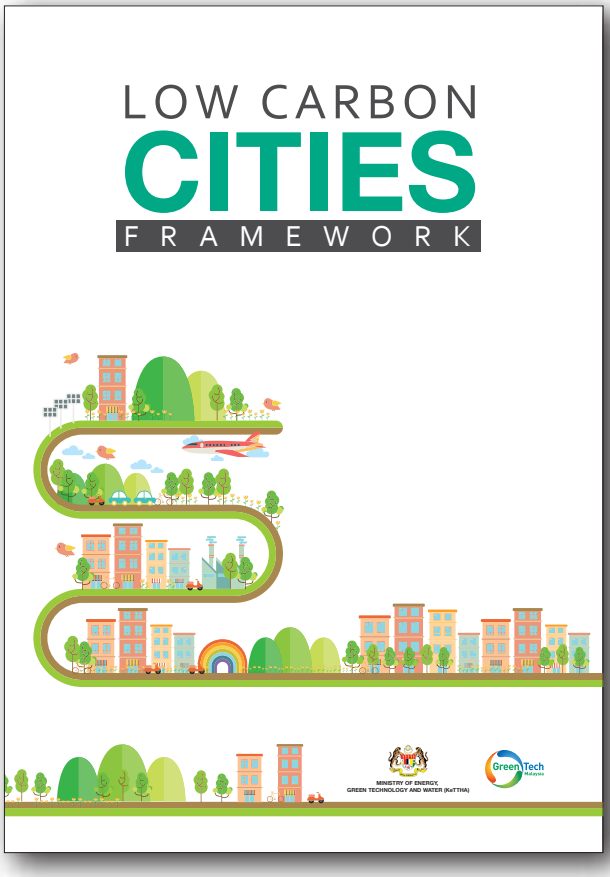
LOW CARBON CITIES FRAMEWORK

MINISTRY OF ENERGY,
GREEN TECHNOLOGY AND WATER (KeTTHA)

GreenTech Malaysia



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Developed By:

MINISTRY OF ENERGY,
GREEN TECHNOLOGY AND WATER (KeTTHA)

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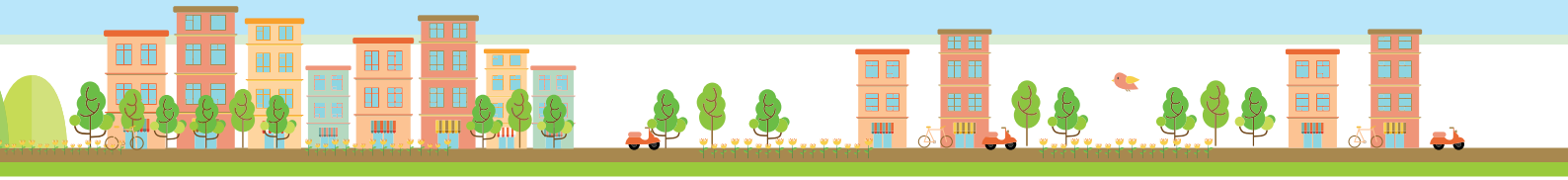

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1 INTRODUCTION

1.1 Global Warming & Climate Change

The Earth's surface needs to retain some of the Sun's heat in order to regulate mean global temperatures, and naturally occurring gases in our atmosphere such as water vapour, methane, nitrous oxide, and carbon dioxide (CO_2) which serve this purpose by trapping the required amount of heat from the sun so that the conditions are conducive to the survival of all living creatures.

However, since the advent of the age of industrialisation in the late 1700s, man-made activities have accelerated the increased presence of some of these naturally occurring gases as well as other man-made gases in our atmosphere. These gases along with other man-made gases **(Table 1.1)** increase the amount of the heat trapped from the sun into our atmosphere and cause global warming and climate change.

The United Nations, through the efforts of the UNFCCC, has established the six gases that contributed to the advent of global warming and climate change with their increased presence in our atmosphere.

No	Name of Gas	Chemical Formula	GWP (over 100 years)	Atmospheric Life Span (years)
1	Carbon dioxide	CO_2	1	100-1000
2	Methane	CH_4	23	12
3	Nitrous oxide	N_2O	296	114
4	Chlorofluorocarbons	CFCs (various)	6000 - 14000	45-1700
5	Hydro fluorocarbons	HFCs (various)	12 - 1200	0.3-260
6	HFCs (various)	SF_6	22000	3200

Table 1.1: Types of GHG in Atmosphere

Of these six gases, CO_2 is the largest and the most commonly referred to in relation to climate change, although the other gasses have a greater impact on climate change when compared to CO_2 in equal volumes. For example, one ton of methane is 23 times more potent than one ton of CO_2. However, CO_2 has been selected as the benchmark measure gas and has the global warming potential of 1 compared to that of methane which is 23. Global warming is primarily a problem of excessive carbon dioxide (CO_2) in the atmosphere, which acts as a blanket that is trapping heat and warming the planet and eventually will cause the rising of the sea level as shown in **Figure 1.1**.

1.1 Global Warming & Climate Change

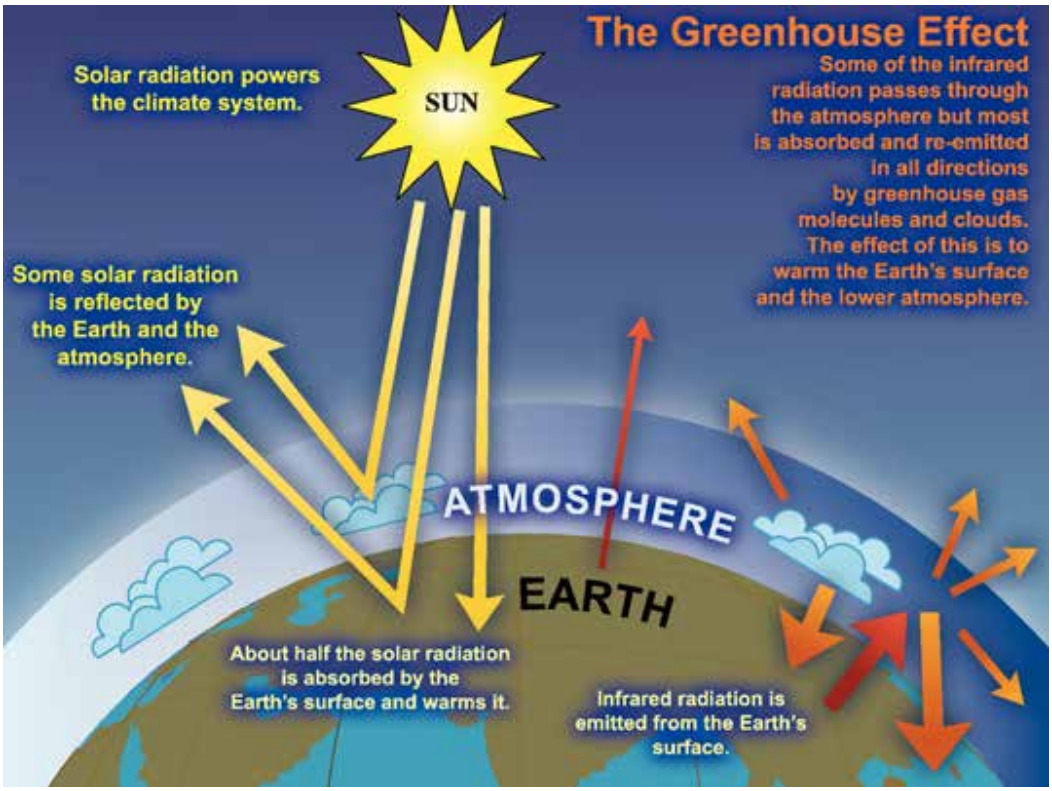
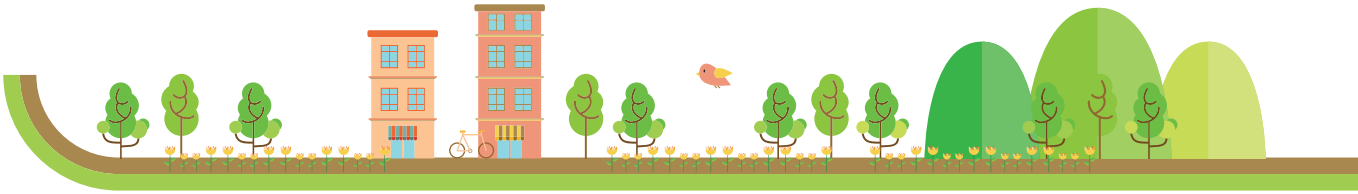


Figure 1.1: The Greenhouse Effect

Source:https://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-1-3.html

It is common knowledge that carbon dioxide emissions are largely responsible for global warming. It elucidates that greenhouse gas emissions in Malaysia has increased substantially by 13 percent per GDP and 32 percent per capita between 1994 and 2000. The total greenhouse gas emissions had increased by 55 percent in year 2000 (Second National Communication, NC2) when compared with the year 1994 levels (Initial National Communication, INC). Malaysia's emission of CO_2 per capita which is at 8.0 metric tons in 2013, which was higher than the average emission for world CO_2 in 2011; only 4.94 metric tons.



1.2 Malaysia's Effort towards Sustainable Development and Climate Change Agenda

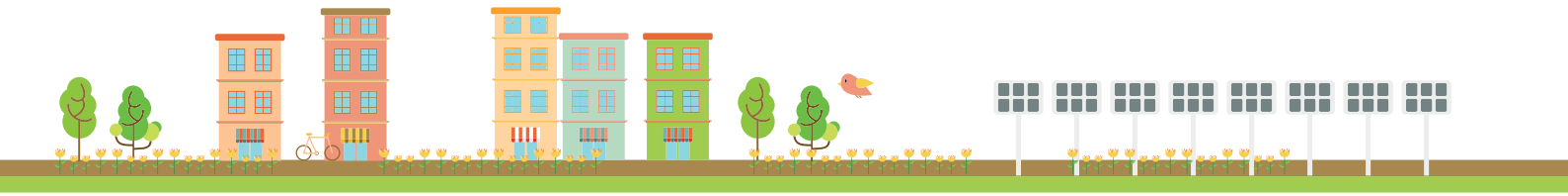
Malaysia is currently one of the most urbanized countries of South East Asia, which is one of the most rapidly urbanized regions around the world. Over the last ten years, the urban population in Malaysia has increased from 66 percent in 2004 to 74 percent in 2014. This growth is expected to continue, as people from rural areas migrate to urban areas for employment, as our economy continue to shift from agriculture sector to industry and services sector.

Increasing rates of urbanisation, recording up to 95% in developing countries, will see cities grow significantly and bringing along with this is a host of socio-economic and environmental challenges from reduced air quality to increased traffic congestion. For example, the Asia-Pacific region is anticipated to see a rise in middle-class consumers of about 2.7 billion people by 2030.

The total population of Malaysia in 2011 was estimated at 29.1 million. This grew to 29.9 million in 2013. The population had increased by 24.9% over the period 2000-2011. Malaysia launched the Economic Transformation Programme (ETP) in 2010 to catalyse investment and economic growth. GDP (at 2005 constant prices) grew from RM543.6 billion in 2005 to RM711.8 billion in 2011 and RM787.6 billion in 2013.

(Source: Malaysia BIENNIAL UPDATE REPORT TO THE UNFCCC, Dec 2015)

The Malaysian effort on environmental issue started since the United Nations Conference on the Human Environment in 1972. Following up to that, Malaysia shows her commitment on the Rio Summit after which the Malaysian National Environmental Policy was established. The policy became the basis for the country to give atention to environmental issues. **Figure 1.2** represents Malaysia's sequence of actions and involvements since 1972.



1.2 Malaysia's Effort towards Sustainable Development and Climate Change Agenda

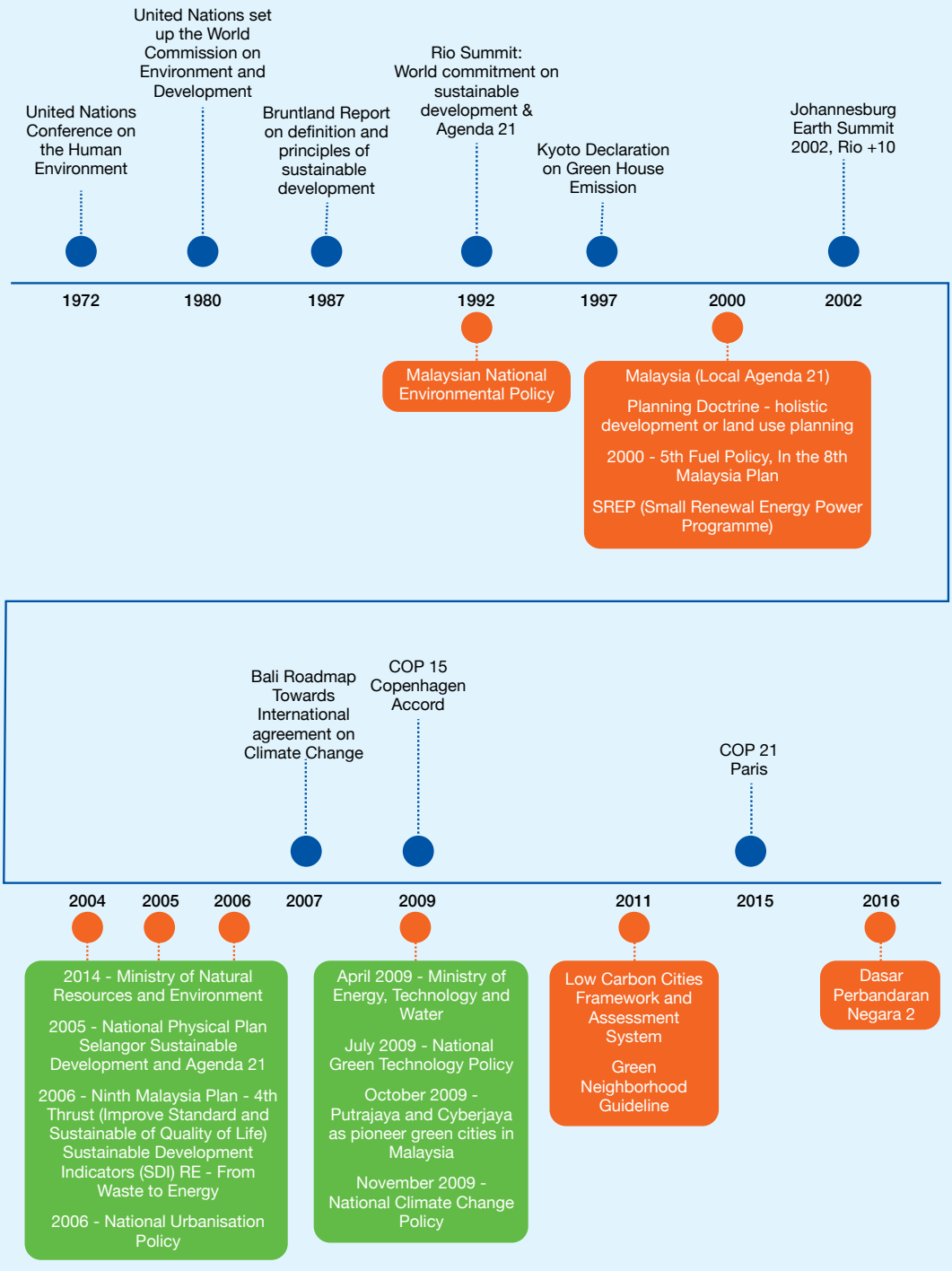


Figure 1.2: Malaysia's Involvements in Sustainability Development Agenda since 1972

1.2 Malaysia's Effort towards Sustainable Development and Climate Change Agenda

Malaysia's direction towards sustainable development can be categorised in 5 hierarchies as described in **Figure 1.3** below.

National Direction

- New Economic Model (NEM)
- Eleventh Malaysia Plan (11MP)
- Economic Transformation Programme (ETP)

National Legislation

- Acts
- Regulations

National Policies

- National Policy on the Environment (2002)
- National Green Technology Policy (2009)
- National Climate Change Policy (2009)
- National Urbanisation Policy 2 (2016)

National Plans

- National Physical Plan (NPP)

Regional Plans

- Sabah Development Corridor (SDC)
- Sarawak Corridor of Renewable Energy (SCORE)
- Comprehensive Development Plan (CDP)
- East Coast Economic Region (ECER)

Figure 1.3: Hierarchy of Framework for Sustainable Development

1.3 Concept of Low Carbon Cities

Under this framework, Low Carbon Cities has been defined as a city that comprises of societies that consume sustainable green technology, green practices, and emit relatively low carbon or GHG as compared with present day practice to avoid the adverse impacts on climate change.

The concept of 'low carbon cities' (LCCs) is currently gaining momentum in the urban development and urban governance scenes as cities come to terms that global warming and climate change are the result of urbanisation, population rise, and economic growth and that the most significant increase of energy consumption and CO_2 emissions take place in cities and urban areas.

The concept of LCCs is closely aligned with sustainable development. Through the adoption of the principle of sustainability, carbon emissions can be reduced through the means and ways in which cities are designed and developed, and the ways resources are consumed. Essentially, LCCs are cities that take serious and effective action to reduce their environmental impact and their CO_2 emissions.

LCCs demonstrate high energy efficiency, power themselves with renewable sources of energy, produce the lowest quantity of pollution possible and use land efficiently; compost used materials, recycle them or convert waste to energy. Fundamentally, LCCs are cities that adopt and embed the principles of sustainable development to contribute minimally to climate change.

1.4 Low Carbon Cities Worldwide

Cities are the world's leading consumers of energy. The world's 27 largest cities consume 9.3% of the world's electricity and produce 12.6% of the world's waste—even though they contain only 6.7% of the world's population.

With highly concentrated and growing populations, cities are major contributors to global carbon emissions. Green cities strive for energy efficiency, adopt renewable sources of energy, utilise land efficiently, compost used materials, recycle or convert waste to energy, and deploy low carbon transport or electric vehicles, which resulting in better pollution control, resources optimisation, and waste reduction. A concerted global effort to build green cities is present. Exemplary cities include:

Copenhagen, Denmark

Copenhagen is at the forefront of the move towards green cities, having been selected as the European Green Capital 2014 by the European Commission. It has also been ranked as the number one green city twice by Global Green Economy Index.

Copenhagen aims to become the world's first carbon neutral capital by 2025 with a mid-term goal of a 20% CO_2 reduction by 2015. To this end, the city has introduced a string of initiatives that address transportation and energy consumption, as well as water and waste management.

The City of Copenhagen received the European Environmental Management Award in 2006, in recognition of a decade of long-term, holistic environmental planing, which halved the amount of sewage discharged into the harbour. The water has been safe for bathing in since 2002 and today it is possible to take a swim in one of the numerous harbour baths just 500 metres from City Hall.

1.4 Low Carbon Cities Worldwide

Stockholm, Sweden

Stockholm was the first city to receive the European Green Capital award by the European commission in 2010, a testament of its progressive and proactive steps to reduce carbon emissions across the board and promote healtheir lifestyle. Stockholm operates with a holistic vision, one which combines growth with sustainable development for the benefit of its 900,000 citizens.

Stockholm has cut carbon emissions by over 25% per inhabitant since 1990 and aims to be fossil fuel independent by 2050. Specifically, the city has effectively cut down its emission rates per inhabitant to about 3.4 tonnes per person in 2009 (compared to 5.4 tonnes per person in 1990) with plans to further reduce carbon emissions to 3 tonnes per resident by 2015, though calculations indicate that output will actually fall to 2.8 tonnes by that time.

Freiburg, Germany

Freiburg in Germany is one of the cleanest cities in the world, giving it the chance to also be on the list of the greenest cities worth visiting. The City of Freiburg is often called Germany's "ecological capital" and has been recognized internationally as one of the world's most liveable sustainable and child-friendly cities.

Numerous sustainability measures such as regional heating, recycling and low-energy buildings have been implemented. Regional planning has focused development within city boundaries, and thus prevented sprawl. Historic castles, villages and towns have been protected.

Not only retaining and enhancing the beauty, walkability, mixed usage and vibrancy of its historic city, Freiburg planning over the last 40 years has emphasized biking, walking and public transit, traffic calming and mixed-usage human-scale development to create a "city of short distances".

1.4 Low Carbon Cities Worldwide

Vancouver, Canada

Vancouver is Canada's greenest city that aims to be called the world's greenest city by 2020 by demonstrating that economic growth and the welfare of its citizens depend on developing renewables, rapid transit systems, and promoting cycling and walking to curb car use. The Vancouver Greenest City Action Plan is divided into 10 goal areas, addressing three overarching areas of focus comprising of Zero Carbon, Zero Waste and Healthy Ecosystems.

Vancouver, which has a population of 600,000, believes that all its power can come from renewables - although getting all heating and cooling and transport without using fossil fuels may take until 2040, depending on whether there is any help from central government.

1.5 Low Carbon City Assessment Worldwide

1.5.1 The Low Carbon City Development Program (LCCDP)

Low Carbon City Development Program (LCCDP) is a systems-approach to low carbon development, which include a framework and set of comprehensive requirements to help the city to plan, implement, monitor, and account for low carbon investments and climate change mitigation actions across all sectors in the city over time. It allows a city to incorporate innovative and cutting-edge practices that exist at the nexus of low carbon development and green growth into city planning. The LCCDP is an approach that builds upon and complements existing efforts in low carbon development and harnesses environmental markets for the unique situation in cities, which was first used by the City of Rio de Janeiro.

(Source: World Bank Organisation, 2013)

1.5.2 ICLEI – Local Government for Sustainability

There are few LCC programs and projects under ICLEI:

i. Green Climate Cities® (GCC) program
The GCC is a comprehensive program on climate change mitigation (reducing greenhouse gas emissions) building on 20 years of ICLEI experience. It covers three phases: analyze, act, and accelerate; offering a comprehensive methodology and tools. GCC is a network that offers capacity building and exchange of opportunities, as well as a wide range of tools and guidance tailor-made to local government's requirements.

ii. Urban Low Emission Development Strategies (Urban-LEDS)
Implemented with UN-Habitat and funded by the European Commission, the Urban-LEDS project is ICLEI's global climate flagship project under the Low Carbon City Agenda - it promotes low emission urban development strategies in model and satellite cities in Brazil, India, Indonesia, and South Africa with supports from European cities.

iii. Energy-safe Cities Initiative
Energy-safe Cities Initiative aims to initiate a rapid transformation to low carbon, resilient, and safe urban energy systems in East Asian local governments. Through this multi-year, multi-stage program, local governments from the People's Republic of China, the Democratic People's Republic of Korea, Japan, Mongolia, and the Republic of Korea shall explore locally specific and sustainable pathways for attaining 100% renewable energy supply systems by the year 2030.

(Source: Potsdam-Institut für Klimafolgenforschung., & World Bank, 2013)

1.5 Low Carbon City Assessment Worldwide

1.5.3 Carbon*n* Climate Registry (cCR)

The carbon*n*© Climate Registry (cCR) was launched at the World Mayors Summit on Climate in Mexico City on 21st November 2010 as the global response of local governments to measurable, reportable, and verifiable (MRV) climate action.

The cCR is a global mechanism developed for local governments by local governments. It enables them to publicly and regularly report their local climate action developments on the following:

(i) Greenhouse gas (GHG) reduction commitments,
(ii) Emissions inventories
(iii) Climate mitigation / adaptation actions

Reported results are used in the Local Government Climate Roadmap, playing a key role in the advocacy of local governments in the global climate negotiations. The Annual Reports of cCR (2011, 2012, 2013) were presented and very effectively used at the United Nations Climate Conferences in Durban (COP 17), Doha (COP 18) and Warsaw (COP 19).

The cCR supports the global credibility of local climate action and ensures transparency, accountability and comparability. The aim is to improve and ensure data are consistent with the standards of the global climate regime.

(Source: Carbonn Climate Registry, 2017)

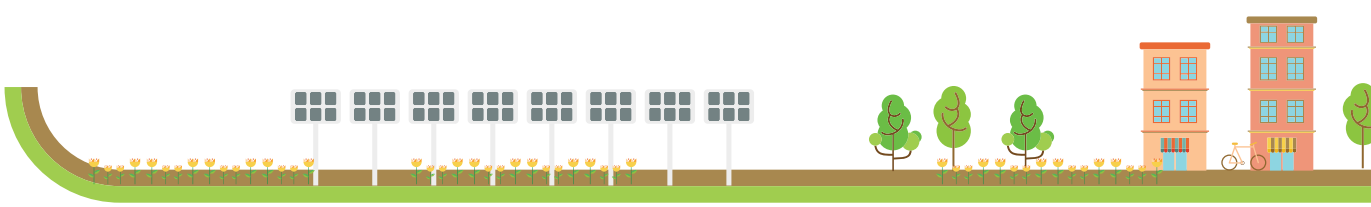
1.5.4 Carbon Trust Low Carbon Cities Programme

Low Carbon Cities Programme by Carbon Trust provides expert advice to core cities, regions and towns by providing inspiration and structure to assist the area partners through the process of achieving carbon and efficiency savings, while also promoting low carbon growth.

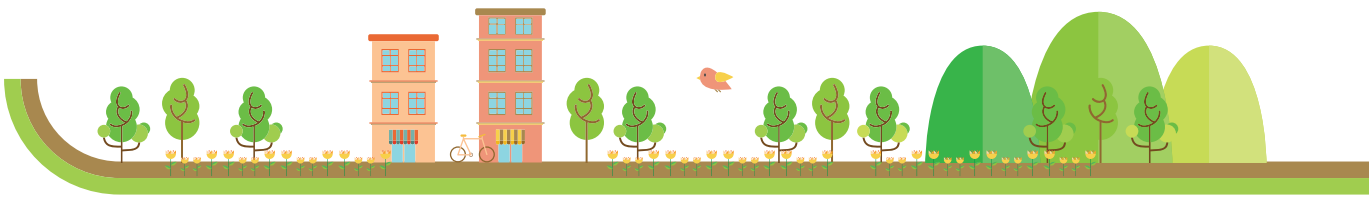
Cities have a huge impact on carbon emissions because of the numbers of people who live and work in them, and because of the example they can set. Proactive cities like London have demonstrated that if governing bodies use their influence imaginatively, they can have a very significant effect on reducing city-wide carbon emissions, which is even beyond their spheres of direct control. The Low Carbon Cities Programme emulates and extends this approach, making it a model for all cities, towns, and indeed local authorities, to utilise.

Carbon Trust have developed a 5-Step Low Carbon Cities Programme methodology. This approach builds on insight from the Carbon Trust's Public Sector Carbon Management Programmes, which have enabled 600 public sector bodies to develop Carbon Reduction Strategies with, on average, 5 year CO_2 reduction targets of 25%. The output is a prioritised carbon reduction action plan for city or regional level carbon reduction.

(Source: Carbon Trust, 2017)



2 SUSTAINABLE DEVELOPMENT FRAMEWORK FOR LOW CARBON CITIES



2.1 Introduction to Sustainable Development Framework

Sustainable cities are characterised as cities where people want to live now and in the future, where the cities meet the diverse needs of existing and future populations, are sensitive to their environment and ensure that their lifestyle and consumptions do not adversely affect the environment, preserve their natural ecology and contribute to a high quality of life. Sustainable cities are safe, inclusive, well planned, built and managed and offer equality of opportunities and good urban services for all.

All the above characteristics can be grouped into eight elements; the combination of which performs like a complete eco-system for sustainable cities (**Figure 2.1**). The sustainable city elements address the three tenets of sustainable development, namely economic, social, and environmental.

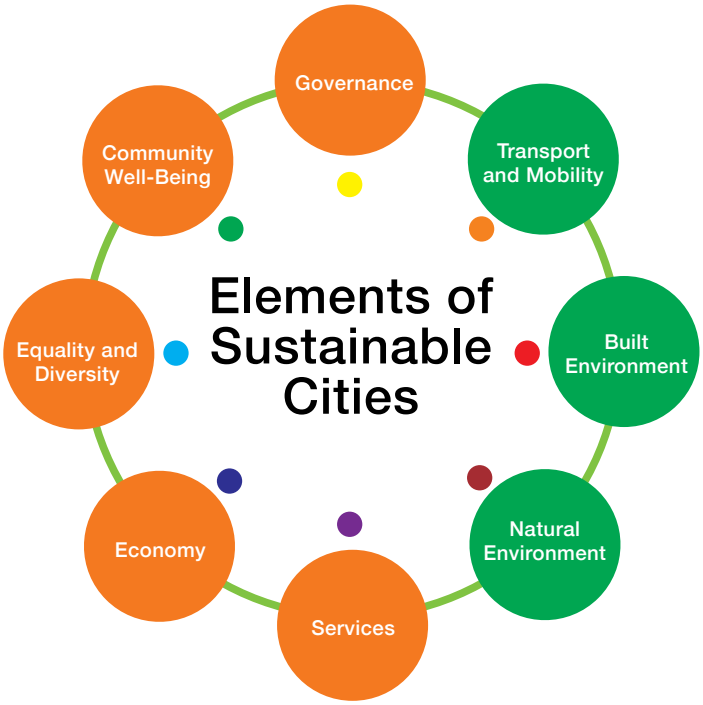


Figure 2.1: Elements of Sustainable Cities

2.1 Introduction to Sustainable Development Framework

As low carbon cities essentially are a sub-set of sustainable cities, the development of the LCCF has been formulated to provide a framework and tool for further implementation of the whole spectrum of strategic and policy development on sustainability within the Malaysian context; with specific focus on tracking carbon emissions at city levels. In the long term, the LCCF and its assessment system (i.e. the Low Carbon Cities Assessment System or known as LCCFTrack) will help to further update the status of improvement made on carbon emission components of sustainable cities.

Figure 2.2 illustrates the relationship of the carbon emission performance-based assessment tool provided by the LCCF within the whole framework for sustainable development in Malaysia.

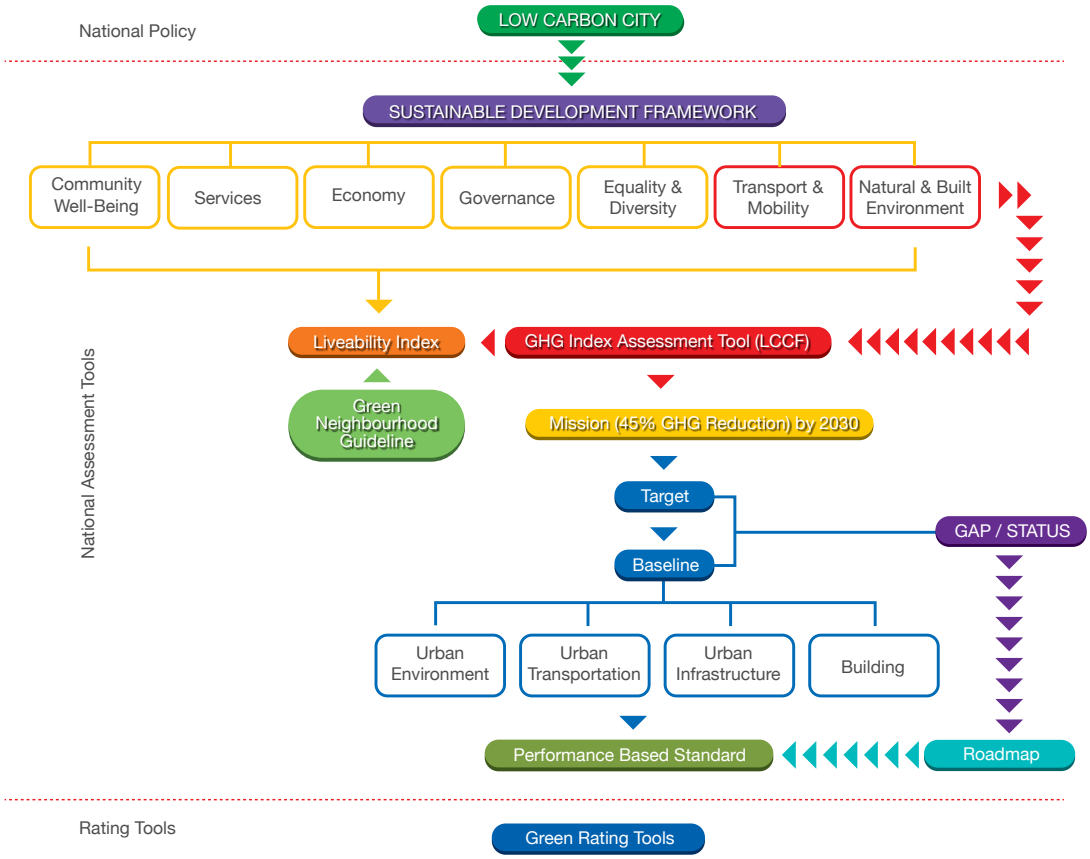
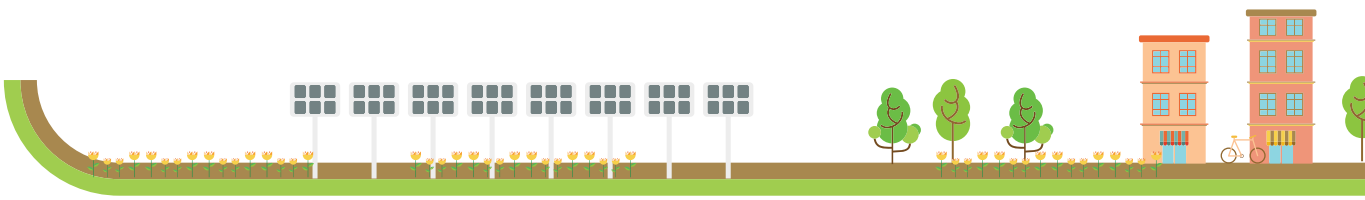


Figure 2.2: Sustainable Development Framework for Low Carbon Cities



2.1 Introduction to Sustainable Development Framework

In 2012, the Federal Department of Town and Country Planning (JPBD) prepared a Green Neighbourhood Planning Guideline as a planning manual for design and development of a green neighbourhood. This Green Neighbourhood Planning Guideline (GNG) aims to provide the basis for state governments to formulate policies and the mechanism to encourage more green neighbourhoods for local authorities to provide the framework in appraising development applications for planning permissions as well for developers in designing their development proposals. The LCCF and GNG are complementary each other towards holistic sustainable development in the country.

(Source: Green Neighbourhood Planning Guideline, Federal Department Town and Country Planning)

Figure 2.3: Design Criteria in Green Neighbourhood Planning Guideline

2.2 Background of Low Carbon Cities Framework (LCCF)

The Malaysian Government is aware on the potential impact of global warming on the nation. Malaysian Government is committed to combat this global phenomenon.The nation's commitment was announced to the global community on 17th December 2009 in Copenhagen, Denmark.

In order to reduce carbon footprint in Malaysia, the Prime Minister, Dato' Sri Haji Mohd Najib Bin Tun Haji Abdul Razak pledged commitment at the 15th United Nations Framework Convention on Climate Change (COP15) 2009 in Copenhagen, Denmark. Malaysia has agreed to reduce its CO_2 emission intensity to the GDP by 40% per GDP per capita by 2020, as compared to 2005 levels - conditional upon transfer of technology and finance from developed nations.

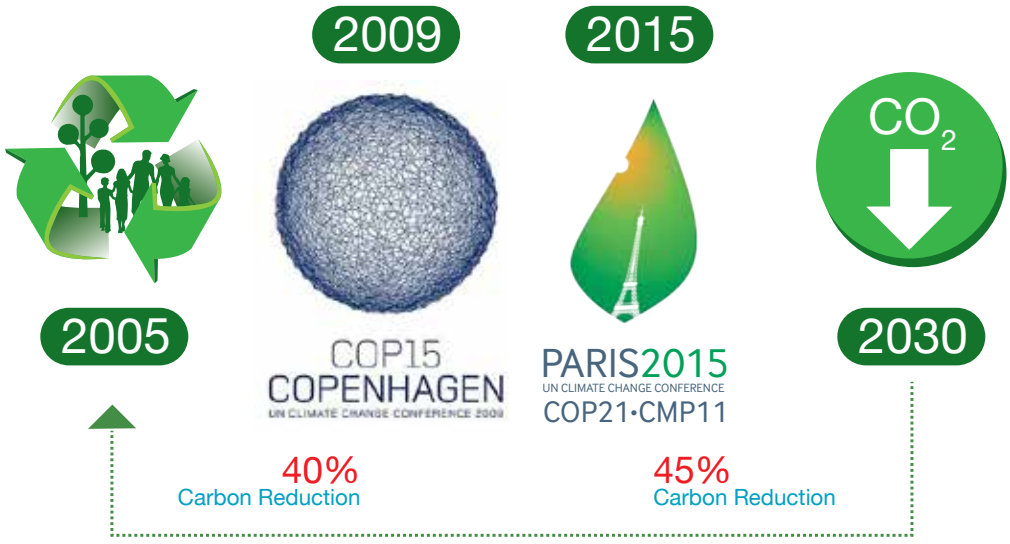
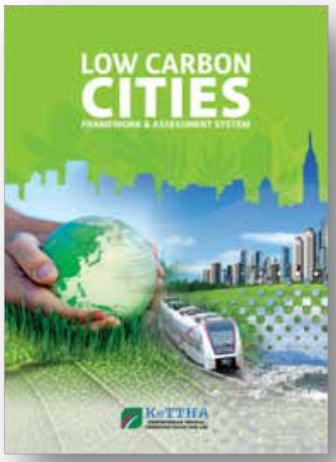


Figure 2.4: Malaysia's Commitment Towards Sustainability

2.2 Background of Low Carbon Cities Framework (LCCF)



As a country that has made steady strides towards mitigating climate change and reducing CO_2 emissions for over a decade, the Prime Minister pledge enhanced target to reduce the country's in-house gas emissions by 45% in terms of emissions intensity of GDP a year 2030 based on 2005 levels in the 21st Conference of Parties (COP21). This pledge is truly commendable.

Prior to COP15, on 24th July 2009, the Malaysian Government unveiled the National Green Technology Policy. This was a turning point in the history of initiatives on sustainable development in Malaysia where a policy focusing on technology, solution, and road map to minimising impacts of development on the environment is formulated.

Whilst green cities or townships have varied definitions and characteristics, more often than not, they have resulted in a definition equivalent to a 'sustainable city'. It makes more sense that a green city would offer long-term sustainability in a holistic manner. Thus the general definition of a green city can be considered to be the same as sustainable city where the characteristics are made up of the three tenets of sustainable development, namely environment, economy, and the social perspective.

Realising the importance of measuring performance of cities and townships, especially their contribution to carbon emission levels of the country and the commitment that Malaysia has made in reducing carbon emission level, the Ministry of Energy, Green Technology and Water (KeTTHA) has embarked on developing a framework for a low carbon city township that guides the implementation of carbon reduction measures in a city/township. This framework, substantiated by an assessment system, allows for performance of such measures to be quantified and monitored. This Low Carbon Cities Framework (LCCF) is part of the Ministry's several initiatives for 2010-2011 which aim to set in motion further initiatives and actions at various levels towards reduction in the overall carbon footprint of the country.

Due to changing circumstances with new emerging sustainable issues and the government's future policies and strategies, LCCF has been reviewed and improved to meet the new requirements (LCCF Version 2).

2.2 Background of Low Carbon Cities Framework (LCCF)

The LCCF bridges the gap between existing policies of the government with the many green city rating tools currently available in the market (**Figure 2.4**). With the government's commitment to carbon footprint reduction, the LCCF helps stakeholders in cities and townships to define their priorities and develop action plans to reduce their carbon emissions as it focuses specifically on strategies and measures towards carbon reduction.

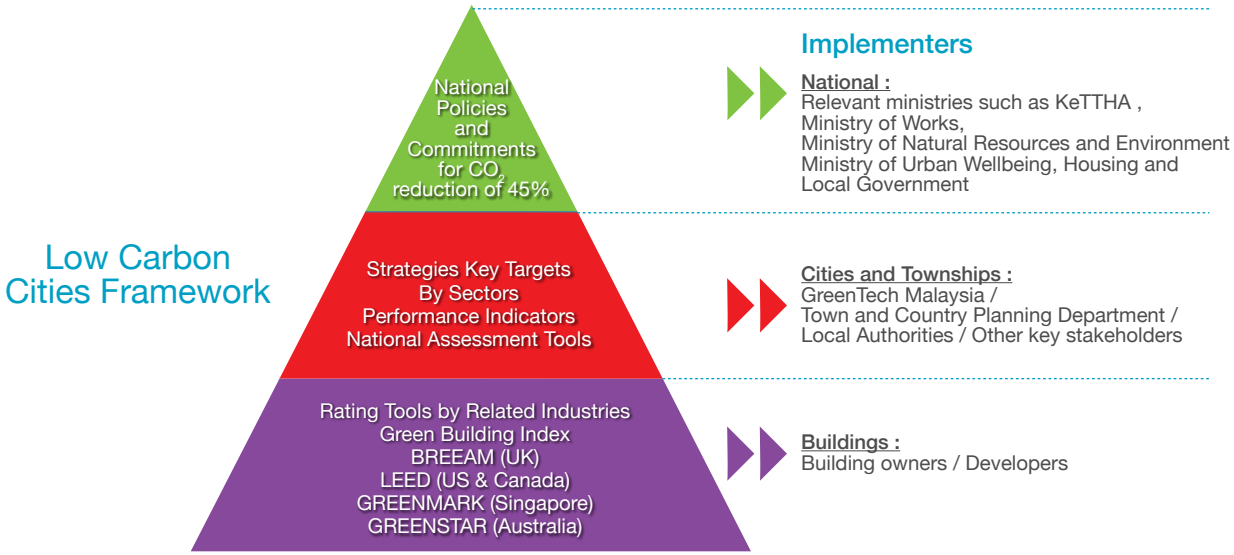
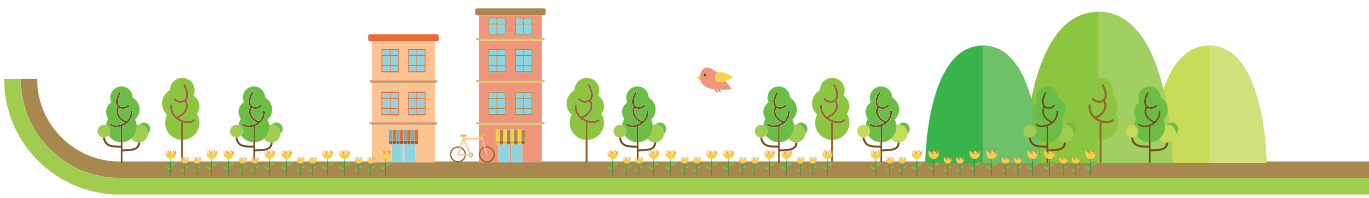


Figure 2.5: LCCF in Relation to National Policies and Rating Tools



2.2 Background of Low Carbon Cities Framework (LCCF)

Whilst most criteria-based rating tools are developed specifically to aid design of new green cities, the LCCF takes into account the birth and ageing of a city or township and the urban development, which is a cyclical process where elements of carbon emission in city activities can result at any stage of a city's lifecycle. The United Nations Environment Programme (UNEP) Sustainable Buildings and Climate Initiative reported that 80% of CO_2 emissions occur during the occupancy stage; hence the importance of quantifying city performance at post design and construction stages.

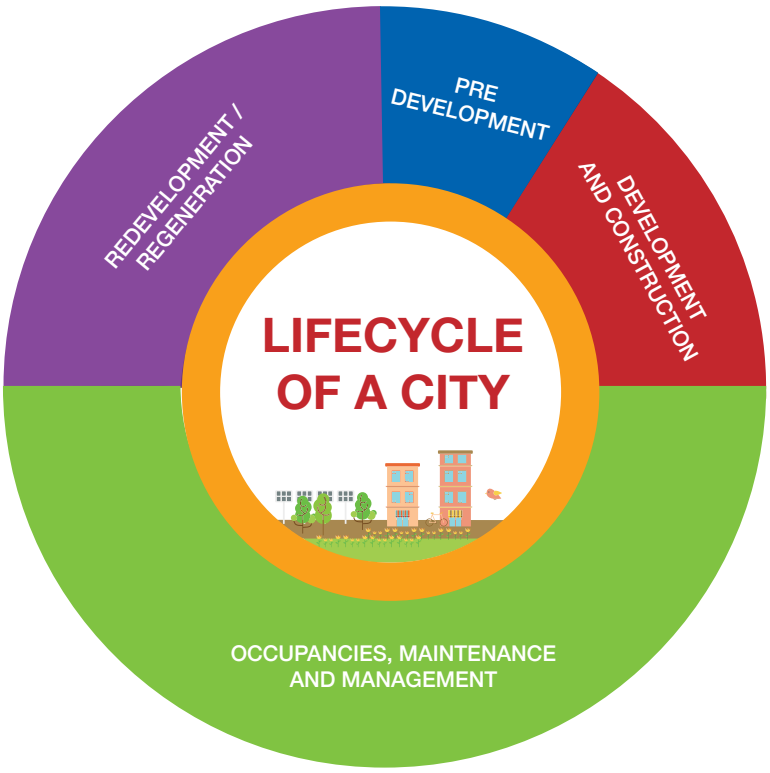
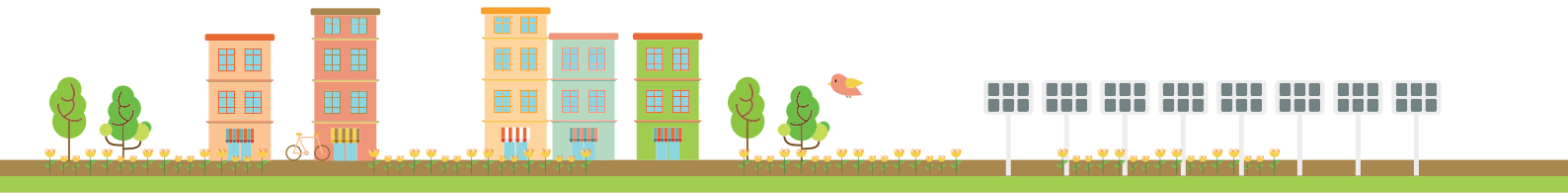


Figure 2.6: Life Cycle of a City



2.3 Performance-Based System

LCCF is a performance-based system which captures the actual environmental impact of a development in terms of total carbon emissions. This measure is carried out through:

(i) The construction stage;
(ii) The embodied carbon contained in the building's constructed form; and
(iii) The operational carbon emissions during the life span of the building.

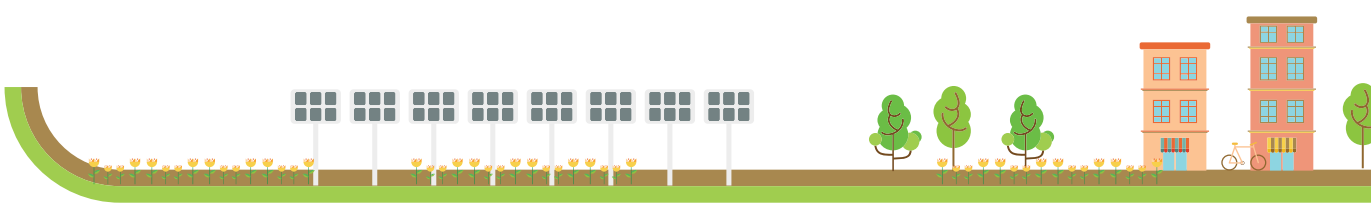
It gives priority to performance criteria which have significant impacts on the environment and ensure that this priority is undertaken to reflect the targeted goal.

This performance-based assessment system prioritises performance-based benchmarks to ensure total environmental impacts in terms of carbon emissions are measured and reduced.

Whereas, 'Criteria-based' systems encourage 'point chasing' rather than activities that result in measured environmental impact that can be achieved by 'performance-based' criteria, where a year on year abatement can be tangibly achieved. Also, 'criteria-based' systems may have a periodic review (of 3 years, in some cases) but environmental impacts in between review periods go unchecked.

A 'GHG reduction' approach is used in this document. The carbon equivalents of each activity producing GHGs are focused on 4 identified elements: Urban Environment, Urban Transportation, Urban Infrastructure, and Building.

These 4 elements are further categorised into 15 performance criteria and 41 sub-criteria, each of which provides specific intents towards carbon reduction targets. Chapter 3 of this document elaborates in further detail the elements and performance criteria.



3 PARAMETERS FOR LOW CARBON CITIES

3.1 Performance Criteria For Low Carbon Cities

The performance criteria for low carbon cities are measurable strategies to reduce carbon emission through policy control, better process and product management, development of technology, transformation in procurement system, consumption strategies, carbon capture and others. In relation to this, the identification of key elements that contribute to city carbon emission is fundamental. This is because a city needs to recognise and determine the areas of concern and territory boundaries in order to measure the performance of its efforts to lower carbon emission.

The key elements identified, which are urban environment, urban transportation, urban infrastructure and buildings, and the further 15 performance criteria and 41 sub-criteria help the stakeholders to comprehend the cities' carbon footprint and at the same time assist them in taking the applicable reduction measures in achieving the national climate aspirations.

As different cities face diverse concerns and challenges, each city must prioritise based to its own essentials and capabilities. **Figure 3.1** shows a summary of the performance criteria and sub-criteria. The 4 main elements are further segregated into 15 performance criteria and 41 sub-criteria

Figure 3.1 Breakdown of Performance Criteria and Sub-criteria

3.1 Performance Criteria For Low Carbon Cities

No	Performance Criteria & Sub Criteria	Page No.
Performance Criteria 1: Site Selection		
UE 1-1	Development Within Defined Urban Footprint	33
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UE 1-3	Development within Transit Nodes and Corridors	35
UE 1-4	Brownfield and Greyfield Redevelopment	36
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UE 2-2	Compact Development	39
UE 2-3	Road and Parking	40
UE 2-4	Comprehensive Pedestrian Network	41
UE 2-5	Comprehensive Cycling Network	42
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Table 3.1: Performance Criteria and Sub-criteria for Urban Environment

3.1 Performance Criteria For Low Carbon Cities

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Table 3.2: Performance Criteria and Sub-criteria for Urban Transportation

3.1 Performance Criteria For Low Carbon Cities

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Table 3.3: Performance Criteria and Sub-criteria for Urban Infrastructure

No	Performance Criteria & Sub Criteria	Page No.
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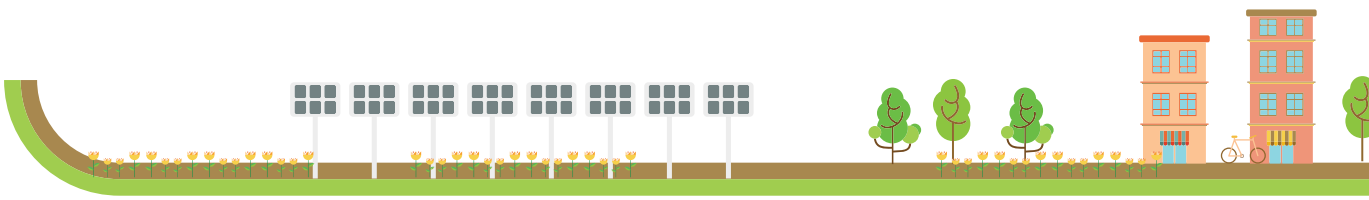
Table 3.4: Performance Criteria and Sub-criteria for Building



3.2 Urban Environment

Performance Criteria 1
SITE SELECTION

UE 1-1	Development within Defined Urban Footprint

Intent
To prioritise development within the defined urban footprint by designating the area inside the boundary for urban development.

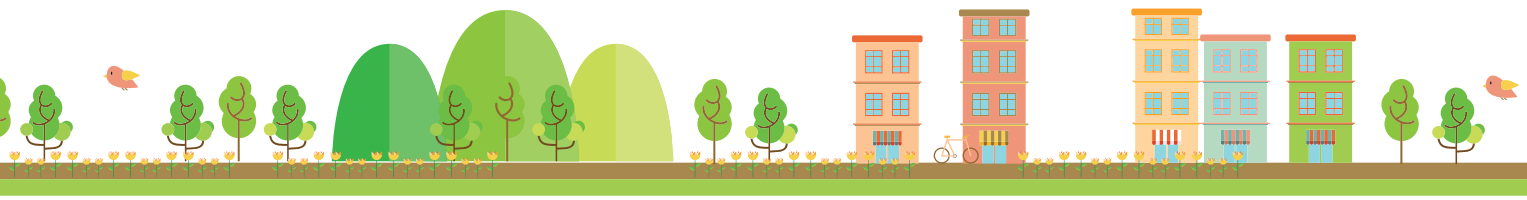
Description
Urban footprint refers to established urban areas which are generally being served by urban services in particular infrastructures and util ties. They include residential (including urban villages), commercial, industrial, open space, community facilities, transport, infrastructures, land already committed/approved for development and vacant land.

Urban footprint forms a set of geographical boundary for a city or township set in an attempt to manage urban growth and control urban sprawl. Prioitising development within the urban footprint compared to selecting a development site outside the urban footprint will reduce travel to the city centre where daily commuting is required. The further the travel, the higher it contributes to CO_2 emission. Developing within the urban footprint will also limit the clea ing of a forest reserve and large plantation areas, as this will reduce the release of CO_2 into the atmosphere.

Development is discouraged outside the defined u ban footprint boundary and it can be a direction for the authority to make decisions for zoning and land use planning.

Carbon Emission Reference
1. 1 km travel by car (petrol) emits 0.26 kg of CO_2. *(Source: LCCF Calculator)*
2. 1 hectare of tropical forest captures 4.3 tCO_2/year to 6.5 tCO_2. *(Source: LCCF Calculator)*
3. 1 acre of developed greenfield area emits 10,000 kg of CO_2 emission.
   (Source: redevelopmenteconomics.com)

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Land use planning policy in development plans to:-
   - Define urban footprint
   - Encourage infill developments
   - Minimise agricultural land conversion



3.2 Urban Environment

Performance Criteria 1
SITE SELECTION

UE 1-2	Infill Development

Intent
To encourage development within and near existing communities and public transit infrastructure.

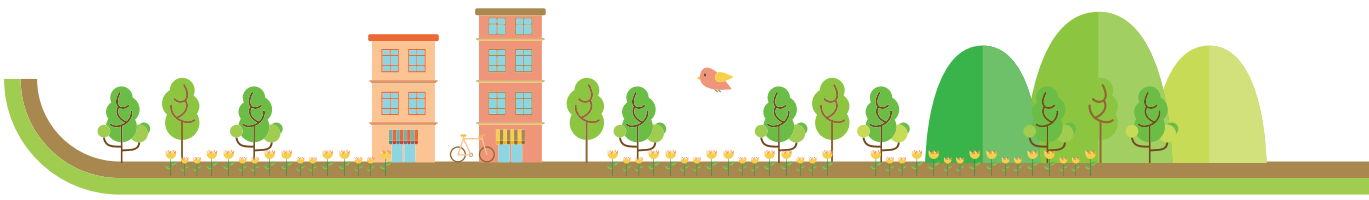
Description
According to the National Urbanisation Policy, infill development is defined as development or redevelopment being implemented on vacant land or a developed site located in an already developed area as well as areas currently being developed.

Selecting infill sites for development will directly reduce CO_2 emission from earthwork activities and infrastructure development. Infill developments are normally located within matured developments and this will reduce the need for major earthwork. I fill development has a significant economic benefit in reduction or elimination of new infrastructure, including new roads, utility services and other amenities. The redevelopment of urban areas helps restore, invigorate and sustain established urban living patterns, creating a more stable and interactive community.

Currently, many development plans in Malaysia have identified infill development as one of the key development strategies to overcome urban sprawl. This strategy has been gazetted as a development policy under development plans such as the National Physical Plan, 2025 Comprehensive Development Plan in Iskandar Malaysia, Pahang Structure Plan, 2006 Selangor Structure Plan, Penang Structure Plan and Johor Bahru Local Plan.

Carbon Emission Reference
1. 1 km travel by car (petrol) emits 0.26 kg of CO_2. *(Source: LCCF Calculator).*
2. 1 acre of development in infill and brownfield area emits 7,000 kg of CO_2 emission (savings of 3,000 kg of CO_2 compared to greenfield development). *(Source: Congressional Research Service, 2009)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Incorporate sustainable infill land use in planning and policy initiatives.
2. Locate the project on a site served by public transit infrastructure, existing water and wastewater infrastructure;
3. Identify infill sites and zoning plans.
4. Provide incentives for infill projects.



3.2 Urban Environment

Performance Criteria 1
SITE SELECTION

UE 1-3	Development within Transit Nodes and Corridors

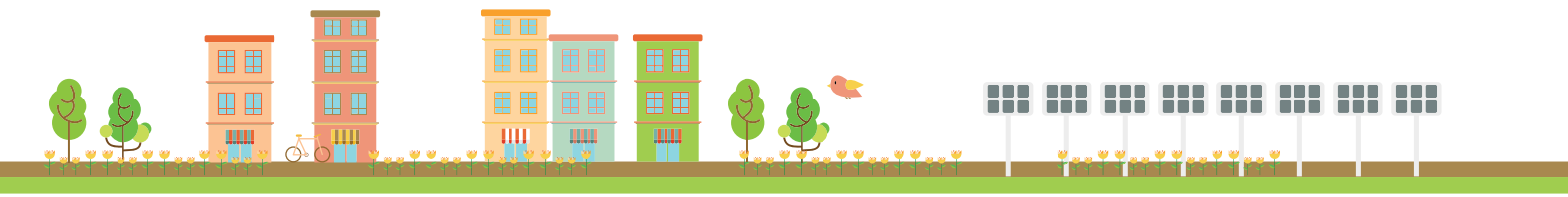
Intent
To reduce energy consumption and mobility of private vehicles by prioritising development within existing public transport corridor.

Description
Transit nodes and corridors generally refer to public transport servies such as rail transit station and bus rapid transit (BRT) station. They are located in a radius of 400 m to 800 m from public transit stops. These locations are designed to encourage public transport use, transit ridership, mixed-use development and pedestrian networks which will reduce the amount of parking spaces and private vehicle use. Development should be encouraged within transit nodes and corridors as this concept relies on the integration between land use and transport system. Thus, it will reduce the CO_2 emissions contributed by private vehicle use.

Development within transit nodes and corridors will revitalise neighbourhoods, increase social interaction, pedestrian and transit-oriented development (TOD). TOD is designed to maximise access to public transport and emphasise the smart growth development strategy which has currently been promoted in many development plans in Malaysia.

Carbon Emission Reference
1 km travel by car (petrol) emits 0.26 kg of CO_2. *(Source: LCCF Calculator)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Prioritise development within transit nodes and corridors in development plans.
2. Intensify development within transit nodes and corridors.
3. Locate a project within 400 m walking distance of bus rapid transit and/or streetcar stops, light or heavy rail stations, and/or other public transport, e.g. ferry terminals.
4. Provide locational incentives for development within transit nodes and corridors (e.g. parking charge reduction).



3.2 Urban Environment

Performance Criteria 1
SITE SELECTION

UE 1-4	Brownfield and Greyfield Redevelopment

Intent
To prioritise and encourage redevelopment of land in brownfield and greyfield areas.

Description
Brownfields are industrial and commercial properties suspected to be environmentally contaminated.

(Source: Camden County Improvement Authority)

Greyfields are properties in urban and older suburban communities that have been under-utilised or abandoned such as a closed shopping strip mall. These properties do not have environmental issues preventing reuse and expansion.

(Source: Camden County Improvement Authority)

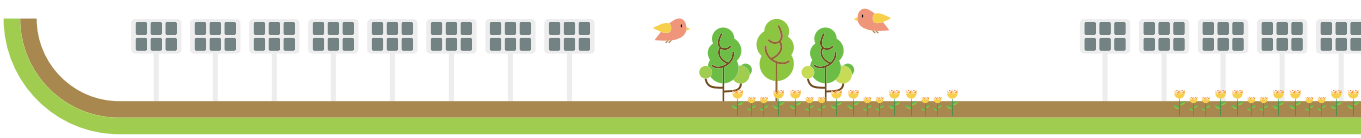
Brownfield and greyfield sites are mostly located within urban footprints. Therefore, prioritising redevelopment at these sites will reduce vehicle trips and discourage urban expansion, which lead to reduction in CO_2 emissions.

The idea of brownfield and greyfield was actually to optimise use of space within the cities. Since the issue of land availability has become a prime concern, brownfield and greyfield redevelopment helps to resolve the scarcity of land whilst improving the social and economic issues of the place.

Brownfield and greyfield redevelopment reduces pressure on undeveloped land. Using existing infrastructure and on-site materials as resources can help reduce project costs for new materials. The rehabilitation of a site with environmental contamination is an opportunity to improve the environmental quality and resources available to local communities.

Carbon Emission Reference
1. 1 km travel by car (petrol) emits 0.26 kg of CO_2. *(Source: LCCF Calculator)*
2. 1 acre of development in infill and brownfield area emits 7,000 kg of CO_2 emission (savings of 3,000 kg of CO_2 compared to greenfield development). *(Source: Congressional Research Service, 2009)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Incorporate sustainable brownfield or greyfield in planning and policy initiatives.
2. Locate a project on a site served by existing water and wastewater infrastructure.
3. Provide incentives for brownfield and greyfield developments.



3.2 Urban Environment

Performance Criteria 1
SITE SELECTION

UE 1-5	Hill Slope Development

Intent
To protect hill slopes to minimise erosion and reduce environmental impacts from hill slope development.

Description
Besides floods, Malaysia also faces soil erosion issues. High rainfall, steep slopes and soil structure are factors that contribute to soil erosion. Hence, it is important to maintain the greenery and vegetation as soil cover to control erosion as well as to maintain the natural landscape.

Hill slopes have minimal impact with respect to GHG emission reduction. However, long-term planning is needed to increase the resilience of resources, natural system and infrastructure against climate change. Protecting hill slopes also directly protects the natural environment and preserves greenfield.

Hill slope developments need to be managed in a sustainable manner and be strictly controlled to protect the environment and safety of city dwellers.

Carbon Emission Reference
1. 1 tropical tree forest absorbs 5.5 kg of CO_2/year. *(Source: LCCF Calculator)*
2. 1 hectare of tropical forest captures 4.3 tCO2/year to 6.5 tCO_2/year. *(Source: LCCF Calculator)*
3. 1 tree absorbs approximately 1,000 kg of CO_2. *(Source: www.conservationfund.org/gozero)*
4. 1 hectare of trees stores 2,600 kg of carbon/year (tree cover for urban areas is about 204 trees/acre, for forests it is about 480 trees/acre). *(Source: coloradotrees.org)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Establish slope protection plan.
2. Identify locations of high and moderate risk erosion.
3. Protect existing slopes over 15% for undeveloped sites as required by local authorities.
4. Restore slope areas with native plants or non-invasive adapted plants.
5. No construction on sites under Class IV category.

(Source: FDTCP 2010)

3.2 Urban Environment

Performance Criteria 2
URBAN FORM

UE 2-1	Mixed-Use Development

Intent
To encourage mixed-use development by promoting transport efficiency and walkability.

Description
Mixed-use development is a building or complex that includes a mixture of land uses. Typically, the term is used when residential uses are combined with office, commercial, entertainment, childcare or civic uses such as schools, libraries or government services.
(Source: Useful Community Development)

A mixed-use development discourages single land use zoning and development and encourages higher density development. Integration between mixed use of sites and the building uses will helps promote sustainability of the place. It will encourage people to walk to their daily activities. This reduces the need to travel by private vehicle or public transport as their daily needs can be easily accessed within the development.

Carbon Emission Reference
1. 1 km travel by car (petrol) emits 0.26 kg of CO_2. *(Source: LCCF Calculator)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Encourage intensity of land uses via mixed-use zone in development plans.
   - Increase housing options for diverse household types.
   - Encourage mixed-income communities.
2. Integrate isolated land use.

3.2 Urban Environment

Performance Criteria 2
URBAN FORM

UE 2-2	Compact Development

Intent
To encourage high-density developments with mixed activities by promoting transport efficiency and walkability.

Description
Compact development related to high residential density with mixed land uses as well as development intensity. Development intensity refers to density control for residential development and plot ratio control for developments such as commercial, mixed-use and industrial developments.

Encouraging higher intensity development within centres will promote mixed-use development and an efficient public transport system. The site layout or development, which considers compact development concept, will provide more space for green areas. Compact developments have a shorter distance between parts of the city. This reduces the need to travel, which directly reduces the emission of CO_2.

Carbon Emission Reference
1. 1 km travel by car (petrol) emits 0.26 kg of CO_2. *(Source: LCCF Calculator)*
2. For earthwork activities:
   - 1 km trip generates 0.85 kg of CO_2 via air pollution.
   - 1 km trip generates 10.03 kg of CO_2 via diesel use.

   (Source: Guidelines to Defra, 2009)

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Plot ratio control by limiting the floor area requirements for development types such as:-
   - Commercial;
   - Industrial; and
   - Mixed-use.

3.2 Urban Environment

Performance Criteria 2
URBAN FORM

UE 2-3	Road and Parking

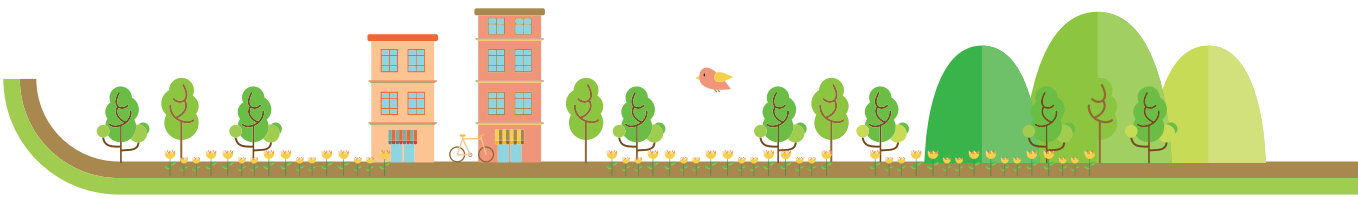
Intent
To reduce environment effects through road and parking surfaces.

Description
Roadways and parking are the main requirements in a city; as facilities for the people and also for ease of movement. A road network connects people from one place to another while parking enables people to leave their vehicles. However, both of these elements contribute to emissions through the heat generated from the surfaces.

It is recommended that less than 20% of the total development area be provided with road and parking surfaces. Clearance of site for the purpose of development will release CO_2 into the atmosphere. In addition to that, CO_2 will be released from the embodied energy of materials used for road and parking surfaces.

Carbon Emission Reference
1. 1 hectare with 0.1 m thickness of asphalt emits 70,150 kg of CO_2/year.
2. 1 hectare with 0.1 m thickness of concrete pavement emits 15,800 kg of CO_2/year.
   (Source: LCCF Calculator)

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Review road designs and parking requirements (e.g.: not more than 20% of the total development footprint area with no individual surface parking lot larger than 2 acres).
2. Reduce the demand for new roads and parking lots.
3. For new non-residential buildings and multi-unit residential buildings, either:-
   - Do not build new off-street parking lots; or
   - Locate all new off-street surface parking lots at the side or rear of buildings, leaving building frontages facing streets free of surface parking lots.



3.2 Urban Environment

Performance Criteria 2
URBAN FORM

UE 2-4	Comprehensive Pedestrian Network

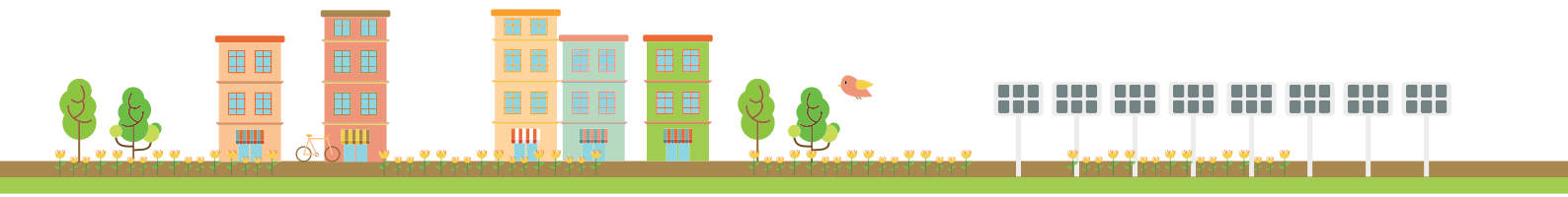
Intent
To reduce car dependency by establishing a comprehensive pedestrian network within the development area.

Description
Walking is well known as a non-motorised mode of transport. It emits zero CO_2 emission, thus gives no harm to the environment. In urban areas, the most efficient alternative for short distance movement or trip is via walking and cycling.

It is important to integrate pedestrian walkways with other activity nodes and public transport. Activity nodes such as schools, colleges and universities, offices, commercial areas and parks should be planned within walking distance (i.e. 400 m radius), and designed with the aim of facilitating walking.

Carbon Emission Reference
1. Walking and cycling emit zero CO_2 emission. *(Source: www.smartertavelsutton.org)*
2. CO_2 released into the atmosphere for clearing of sites to prepare for the pedestrian network.
3. CO_2 released from embodied energy of materials used for the construction of the pedestrian network.

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Identify and demarcate areas where no private vehicular access is allowed.
2. Provide dedicated and continuous pedestrian walkways in current and future developments.
3. Provide sufficient pathways for pedestrians with covered/shaded walkways.
4. Ensure safe and comfortable pedestrian walkways in all developments.
5. Incorporate the universal urban design along public sidewalks and internal pedestrian walkways, particularly those that lead to and from transit stops or stations.



3.2 Urban Environment

Performance Criteria 2
URBAN FORM

UE 2-5	Comprehensive Cycling Network

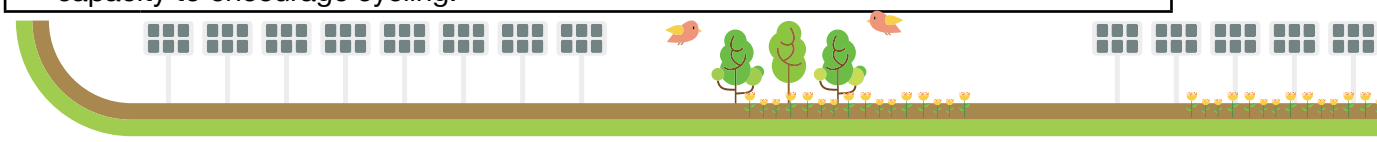
Intent
To reduce car dependency by establishing a comprehensive cycling network within development area.

Description
Apart from using public transport modes such as bus and train, there is a necessity to develop cycling as another choice in supporting sustainable transport. It is well known that one of the main factors that contribute to climate change and greenhouse gas emissions is the dependency on private vehicles. Thus, cycling can help tackle this issue.

There is a need to make a change in people's behaviour by encouraging cycling to get to places in a short distance away. Instead of using cars or motorcycles, people should use bicycles which emit zero CO_2. A comprehensive cycling network should be established within a development or city. The routes should be easily accessible and well connected.

Carbon Emission Reference
1. Walking and cycling emit zero CO_2. *(Source: www.smartertavelsutton.org)*
2. CO_2 released into the atmosphere for clearing of sites to prepare for the cycling network.
3. CO_2 released from embodied energy of materials used for the construction of cycling network.

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Identify and demarcate areas where no private vehicular access is allowed.
2. Provide dedicated and continuous lane for cycling in current and future developments.
3. Provide sufficient pathways for cycling with covered/shaded walkways.
4. Design and/or locate the cycling network to meet at least one of the three requirements below:-
   a) An existing cycling network of at least 5 continuous miles in length within a 300 m cycling distance of the project boundary.
   b) If the project is 100% residential, an existing cycling network begins within 300 m cycling distance of the project boundary and connects to a school or employment centre within a 3-km cycling distance; and
   c) An existing cycling network within a 1/4-mile cycling distance of the project boundary connects to several diverse uses within 3 miles of cycling distance from the project boundary.
5. Provide bicycle repair services within the network and bicycle parking and storage capacity to encourage cycling.



3.2 Urban Environment

Performance Criteria 2
URBAN FORM

UE 2-6	Urban Heat Island (UHI) Effect

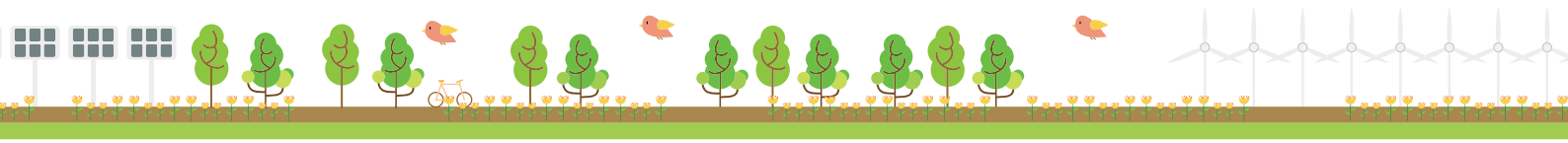
Intent
To reduce urban heat island effect in the cities or townships.

Description
UHI refers to a phenomenon where the cities and townships are significantly warmer than their surrounding areas. The temperature is slightly different between cities and their surroundings, due to major causes which are the lack of vegetation and the presence of dark surfaces (building materials). As urban heat islands lead to increased temperatures within cities and townships, they worsen the air quality.

The effects from the UHI can be seen through energy use, environmental pollution and general health of the city dwellers. Cities that experience the UHI phenomenon tend to increase their energy consumption through use of air conditioning. When the temperature becomes warmer due to the heat absorbed by the building surfaces and materials, the occupants of a building will increase use of air conditioners.

The UHI can be reduced by providing more shade trees at streets and vegetation on roof tops as well as external façades of buildings. As a general rule, 10% increase in vegetation cover reduces the temperature about three degrees, hence providing a cooling effect to the surrounding environment.

Carbon Emission Reference
1. A tropical forest absorbs 5.5 kg of CO_2/year. *(Source: LCCF Calculator)*
2. A hectare of tropical forest captures 4.3 tCO_2/year to 6.5 tCO_2/year. *(Source: LCCF Calculator)*
3. 1 tree absorbs approximately 1,000 kg of CO_2. *(Source: www.conservationfund.org/gozero)*
4. 1 acre of trees stores 2,600 kg of carbon/year (where tree cover for urban area is about 204 trees/acre, for forest it is about 480 trees/acre). *(Source: coloradotrees.org)*

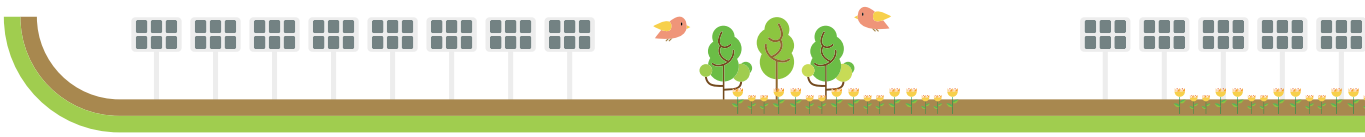


3.2 Urban Environment

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:-

1. Incorporate urban form guidelines to achieve natural climate conditions in development plans.
2. Encourage mixture of high-rise and low-rise buildings and innovative building orientation for sunlight and wind.
3. Encourage innovative building designs incorporating features such as roof gardens and vertical gardens.
4. Increase percentage of tree coverage from the total land areas.
5. Provide more parks and gardens in development plans.
6. Plant more trees near office blocks, along streets and within residential areas.
7. Use grid block at parking area to reduce the heat island effect and surface runoff.
8. Use water-retentive pavement or other pavement materials that help to reduce heat.
9. Use grid block at parking areas to reduce the heat island effect and surface runoff.
10. Use solar reflective coatings or light colour for building surfaces to reflect heat.
11. Use paving materials of solar reflective index (SRI) 29 or higher; and
12. Provide open grid areas (parking, roads and sidewalks) with paving material of SRI 29.



3.2 Urban Environment

Performance Criteria 3
URBAN GREENERY AND ENVIRONMENT QUALITY

UE 3-1 | Preserve Natural Ecology, Water Body and Biodiversity

Intent
To provide natural restoration of carbon by improving urban biodiversity through preservation and conservation of natural environment and water bodies or wetlands.

Description
Biodiversity is defined as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part of including diversity within species, between species and of ecosystems.

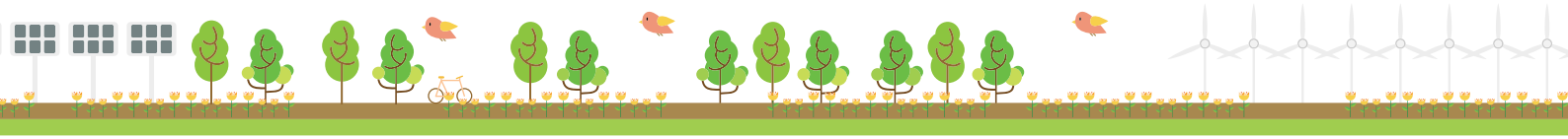
(Source: National Physical Plan-2)

Meanwhile, natural ecology also includes wetlands which provide many benefits to society. They are among the most productive and biodiverse ecosystems in the world — comparable to rain forests and coral reefs. They help improve water quality, including that of drinking water, by intercepting surface runoff and removing or retaining inorganic nutrients, processing organic wastes and reducing suspended sediments before they reach open water.

Natural ecology and water body provide natural restoration of CO_2. Hence, disturbing the ecology and water bodies for development purposes will release CO_2 into the atmosphere. Meanwhile, a large body of water such as a lake or wetland can absorb CO_2 already present in the air and function as a carbon sink.

Carbon Emission Reference
1. A tropical forest absorbs 5.5 kg of CO_2/year. *(Source: LCCF Calculator)*
2. 1 hectare of tropical forest absorbs 4.3 tCO_2/year to 6.5 tCO_2/year. *(Source: LCCF Calculator)*
3. 1 hectare of tropical wetlands absorbs 1.48 tCO_2/year. *(Source: LCCF Calculator)*
4. 1 tree absorbs approximately 1,000 kg of CO_2. *(Source: www.conservationfund.org/gozero)*
5. 1 acre of trees stores 2,600 kg of carbon/year (where tree cover for urban area is about 204 trees/acre, for forest it is about 480 trees/acre). *(Source: coloradotrees.org)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:
1. Incorporate green and blue corridors in development plans.
2. Identify possible sites for environmental sensitive protection.
3. Preserve forests, wetlands and water bodies.
4. Enhance urban biodiversity through the enhancement of existing habitats and creation of new habitats.



3.2 Urban Environment

Performance Criteria 3
URBAN GREENERY AND ENVIRONMENT QUALITY

UE 3-2 | Green Open Space

Intent

To increase percentage of green open space within cities or townships.

Description

Open space is specifically for public use or benefit. In general, it refers to land or space allocated as an area for relaxation/ picnic and recreation. It includes gardens, children's playground, playfield, sports ground, floral garden as well as landscaped and planned area.

(Source: National Urbanisation Policy)

Green open space is important as it helps to reduce the GHG and beautify the landscape of a city and is simultaneously vital for the people. This shows that green open space is important not only to help reduce the GHG, but also as a recreational area for the city dwellers to relax and play. Plants can absorb CO_2 during photosynthesis which leads to carbon sequestration.

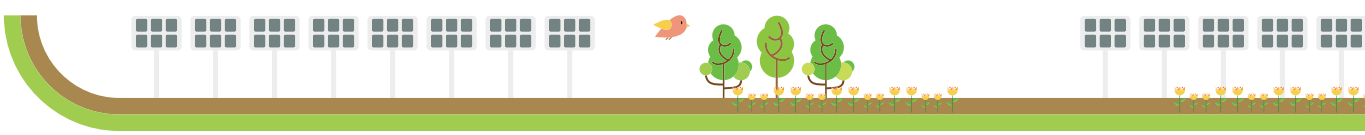
Carbon Emission Reference

1. A tropical forest absorbs 5.5 kg of CO_2/year. *(Source: LCCF Calculator)*
2. A hectare of tropical forest absorbs 4.3 tCO_2/year to 6.5 tCO_2/year. *(Source: LCCF Calculator)*
3. 1 tree absorbs approximately 1,000 kg of CO_2. *(Source: www.conservationfund.org/gozero)*
4. 1 acre of trees stores 2,600 kg of carbon/year (where tree cover for urban area is about 204 trees/acre, for forest it is about 480 trees/acre). *(Source: coloradotrees.org)*

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:-

1. Gazette green open space.
2. Preserve more forest and green spaces.
3. Increase percentage of tree coverage from the total land area.
4. Incorporate requirements for specific green areas near office blocks, along streets and within residential areas through tree planting.
5. Plant fast growing, decorative and low-maintenance types of vegetation.



3.2 Urban Environment

Performance Criteria 3
URBAN GREENERY AND ENVIRONMENT QUALITY

UE 3-3	Number of Trees

Intent
To increase percentage of tree coverage within cities or townships.

Description
Trees are the most beneficial element that helps the environment. As trees mature, they will save greater amounts of carbon. For instance, a ten-year-old tree will sequester more carbon than a five-year-old tree, but not as much carbon as a twenty-year-old tree. In short, increase in the number of trees results in an increase in carbon sequestration.

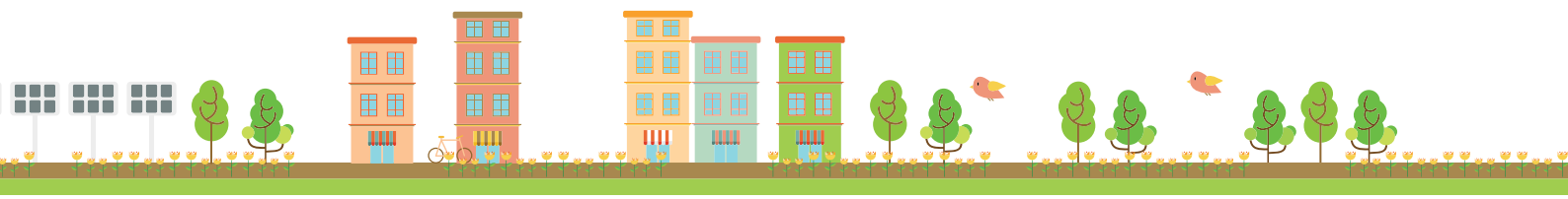
(Source: www.upsonemc-carbonoffset.com/CO_2treestore)

With this, the CO_2 emission in a city can be reduced through a natural process. Trees can absorb CO_2 during photosynthesis, which helps in cooling the environment, removing air pollutants, lowering GHG emissions and simultaneously reducing the urban heat island effect. In summary, trees are the most useful and effective tool if they are planted in strategic locations within the city.

Meanwhile, the increase in percentage of tree and vegetation coverage also indirectly improves the air quality.

Carbon Emission Reference
1. The upper (green) vegetation of a tropical forest absorbs 5.5 kg of CO_2/year. *(Source: LCCF Calculator)*
2. A tree absorbs approximately 1,000 kg of CO_2. *(Source: www.conservationfund.org/gozero)*
3. 1 acre of trees stores 2,600 kg of carbon/year (where tree cover for urban area is about 204 trees/acre, for forest it is about 480 trees/acre). *(Source: coloradotrees.org)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:-
1. Incorporate a tree planting programme and campaign.
2. Increase percentage of tree coverage of the total land area.
3. Increase the number of trees near office blocks, along streets and within residential areas.
4. Encourage planting of fast growing, decorative and low-maintenance types of vegetation.
5. Organise a landscaping competition among schools to promote the “go green” culture among the younger generation (students).



3.3 Urban Transportation

Performance Criteria 4
REDUCTION IN USE OF MOTORISED TRANSPORT ON URBAN ROAD NETWORK

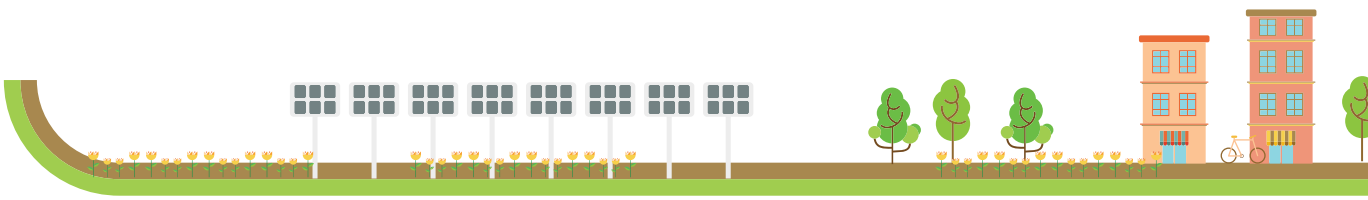
UT 1-1	Classified Traffic Volume on Urban network

Intent
To reduce the number of private vehicle traffic volume on the urban road network, thus contributing to overall lower motorised traffic and lower overall carbon footprint.

Description
The use of private vehicles on urban roads is very common in this country especially when the road infrastructure is well developed and the ownership and use of the private car is not difficult. The local car industry and the continuous support from the loan agencies allow the public to easily own and use private cars for their daily travel. The ownership of private vehicles itself is not really causing any negative impacts to the urban road environment, however, the use of these private vehicles for work trips and other urban travel would be an issue in terms of fuel consumption and carbon emission (assuming the vast majority are still using the conventional internal combustion engine).

The use of private vehicles can further aggravate the situation when most of the private vehicles are single occupancy vehicles (SOV) which refers to a private operated vehicle where the only occupant is the driver. Such vehicles would most probably be used for personal travel, daily commuting, and running daily errands. The increasing use of private vehicles especially in urban areas contributes greatly to carbon emission into the atmosphere, thus leading to global environmental problems such as global warming. Consequently, there is a need to lessen the number of private vehicles on the urban road network in order to reduce the carbon emitted into the atmosphere from transport. This can be achieved by measures that would discourage the use of private vehicles for daily trips (especially commuting trips) and instead shift them towards the use of public transport. An alternative to the car should be provided, for instance ensuring the availability of an efficient public transport system in selected areas. This can achieve the targets of reducing private car dependency while at the same time able contributing to CO_2 reduction.

The classified traffic volume on the road network can be determined by the city hall or municipal authority as and when required. However, a yearly monitoring of this data would be preferred so that this performance criteria would assist the authority in the evaluation of strategies implemented for the purpose of carbon reduction from road transport.



3.3 Urban Transportation

Carbon Emission Reference

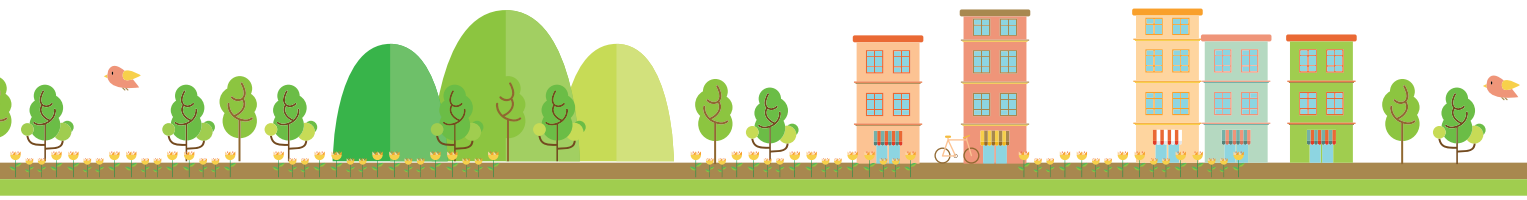
1. Average 64.4 km/car/day = 17.6 kg of CO_2 emission.
2. Average 64.4 km/bus/day = 1.6 kg of CO_2 emission.

(Source: ACTR- Public Transit vs. Single Occupant Vehicles Carbon Emissions to Climate Change)

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:-

1. Determine the public transport policy in development plans.
2. Review car park requirements and increase car park charges in CBD or selected areas.
3. Ensure service provided is sufficient (i.e.: increase the bus rapid transit service frequency).
4. Implement TOD with transit station or as the centre of development based on transit supportive, connectivity, multimodal and feeder systems.
5. Enhance walking and cycling facilities as access modes to/from transit stations.
6. Implement road area pricing and congestion charges in selective areas (i.e.: CBD).
7. Increase 'park & ride' areas outside city boundary.



3.3 Urban Transportation

Performance Criteria 4
REDUCTION IN USE OF MOTORISED TRANSPORT ON URBAN ROAD NETWORK

UT 1-2	Vehicle-km of Travel by Modes

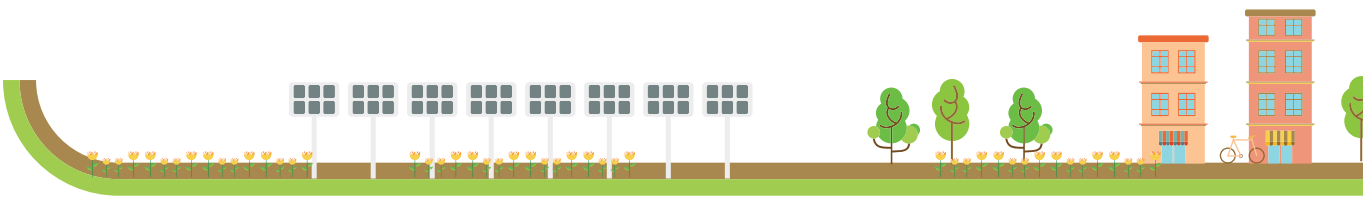
Intent
To achieve a reduction in the total vehicle-km of travel within the urban road network so that the total carbon emission from road transport can be reduced.

Description
The amount of vehicle-km of travel by motorised vehicles will reflect on the carbon emission to the road environment especially for the normal gasoline and diesel vehicles, whether private vehicles or public buses and taxis. The reduction in total vehicle-km of travel within an urban area would be a good indicator on the reduction of carbon emission from transport.

A reduction in the total vehicle-km of travel can be achieved when private car users switch to public transport for their daily travel, particularly for commuting work trips. Carpooling or vanpooling can also result in reduction in vehicle-km of travel. The use of bicycles and walking for very short trips within a residential area or sub-urban community instead of using the private car will also result in reduction of total vehicle-km of travel.

Hence, any measures and policies to reduce the total vehicle-km of travel would be effective in reducing carbon emission. Thus, vehicle-km of travel is an important performance criteria for low carbon cities and communities.

Carbon Emission Reference
1. Average 64.4 km/car/day = 17.6 kg of CO_2 emission.
2. Average 64.4 km/bus/day = 1.6 kg of CO_2 emission.
   (Source: ACTR- Public Transit vs. Single Occupant Vehicles Carbon Emissions to Climate Change)
3. Walking and cycling release 0 kg of CO_2. *(Source: www.smartertavelsutton.org)*
4. 1 km round trip walking and cycling saves 6 kg/day of CO_2 (carbon savings per day compared to the use of car). *(Source: www.smartertavelsutton.org)*

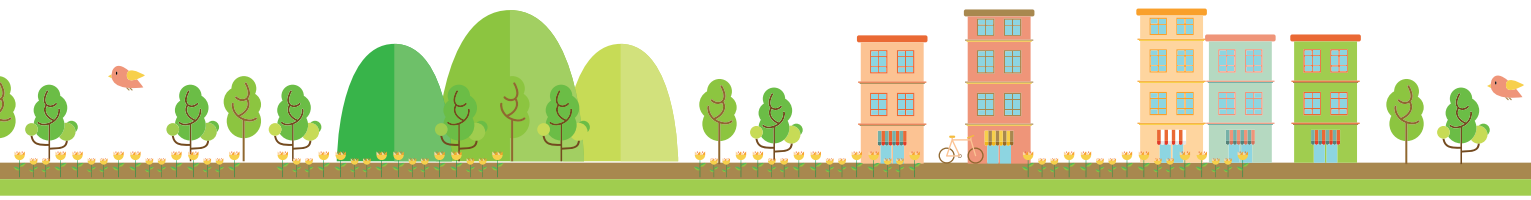


3.3 Urban Transportation

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Determine the public transport policy in development plans.
2. Review car park requirements and increase car park charges in CBD or selected areas.
3. Ensure service provided is sufficient (e.g. increase the bus rapid transit service frequency).
4. Implement TOD with transit station or as the centre of development based on transit supportive, connectivity, multimodal, and feeder systems.
5. Enhance walking and cycling facilities as access modes to/from transit stations.
6. Implement road area pricing and congestion charges in selective areas (i.e.: CBD).
7. Increase 'park & ride' areas outside city boundary.
8. Increase coverage of areas within transit stations and rail corridors.
9. Provide well-planned, covered and safe (especially at night) walkways or bicycle ways leading up to feeder transport.
10. Provide ample and secure bicycle parking in order to ensure ease of use of all public transport facilities.
11. Provide suitable vehicles with low carbon emissions as feeder transport for passengers travelling to public transport stations or hubs.



3.3 Urban Transportation

Performance Criteria 5
INCREASE IN PUBLIC TRANSPORT USE

UT 2-1 Public Transport Ridership

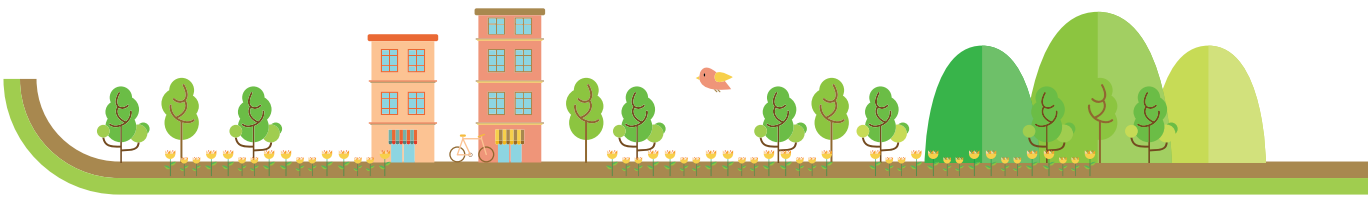
Intent
To increase public transport ridership by having more private vehicle users to shift from taking their private vehicles to taking public transport for their trips, thus reducing the overall carbon footprint.

Description
Public transport is an efficient mode of travel where it can accommodate a large number of passengers at one time and offer a wide coverage of destinations. For instance, public transport is a primary mode of transport in cities like Singapore, Hong Kong, Australia, and Curitiba. In Curitiba, for example, 40% of the population uses public transport as the commuting mode while in Hong Kong, more than 90% of the population uses public transport and that excludes walking. This shows that public transport can be the preferred choice if the system works efficiently.

(Source: Public Transport: Lessons To Be Learnt From Curitiba and Bogota)

Furthermore, this commuting mode can contribute to reducing each passenger's per capita carbon footprint. Encouraging or shifting the daily mode of travel to a clean fuel powered mass public transport system instead of private vehicle travel will able to reduce CO_2 on each kilometre travelled. This approach of shifting from private vehicle to low emission public transport as a mean of daily travel should be adopted as a continuing effort, which leads to reduction in CO_2 emission.

Carbon Emission Reference
1. Average 64.4 km/car/day = 17.6 kg of CO_2 emission.
2. Average 64.4 km/bus/day = 1.6 kg of CO_2 emission.
   (Source: ACTR- Public Transit vs. Single Occupant Vehicles Carbon Emissions to Climate Change)
3. Walking and cycling release 0 kg of CO_2. *(Source: www.smartertavelsutton.org)*
4. 1km round trip walking and cycling saves 6 kg/day of CO_2 (carbon savings per day compared to the use of car). *(Source: www.smartertavelsutton.org)*

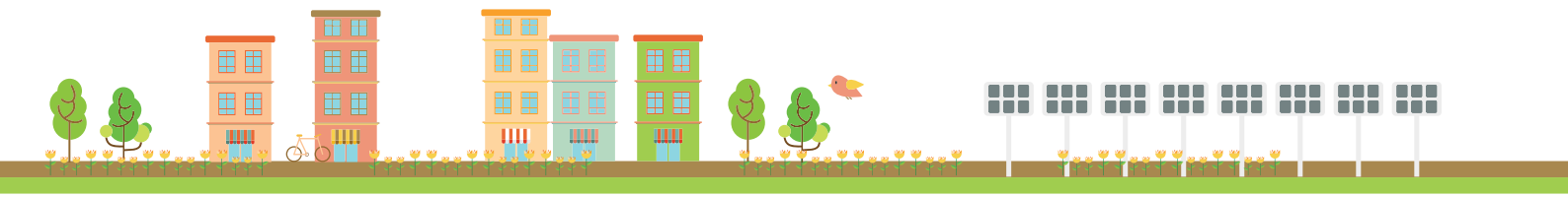


3.3 Urban Transportation

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:-

1. Improve accessibility to/from public transport stations and stops.
2. Provide good feeder systems to/from public transport stations and stops.
3. Improve walking and cycling facilities near and around public transport stations.
4. Provide dedicated lanes for cycling and walking in transit-oriented zones.
5. Provide sufficient pathways for pedestrian with covered/shaded walkways.
6. Create pedestrian and cycling “shortcuts” that lead directly to transit. Pathways require minimum 6-metre right-of-way. Look for opportunities to link “shortcuts” to the larger green space, pedestrian, and cycling networks.
7. Leading up to feeder transport.
8. Provide ample and secure bicycle parking in order to ensure ease of use of all public transport facilities.
9. Provide suitable vehicles with low carbon emissions as feeder transport for passengers travelling to public transport stations or hubs.



3.3 Urban Transportation

Performance Criteria 5
INCREASE IN PUBLIC TRANSPORT USE

UT 2-2	Public Transport System Improvement and Coverage

Intent

To improve the public transport system and coverage area to entice the travelling public to make public transport as a mode of choice for daily travel, hence reducing the dependence on private transport.

Description

Public transport must be made available to the general public. It also has to be accessible and affordable. These three factors, namely, availability, accessibility and affordability are the basic ingredients that would make public transport more attractive to the general public as a mode of choice. When public transport becomes the mode of choice as compared to the private car, the trips made by private vehicles will reduce and shifted to trips made by public transport. Hence, leading to lowering the traffic volume on the roads and subsequently reduction of carbon emission from road transport.

More public transport network coverage has to be planned, designed, and implemented to make it available to wider section of the population and the travelling public. Accessibility to public transport nodes (stops, terminals, stations) needs to be enhanced such as having efficient and reliable feeder systems and related facilities. When the cost of taking public transport is affordable, the public will be attracted to utilize it. Readily available and accessible public transport information is also important.

To ensure good access to public transport service, it should be provided within a reasonable walking distance of one's origin and destination. One important aspect that determines one's choice of transport is the existence or absence of transit services within or near to one's origin and destination. Higher capacity transit systems, use of bus-ways and an integrated transport information system are a few examples that could also be implemented to improve the system, while at the same time reduce the carbon emission into the atmosphere.

Walking and cycling, also known as non-motorised modes of transport can be integrated into the public transport system as feeder modes to the transit systems. In urban areas, for instance, the most efficient alternative for short distance trip is via walking and cycling.

As a whole, an improved public transport system and coverage as well as its feeder services improvement will increase the use of public transport and reduce private vehicles on the roads, hence, reduce the overall carbon emission from transport.

3.3 Urban Transportation

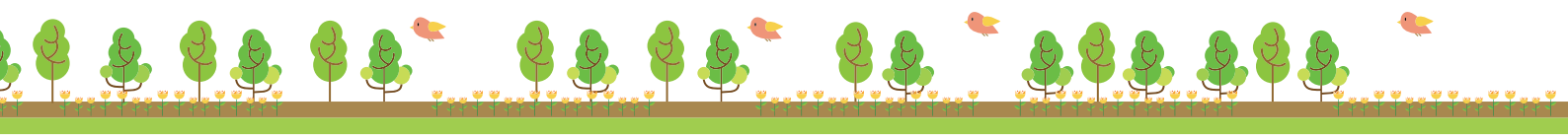
Carbon Emission Reference

1. Average 64.4 km/car/day = 17.6 kg of CO_2 emission.
2. Average 64.4 km/bus/day = 1.6 kg of CO_2 emission.
   (Source: ACTR- Public Transit vs. Single Occupant Vehicles Carbon Emissions to Climate Change)
3. Walking and cycling release 0 kg of CO_2. *(Source: www.smartertavelsutton.org)*
4. 1 km round trip walking and cycling saves 6 kg/day of CO_2 (carbon savings per day compared to the use of car). *(Source: www.smartertavelsutton.org)*

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Improve public transport system and service characteristics.
2. Improve accessibility to/from public transport stations and stops.
3. Provide good feeder systems to/from public transport stations and stops.
4. Improve walking and cycling facilities near and around public transport stations.
5. Provide dedicated lanes for cycling and walking in transit-oriented zones.
6. Provide sufficient pathways for pedestrian with covered/shaded walkways.
7. Create pedestrian and cycling “shortcuts” that lead directly to transit. Pathways require a minimum 6-metre right-of-way. Look for opportunities to link “shortcuts” to the larger green space, pedestrian,and cycling networks.



3.3 Urban Transportation

Performance Criteria 6
MODE SHIFT FROM PRIVATE TO PUBLIC TRANSPORT AND NON-MOTORISED TRANSPORT

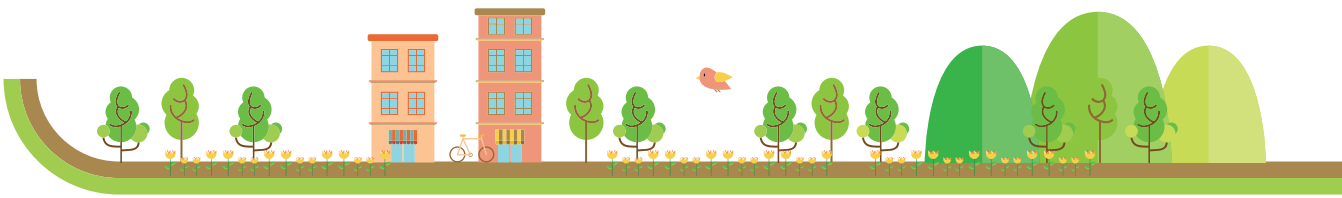
UT 3-1	Modal Share of Private, Public, and Non-Motorised Transport

Intent
To increase the mode share of public transport and non-motorised transport and reduce that of private transport in order to reduce carbon emission.

Description
One indicator to understand whether there is mode shift from private to public and non-motorised transports is to monitor the increase of mode share of the public and non-motorised transports against that of the private transport. The implication of an increased mode share of the public and non motorised transports is the overall reduction in numbers of motorised vehicles on the road, thus reducing carbon emission.

By monitoring the changes to the mode share of these three components of the traffic stream, the shift between the transport modes may be reduced to some extent. If the trend shows that the mode share of the public transport has been increasing, it means that there could be a shift from private to public, assuming the share of non-motorised transport remains fairly the same. If the share of non-motorised transport also increases together with public transport (thus reducing the share of private), it means that the shift from private to public and non-motorised transports is even more significant, and this indicator is important in terms of reduction of carbon emission from transport.

Carbon Emission Reference
1. Average 64.4 km/car/day = 17.6 kg of CO_2 emission.
2. Average 64.4 km/bus/day = 1.6 kg of CO_2 emission.
   (Source: ACTR- Public Transit vs. Single Occupant Vehicles Carbon Emissions to Climate Change)
3. Walking and cycling release 0 kg of CO_2. *(Source: www.smartertavelsutton.org)*
4. 1 km round trip walking and cycling saves 6 kg/day of CO_2 (carbon savings per day compared to the use of car). *(Source: www.smartertavelsutton.org)*

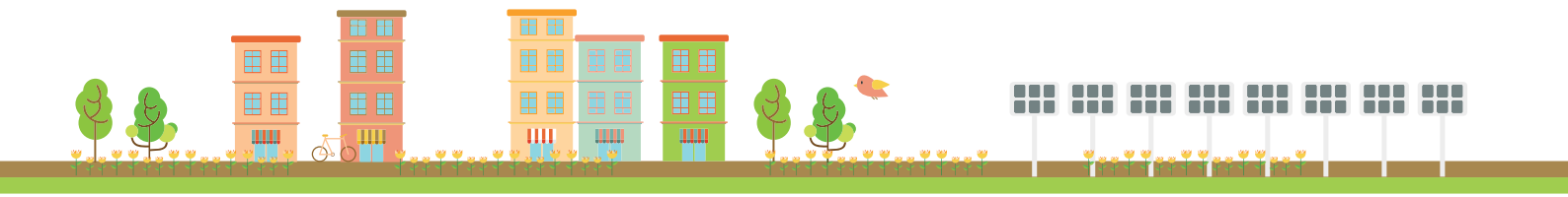


3.3 Urban Transportation

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Improve public transport system and service characteristics.
2. Improve accessibility to/from public transport stations and stops.
3. Provide good feeder systems to/from public transport stations and stops.
4. Improve walking and cycling facilities near and around public transport stations.
5. Provide dedicated lanes for cycling and walking in transit-oriented zones.
6. Provide sufficient pathways for pedestrian with covered/shaded walkways.
7. Create pedestrian and cycling "shortcuts" that lead directly to transit. Pathways require a minimum 6-metre right-of-way. Look for opportunities to link "shortcuts" to the larger green space, pedestrian and cycling networks.



3.3 Urban Transportation

Performance Criteria 7
USE OF LOW CARBON TRANSPORT MODES

UT 4-1	Use of More Fuel-Efficient Vehicles for Passenger Vehicles and Green Freight Transport

Intent
To encourage the use of more fuel-efficient vehicles for road transport to reduce carbon emission from transport.

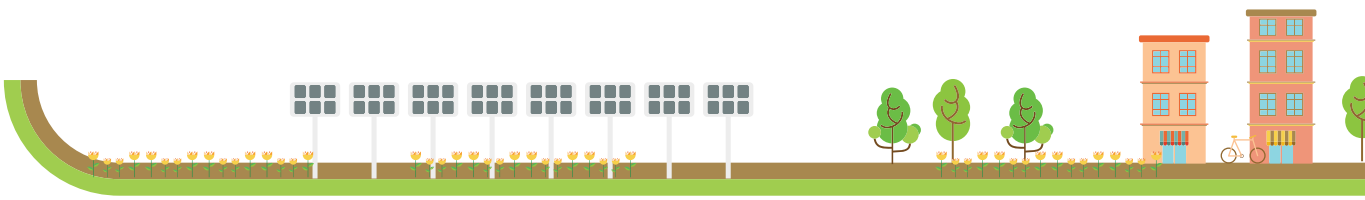
Description
A conventional vehicle is one of the major contributors of CO_2 emission through fuel combustion during vehicle operation. For instance, the average conventional vehicle emits 6000 to 9000 kg of CO_2 which leads to global warming potential. One of the effective ways to reduce CO_2 emission from the conventional vehicle is to switch to a lower carbon type of vehicle (i.e. a hybrid vehicle).

An example of a low carbon vehicle emitting less CO_2 is a hybrid vehicle merging the features of a conventional engine and electric vehicle. The combination allows the electric motor and batteries to operate the combustion engine more efficiently, thus cutting down on fuel use. As a result, this type of vehicle will produce less combustion, thus significantly reducing the CO_2 emission. Nonetheless, there are several barriers to using this type of vehicle such as the expensive battery technology, limited driving range, and the need for a dense network of charging facilities. According to the European Environment Agency, such a battery costs EUR 15,000 to EUR 40,000, which is RM 65,000 to RM 173,000. In order to cater for the cost and encourage wider green vehicle use, some cities and countries provide the users incentives like tax rebates, subsidies, free parking in urban areas and exemption from congestion charges and road taxes.

(Source: www.eea.europa.eu/articles/the-electric-car-2014-a-green-transport revolution-in-the-making)

Even though the low carbon vehicle such as the hybrid car in the current market is normally more expensive than the conventional vehicle, it pays off in the long term for the environment and also the user. Furthermore, more users switching from conventional vehicles to low carbon vehicles will contribute to money savings and significantly help reduce CO_2 emission, hence helping to prevent global warming. Another benefit of using low carbon vehicles is that the vehicles consume less fuel, resulting in the use of fewer natural resources.

(Source: ktn.innovateuk.org/)



3.3 Urban Transportation

Besides using electricity as an alternative, another way to achieve clean engine motor vehicles is via biofuel or biodiesel. These sources emit less CO_2 compared to conventional petroleum-based gasoline and diesel fuels. Clean fuel on-road and non-road public transport modes can significantly reduce CO_2 emission into the atmosphere for each kilometre travelled. Transport modes powered by clean fuel offer the advantages of cleaner operation than conventionally powered transport modes. This is due to the absence of polluting by-products produced by internal combustion engines.

(Source: www.epa.gov/greenvehicles/Wcyd.do)

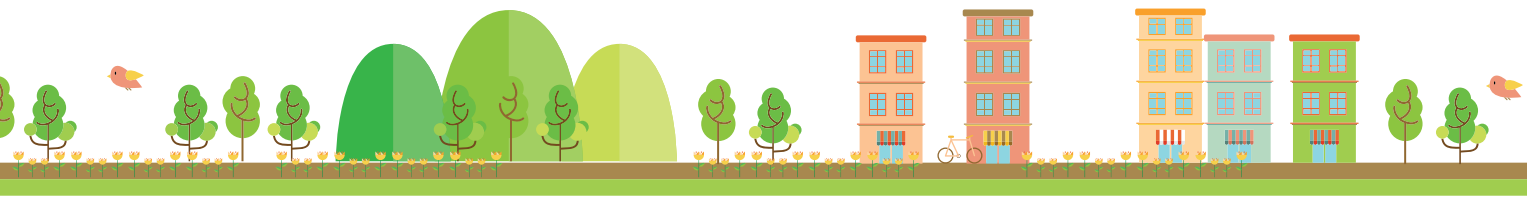
Carbon Emission Reference

1. 1 km travel by car (petrol) emits 0.26 kg of CO_2.
2. A car using petrol generates 0.162 kg of CO_2/km.
3. A car using diesel generates 0.169 kg of CO_2/km.
4. A car using NGV generates 0.130 kg of CO_2/km.
5. An electric car generates 0.135 kg of CO_2/km. *(Source: en.wikipedia.org/wiki)*
6. NGV emits 0.2 kg of CO_2/km. *(Source: ACTR- Public Transit vs. Single Occupant Vehicle Carbon Emissions to Climate Change)*

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Convert existing government vehicles from conventional to low carbon vehicles (hybrid cars).
2. Encourage combination of diesel and electric motor or biodiesel engine.
3. Impose condition for charging point facilities for hybrid vehicles on all applications for petrol stations.
4. Provide facilities such as public charging infrastructure in parking and neighbourhood areas.
5. Provide locational incentives, e.g. parking charge reduction.
6. Implement and monitor public awareness campaigns.
7. Formulate a green vehicle policy.
8. Provide riders with a simple carbon calculator to determine how much carbon is abated due to the use of an alternative clean fuel driven public transport system.
9. Organise more green awareness campaigns on clean fuel use.



3.3 Urban Transportation

Performance Criteria 7
USE OF LOW CARBON TRANSPORT MODES

UT 4-2	Number of Charging Stations

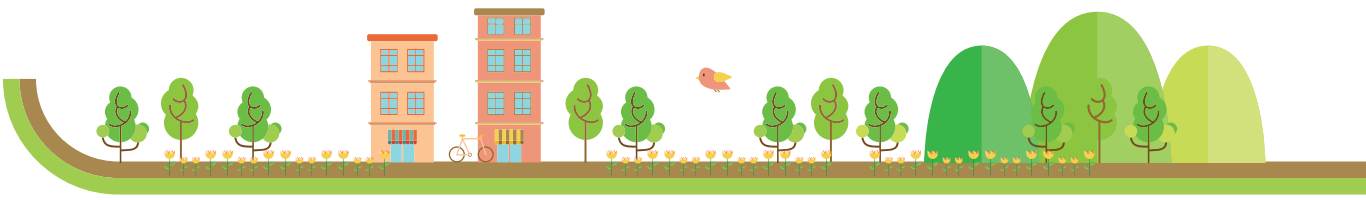
Intent
To increase the number of charging stations over a period of time while ensuring appropriate spatial distribution to encourage the use of EEVs and EVs.

Description
The charging stations are necessary and the number of charging stations have to be increased over a reasonable period of time to enable more users of EEVs and EVs to gain access for recharging their vehicles. The spatial distribution of the charging stations will also have to be considered to make it closer and convenient for users to access. In this way, more people may be encouraged to consider using this type of vehicle.

The increase in the number of charging stations may also be indicative of the need to serve the increasing number of clients who are using EEVs and EVs. Either way, the increase in the number of charging stations may be an indication that the use of low carbon transport modes are on the rise, hence resulting in reduction of carbon emission.

Carbon Emission Reference
1. 1 km travel by car (petrol) emits 0.26 kg of CO_2.
2. A car using petrol generates 0.162 kg of CO_2/km.
3. A car using diesel generates 0.169 kg of CO_2/km.
4. A car using NGV generates 0.130 kg of CO_2/km.
5. An electric car generates 0.135 kg of CO_2/km. *(Source: en.wikipedia.org/wiki)*
6. NGV emits 0.2 kg of CO_2/km. *(Source: ACTR- Public Transit vs. Single Occupant Vehicle Carbon Emissions to Climate Change)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies may consider the following actions:-
1. Convert existing government vehicles from conventional low carbon vehicles (hybrid cars).
2. Encourage combination of diesel and electric motor or biodiesel engine.
3. Impose condition for charging point facilities for hybrid vehicles on all applications for petrol stations.
4. Provide facilities such as public charging infrastructure in parking and neighbourhood areas.
5. Provide locational incentives, e.g. parking charge reduction.
6. Implement and monitor public awareness campaigns.



3.3 Urban Transportation

Performance Criteria 8
IMPROVEMENT TO LEVEL-OF-SERVICE OF ROAD LINKS AND JUNCTIONS

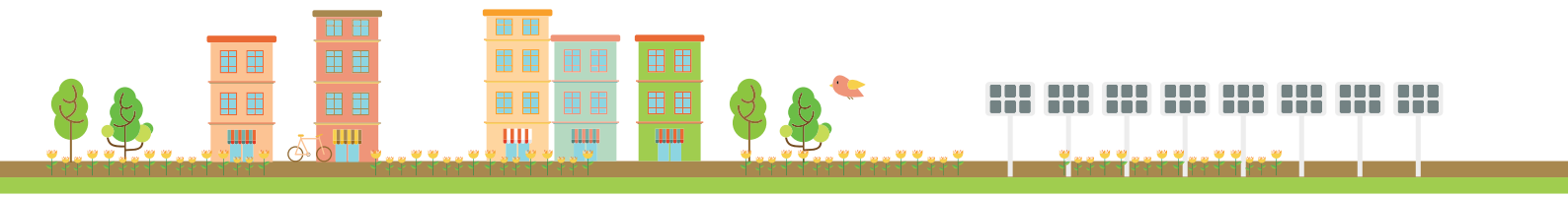
UT 5-1	Performance of Road Links and Junctions

Intent
To improve the performance of road links and junctions so that there will be less delay to traffic flow due to less number of vehicular traffic in the traffic stream or due to physical improvement on the road links and junctions.

Description
The traffic flow conditions on road links and junctions are influenced both by the traffic demand as well as the physical condition of the road links and junctions. When there is high traffic demand, the resulting congestion on the road links and junctions will result in delays and slow moving traffic. This will result in non-optimal vehicle operation and fuel consumption and CO_2 emission will increase. The non-optimal geometrics of the road links and junctions will also add to the problem.

As such, the performance of the road links and junctions has to be improved so that traffic operations can also be improved. This can be achieved by having lesser traffic demand and/or physical improvement of the road links and junctions. Lesser vehicular traffic demand will be achieved when more private transport users shifted to public transport through effective measures, which need to be implemented. Physical improvement can be made to those bottlenecks identified in the road network so that road links and junctions can perform better. Nevertheless, it is quite common that when physical improvements are made to the road network, this will attract additional users and/or diverted traffic from other parts to use the new improved portions of the network. Hence, improvement to the physical road network alone will not necessarily improve the performance of the road links and junctions. It has to be implemented together with other measures to reduce private transport demand.

An improved performance of the road links and junctions will be an important indicator for low carbon transport system in a city.



3.3 Urban Transportation

Carbon Emission Reference

1. 1 km travel by car (petrol) emits 0.26 kg of CO_2.
2. A car using petrol generates 0.162 kg of CO_2/km.
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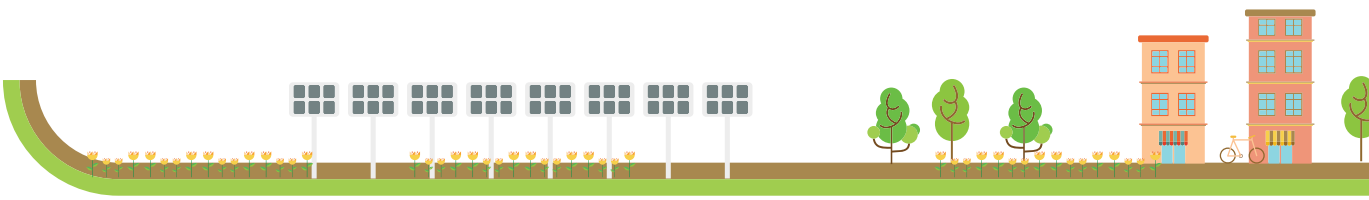
4. A car using NGV generates 0.130 kg of CO_2/km.
5. An electric car generates 0.135 kg of CO_2/km. *(Source: en.wikipedia.org/wiki)*
6. NGV emits 0.2 kg of CO_2/km. *(Source: ACTR- Public Transit vs. Single Occupant Vehicle Carbon Emissions to Climate Change)*

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Provide a comprehensive and integrated traffic management plan.
2. Improve traffic engineering measures for better level-of-service.
3. Improve level of compliance with speed limits through strict traffic law enforcement.
4. Increase active systems such as coordinated traffic signals, smart traffic control, and ITIS (Integrated Transport Information System) to overcome congestion issues.
5. Identify bottlenecks in the road network for improvement.
6. Improve public transport system and service characteristics.
7. Improve accessibility to/from public transport stations and stops.
8. Provide good feeder systems to/from public transport stations and stops.
9. Improve walking and cycling facilities near and around public transport stations.
10. Provide dedicated lanes for cycling and walking in transit-oriented zones.
11. Provide sufficient pathways for pedestrian with covered/shaded walkways.
12. Create pedestrian and cycling “shortcuts” that lead directly to transit. Pathways require a minimum 6-metre right-of-way. Look for opportunities to link “shortcuts” to the larger green space, pedestrian and cycling networks.
13. Implement and monitor public awareness campaigns.



3.3 Urban Transportation

Performance Criteria 8
IMPROVEMENT TO LEVEL-OF-SERVICE OF ROAD LINKS AND JUNCTIONS

UT 5-2	Average Link Speeds and Journey Speeds

Intent

To improve average links speeds and journey speeds so that a more optimal vehicle operation is achieved with respect to fuel consumption and CO_2 emission.

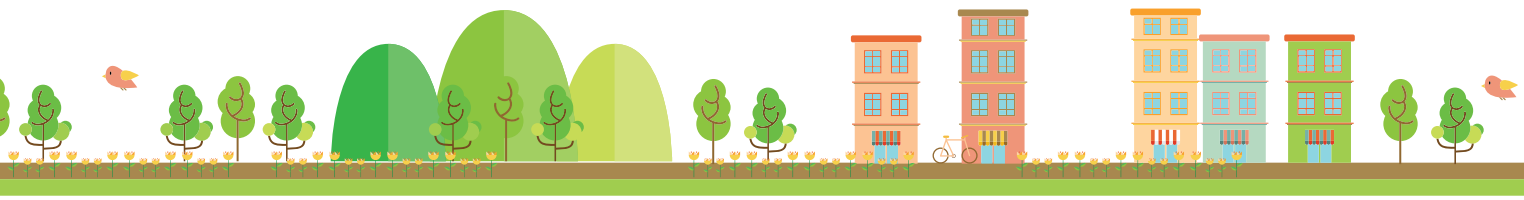
Description

Motorised vehicles moving at very low speeds will not be optimal in terms of fuel consumption and CO_2 emission. Similarly is the case when these vehicles are moving at excessively high speeds. Generally, it is quite well known that in most cases the optimal speed will be between 80-90 km/h for achieving reasonably good fuel consumption and lower CO_2 emission.

Therefore, it is important to have vehicles in the traffic stream to move at such optimal speeds. Link speed refers to the average speed of vehicles travelling on road links between two successive junctions or intersections, where-as journey speed refers to the average speed of the vehicle between the origin and destination (i.e. from home to the office). Link speed will exclude the time spent stopping or waiting at junctions or intersections. So, if the average link speed is low, it means that the congestion level on that link is high due to high traffic demand and high volume to capacity ratio (v/c ratio).

As for average journey speed, it will accumulate the total time spent on the road links and intersections/junctions for the whole journey between origin and destination, and divide the total distance travelled for the whole journey by this total travel time. The lower the average journey speed the longer will be the time spent by the vehicles on the road and the higher will be the CO_2 emission. Similarly, the lower the average link speed the higher will be the CO_2 emission.

Improvement on the average link speeds and journey speeds towards the optimal values will imply an improvement to the level-of-service (LOS) of the road links and junctions. Hence, contributing towards the reduction of CO_2 emission.



3.3 Urban Transportation

Carbon Emission Reference

1. 1 km travel by car (petrol) emits 0.26 kg of CO_2.
2. A car using petrol generates 0.162 kg of CO_2/km.
3. A car using diesel generates 0.169 kg of CO_2/km.
4. A car using NGV generates 0.130 kg of CO_2/km.
5. An electric car generates 0.135 kg of CO_2/km. *(Source: en.wikipedia.org/wiki)*
6. NGV emits 0.2 kg of CO_2/km. *(Source: ACTR- Public Transit vs. Single Occupant Vehicle Carbon Emissions to Climate Change)*

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Provide a comprehensive and integrated traffic management plan.
2. Improve traffic engineering measures for better level-of-service.
3. Improve level of compliance with speed limits through strict traffic law enforcement.
4. Increase active systems such as coordinated traffic signals, smart traffic control, and ITIS (Integrated Transport Information System) to overcome congestion issues.
5. Identify bottlenecks in the road network to be improved.
6. Improve public transport system and service characteristics.
7. Improve accessibility to/from public transport stations and stops.
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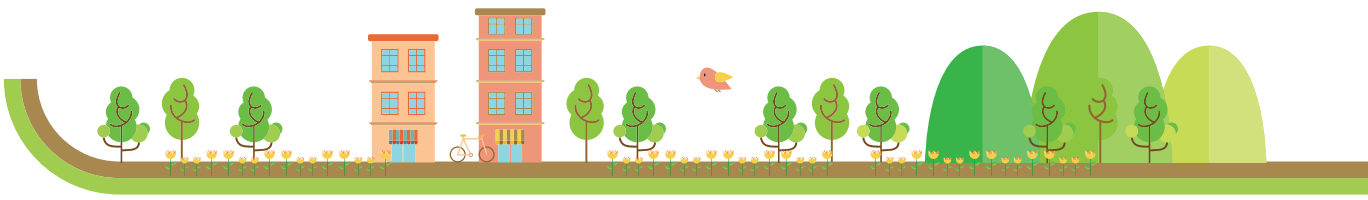


3.3 Urban Transportation

Performance Criteria 9
UTILISATION OF TRANSIT-ORIENTED-DEVELOPMENT (TOD) APPROACH

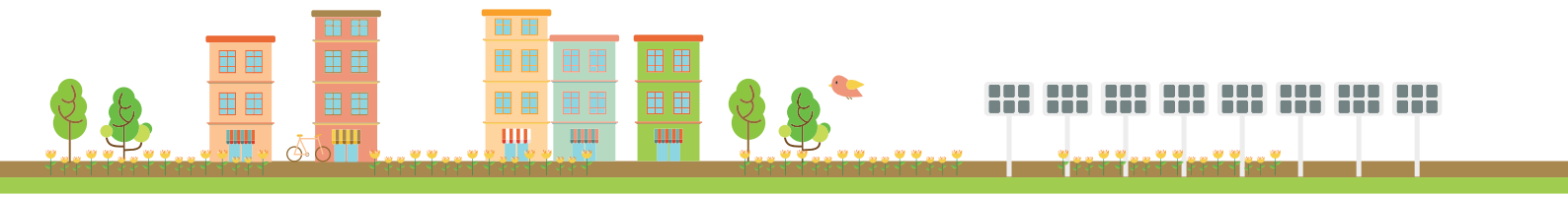
UT 6-1	New Development and Redevelopment Schemes Incorporating TOD Concept

Intent
To encourage the incorporation of transit-oriented development approach in any new development or re-development schemes in the urban areas.

Description
The basic idea in dealing with CO_2 emission from transport is to reduce the need to travel by private motorised modes for most of the trips to be made by the urban dwellers. This way, the overall reduction in CO_2 emission could be achieved. As land-use development gives rise to trips generated from the development area, a smart and well-planned TOD concept development or re-development would be most appropriate to achieve the desired objective. With the TOD concept, trips made using private motorised vehicles will be minimised since most of the trips made to/from the development area will be using public transit or a combination of low carbon feeder modes, NMT, and public transport.Movement within the TOD area will be mainly using non-motorised transport (also known as Active Transport) or low carbon para-transits.

As more land-use planning in the urban areas move towards incorporating the TOD concept, less dependence on private transport will be achieved. This way, the objective of achieving greater reduction in CO_2 emission from transport could be attainable.

Carbon Emission Reference
1. Walking and cycling release 0 kg of CO_2. *(Source: www.smartertavelsutton.org).*
2. 1 km round trip walking and cycling saves 6 kg/day of CO_2 (carbon savings per day compared to the use of car). *(Source: www.smartertavelsutton.org)*
3. Reduction in CO_2 of about 20% can be obtained by techniques to mitigate congestion in urban areas. *(Source: Matthew Barth and Kanok Boriboonsomsin)*

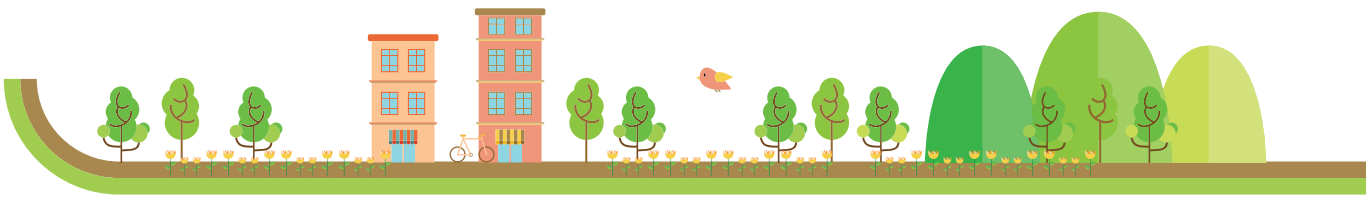


3.3 Urban Transportation

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Review land-use development and re-development policies to incorporate TOD concept.
2. Integrate infrastructure for walking and cycling in urban road design.
3. Enhance facilities for walking and cycling in TOD areas as well as first-mile-last-mile zones around transit stations.
4. Review policy on parking system and rates.
5. Discourage the use of private vehicles in TOD areas.
6. Enhance para-transit services to supplement the public transport system.
7. Address the Traffic Impact Assessment (TIA) within the city. The 'worst case scenario' should be deliberated upon in great detail.
8. Layout of new streets, lanes, pedestrian, and cycling connections in a connected network of short block lengths that offer route choice.
9. Use appropriate and clearly defined innovative traffic calming techniques that promote a safer environment for non-motorised travel in TOD areas.



3.3 Urban Transportation

Performance Criteria 9 UTILISATION OF TRANSIT-ORIENTED-DEVELOPMENT (TOD) APPROACH	
UT 6-2	**Walking and Cycling Facilities to Support Access and Mobility to/ from Public Transit Nodes**

Intent

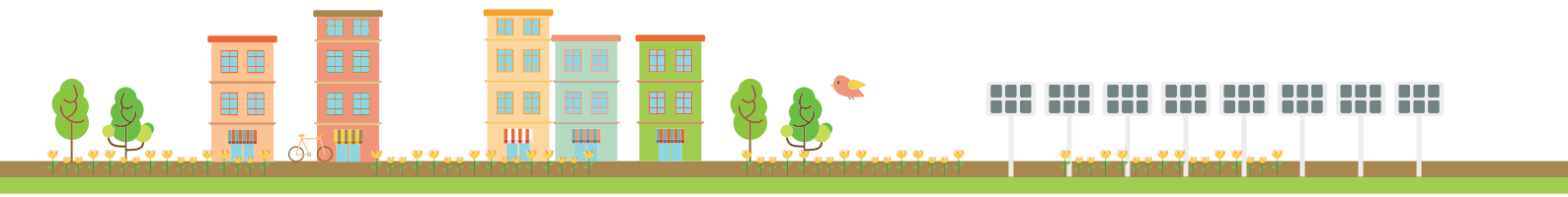
To enhance walking and cycling facilities to support access to/from public transport stops/stations/terminals to make it more attractive for the shift from private transport to public transport.

Description

Part of the success of a TOD will depend on the extent to which non-motorised transport modes (walking and cycling) are being planned, implemented, and utilised within the TOD area as access modes to/from public transport stops/stations/terminals. Apart from the TOD areas, the enhancement of walking and cycling facilities within the first-mile-last-mile of any trip made via public transit should also be planned and implemented. This will increase the attractiveness to travellers who wish to shift from private transport to public transport for their daily travel.

In certain societies, the general public may not realised that walking and cycling are important modes of transport (apart from the usual co-benefits such as health related). In actual fact, walking and cycling are the most efficient modes of transport for short distance trip (if adequate facilities are provided). When trip makers began to realise the importance of shifting from the private transport to public transport (because of concerns ranging from environmental awareness to financial considerations), the availability of adequate, efficient, and safe infrastructure for non-motorised transport to act as access modes to/ from public transport stops/stations/terminals will definitely be required. A well-planned walking and cycling network need to be integrated with the public transport system.

As such, when walking and cycling becomes part of the trip chain for a public transport user who shifted from his/her private vehicle to public transit, there will be one less private vehicle on the road. Hence, less carbon emission from transport is achieved when more private vehicles are off the road.



3.3 Urban Transportation

Carbon Emission Reference

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3. Reduction in CO_2 of about 20% can be obtained by techniques to mitigate congestion in urban areas. *(Source: Matthew Barth and Kanok Boriboonsomsin)*

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies may consider the following actions:-

1. Review land-use development and re-development policies to incorporate TOD concept.
2. Integrate infrastructure for walking and cycling in urban road design.
3. Enhance facilities for walking and cycling in TOD areas as well as first-mile-last-mile zones around transit stations.
4. Review policy on parking system and rates.
5. Discourage the use of private vehicles in TOD areas.
6. Enhance para-transit services to supplement the public transport system.
7. Address the Traffic Impact Assessment (TIA) within the city. The 'worst case scenario' should be deliberated upon in great detail.
8. Layout of new streets, lanes, pedestrian and cycling connections in a connected network of short block lengths that offer route choice.
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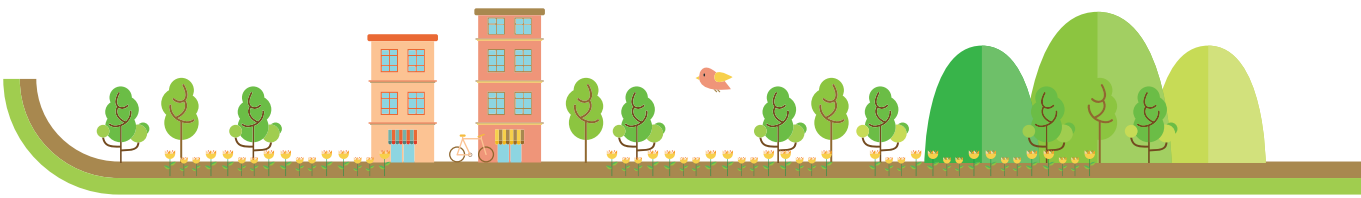


3.4 Urban Infrastructure

Performance Criteria 10
INFRASTRUCTURE PROVISION

UI 1-1 | Land Take for Infrastructure and Utility Services

Intent
To reduce land take for infrastructure and utility services through efficient design of main infrastructures either under or above ground by incorporating current and future utility requirements.

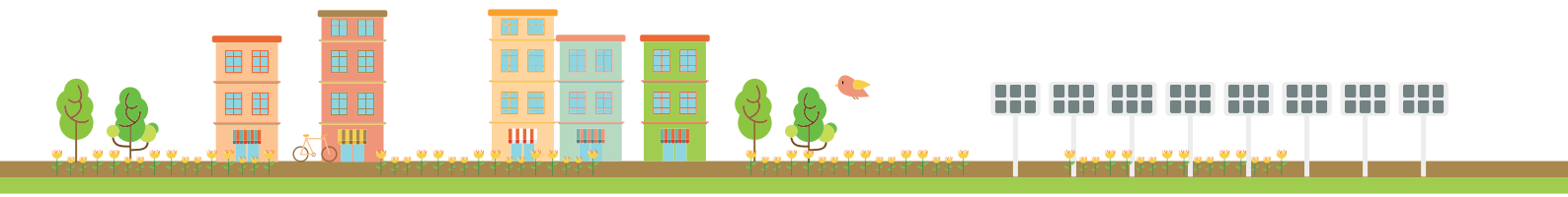
Description
Land take occurs due to the dispersion of development, be it for housing, transport, infrastructure, services, recreation, and more. Land take is commonly to cater for infrastructure purposes and normally involves greenfield areas and open spaces.

This land take will accommodate road networks, reserves for water tanks, sub-stations, sewerage treatment plants and reserves for the reticulation networks of water, electricity and telephone cables, high speed broadband cables, etc.

High percentage in land take leads to inefficiency of land used and more space requirement, leading to more land-use changes. Changes in land use, for example from greenfield area to infrastructure use, can generate high carbon emissions. Hence, efficiency in land-use planning, especially for the provision of urban infrastructure facilities, can help reduce carbon emission.

Carbon Emission Reference
1. 1 acre of developed infill or brownfield area = 7,000 kg of CO_2 emission (every acre of infill and brownfield development used for infrastructure reserve can reduce 30% of CO_2 emission compared to greenfield area). *(Source: Congressional Research, 2009)*

Recommendations for Carbon Emission Reduction
Developer and relevant agencies should take the following actions:-
1. Encourage the inclusion of green initiatives and green technology application in the early design stage into the development i.e. to consider use of natural lighting and ventilation.
2. Identify and implement right depth and gradient in designing of trenches with consideration of future need and safety.
3. Plan effectively for greater land use activity.
4. Share and optimize utility reserves.
5. Identify spine of township which integrates between existing infrastructure and utility reserve system.



3.4 Urban Infrastructure

Performance Criteria 10
INFRASTRUCTURE PROVISION

UI 1-2 Earthwork Management

Intent

To encourage a well-planned earthwork with minimal cut and fill work which ensure reduced CO_2 due to the movement of heavy machineries, especially dump trucks and avoid any flooding downstream.

Description

Earthwork is the first activity that takes place during construction which heavily involves cut and fill work and subsequently the movement of soil by heavy machineries.

The use of heavy machineries such as backhoe and dump trucks will consume a lot of energy and emit CO_2 as well generates noise pollution. Excessive earthwork also will cause soil erosion and sedimentation which poses serious threat to water quality.

Therefore, proper earthwork management plan with effective design will help to conserve the environment through restoring damaged areas and protecting biodiversity of the area.

Carbon Emission Reference

1. Diesel Dump Truck emitted 255 tons CO_2/year.
   Diesel Excavator emitted 21 tons CO_2/year. *(Source: www.fema.gov/)*
2. 1 km trip of dump truck = 10.03 kg of CO2 via diesel use. *(Source: 2009 Guidelines to Defra)*

Recommendations for Carbon Emission Reduction

Developer and relevant agencies should take the following actions:-

1. Encourage to build according to the terrain as much as possible and earthwork design to reduce cut and fill work and movements of heavy machineries. It should follow the JKR guidelines.
2. Prioritize transporting soil from cut and fill work within the project rather than outside.
3. Ensure proper erosion and sedimentation control plans are prepared and designed effectively in preventing illicit discharges from the project sites from cut and fill work.

3.4 Urban Infrastructure

Performance Criteria 10
INFRASTRUCTURE PROVISION

UI 1-3	Urban Storm Water Management and Flood Mitigation

Intent
To reduce impact of flood and enhance water quality as well as protect life and property.

Description
As a tropical country which receives high rainfall throughout the year, flood can easily happen.

Without proper storm water management, rainwater that has been collected and carried away into drainage system will overflow to dry land and road surfaces due to blockage or heavy rainfall.

Good storm water management techniques such as preservation of vegetation and water bodies will definitely improve the flood mitigation system and preserve CO_2 sinking vegetation.

Carbon Emission Reference
No direct CO_2 emission.

Recommendations for Carbon Emission Reduction
Developer and relevant agencies should take the following actions:-

1. Establish a local flood plain management plan that include the identification of high and moderate risk locations as reference for future development.
2. Avoid development at flood plain areas and highly developed areas.
3. Establish storm water management plan for developed areas.
4. Review the drainage and irrigation systems as part of establishing the storm water management plan.
5. Implement good maintenance practice of drainage system especially in avoiding blockage and weed growing.
6. Introduce better water retention techniques through green technology e.g. pervious pavement and turf block.
7. Establish integrated coastal/shoreline management plan if applicable.

3.4 Urban Infrastructure

Performance Criteria 11
WASTE

UI 2-1	Construction Waste Management

Intent
To reduce construction waste generation by implementing effective waste management.

Description
Construction waste consists of materials that are no longer required such a steel, wood, bricks, concrete and others.

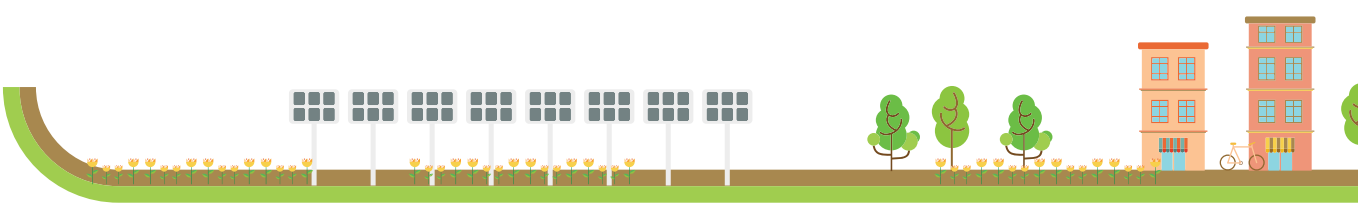
In general, construction waste is bulky, heavy and mostly unsuitable for disposal by composting or incineration. Due to that, the construction waste normally end up in illegal dumping sites.

In order to address the issue of illegal dumping of construction waste and impact to the environment, improvement at design stage and use of sustainable or recycled materials need to be implemented. The developers should work to reduce, reuse, and recycle the construction waste before disposing to landfill.

The respective Local Authorities should monitor and ensure that construction waste are disposed at designated area and not illegally dump or open burn at the construction sites.

Carbon Emission Reference
1. 2 tons CO_2 emitted in producing 1 ton steel.

Recommendations for Carbon Emission Reduction
Developer should take the following actions:-
1. Establish the waste management plan based on type of wastes and disposal methodology.
2. Implement segregation of waste at source before transferring to material recovery facility (MRF) or landfill.
3. Minimize waste generation at construction site through the awareness programme, green technology introduction and guidelines establishment.
4. Reuse some of the construction waste such as unwanted brick and concrete as a sub-grade of access road to the construction site.
5. Enforce the use of certified recycled construction and industrial materials in development projects.



3.4 Urban Infrastructure

Performance Criteria 11
WASTE

UI 2-2	Industrial Waste Management

Intent
To reduce the generation of industrial waste from industrial processes.

Description
Industrial wastes should be understood to mean any substance, solid or non-solid, organic or non-organic or any substances in whatever state produced either directly or indirectly from any industrial activity as its direct or indirect by-product. Industrial wastes include any matter prescribed to be scheduled wastes, or any matter whether in a solid, semi-solid or liquid form, or in the form of gas or vapour which is emitted, discharged or deposited in the environment in such volume, composition or manner as to cause pollution.

In managing industrial wastes which eventually reduce CO_2 emission, industries need to choose options such as waste prevention either through product substitution or process replacement and source reduction through product formulation or process modification and improvement and equipment design.

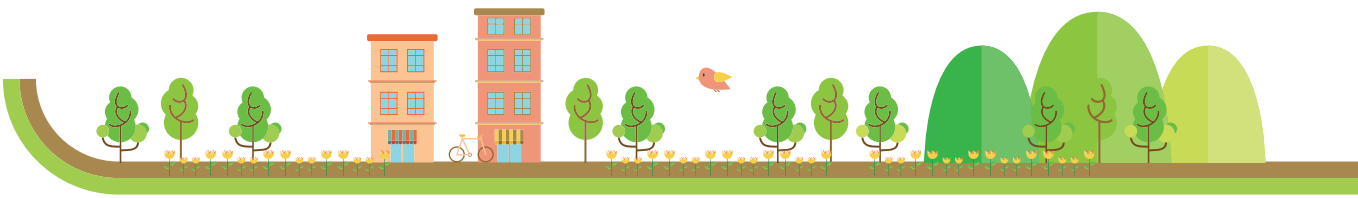
Carbon Emission Reference
1. 1 kg of tile production emits 0.46 kg of embodied CO_2. *(Source: Guidelines to Defra, 2009)*
2. 1 kg of HDPE pipe production emits 2.0 kg of embodied CO_2. *(Source: Guidelines to Defra, 2009)*
3. 1 kg of plasterboard production emits 0.38 kg of embodied CO_2. *(Source: Guidelines to Defra, 2009)*
4. 1 kg of plywood production emits 0.81 kg of embodied CO_2. *(Source: www.extranetevolution.com)*

3.4 Urban Infrastructure

Recommendations for Carbon Emission Reduction

Developer and relevant agencies should take the following actions:-

1. Adopt cleaner production and green technology in industrial processes.
2. Work toward waste prevention at source through production or process replacement and raw material reduction.
3. Establish the waste management plan based on type of wastes and disposal methodology.
4. Implement segregation of waste at Source before transferring to material recovery facility (MRF) or landfill.
5. Minimize waste generation at industry site through the awareness programme, green technology introduction and guidelines establishment.
6. Implement industry symbiosis initiative where waste or by-product of two or more companies or industries can be reused or raw material of the other industries.
7. Use of certified recycled material as the alternative raw material for production where possible e.g. recycled PVC pallet for plastic production.



3.4 Urban Infrastructure

Performance Criteria 11
WASTE

UI 2-3	Municipal Solid Waste (MSW) Management

Intent

To reduce municipal waste generation by implementing effective waste management that will reduce waste from going to landfill.

Description

Municipal solid waste generated consists of daily consumed items such as food waste, plastics, bottles, and paper.

Most common method of waste disposal is landfill which mostly are open dumping grounds. Without proper management of waste at the landfill, it will pollute the air and water of the surrounding, eventually causes CO_2 emission.

Effective waste management will reduce the waste to landfill through 3R activities (Reduce, Reuse, and Recycle) and for organic solid waste is easily convertible to biogas and composting materials such as organic fertilizer.

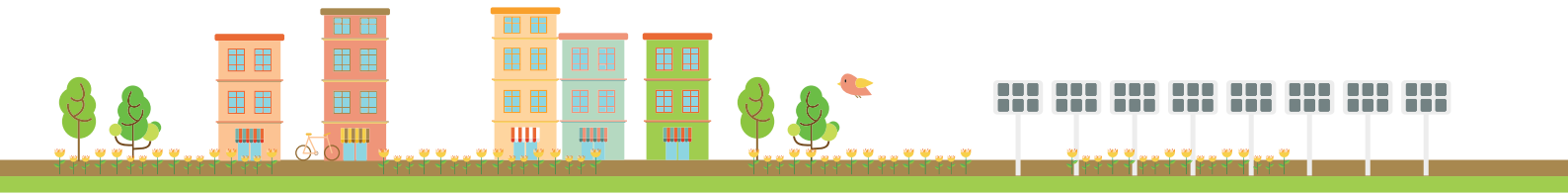
Carbon Emission Reference

1. 7,300 kg of CO_2 emission/person/year or 2 kg of CO_2 emission/person/day - figure for Malaysia. *(Source: United Nations, 2007)*
2. 1 km trip of dump truck = 0.85 kg of CO_2 via air pollution. *(Source: Guidelines to Defra, 2009)*
3. 1 km trip of dump truck = 10.03 kg of CO_2 via diesel use. *(Source: Guidelines to Defra, 2009)*

Recommendations for Carbon Emission Reduction

Local Authorities should take the following actions:

1. Promote awareness on 3R campaign and establish recycling centres easily assessable to public to facilitate waste separation at source.
2. Establish the material recovery facilities (MRF) for further segregation process of waste collection from lorry.
3. Divert and minimise food waste from entering the landfill by introducing waste composting program.
4. Land fill establish should be of sanitary standard which has features consisting of liners, leachate collection and treatment, gas harvesting and daily and final covers.
5. Reduce methane emission by capturing the landfills gaseous for energy generation.
6. Introduce some incentives for recycling or punitive measures i.e. Pay-As-You-Throw as to encourage public to recycle and reduce waste generation.



3.4 Urban Infrastructure

Performance Criteria 12
ENERGY

UI 3-1	Energy Optimisation

Intent

To optimise energy consumption through alternative solution and innovative technology that provide better efficiency and use less energy (with at least minimum 10% reduction in electricity).

Description

Generally, cities account for over 70 percent of global energy use which resulted in more than 40 percent of greenhouse emission worldwide. (UNEP Publication) Half of cities energy consumption is for heating and cooling. Apart from that, building and street lighting are among the large energy consumed that contributed to CO_2 emission.

Energy consumption in cities can be reduced through the application of energy efficient programs which may include replacing current street lighting bulb with LED and using solar panel as source of power generation.

Carbon Emission Reference

1. A normal bulb consumes 250 W of energy and emits 0.17 kg of CO_2.
2. An LED bulb consumes 100 W of energy and emits 0.068 kg of CO_2.
3. Every 1,000 kWh of energy used emits 0.68 kg of CO_2. *(Source: www.gg-energy.com)*

Recommendations for Carbon Emission Reduction

Developer and relevant agencies should take the following actions: -

1. Introduce Green Building requirement for all new building within the Local Authority planning approval.
2. Introduce Energy Efficiency (EE) requirement for existing building in local authorities.
3. Encourage eco-friendly approaches through using renewable energy such solar energy for street lighting.
4. Encourage the use of natural light in the enclosed public place through better design and plan.
5. Include the energy saving passive or innovation design in street lighting installation.
6. Use of energy efficient bulbs and devices ensuring less waste in energy consumption.

3.4 Urban Infrastructure

Performance Criteria 12
ENERGY

UI 3-2	Renewable Energy

Intent
To encourage the use of renewable energy source and reduced dependency on fossil fuel energy.

Description
Alternative sources of energy can be obtained from the sun, wind, or water. A country like Malaysia receiving high percentage of sunlight and other natural source of energy, can easily promote use of Renewable Energy especially for buildings, roads, and other services.

Renewable Energy such as solar, wind, or biogas will contribute to low CO_2 emission. With initiative of installing solar panels at buildings and also biogas energy facilities, it will reduce the CO_2 emission significantly.

Carbon Emission Reference
1. Energy produced is 1170 to 1600 kWh/m2 for roof-top system.
2. Energy produced is 630 to 830 kWh/m2 for façade system.

Thus;

1. Every 1,000 kWh of energy used emits 0.68 kg of CO_2, thus:
   - 1 m2 of solar panel saves 796 to 1088 kg of CO_2/year for roof-top system.
   - 1 m2 of solar panel saves 429 to 565 kg of CO_2/year for façade system.

(Source: www.gg-energy.com)

Recommendations for Carbon Emission Reduction
Implementer and relevant agencies should take the following actions:-

1. Conduct awareness programme to general public and private businesses on Renewable Energy.
2. Encourage collaborative efforts among all stakeholders in promoting and implementing Renewable Energy.
3. Include any potential Renewable Energy sources in building design of business and office complex.
4. Encourage the use of renewable energy by providing a good incentive such as tax rebate, subsidies etc.

3.4 Urban Infrastructure

Performance Criteria 12
ENERGY

UI 3-3	Side-Wide District Cooling System

Intent
To implement district cooling as an alternative to reduce energy use and adverse energy-related environmental effects.

Description
District cooling is a centralised cooling plant which is modern and environmental friendly. It is a system that distributes chilled water from a cooling plant to residential, commercial and industrial facilities. It is connected through a network of underground pipes.

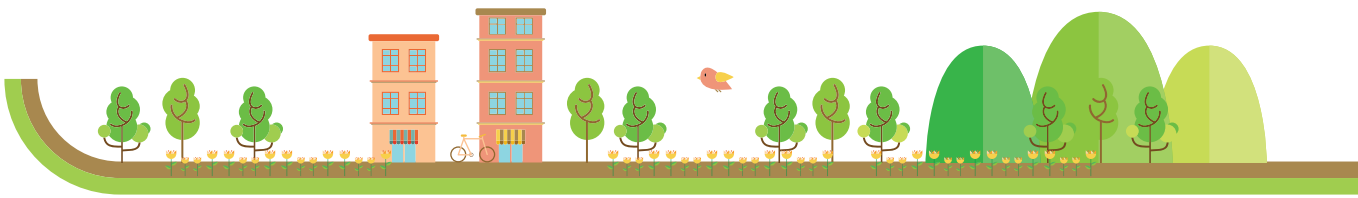
District cooling gives several benefits in terms of energy savings and the environment. As much as 65% of electricity use can be reduced by district cooling compared to a traditional air conditioning system. Applying the district cooling system will also give a significant reduction of costs for operation and maintenance.

In terms of environmental benefits, district cooling is indirectly able to reduce a certain amount of CO_2, lessen air pollution, decrease emissions of ozone-depleting refrigerants, combat global warming and help control the demand for electricity.

(Source: heating.danfoss.com)

Carbon Emission Reference
1. The district cooling system indirectly helps to reduce as much as 40% of CO_2 emissions. *(Source: District Heating & Cooling - A Vision towards 2020-2030-2050, DHC+ Technology Platform, 2009)*

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions:
1. Reduce energy use and adverse energy-related environmental effects by employing district cooling strategies.



3.4 Urban Infrastructure

Performance Criteria 13
WATER MANAGEMENT

UI 4-1	Efficient Water Management

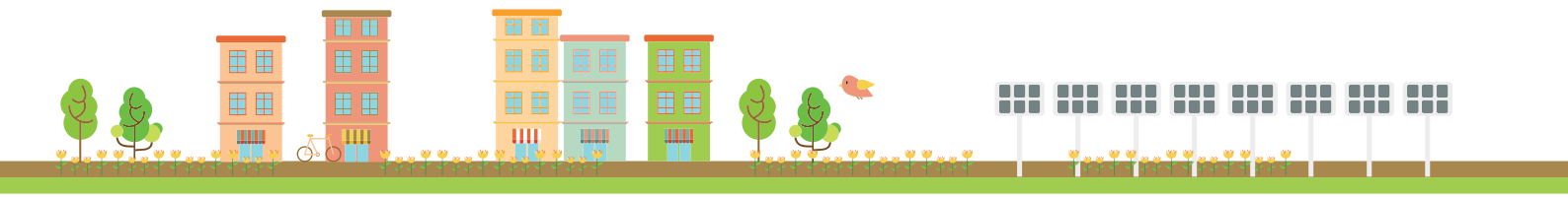
Intent
To establish Efficient Management of treated water supplied throughout premises including reuse of grey water and rainwater harvesting for non-human contact purposes.

Description
Annually, there is an estimated 1.99 billion m^3 or 37% of non-revenue water (NRW). This is the amount of water that is lost in the system – the difference in the supply of water produced and the consumption of water within a region. It is estimated that carbon emission in the production of 1 million litres (mi) of water is 276 kg/ml.

(Source: www. water.org.uk/home/policy/reports/sustainability-indicators-2007-08)

The figure implies that there is an insurmountable amount of carbon lost in the NRW. There is thus a need to better manage the water that is produced. Reusing and recycling of water can help to reduce carbon emissions where less water needs to be produced for urban services and daily uses like washing the car and watering the plants. Reusing and recycling water can be done through rainwater harvesting and grey water recycling. Heavy rainfall in this country should be benefited than left as surface water runoff.

Carbon Emission Reference
1. 1 million litres (mi) of water emits 276 kg of CO_2. *(Source: www. water.org.uk/home/policy/reports/sustainability-indicators-2007-08)*

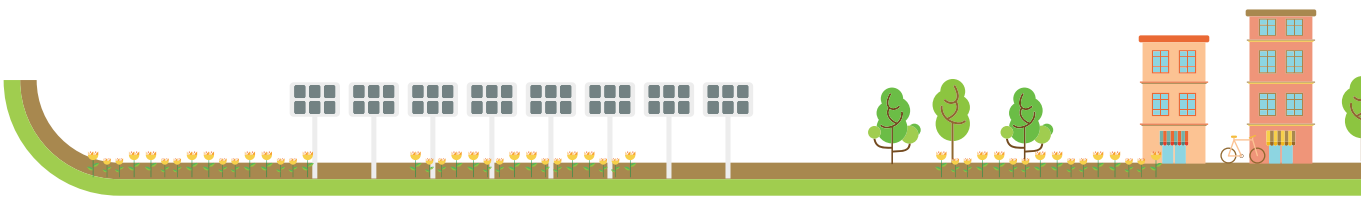


3.4 Urban Infrastructure

Recommendations for Carbon Emission Reduction

Developer should take the following actions:

1. Improve treated water management system by reducing pipe leaking and illegal consumption.
2. Introduce energy efficiency devices that can reduced energy consumption e.g. energy efficient pump in processing and supplying operation.
3. Encourage and provide incentive to building owner to install the rainwater harvesting system and grey water treatment plant in their premises.
4. Increase the awareness of building owner and public to reduce water consumption and the benefit of using Grey (reuse) water and rain harvesting water for non-human contact purposes.
5. Encourage the use of low sanitary fittings (WELPS) in facilities design for new development.
6. Ensure all building and residential areas are properly connected to centralised sewerage treatment system.
7. To install, maintain, and repair the treated water equipment or system such as piping, pump and meter with effective monitoring and maintenance activities according to JBA enforced standards.
8. Integrate natural water resources and storm water retention ponds in the design of city infrastructure as the quality water supply for treated water processing.



3.5 Building

Performance Criteria 14
SUSTAINABLE BUILDINGS MANAGEMENT SYSTEM

B 1-1	Energy Management System

Intent
To encourage the implementation of systematic energy management system to monitor and maintain the energy and water consumption for new and existing buildings.

Description
Energy Management System will help buildings save energy cost as well as helping to conserve resources and tackle climate change. There are two Energy Management System which a building can adopt:

i. MS ISO 50001 (Energy Management Systems).
ii. EMGS AEMAS (Energy Management Gold Standard – ASEAN Energy Management Scheme).

Both systems, will guide building owners to:

i. Develop a policy for more efficient use of energy.
ii. Fix targets and objectives to meet the policy.
iii. Use data to better understand and make decisions about energy use.
iv. Measure the results.
v. Review how well the policy works, and
vi. Continually improve energy management.

Carbon Emission Reference
No direct CO_2 emission.

Recommendations for Carbon Emission Reduction
Local authorities and other related agencies should take the following actions: -

1. Implement Energy Management System for the buildings.
2. Get certification either from:
   i. SIRIM for MS ISO 50001.
   ii. AEMAS (GreenTech Malaysia) for Energy Management Gold Standard.

3.5 Building

Performance Criteria 14
SUSTAINABLE BUILDINGS MANAGEMENT SYSTEM

B 1-2	Facility Management

Intent

To encourage the implementation of integrated facility management system to consolidate all building services under one management team. The intent is to streamline communication and make day-to-day operations easier to manage. Thus, ensuring the Energy Management System being managed thoroughly.

Description

Facility Management encompasses multiple disciplines to ensure functionality of a building by integrating people, place, process, and technology. This is a systematic method of consolidating many or all of building services under one management team and ideally under one contract.

On average, the life cycle of the buildings is around 60 years. Therefore, transforming them into high-performing buildings will be an important steps beneficial to reduce their CO_2 emissions. In addition, high-performance buildings can increase occupant satisfaction, reduce operating costs, and attract higher market value.

Carbon Emission Reference

No direct CO_2 emission.

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:

1. Implement a systematic Facility Management under one management team.
2. If possible, all building services should be under one contract for easier control and monitoring.

3.5 Building

Performance Criteria 15
LOW CARBON BUILDING

B 2-1	Passive & Active Designs

Intent

New Buildings:
To design and construct low carbon buildings with active and passive design features.

Existing Buildings:
i. To operate, improve, and maintain low carbon buildings with active design features through retrofitting.
ii. To extend the life cycle of existing building stock and enhance the building performance.

Description

There are various technological possibilities to design a low carbon building at a planning stage with active and passive design features. Also, various potentials to improve energy efficiency and reduce CO_2 emissions in an existing building with active and passive design features. Optimizing passive and active design strategies to reduce heat gain in buildings will lead to low CO_2 emissions.

Carbon Emission Reference

1. An 8-storey apartment building with east–west orientation experiences total solar gain of 0.14 kWh/m^2 compared to 0.01 kWh/m^2 for a north-south orientation.

3.5 Building

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions: -

1. Prioritise active and passive design solutions on buildings.
2. There are many strategies for active and passive design features to be adopted in new and existing buildings.

a. Passive Design Strategies:
   - i. Building Form, Core Location and Orientation.
   - ii. Daylight Harvesting.
   - iii. Glazing Properties.
   - iv. External & Internal Shades.
   - v. Wall Insulation.
   - vi. Roof Insulation.
   - vii. Atrium Ventilation Strategies.
   - viii. Zoning & Infiltration Controls.
   - ix. Interior Layout Office.

b. Active Design Strategies:
   - i. Efficient Lighting Design Strategies.
   - ii. Energy Rating Electrical Appliances.
   - iii. Air-Conditioning System Design.
   - iv. Energy Efficient Technology in Lift and Escalator Systems.
   - v. Building Energy Management System.
   - vi. Rain Water Harvesting System.
   - vii. Renewable Energy.

3.5 Building

Performance Criteria 15
LOW CARBON BUILDING

B 2-2	Operational Energy Consumption

Intent

New Buildings:
To design, construct and operate buildings with low operational energy consumption.

Existing Buildings:
To operate and improve and maintain buildings as low operational energy consumption.

Description

The energy used by buildings mostly generated by burning fossil fuels, which release CO_2 emissions that contribute to climate change. A building need to be energy efficient to consume less energy and generate fewer CO_2 emissions. A new building should achieve and maintain verifications of its verified levels or declared energy efficiency after commissioning process. For existing building, it needs to improve its energy consumption from business as usual (BAU). The building sector contributes to carbon footprint through 40% of energy use and 80 to 90% of the energy used by the building sector is consumed during the operational stage of the life cycle of the building.

(Source: www.unep.org/ Common Carbon Metric, UNEP)

Benchmarking:
To monitor the operational energy consumption. Comparisons with simple benchmarks of annual energy use (e.g. kWh/m2/year for office building, kWh/production/year for industry, kWh/bed occupied/year for hospital) allow the standard of energy efficiency to be assessed. The Common Carbon Metric (CCM) is an initiative by the United Nations Environment Programme – Sustainable Buildings and Climate Initiative (UNEP-SBCI) to enable emissions from buildings to be consistently assessed, compared, and the improvements measured. The intention of the CCM is to give the building sector a guide to measure, report, and verify reductions in a consistent and comparable way. The Common Carbon Metric for Malaysia established by the Ministry of Green Technology & Water and Malaysian Green Technology Corporation provides the baseline of building typologies and benchmark needed for operational energy emissions and carbon reductions for achieving the national climate goals.

(Source: www.unep.org/Common Carbon Metric, KeTTHA, MGTC, Malaysia)

3.5 Building

Support Program to Low Carbon Building:
Low Carbon buildings which comply with the building energy operational consumption benchmark will emit less GHG than regular buildings.
Sustainable Low Carbon Building facilitation & Assessment towards Nearly Zero Energy in Building (NZEB) by SEDA Malaysia.

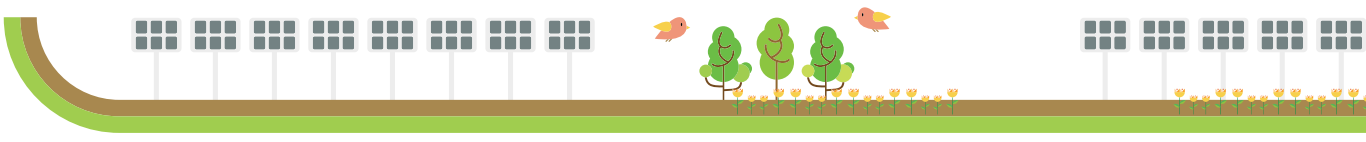
Carbon Emission Reference

1. The carbon emission factor for electricity is 0.741 kg CO_2e/unit.
   (Source: *http://www.greentechmalaysia.my/carboncalculator/process.php*)

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:-

1. Compare building performance to the benchmark set by the CCM for building typologies (Offices, Residential buildings, Hotels, Hospitals, Schools/Institutional buildings and Commercial (retail) & industrial buildings).
2. Encourage all large-scale businesses (e.g. office and commercial buildings) to submit Energy Audit Report for existing buildings.
3. Monitor performance through measurement, reporting, and verification (MRV).
4. Develop a policy to construct new building as a green or energy efficient building.
5. Assess & monitor of energy and carbon reduction.



3.5 Building

Performance Criteria 15
LOW CARBON BUILDING

B 2-3	Operational Water Consumption

Intent

New Buildings:
To design, construct, and operate buildings with low operational water consumption.

Existing Buildings:
To operate and improve water efficiency performance (low operational water consumption) of a building.

Description

According to UNEP, the building sector contributes to carbon footprint through 25% of water use. A new building should achieve and maintain verifications of its verified levels or declared water efficiency after commissioning process. For existing building, it needs to improve its water consumption from Business As Usual (BAU).

Benchmarking:
To monitor the operational water consumption (water efficiency performance) by comparing the BAU and the current performance with simple benchmarks of annual water use (e.g: litres/person/year, litres/no.of bed/year for hospital, litres/no. of rooms/year for hotel) allow the standard of energy efficiency to be assessed. The Common Carbon Metric for Malaysia established by the Ministry of Green Technology & Water and Malaysian Green Technology Corporation provides the baseline of building typologies and benchmark needed for operational water emissions and carbon reductions for achieving the national climate goals.

(Source: Common Carbon Metric, KeTTHA, MGTC, Malaysia)

Low carbon buildings which comply with the building water operational consumption benchmark will emit less GHG than regular buildings.

Carbon Emission Reference

1. The system processes for 1 cubic metre of water emit 0.419 kg of CO_2.
2. 1 million litres (mi) of water emits 276 kg of CO_2.

(Source: www.water.org.uk/home/policy/reports/sustainability-indicators-2007-08)

Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions: -

1. Compare building performance to the benchmark set by the CCM for building typologies (Offices, Residential buildings, Hotels, Hospitals, Schools/Institutional buildings and Commercial (retail) & industrial buildings).
2. Encourage all large-scale businesses (e.g. office and commercial buildings) to prepare Building Water Audit which cover GHG Reduction Plans.
3. Monitor performance through measurement, reporting and verification (MRV).

3.5 Building

Performance Criteria 15
LOW CARBON BUILDING

B 2-4	Preserve Existing Building Stock by Retrofitting

Intent

To reduce emissions from buildings through retrofitting to extend the life cycle of existing building stock and enhance the building performance.

Description

CO_2 emissions generated from buildings cover all stages of their life cycle; planning, design, construction, operation, and demolition.

Rather than constructing a new building, retrofitting the existing building stock will extends the life cycle of a building by conserving resources and reducing adverse environmental effects. These efforts will also reduce the amount of demolition and construction waste deposited in landfills and minimize the use of natural resources for constructing a new building. Retrofitting also enables upgrading of buildings with systems using new technologies, therefore leading to CO_2 emission reduction.

Carbon Emission Reference

1. 1 ton of cement emits 0.93 ton of CO_2.
2. 1 ton of aluminium emits 8.24 tons of CO_2.
3. Energy produced is 1170 to 1600 kWh/m^2 for roof-top system.
4. Energy produced is 630 to 830 kWh/m^2 for façade system.

Thus;

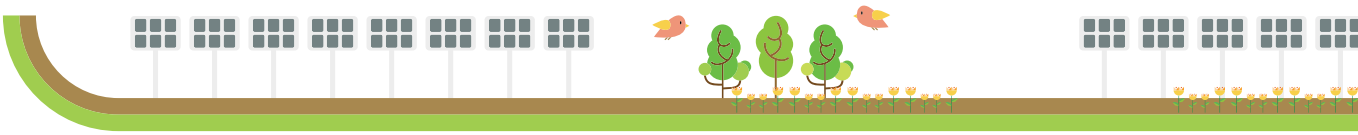
1. Every 1kWh of energy used emits 0.741 kg of CO_2, thus:
   - 1 m^2 of solar panel saves 796 to 1088 kg of CO_2/year for roof-top system.
   - 1 m^2 of solar panel saves 429 to 565 kg of CO_2/year for façade system.

   (Source: www.gg-energy.com)

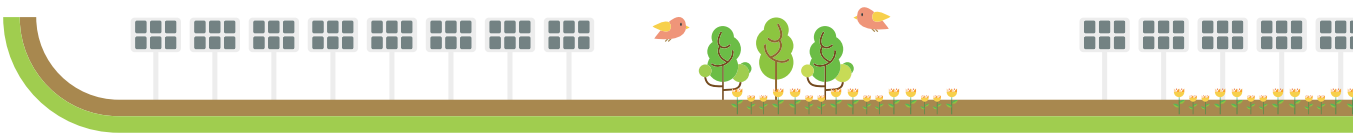
Recommendations for Carbon Emission Reduction

Local authorities and other related agencies should take the following actions:

1. Retrofit and reuse existing habitable building stock.
2. Preserve historical buildings and cultural landscapes.



4 LOW CARBON CITIES APPLICATION



4.1 Implementation Approach

Different cities face different issues and challenges. This being the case, each city should then be ranked according to its own demographics and attributes. Cities need to identify and list out the key elements that they want to measure and determine the areas of concern and territory boundaries. It is essential for cities to recognize and understand which elements are the major contributors of the cities' carbon/GHG emissions. Once the elements have been identified, they have a choice between:

a) **City Based Approach**
   - mitigating certain performance criteria (> 10 sub-criteria) as stated within the LCCF, regardless of elements selection.

   OR

b) **One-System Approach**
   - mitigating one or more performance criteria (=< 10 sub-criteria) as stated within the LCCF, regardless of elements selection.

For a **City-Based Approach**, a holistic view is taken. Almost all criteria are considered and mitigated. A step by step process to address each of the four main criteria is conducted. Each of the 41 sub-criteria is considered in detail. The outcome will be to derive a complete baseline and subsequently to develop a reduced carbon footprint from this baseline, then implement the same within the entire development.

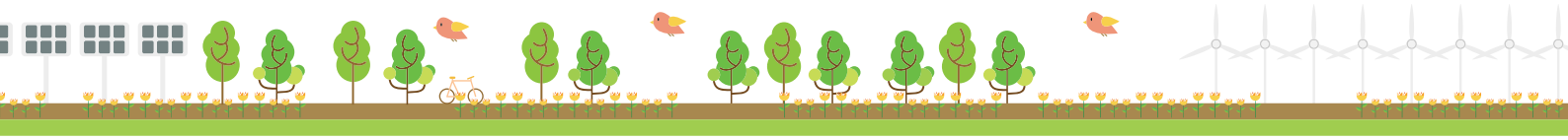
Curitiba, Brazil and Stockholm, Sweden are some examples of such cities that have applied the holistic city-based approach.

(Source: www.worldbank.org/eco2)

The **One-System Approach** on the other hand is applied when the decision is made to proceed with an exercise towards a low carbon city but only in particular selected performance criteria and sub-criteria as described in the main 4 elements, as a start and to establish a road map towards a holistic city-based approach. Although this approach has less impact, nevertheless it is a start and over time may be converted into a holistic city-based approach.

Yokohama in Japan is an example of such a city.

(Source: www.worldbank.org/eco2)



4.2 Application, Approval, & Recognition Process

The following points will detail out the application of LCCF.

4.2.1. Low Carbon Cities Application

Local Authorities will play a major role in undertaking policy initiatives on lowering carbon emissions of the city. The following diagram shows the application of the LCCF at the local authority level (**Figure 4.1**).

Figure 4.1: Low Carbon Cities Implementation Steps

4.2 Application, Approval, & Recognition Process

Step 1 – Identify Project & Mobilise City Stakeholders

At this early stage, Local Authorities need to identify project(s) and potential stakeholders for the plan within a city context such as Developers, NGOs, institutions and the local community.

Onward, Local Authorities should take the initiative to form a taskforce to implement LCCF which shall include people or groups like the project leader, project members, council members and Developers. Local Authorities can adopt either using City-Based approach or One-System approach.

Local Authorities and Developers need to formulate Project Brief Document in order to establish LCCF carbon baseline for the project.

Step 2 - Emission Baselines and Opportunities

For the next step, Local Authorities shall create the baseline according to the following procedure:

(i) Decide LCCF boundaries;
(ii) Decide base year and final year;
(iii) Declare total population at base year and final year (day population or night population whichever the highest);
(iv) Compile data for base year according to selected criteria.

From the baseline result, Local Authorities should prioritise which low carbon strategy can provide better opportunities for carbon reduction.

The next step is to establish a baseline based on 'Business as Usual' (BAU). This step consists of establishing the carbon footprint based on an implementation plan where no carbon reduction plan is considered, hence its name; 'BAU'.

Upon completion and evaluation of the baseline assessment, Provisional Certificate shall be given to the Local Authorities by KeTTHA / GreenTech Malaysia.

Step 3 - Develop City Strategy (Blueprint Implementation)

Once the project and baseline have been identified, it is then important to embark on a carbon reduction plan and strategy. This plan will automatically be able to derive the amount of emission abatement when the plan is successfully implemented.

The 'What', 'How' and 'Who' of the carbon reduction programme need to be described together with strategies and programmes or activities for implementation.

4.2 Application, Approval, & Recognition Process

Step 4 - Implement and Measure

At the implementation stage, the plan and strategy must be carefully adhered to. This will result in minimal slippage from the original intent. During the entire implementation process, improvements in the abatement plan can also be introduced, provided these improvements do not negatively impact the schedule and budget of the project.

Such a project should be undertaken by the taskforce responsible for the delivery of specified projects as stated in the Carbon Reduction Management Plan or Low Carbon City Action Plan.

Once the project is underway, the taskforce needs to collect data that is needed based on selected criteria on an annual basis until the final year. The purpose is to update the annual emission inventory.

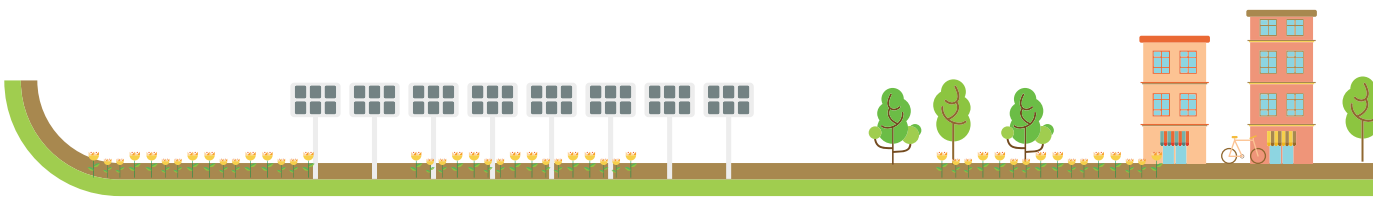
The information should then be fed into the plan to assess whether the city is on track to meet any targets set. On completion of the project and upon commissioning of all systems, the performance of the project can start to be measured periodically. The team can choose to measure the performance based on its specific timeline every year.

Step 5 - Review and Monitor

Reviewing of the project's action plan and result monitoring is important to ensure that the projected carbon emissions are achievable. If the target was achieved, the team can plan for further reduction in the next phase of development as planned in the road map.

To obtain Diamond Recognition by the Federal Government, Local Authorities need to submit their final data collection for review, assessment and verification by GreenTech Malaysia. Once Diamond Recognition was approved and obtained by the Local Authorities, continuous effort must be done to ensure continuous low carbon city development effort in each project's boundaries.

The Diamond Recognition is valid by each final year basis, meaning Local Authorities will reapply for the next phases in order to have continuous effort of low carbon city implementation throughout its operation.



4.2 Application, Approval, & Recognition Process

4.2.2. Recognition Process

Diamond Recognition by the Federal Government will only be given to the Local Authorities. However, stakeholders (Developers) in their effort to reduce carbon emission in the defined Local Authorities areas shall be given award recognition certificate for their assistance in helping the Local Authorities achieving the Diamond Recognition, provided if their development or programme managed to reduce carbon emission. **Figure 4.2** shows the overall implementation approach under LCCF.

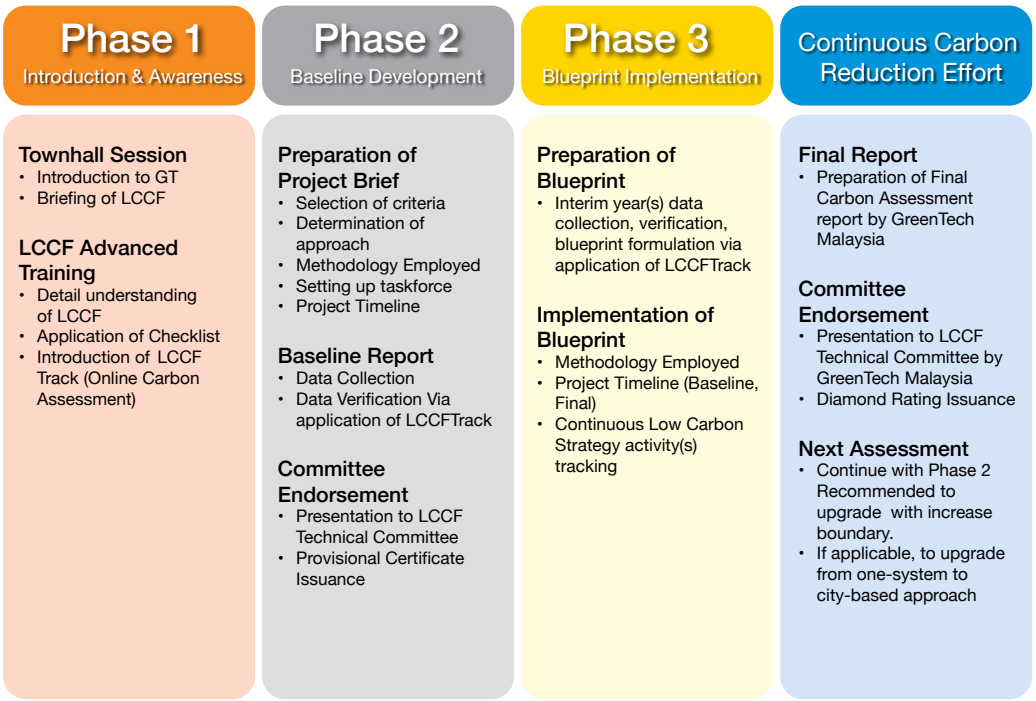


Figure 4.2: Overall LCCF Implementation Phase

4.2 Application, Approval, & Recognition Process

Reduction performance of a city, either through the city-based approach or one-system approach, will be awarded a carbon assessment performance recognition as shown in **Table 4.1**. This Diamond award takes place during the Phase 3: Blueprint Implementation Phase.

Carbon Reduction Level	Level of Achievement
100	Carbon Neutral
70 - 99%	Best Practice 5
50 - 69%	Best Practice 4
30 - 49%	Best Practice 3
10 - 29%	Best Practice 2
1 - 9%	Best Practice 1

Table 4.1: Carbon Assessment Performance Recognition

4.3 LCCF Checklist

LCCF Checklist is the minimum requirement list set by KeTTHA and GreenTech Malaysia in order to gauge whether a project or development is ready or not ready to commit in the development and implementation of Low Carbon City element in their jurisdiction. As the first step in any registration of LCCF Project, the Checklist must be fully complied. If the Checklist process failed, the project or development must take necessary action in order to comply with the Checklist requirement. Failure to pass minimum marks in the checklist will grant no approval to validate itself suitable to enrol in LCCF project. LCCF Checklist can be filled up by Local Authorities (for existing completed city) and Developers (for new project development/ city). The general LCCF Checklist can be referred in the **Appendix 1**.

Table 4.2 shows passing score for the checklist is 50 and above. Score below 50 indicates that the applicants will need to review their checklist selection in order for their project to be eligible in the LCCF Program. Total scores from each element will be combined in this section to produce a LCCF Checklist Score. The score for the LCCF Checklist are as follows:

% SCORE	LCCF CHECKLIST ACHIEVEMENT
>90	Outstanding
80 - 89	Excellent
70 - 79	Very Good
60 - 69	Good
50 - 59	Pass
<50	Unclassified

Table 4.2: Score for LCCF Checklist

Unclassified (<50) score represents performance that is not compliant to the LCCF requirements. This may be due to failure to meet the key assessment or the overall threshold score required for baseline carbon emission calculation.

4.4 Application of the LCCF Checklist

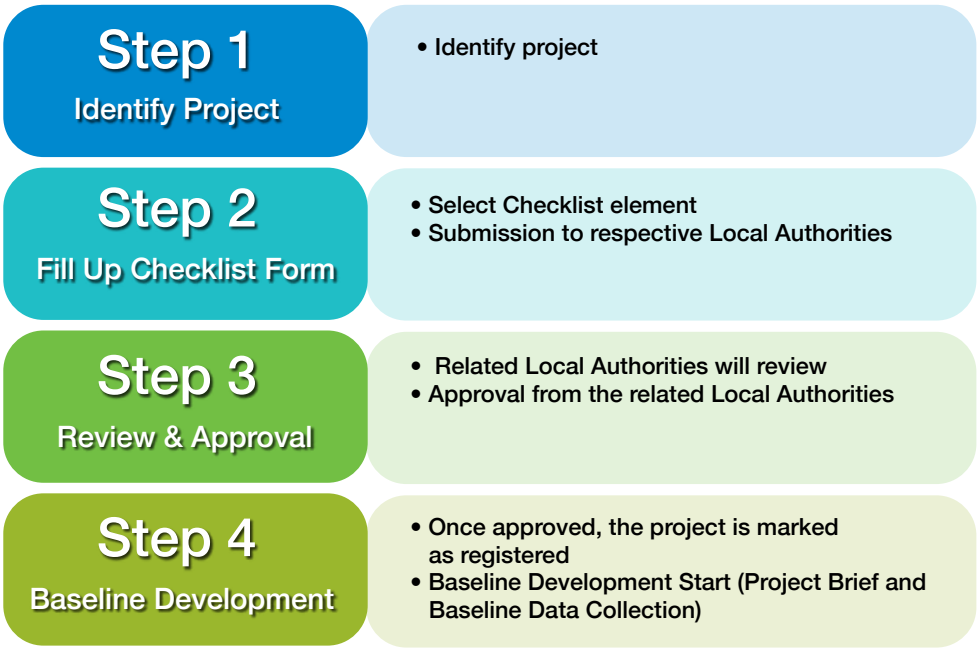


Figure 4.3: Application of the LCCF Checklist

Step 1 - Identify Project

Local Authorities or Stakeholders need to identify the type of project that they intend to develop and implement under LCCF programme. Details such as total area and LCCF border area, and population at baseline year and final year of the selected area must also be declared.

Step 2 – Fill Up Checklist Form

There are 107 checklist elements in the Checklist. The project must able to select which elements are applicable and which are not applicable to their project. The total marks shall be based on the total checklist applicable to the project.

Step 3 – Review & Approval

It is recommended for the applicants especially Developers to meet with their respective Local Authorities to discuss which checklist elements are related to their project. Several discussions or consultations with their respective Local Authorities might be expected before approval can be granted. Approval of the Checklist shall be carried out by the respective Local Authorities related to the development area. Submission of Checklist is via LCCFTrack.

Step 4 – Baseline Development

Once the Checklist application was approved, the project is officially registered under LCCF Programme. The next step is for the applicants to proceed with the Baseline Development Stage where they will need to formulate Project Brief document and baseline data collection and input via LCCFTrack. This step onwards shall be guided by GreenTech Malaysia.

4.5 Relationship between Framework and the Assessment System

The relationship between the Framework and the Assessment System; LCCFTRACK should be clearly understood and this is an important requirement to achieving accurate results in the entire undertaking. LCCF TRACK is a dedicated online carbon assessment system for Low Carbon Cities/ Zones which was designed to support the implementation of Low Carbon Cities Framework (LCCF) by the Government of Malaysia and can be accessed online via web portal: **www.greentownship.my**. This system is developed and managed by GreenTech Malaysia.

The framework will provide the elements on which the approach will be hinged, whereas LCCFTrack will utilise these ingredients and convert them into carbon equivalents. The two are not separable and should be read in conjunction with each other. The usage of both is sequential, starting with the framework. The following diagram (**Figure 4.4**) shows the overall connection and process flow that bind together framework and assessment under LCCF.

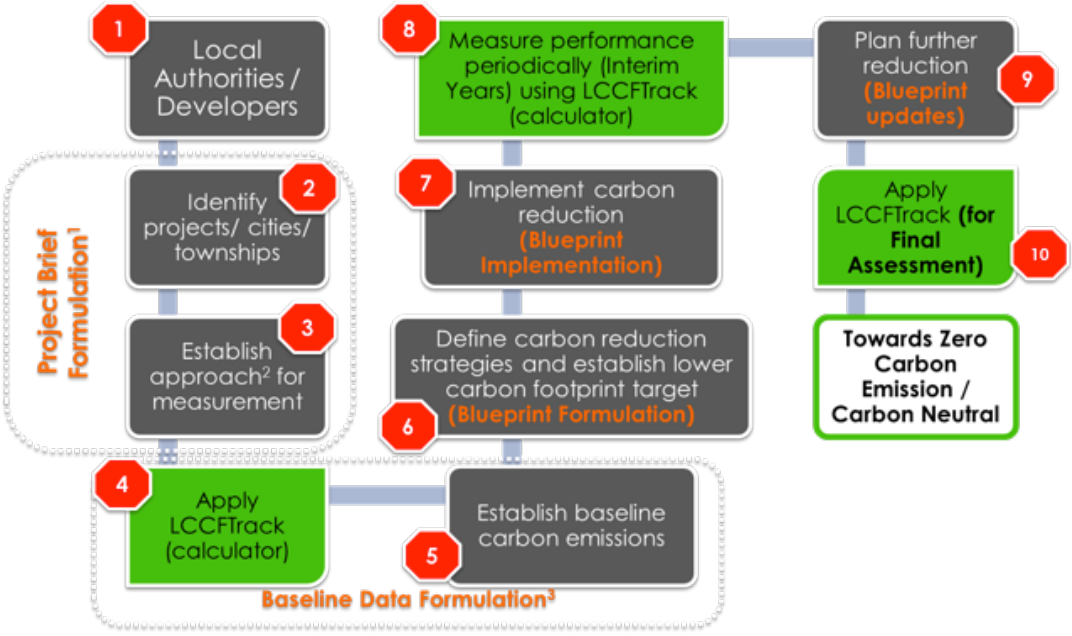


Figure: 4.4: Key Action Flow of LCCF Diamond Recognition

ACKNOWLEDGEMENT

Ministry of Energy, Green Technology and Water
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ACKNOWLEDGEMENT

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ACKNOWLEDGEMENT

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GLOSSARY

COMPONENT	DESCRIPTION
Activity Data	Data on the magnitude of a human activity resulting in CHG emissions. Data on energy use, miles travelled, input material flow and product output are all examples of activity data that might be used to compute CHG emissions. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Abatement	Reducing the degree or intensity of greenhouse gas emissions. *(Source: unfccc.int/essential_background/glossary/items)*
BAU (Business-As-Usual)	A normal execution of standard functional operations within an organisation, particularly in contrast to a project or programme which would introduce change. *(Source: en.wiktionary.org/wiki/business_as_usual)*
Biodiversity	The range of variation found among microorganisms, plants, fungi and animals. Also the richness of species of living organisms. *(Source: www.esa.org/education_diversity/pdfDocs/biodiversity.pdf)*
Brownfield	An area which is abandoned or underused industrial and commercial facilities available for re-use. However, any expansion or redevelopment in this area is complicated due to environmental contamination. *(Source: www.epa.gov/OCEPATERMS/bterms.html)*
Building	Construction work that has the provision of shelter for its occupants or contents as one of its main purposes; usually partially or totally enclosed and designed to stand permanently in one place. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Carbon Adsorption	Removal of contaminants from ground water or surface water in a treatment system by forcing it through tanks containing activated carbon treated to attract the contaminants. *(Source: www.epa.gov/OCEPATERMS/cterms.html)*
Carbon Footprint	The direct effects that one's actions and lifestyle have on the environment in terms of carbon dioxide emissions. It can be direct or indirect impact in accelerating climate change. *(Source: www.dcnr.state.pa.us/brc/grants/Glossary.doc)*
Carbon Sequestration	Carbon that is removed and stored from the atmosphere in carbon sinks (such as oceans, forests or soils) through physical or biological processes, like photosynthesis. *(Source:www.greenfacts.org/glossary/abc/carbon-sequestration.htm)*
Carbon Stock	The quantity of carbon contained in a reservoir or system which has the capacity to accumulate or release carbon. *(Source:www.greenfacts.org/glossary/abc/carbon-stock.htm)*

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COMPONENT	DESCRIPTION
Carbon Storage	Carbon that is stored within tree tissue (roots, stems and branches). The amount stored will increase as the tree grows and once it dies or decays, the stored carbon will be released back into the atmosphere. *(Source: urbanforest.dehort.org/glossary)*
CCM (Common Carbon Metric)	A tool used to measure, report and verify reductions in a consistent and comparable way in order to support GHG emission reductions through accurate measurement of energy efficiency improvements in building operations. *(Source: www.unep.org/sbci/pdfs/UNEPSBCICarbonMetric.pdf)*
CH_4	Methane, a Kyoto Protocol greenhouse gas. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
CHP (Combined Heat and Power)	An energy conversion process in which more than one useful product, such as electricity and heat or steam, is generated from the same energy input stream (cogeneration). *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Climate Change	Climate change is any long-term significant change in the average weather of a region of the earth as a whole. For more information, see average weather. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Climate Neutrality	Climate neutrality is a term that refers to an entity with no net GHG emissions. Achieved by reducing greenhouse gas emissions as much as possible and by using carbon offsets to neutralise the remaining emissions. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
CO_2 Equivalent (CO2e)	The universal unit for comparing emissions of different GHGs, expressed in terms of the global warming potential (GWP) of one unit carbon dioxide. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
DCS (District Cooling System)	The centralised production and distribution of cooling energy where chilled water is delivered via an underground insulated pipeline to office, industrial and residential buildings to cool the indoor air of the buildings within a district. *(Source: www.empower.ae/php/what-is-district-cooling.php?id=1)*
Emission Factor	GHG emissions expressed on a per unit activity basis. For example, metric tons of CO_2 emitted per million Btus of coal combusted or metric tons of CO_2 emitted per kWh of electricity consumed. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Energy Performance	Delivered energy use for building operations, and scope one and two greenhouse gas emissions. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*

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COMPONENT	DESCRIPTION
Floodplain	An area of low-lying ground adjacent to a river or other type of water body that is subject to flooding. *(Source: www.dcnr.state.pa.us/brc/grants/Glossary.doc)*
GDP (Gross Domestic Product)	The market value of all final goods and services produced within a country in a given period. It is often considered an indicator of the economic health of a country as well as its standard of living. *(Source: www.investopedia.com/terms/g/gdp.asp)*
GFA (Gross Floor Area)	The total floor area contained within a building, including the horizontal area of external walls. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
GHG (Greenhouse Gas)	A gas that contributes towards potential climate change such as carbon dioxide (CO_2), methane (CH_2) and nitrous oxide (N_2O). *(Source: www.epa.gov/OCEPATERMS/gterms.html)*
GHG Inventory	A quantified list of an organisation's GHG emission sources. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Green Building	Sustainable or high-performance building. Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from sitting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability and comfort. *(Source: EPA, United States Environmental Protection Energy)*
Greenfield	An agricultural, forest or undeveloped land in a city or rural area used for agriculture, landscape design or left to evolve naturally. *(Source: www.businessdictionary.com/definition/greenfield-site.html)*
Grey water	Wastewater that is generated from domestic activities such as laundry, dishwashing and bathing which can be recycled on-site for uses such as landscape irrigation, and constructed wetlands. *(Source: www.greensystems.net/greywater.html)*
Greyfield	Usually former commercial properties which are underutilised or vacant. It can also be an area that was previously developed and is not contaminated. *(Source: www.dcnr.state.pa.us/brc/grants/Glossary.doc)*
GWP (Global Warming Potential)	The ratio of radioactive forcing that would result from the emission of one unit of a given GHG compared to one unit of carbon dioxide (CO_2).
HFCs (Hydro-fluorocarbons)	HFCs are Kyoto Protocol greenhouse gases. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Index	A framework for tracking & reporting building performance over time.

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COMPONENT	DESCRIPTION
	(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)
Infill	New construction or redevelopment of small residential, commercial or industrial properties on previously developed land in cities or developed suburbs. *(Source: www.brownfieldstsc.org/glossary)*
Innovation	A change in the thought process for doing something or new stuff that is made useful. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
IPCC (Intergovernmental Panel for Climate Change)	An international scientific body for the assessment of climate change. The role of the IPCC is to assess the scientific, technical and socio-economic factors relevant to understanding the risk of human-induced climate change. *(Source: www.ipcc.ch/organization/organization.shtml)*
Low Hanging Fruits	Targets or goals which are easily achievable and which do not require a lot of effort. *(Source: www.urbandictionary.com)*
N_2O (nitrous oxide)	A Kyoto Protocol greenhouse gas. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
NGV (Natural Gas Vehicle)	An alternative fuel vehicle that emits less emission compared to other traditional and alternative fuels. It can be used as compressed natural gas (CNG), liquid natural gas (LNG) or even blended with hydrogen. *(Source: www.iangv.org/home.html)*
PFCs (Per fluorocarbons)	PFCs are Kyoto Protocol GHGs. *(Source: UNEP SBCI – Sustainable Buildings and Climate Initiative, 2009)*
Rainwater Harvesting	A method of storing and using rainwater for irrigation and watering plants, washing cars, flushing toilets, supplying washing machines and any other non-potable water uses. *(Source: www.waterbowser-watertank.co.uk/rainwater-harvesting.php)*
SOV (Single Occupancy Vehicle)	A privately-operated vehicle whose only occupant is the driver. The drivers of SOVs use their vehicles primarily for personal travel, daily commuting and for running errands. *(Source: en.wikipedia.org/wiki/Single-occupant_vehicle)*
Stakeholder	Any organisation, governmental entity or individual that has a share or an interest in environmental regulation, pollution prevention, energy conservation, etc. *(Source: www.epa.gov/oaqps001/community/glossary.html)*
Sustainable Development	Sustainability is the ability in meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a

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COMPONENT	DESCRIPTION
	better life without jeopardising the opportunities for future generations. *(Source*: www.un-documents.net/ocf-02.htm#I*)*
UHI (Urban Heat Island)	The relative warmth of a city compared with surrounding rural areas. This is related to changes in runoff, the concrete jungle effects on heat retention, changes in surface albedo, changes in pollution and aerosols, and so on. *(Source: resilient-cities.iclei.org/bonn2011/resilience-resource-point/glossary-of-key-terms)*
UN (United Nations)	The United Nations is an international organization founded in 1945 made up of 193 Member States. It aims at facilitating cooperation in international law, international security, economic development, social progress, human rights, and achievement of world peace. *(Source: www.un.org/Overview/uninbrief)*
UNEP (United Nations Environment Programme)	A designated authority of the United Nations system in environmental issues at the global and regional level. The authorisation is to coordinate the development of environmental policy consensus by keeping the global environment under review and bringing emerging issues to the attention of governments and the international community for action. *(Source: www.unep.org/resources/gov)*
UNFCCC (United Nations Framework Convention on Climate Change)	An international environmental treaty with the goal of achieving the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. *(Source: unfccc.int/essential_background/convention/background/items)*
Urban Footprint	Amount of space that people use when in public places like sidewalks, exercise paths and public transport (trains, buses, etc.). *(Source: www.urbandictionary.com)*
Urban Forest	All types of vegetation that grow in a city, town or a suburb. In a wider sense, it may include any kind of woody plant vegetation growing in and around human settlements. *(Source: www.definition-of.net/urban+forest)*
VMT (Vehicle Miles Travelled)	A measure of the extent of motor vehicle operation; the total number of vehicle miles travelled within a specific geographic area over a given period of time. *(Source: www.epa.gov/OCEPATERMS/vterms.html)*
Wastewater	Used water which is discharged from the home, community, farm or industry. It contains dissolved or suspended matter that is harmful and damages the water quality. *(Source: www.epa.gov/OCEPATERMS/wterms.html)*

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COMPONENT	DESCRIPTION
Wetlands	An area that is saturated by surface or ground water with vegetation adapted for life under those soil conditions, such as swamps, bogs, fens, marshes and estuaries. *(Source: www.epa.gov/OCEPATERMS/wterms.html)*

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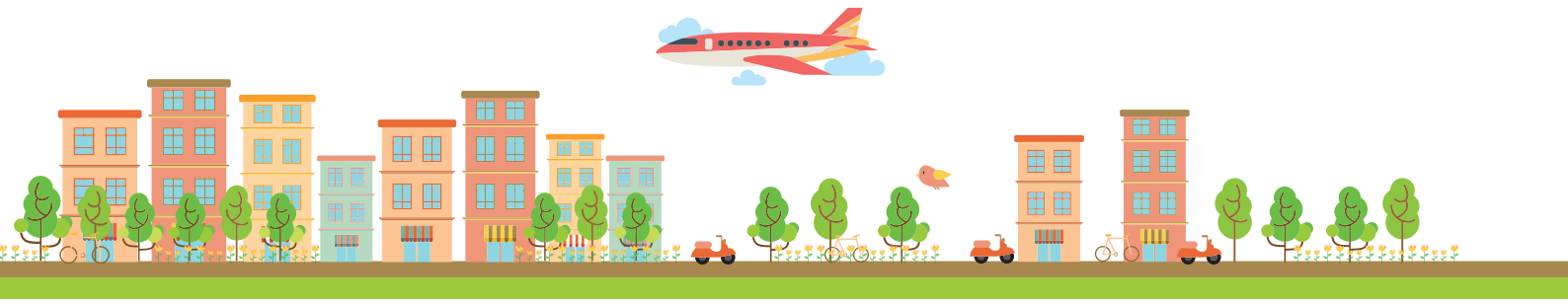

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