



مِنْظَمَةُ الْعَالَمِ الْإِسْلَامِيِّ لِلتَّحْقِيقِ وَالرَّبِّيعَةِ وَالرَّبِّيعَةِ وَالرَّبِّيعَةِ
ISLAMIC WORLD EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
ORGANISATION DU MONDE ISLAMIQUE POUR L'ÉDUCATION, LES SCIENCES ET LA CULTURE

Guidance Document on Green Cities and their Role in Achieving Sustainable Development Goals

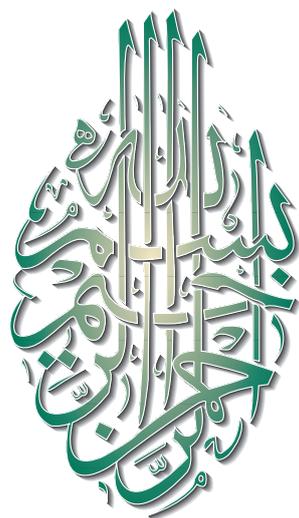


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INTRODUCTION

This guidance document deals with the concept of green cities in terms of their characteristics, criteria and role in achieving sustainability and sustainable development. Cities consume a large amount of natural resources, due to the huge consumption of materials, energy and water and they generate waste and air pollution; hence, developing and transforming cities to be green and sustainable is becoming a must. The high pattern of resources consumption could be significantly managed and mitigated, if cities are developed in line with green and sustainability measures. Countries worldwide are facing a major challenge to meet the needs of urban population growth including housing, infrastructure, transportation, energy and water as well as access to basic services such as education and health care. Cities with non-comprehensive climate action plans, due to the lack of data and tools, are characterized with high GHG emissions amounting to 70 per cent. It has been witnessed during the past decade that climate change severely impacted many cities worldwide as a result of the increasing rate of GHG emissions, mainly CO₂.

Climate Change (CC) has globally gained tremendous attention over the last decade. The Paris Agreement at the end of COP 21, signed by 196 countries, has changed the world's view regarding the imminent impacts of CC risks. There is an urgent need for developing **Green and Sustainable Cities**, and upgrading conventional cities to adopt and incorporate features of a green city such as renewable energy, energy efficiency, waste management and recycling.

Sustainable Development and linking it to cities is becoming vital when it comes to developing cities. Creating cities in line with sustainable development measures, linking urban development and related policies with **sustainable development goals (SDGs)**, particularly SDG 7 (Affordable and Clean Energy); SDG 11 (Sustainable Cities and Communities); SDG 12 (Responsible Consumption and Production); and SDG 13 (Climate Action), is becoming of a prime priority - especially in developing countries.

The **definitions of a green city** are presented, including: Eco-cities, Environmentally Friendly Cities and Sustainable Cities. Nevertheless, other definitions that define a city as Smart, Regenerative and Futuristic along with that introduced by the United Nations, "Resilient Cities" and "Liveable Cities" are also discussed.

Developing of green cities requires the full understanding of the **green city's features** such as: a) Clean and smart transport; b) Green and smart buildings; c) Renewable energy; d) Water management and recycling; e) Waste management and recycling; and f) Sustainable land management. It is also very important in transforming existing cities to meet green measures to apply new technologies and innovation, yet use robust tools to achieve green, sustainable and resilient cities.

The **Criteria for ranking Green Cities** are vital to assess the capability of a city to meet green standards. The most renowned criteria for ranking a green city, include: a) Green City Index (GCI); b) EU Green Capital Programme (EU-GCP); and c) Sustainable City Index (SCI), are highlighted and discussed. Also, the recent "33 Green Indicators" are highlighted and discussed along with examples of selected cities that scored high on the GCI and EU-GCP. The impact of green cities on the economy is tremendous since cities represent 80 per cent of the global GDP, some cities have a long way to go to be green and sustainable, and some cities deserve recognition in their attempt and effort in contributing to that cause.

The **report is organised in six folds**: Part I highlights problems and challenges facing cities and the importance of developing green cities and identify the risks caused by severe events in cities due climate change; and Part II addresses the relationship between Sustainable Development and Cities. Part III presents the green city definitions and features, whereas Part IV reviews the international renowned criteria for ranking a Green City. In addition, Part V is mainly discussing the impact of Green Cities on the economy. Finally, Part VI presents the conclusions and recommendations for a Green City.

PART I

Current situation and challenges

Cities are encountering various strategic challenges to meet green criteria, standards and sustainable development measures. In many countries, the ‘business as usual’ (BAU) model led to these defies, including the colossal population increase. The major challenge is to fulfil the needs of urban population growth that would require housing, infrastructure, transportation, energy and water as well as access to basic services such as education and health care. In poor cities, this situation can be even more troublesome, yet the level of pollution (air, water and land) is rising at an alarming rate. In addition, residents living on marginal lands will face risks from storms, flooding, disease, and above all climate change risks (CCRs).

More than 50 per cent of the world’s population, estimated at about 7.5 billion¹, resides in cities. According to the United Nations (UN), such urban population growth is expected to reach 70 per cent by 2050. The overall growth of the world’s population, merged with urbanization, could add extra 2.5 billion inhabitants by 2050. **Figure 1** shows the world’s top ten fastest growing cities and their projected growth by 2025. In Asia and Africa, this number of inhabitants could increase to reach 90 per cent. The UN Population Division, World Economic Forum presented the population growth of the top 15 Mega Cities, where nine are in Asia and the rest are in North America and Latin America (**Figure 2**). Such growth, in Mega Cities, is predicted to rise from 269 million in 2011 to 364 million by 2025, an increase of 29 per cent³. In the past 64 years alone, the global urban population increased from 746 million to 3.9 billion². This rapid increase in urbanization, is a major problem which puts an enormous pressure on the natural resources, specifically water, energy and raw materials. In this context, cities currently consume 60 to 80 per cent of the global total energy (electricity, transport, etc.) and are responsible for 75 per cent of the natural resources, and 70 per cent of carbon dioxide (CO₂) emissions⁴. Traffic congestion, noise and pollution are now the key negative features in most cities. Asia is already facing vast environmental challenges, particularly China (Beijing and Shanghai). To this end, eleven of the twenty most polluted cities in the world and three of the top five CO₂ emitting economies are in Asia. In Asian cities, losses from traffic-related congestion amount to 5 per cent of Gross Domestic Product (GDP)⁵. With these challenges in mind, and unless local authorities and government develop cities to be green and sustainable and meeting sustainable development goals (SDGs); these challenges will remain to be massive and become catastrophic, not only for most countries, but also for the world.

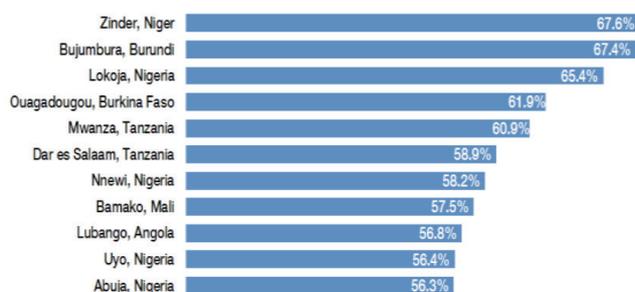


Figure 1: The top ten fastest growing cities in the world – their projected growth by 2025

Image source: <https://www.weforum.org/agenda/2017/02/the-world-s- fastest-growing-cities/>



Figure 2: The population growth in the world's top 15 Megacities (2011-2025)

Image source: <https://www.statista.com/chart/1826/population-growth- in-the-worlds-megacities/>

Climate Change Risks on Cities

During the past decade, climate change (CC) impacted many cities worldwide due to the increase of greenhouse gas (GHG) emissions, mainly CO₂. Cities with non-comprehensive climate action plans, due to the lack of data and tools, are characterized with high GHG emissions amounting to 70 per cent⁶. Promoting and developing Green Cities (GC) will assist in reducing such emissions. Climate change is the main cause to extreme events, weather instability, sea levels rising and with many unknowns concerning the immensity and timing of these impacts. In this context, CCRs are becoming extremely relevant and more climate actions are needed.

Different cities will encounter imminent risks, especially those below sea level and will be most vulnerable to CCRs. Climate change impacts have been manifested in many cities worldwide. In November 2016, the Eastern coast of Egypt - particularly the Governorate of the Red Sea - has been recently hit by severe storms that caused damage to the infrastructure and houses in the city of Ras Gharib. Such storms and floods in the desert area in South East Egypt, led to the discoloration of the River Nile (**Figure 3, 4**). South Korea experienced torrential rain that hit the capital Seoul for several days during October 2016, and resulted in the death of at least 32 people due to landslides and sudden floods⁸ (**Figure 5 and 6**). In addition, Europe faced heavy rain storms and severe flooding in the past year. These storms resulted in thousands being evacuated from their homes and the death of least six people. The Seine River rose 14 feet higher than normal, the highest level since 1982⁷, when severe floods covered Paris. The rising water level from the river banks from Paris to Bavaria threatened homes and business, hence affected the economy. In Southern Bavaria, floods swamped the town of Simbach and led to multiple casualties (**Figure 7, 8**).



Figure 3: Discoloration of the River Nile, Oct. 2015

Image source: <http://www.cairoscene.com/Buzz/Murky-Nile-Causes-Multiple-Water-Purification-Plants-to-Suspend-Operations>



Figure 4: Floods in Ras Gharib, Egypt, 2015)

Image source: <http://racurs.ua/news/78405-v-rezultate-masshtabnogo-navodneniya-v-egipte-pogiblo-26-chelovek-video>



Figure 5: Landslides cover a street with mud beside an apartment block in Seoul, South Korea, 2016

Image source: <http://www.telegraph.co.uk/news/picturegalleries/worldnews/8665688/Torrential-rain-storms-in-South-Korea-lead-to-flooding-and-landslides.html>



Figure 6: Sea waves rising above normal, Seoul, Capital of South Korea, 2016

Image source: <http://www.kazpravda.kz/news/mir/22-cheloveka-pogibli-v-rezultate-navodneniya-v-egipte/>



Figure 7: Floods swamped Simbach in southern Bavaria, Germany. 2016

Image source: <http://www.bbc.com/news/world-europe-36429381>

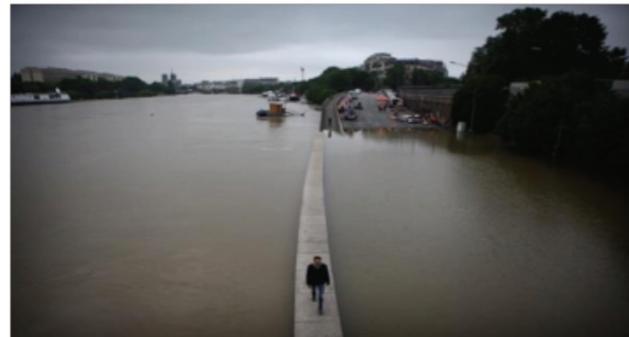


Figure 8: Infrastructure damage due to river Seine rising 14 ft., the highest level since 1982

Image source: <http://www.bbc.com/news/world-europe-36429381>

COP 21 - PARIS AGREEMENT 2015

Climate Change (CC) has gained tremendous attention in Paris during December 2015. The signed Paris Agreement at the end of COP 21 has changed the world's view regarding the imminent impacts of CC and the urgent need for developing sustainable and green cities, yet upgrading the existing conventional cities to include features of green city such as renewable energy, energy efficiency and managing material consumption as well as waste recycling.

For the first time, the Paris Agreement brought all nations to participate in a mutual cause and to commence efforts to adapt to climate change and recommend climate actions. This agreement aims at strengthening the international response to the threat of CC by keeping a global temperature rise this century below 2 degrees Celsius above pre-industrial levels and to join efforts in limiting the temperature increase even further to 1.5 degrees Celsius. These 196 countries have agreed to meet every 5 years in order to set more ambitious targets, report to each other and to the public, and to create a robust goal, with transparency and accountability. In addition, recognizing the significance of preventing losses, reducing possible damages related to CC impacts, working to enhance the understanding of the issue and supporting countries to adapt with CC. To reach these goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be formed, thus supporting action taken by developing countries and poor countries as well, in line with their own objectives⁸.

COP 22 - Marrakech 2016

After COP 21 in Paris, COP 22 has convened in Marrakech from November 8 to 18, 2016. The COP 22 Action Proclamation Calling for “highest political commitment” to combating CC has been manifested in the final declaration, which is boldly summarised as an era of implementation for climate action and sustainable development - **Figure 9**. The International Resource Panel of the United Nations Environment Programme (UNEP) presented 10 key messages on CC; one of these important messages is about cities and their infrastructure is depicted in **Box 2**¹⁰. The essence of the message is mainly concerning developing cities with lesser resource consumption and lower emissions.

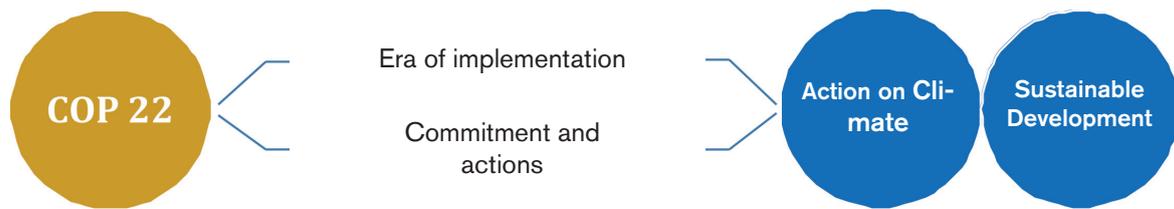


Figure 9: Recommendations of COP 22, Marrakech, November 2016

BOX 1: COP 22

“Our climate is warming at an alarming and unprecedented rate and we have an urgent duty to respond.”

COP 22, Marrakech 2016

BOX 2: Cities and Infrastructure

“Cities and their infrastructure should be designed in ways that they are less resource and emission intensive and which create a less polluted healthier environment for their residents.”

PART II

Sustainable Development and Cities

Cities consume large amounts of natural resources due to the huge consumption of materials, energy and water, and they generate waste and air pollution. Such high pattern of usage could be significantly mitigated - if cities are developed in line with green and sustainable measures. Developing cities in line with sustainable development (SD) measures and linking urban development and related policies with sustainable development goals (SDGs), particularly SDG 7: Affordable and Clean Energy; SDG 11: Sustainable Cities and Communities; SDG 12: Responsible Consumption and Production; and SDG 13: Climate Action, is becoming a prime priority, especially in developing countries.

The de-carbonisation of electricity by utilising renewable energy and enhancing the efficiency of electricity use globally would also assist in realising the 2 Degree Celsius target, achieving SDGs, improving liveability and the viability of cities. Thus, sustainability of urban development should focus on addressing the six dimensions of sustainability (**Figure 10**) in all aspects of cities' development to ensure resilience and offset CCRs.

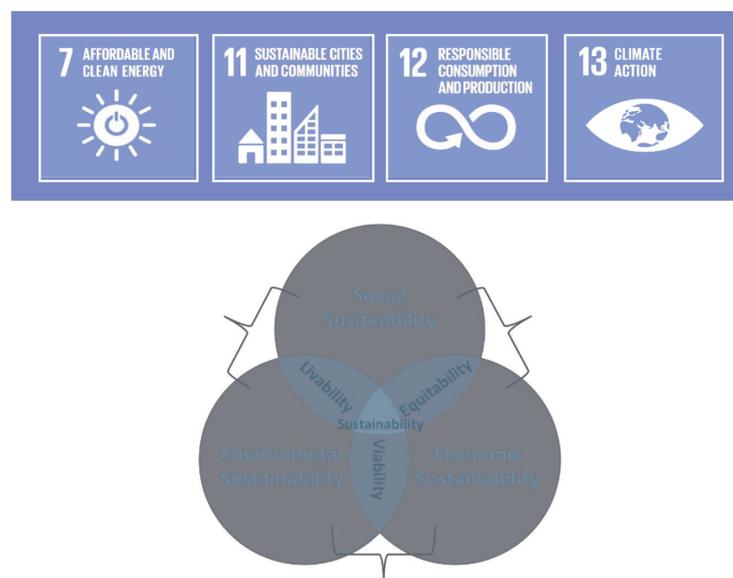


Figure 10: The six dimensions of sustainability for cities' development

The 20th century growth in annual extraction of construction materials, minerals, fossil fuels, and biomass have increased by a factor of 34, 27, 12 and 3.6, respectively. Nevertheless, the total material extraction has increased by 8 times. According to the IRP, the global resource savings of USD 2.9 to 3.7 trillion each year by 2030 can be achieved by decoupling technologies. Improvement in energy and water efficiency are technically possible and commercially viable in many sectors (construction, transport, agriculture, food and hospitality, and industry). This improvement could be estimated to around 60 to 80 per cent. For example, the annual energy

demands could be decreased by more than half over the next 12 years while realizing the development goals, which can be achieved by exploiting currently available technologies and techniques.

In the attempt to create a healthier environment for the city's inhabitants, liveable cities – such as Vancouver and Singapore – combine compact design, green spaces, smart and clean transport, low emissions and good air quality. Solving major challenges such as traffic congestion, air pollution, lack of physical activity and waste management can contribute to the reduction of carbon emissions and pollution, and consequently can decrease health care cost and improve liveability.

BOX 3: William Shakespeare's vision for cities

"What is the city but the people?"

William Shakespeare

Part III

Green City

There are many definitions of cities apart from the well-known that dealt with Green Cities, Eco-cities, Environmentally Friendly Cities and Sustainable Cities. Nevertheless, there are some new definitions that could define cities as Smart, Regenerative and Future cities. The UN has come up with new terms “Resilient Cities” and recently “Liveable Cities”. A Green City is somewhat a loose concordance of Sustainable City, but it does not necessarily mean a Sustainable City. The explanation of a sustainable city is described by many institutions as “Cities around the world that are actively making changes to become more sustainable by recognising the interest, motivations, and models of these cities.” Nonetheless, a city can be classified as sustainable when it is economically viable, socially viable, environmentally viable and financially viable with good governance and institutional enhancement.

Green cities (GCs), cover thousands of urban areas around the world; all determined to decrease their environmental impact by reducing waste, increasing recycling, lessening emissions rate by using sustainable energy (renewable energy and energy efficiency), expanding housing density while enlarging open spaces, and encouraging the development of sustainable local businesses. Cities, with business as usual (BaU) models, are responsible for about 75 per cent of the total CO₂ emissions, which involves a huge portion of global GHG emissions, mostly generated in building and construction, transport and energy sectors. According to the Asian Development Bank (ADB), reducing carbon emissions in cities will require some major actions as shown in **Figure 11**.

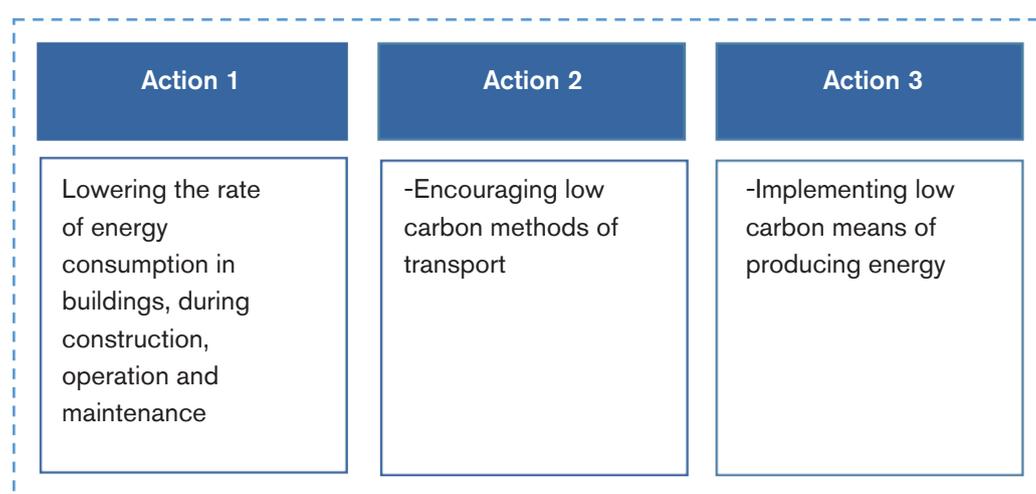


Figure 11: Actions required to reduce carbon emissions according to ADB



Figure 12: Cities worldwide with Green City's features
 Source: <http://www.mnn.com>

One of the best examples of an archetypal green city is Curitiba in Brazil which is classified as one of the world's greenest cities. The mayor of Curitiba, Jamie Lerner, closed six main streets of the city's business district for pedestrians only. This zone is now three times larger and serves as the centre of the bustling metropolis. Also, a high-tech bus (HTB) system has been established to immensely reduce energy consumption, air pollution and traffic congestion. Today, this HTB system serves 2.2 million inhabitants everyday in Curitiba.

Features of a Green City

What makes a city green? Features of a green city include: (a) Investing in clean and smart transport, (b) Green and smart buildings or retrofitting old ones, (c) Use of sustainable energy, (d) Recycling grey water and management, (e) Managing and recycling waste, and (f) Sustainable land management (Figure 12). Although the EPA has not established official criteria for ranking the greenness of a city, there are several key areas to measure for effectiveness in carbon footprint reduction.

Clean and Smart Transport

Singapore

Singapore is ranked third after UAE and Hong Kong for intelligent transport on the WEF Global Competitiveness Index 2016. The country's sophisticated Intelligent Transport System (ITS) uses data collection and solutions to run traffic in a safe and a smooth way. Other transport initiatives were also implemented such as free public transportation in pre-morning peak hours, a vehicle quota system, a congestion charge, and an extensive public transport system. Included in the ITS, is a variety of technologies related to transportation, that is the world's first Electronic Road Pricing (ERP) systems.

BOX 4: Means of clean and smart transport in Singapore

1. Intelligent Transport System – ITS.
2. ITS's Operation Control Centre.
3. Electronic Road Pricing – ERP.
4. Free morning Transport in pre-peak hours
5. GPS on Taxis.
6. Parking Guiding System – PGS.

The ERP utilizes an in-effect congestion charge, it uses a system of short-range radio communication that deduces charges from smart cards incorporated in all vehicles; it charges according to traffic flows and the time. Other elements include a monitoring and an advising system, alerting drivers to traffic accidents on main roads, also a GPS on taxis that monitors and reports traffic conditions around the city and a Parking Guidance System (PGS). The PGS collects data on the available parking spaces and displays the collected data on electronic panels located across the city. Cars, searching for parking spots, can view the parking options from the road. Therefore, reducing time and fuel in the journey of searching for parking spots in the most congested areas of the city. Information from various sources feed into the Operation Control Centre ITS, in which it is processed, and then provided to the public as active information (**Figure 13**). It is a massive achievement bearing in mind that the population has exceeded the double since 1990. In Cairo, Egypt the PGS has been introduced and in operation since December 2015 for the main car parking in Tahrir Square.



a. ITS Operation Control Centre
Image Source: <http://jbabiesdad.blogspot.com/2013/01/the-intelligent-transport-systems-centre.html>



b. Electronic Road Pricing – ERP
Image Source: <https://vulcanpost.com/255021/new-virtual-cashcard-banish-erp-trouble/>



c. Parking Guidance System – PGS
Image Source: <http://jbabiesdad.blogspot.com/2013/01/the-intelligent-transport-systems-centre.html>

Figure 13: Clean and smart transport in Singapore

BOX 5: Cities incorporating ERP as clean & transport system in Asia, Europe and North America

- | | |
|---------------|---------------|
| Singapore | Dubai |
| Hong Kong | London |
| Milan Toronto | Stockholm |
| | San Diego, CA |

BOX 6: Key points for BRT system in Bogota, Colombia

Ultra-efficient bus and taxi fleets.

1. Bus Rapid Transit system (BRT), launched in 2000, shuttles over 70% of the city's 7.1 million persons.
2. Future goals are: replacing all city's diesel fleet with hybrid & electric buses, and electrifying the entire taxi fleet.
3. Adding a new metro line.

Lagos, Nigeria

In the city of Lagos, clean and smart transport – as a feature of a green city – was introduced to mitigate CO₂ emissions, lower air pollution and improve health and environment. In Nigeria, particularly Lagos, Bus Rapid Transit (BRT) system, led to the reduction in CO₂ by 13 per cent, and the journey time has been reduced by up to one half for a growing number of commuters¹⁰. Thus, it is considered a promising step towards making one of Africa mega cities' Green.

Casablanca, Morocco, Dubai, UAE and Cairo, Egypt

The city of Casablanca introduced an electric tram network for better mobility that encourages public transport. This helped in reducing the CO₂ emissions in the city. Many citizens are shifting from private to public transport in the crowded city to save time. Between 2012 and 2013, 21.812 million passengers have travelled aboard the Casablanca tramways. In November 2014, Dubai also started the operation of a new tram network (11 km track) to link Dubai metro to residential districts nearby (**Figure 14**). The tram serves 10,500 passengers daily since opening and moving 3.725 million passengers yearly²². Egypt announced a new monorail to connect three cities in the Greater Cairo metropolitan area.



a. Electric tram network in Casablanca
Image: Author



b. New electric tram in Dubai
Image: http://gulfnews.com/polopoly_fs/1.1408579!/image/jpg_gen/derivatives/box_475/3073944895.jpg.3073944895/

Figure 14: Clean and smart transport in Casablanca, Morocco and Dubai, UAE

Green and Smart Buildings

Generally, buildings' roofs form about 22 to 30 per cent of the city's fabric, whereas pavements (roads and parking areas) comprise 30 to 40 per cent and the rest is for green and water areas. The main purpose of green and smart buildings is to provide enhanced life experience while integrating all aspects of intelligent systems, including energy management, lighting, comfort and security (**Box 7**).

To create a smart and green city, smart buildings have to be included as they improve the quality of the citizens' lives which, in fact, is the core of smart city formation²⁴. Through the developing green and smart buildings, they should include low-tech systems (Green roof and green wall) and high-tech systems (Renewable Energy and Building Energy Management System - BEMS).

BOX 7: Smart building components

- Building envelope & façade control
- Security & surveillance systems
- Heating, Ventilation & Air Conditioning (HVAC)
- Water management systems
- Parking management systems
- Building Energy Management System (BEMS)

Portland, USA

One of the successful cities that adopted a Green Building Policy is the city of Portland – Oregon, USA. This policy requires new construction and major renovations of the city's facilities to meet a certified level of LEED. Building construction projects, operations and maintenance will be financed at an appropriate level for the execution of the Green Building Policy. The city of Portland – OR has the highest percentage of green buildings. **Box 8** presents some of the requirements for new city- owned construction projects in Portland - OR.

BOX 8: Portland's Current Requirements for New City-Owned Construction Projects

- Recycle 85% of all construction and demolition (C&D) waste;
- Have 30% water savings beyond the Energy Policy Act of 1992 baseline requirements,
- Use no potable water for building landscaping, except during first two years,
- Have 30% energy savings beyond LEED baseline requirements,
- Use building commissioning strategies required to be eligible for the Sustainable Building Business Energy Tax Credit,
- Include an eco-roof with at least 70% coverage and high reflectance and Energy Star- rated roof material on any non-eco-roof surface area, and
- Incorporate renewable energy systems when possible or required by state policies.

Al-Bahar Smart Towers – Abu Dhabi, and World Trade Centre 1 – Bahrain

A smart building adapts to its surrounding while ensuring the maximum comfort and quality of living for the occupants. One of the most successful smart building is the Al-Bahar twin towers in Abu Dhabi. The tower was formally sheathed in a glazed curtain wall that was not ideal for the desert climate, therefore a secondary sun screen was built to offset the glare without permanently blocking the views and daylight (**Figure 15.a, b**). The secondary sun screen is in the form of series of faceted fiberglass rosettes which open and close in response to the temperature of the façade. Such screen is estimated to reduce solar gain by more than 50 per cent, therefore reduce the energy needed for air conditioning. The buildings' facades are computer controlled to respond to optimal solar and light conditions. Another example is the World trade Centre in Bahrain (**Figure 15.c, d**). The building integrates large- scale wind turbines into its design in order to raise global awareness for sustainable design. The three 29 meters diameter wind turbines are supported on 31.5 meters long bridges (70 ton) between the towers; each turbine generates 225kW. The initial energy yields during the design phase was approximately 15 per cent of the total energy consumed.

Renewable Energy

Many cities are primarily focusing on sustainability and renewable energy (RE). To achieve SDG 7 and SDG 11, the increase of sustainable energy, particularly RE share is significant. Renewable energy is a clean source to generate power and it lessens CO₂ emissions and creates less pollution. Also, it provides better energy security and resilience to external shocks. **Box 9** shows the three main areas in which any city can utilise RE. In addition, investing in RE will provide new jobs and bigger economic opportunities in cities. According to IRENA, doubling the share of renewables in the global energy mix by 2030 can provide millions of new jobs, improve health and boost the global economy by up to USD 1.3 trillion. To promote RE in a city, citizens' support is essential. Promoting RE also depends on whether targets and policies are set at the national or local level, and the level of control that cities have over utilities. For example, Egypt has set a RE target of 22 per cent by 2022.



a. Al-Bahar smart towers in Abu Dhabi



b. The smart façade



c. Bahrain World Trade Centre



d. The three installed wind turbines

Figure 15: Al Bahar towers, UAE and Bahrain's World Trade Centre as Smart buildings.
Images: <http://gizmodo.com/5-smart-building-skins-that-breathe-farm-energy-and-g-1254091559>

BOX 9: Cities can accelerate the share of RE in 3 priority areas

1. Renewable energy in buildings.
2. Sustainable options in transport.
3. Creating smart integrated urban energy systems

Water Management and Recycling

Twelve per cent of all fresh water is consumed in buildings, which contribute to the generation of solid waste estimated at 40 per cent of the total volume from buildings. Water demand is projected to overshoot supply by 40 per cent by 2030, if efficiency of water use isn't improved. There's a huge pressure on water resources from the increase of population, economic growth, climate change, pollution, and other challenges thus it forms major impacts on our social, economic, and environmental well-being. Almost 50 per cent of the global wetland have been lost of development. Water became in worst quality, thus threatening ecosystem and health. Globally, 780 million people lack access to clean water. The water problem is rooted in poor management, ineffective institutions and improper economic incentives, in addition to failure in applying new technologies and innovation.

Recycling Waste

Every year the world produces a massive 2.12 billion tons of waste. About 2,145 million tons of waste were treated in the EU (2014). According to the UNEP, wastewater management is one of the six green economy sectors. Managing and recycling waste is extremely important since waste has a negative impact on the environment and human life (Box 10). Waste releases GHG emissions, mainly CO₂ and Methane that negatively affect the environment and people living in cities.

BOX 10: Benefits of Recycling on the Environment and Human life

Environment

- Waste landfills release harmful chemicals & GHGs. Hence, recycling helps to reduce these emissions,
- Global warming is an affect of deforestation. The need for raw materials will be reduced through recycling, and
- Recycling can reduce the energy consumed in producing from raw materials and help save natural resources.

Human Life

- Recycling reduces production cost instead of making products from raw material, and
- It helps preserve natural resources for future generations. Recycling reduces the need for raw materials; it also uses less energy, therefore preserving natural resources for the future.

Sustainable Land Management

Sustainable land management integrates the management of land, water, biodiversity, and other environmental resources to ensure the long-term sustainability of the eco-system's livelihoods. As a part of land management, increasing green and open spaces can be a huge benefit to the environment, hence, the quality of life (livability) in cities is improved. Green spaces filter pollutants and dust from the air, in addition to providing shade, decrease temperature in urban areas and help in reducing erosion of soil into waterways.

BOX 11: Example of the “Green Indicators”

1. Looking at the total energy attained by a city through its renewable resources thus measuring its renewable energy usage,
2. Air pollution percentages on a daily basis,
3. Public transport frequency of use, and
4. Various economic and social variables.

Part IV

Criteria for Ranking a Green City

There are many methods to assess the level of cities to meet green standards. This includes: a) the Green City Index (GCI); b) EU Green Capital Programme (EU-GCP); and c) Sustainable City Index (SCI). One of the most recent methods for assessing eco-cities is the one developed by Lawrence Berkley National Laboratory in California which includes 33 Green Indicators according to a study published in 2015. These 33 Green Indicators were developed to assess Chinese cities. There are also 14 other international methods to assess Green Cities. To measure the city's level of greenness or its relation to the environment is rather complex and challenging from an analytical view point. Nevertheless, the term “eco-city” in itself is ill-defined through the years as there is no 100 per cent assurance of its exact definition. Some of the cities that incorporated green features and measures are in Germany, particularly HafenCity, and Tianjin's Eco-city in China as well as in Malmo, Sweden.

One of the well-established indicator systems is the European Green Capital Programme (EGCP) which is known for its robust and detailed assessment of various areas such as Wastewater treatment, Noise pollution, Air quality, Biodiversity, and Green Spaces as shown in **Figure 16**. The only shortfall of EGCP, it is confined to European cities. The result of assessing European cities led to winning the title of GC; these cities are Copenhagen, Denmark (2014), Bristol, UK (2015), and Ljubljana, Slovenia (2016). Another prominent indicator system is the “Green City Index” (GCI) developed by “The Economist Intelligence Unit” sponsored by Siemens. In such system, indicators are: energy and CO², water, air quality, transport, and waste. In general, this programme is covering Europe, Latin America, North America (US and Canada), Africa and lately, Asia.

BOX 12: European Green Capital assessment Criteria⁴⁹

- Climate Change & energy performance,
- Mobility,
- Biodiversity & Land Use,
- Quality of Air & the Acoustic Environment,
- Waste Management & Circular Economy, and
- Water & Wastewater management.

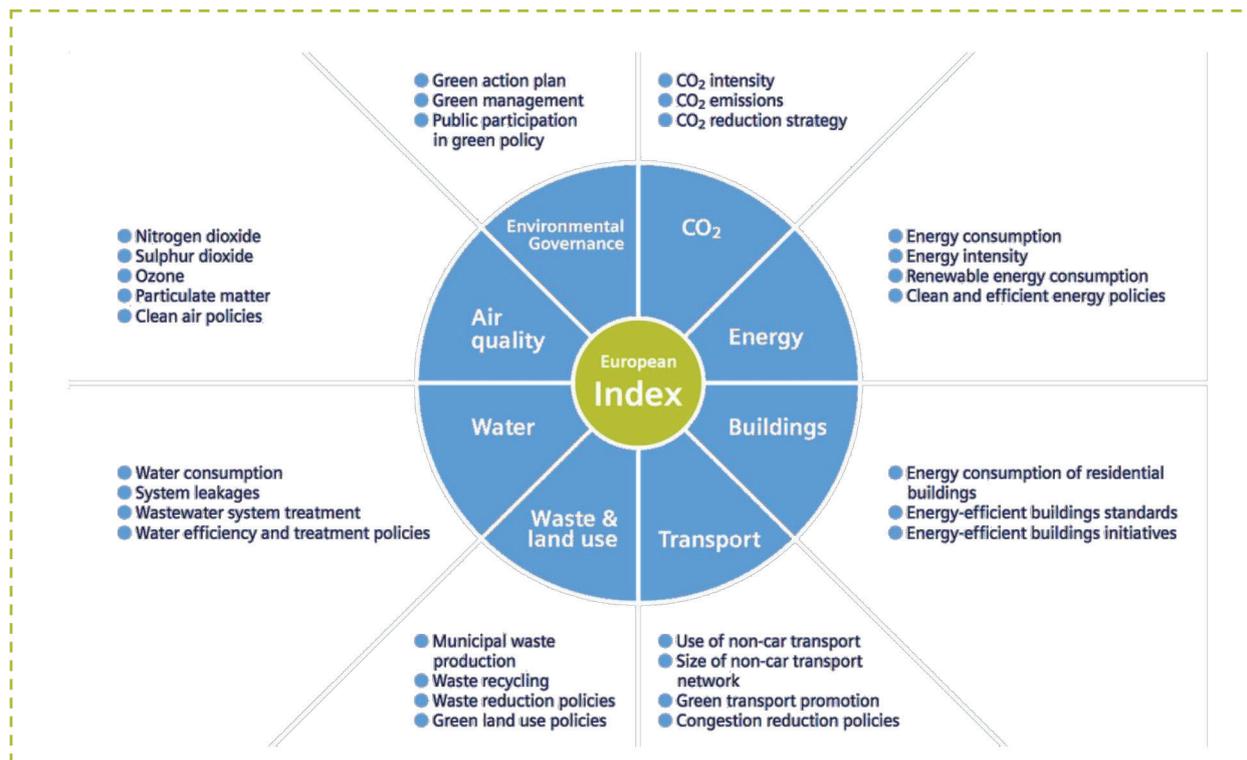


Figure 16: The European Green City Index evaluates 16 quantitative and 14 qualitative indicators

Innovation and New Technology

Cities nowadays should address innovation and be more interactive in regards to be transformed into green and sustainable cities. New technologies play a major role in making cities green, smart and sustainable, especially when it comes to technology related to managing the city, its transport system and sustainable energy (renewable energy and energy efficiency)

Innovation

New innovation has been applied in many cities around the world to support forward thinking in making cities green, smart and sustainable, and helping the residents to live a healthier life and enjoy liveability. Cities Climate Leadership Group - C40 has listed many cities that featured innovation through some programmes and systems.

New technology

Due to the high number of cities facing congestion problems in the past 10 years, new technologies have been widely adopted and implemented to overcome such challenges. This has been manifested in Buenos Aires, where a bike-sharing programme and Bus Rapid Transit (BRT) system were implemented as part of climate adaptation and reduce the city's carbon footprint.

BOX 13: Data of the CURB Tool to support City's officials

- a. Implement a set of climate-smart options.
- b. Set achievable goals.
- c. Simulate technology & policy changed to determine the best course of action.
- d. Analyse deeply the project's financials.

Many tools have been also used to process data to update Climate Action in cities. One of these new tools is called Climate Action for Urban Sustainability (CURB), which was developed by The World Bank along with C40 Cities, the Compact of Mayors, and other partners. The CURB main role is to intricately provide assessment and analysis which in turn offers support to governments in planning highly effective approaches to combat carbon emissions. The city-related data are processed by CURB to estimate the cost, viability, and effect of different scenarios of climate actions. Box 13 highlights the process in which the CURB tool aids the city's officials.

The new technology tool was first used in Buenos Aires where CURB'S user-friendly graphics, financial projections, and other features were applied to help city planners to enhance communication and improve coordination within the city government. Regardless of the state of the city planning methods in using such tool, CURB is considered to be a strong worldwide tool to use worldwide, meaning it can be used in both developing and developed countries.

PART V

Impact of Green Cities on Economy

Cities worldwide form 80 per cent of the global GDP. Consequently, cities have a major impact on the economy based on the lifestyle, balance between consumption and production, managing resources, minimising wastes, and improving efficiency. Therefore, Green cities can further improve the economy (**Box 14**). Nevertheless the UNEP launched an initiative on green economy where sustainable cities and green buildings are one of its major sectors. Green cities impact the national economy. For example, managing waste might yield in savings in energy of an equivalent of USD 16.6 trillion by 2050 not to state all the benefits sustainable cities will attain.

BOX 14: New climate economy

According to a research carried out by the New Climate Economy, investing in sustainable urban infrastructure such as public transport would improve the quality of life in the city.

Building green and sustainable cities of the future could be challenging to some nations. Financial situation will be at a rough start and investing might be challenging at first but cities are piling up to express interest. Results, both functionally and financially as investments, are already manifested. Developing green cities can also assist in creating new jobs resulting from adopting of the below six sectors of the green economy.



SECTION 2

Master Plan of model green cities



- **Green areas**, in order to increase biodiversity proliferation inside green urban spaces, to improve life quality standards of inhabitants, to rise up property value in surrounding context and to increase the population of endangered species inside urban green areas.

GREEN

GREEN CORRIDORS

RECREATIVE SPACES

NATIVE VEGETATION SPECIES

STRATEGIC ACTIONS

PROMOTE GREEN CORRIDORS, WHICH MAY PERMIT THE CONTINUITY OF A SYSTEM AND THE CONNECTION BETWEEN URBAN, SUBURBAN AND RURAL GREEN SPACES, IN ORDER TO PROTECT AND ENHANCE BIODIVERSITY AND ECOLOGICAL HABITATS

PROVIDE TO CHILDREN AND YOUNG PEOPLE PLAY AND RECREATION SPACES, ALSO RELAX, CULTURAL, SOCIAL, RECREATIONAL, SPORTING AND COMMUNITY FACILITIES

RISE PROPERTY VALUE AND AID CONTEXT REGENERATION, WITH THE INSERTION OF AN OPEN SPACE WHICH MAY REINFORCE COMMUNITY IDENTITY AND PRIDE

PROMOTE THE CONDITION FOR LOCAL FOOD PRODUCTION AND FOR THE REPRODUCTION OF ENDANGERED NATIVE VEGETATION SPECIES (TO GUARANTEE THEIR SURVIVAL)

USE ONLY NATIVE SPECIES IN ORDER TO AVOID THE RISK OF ILLNESS AND BIODIVERSITY DESTRUCTION

- **Water:** to review and to modify the city's regulation to establish that new construction provides its own rain water system cycle and its reuse for cleaning purposes, toilets and irrigation that stimulate the reduction of charges into city's drainage system during heavy rain periods as well as the reduction of urban heat wave and heat perception in open spaces, providing 100% of water resource for irrigation of green areas, edible gardens and green houses.

WATER

STRATEGIC ACTIONS

APPLICATION OF PHYTO-DEPURATION SYSTEMS ON NEW CONSTRUCTION BUILDINGS

COLLECTION AND MANAGEMENT OF RAIN WATER ON NEW BUILDING ROOFS AND NON-PERMEABLE SOIL, CONNECTING THE OVERFULL SYSTEM WITH THE RAIN WATER SYSTEM OF THE PARK

COLLECTION AND MANAGEMENT OF RAIN WATER FROM SURROUNDING STREETS, AS WELL AS THE NON-PERMEABLE SOIL AREAS INSIDE THE PARK USING A SUSTAINABLE URBAN DRAINAGE SYSTEM (SUDS), TO REDUCE THE RISK OF STREET AND RIVER FLOODS

DISTRIBUTION

CREATE AN ECO-LAKE FOR THE STORAGE OF PHYTO-DEPURATED RAIN WATER, USING THIS OPEN WATER SOURCE TO LOWER THE URBAN HEAT WAVE IN THE AREA AND SURROUNDING CONTEXT

USE RAIN WATER FOR THE CREATION OF A NEBULIZATION SYSTEM USING FOUNTAINS, SPRINKLERS AND WATER GAMES, TO LOWER DOWN THE CLIMATE TEMPERATURE IN THE AREA DURING THE SUMMER SEASON

USE RAIN WATER FOR THE PARK, URBAN FARMING AND GREENHOUSES IRRIGATION SYSTEMS

PROVIDE FRESH WATER POINTS FOR COMMUNITY CONSUMPTION (FILTRATED AND STERILIZED);

- **Mobility:** promoting and develing urban mobility with ecologic devices as electric cars and buses; increasing the diffusion of pedestrian and cycle pathways, in order to guarantee the system continuity, allowing access to each point of the city and providing the installation of recharging points for private and public electric transport. Beside the increased cycle parking areas, to simplify connections and private mobility encourage people to move with public transport.

- To envelop existing cycle paths and pedestrian ways
- To simplify pedestrian mobility through different thematic paths
- Green passages and fully-equipped areas
- To create a pecking order between different communication networks
- To ensure public acces to green areas
- To increase the percentage of people using bike sharing system
- To introduce car sharing in urban mobility network

- **Lighting and photovoltaic production:** the installation of photovoltaic cells increase usage of solar energy to power public transport. The architectural integration of PV in covered pedestrian pathways allow the installation of self-sufficient lighting system



- **Waste:** with the aims to reuse of around 780 tons of organic waste in fertilizers and biogas production; to recycle electronic devices that are usually released into non differentiated waste; to create a new waste collection system based on incentives for the community, using waste as an economical resource.

STRATEGIC ACTIONS

INTRODUCE AN ECOLOGIC ISLAND WITH THE MAIN SCOPE OF RECYCLING ORGANIC WASTE, CARTON AND PAPER. ORGANIZE COMPOST FOR FERTILIZERS PRODUCTION AND BIO-GAS PRODUCTION WITHIN THE INDUSTRIAL AREA (APEA). WHILE THE PAPER AND CARTON WILL BE USED TO PRODUCE PACKAGING FOR THE KM 0 FOOD PRODUCTION AND MARKET

INSTALLATION OF SMART COLLECTORS FOR ELECTRONIC REFUSE IN ORDER TO RECYCLE ELECTRIC AND ELECTRONIC DEVICES PROPERLY

DESIGN A NEW COLLECTION SYSTEM FOR NEW BUILDINGS INSTALLING REFUSE DUCTS WITH ACCESS IN EVERY STORY OF THE BUILDING

INSTALLATION OF UNDERGROUND REFUSE BOXES AND IMPLEMENT A CODE-BAR SYSTEM TO PROMOTE A PROPER SEPARATION OF REFUSE PACKAGES. ALLOWING THE SYSTEM TO BE SUSTAINABLE ECONOMICALLY AND TO MANAGE AN INCENTIVE/SANCTION METHOD APPLICABLE TO EACH UNIT

RECYCLE ORGANIC WASTE, CARTON AND PAPER

FERTILIZERS

SMART COLLECTORS FOR ELECTRONIC REFUSE

Green urban area as civic meeting and integration spaces

The positive impacts allow to increase education, perception, and conception towards new environment developments, introducing local food consumption at local school and education centres

- **Social gardens and local food production** with the aims to satisfy local community needs by a local food production, increasing social integration and cooperation among new scheme of green/open areas. The awareness towards environment and the importance of local food production encourage the reuse of recycled waste transformed in-place into fertilizers and packaging.

OBJECTIVES



- **Educational dimension**
 - Educate and involve the community into the project development in order to guarantee its success and sustainability
- **Social Dimension**
 - Encourage the development of degraded areas and unused agricultural lands
 - Stimulate Community Integration and Participation
- **Ecological dimension**
 - Preserve and increase biodiversity status inside an urban context (maintaining traditional land production)
- **Economical dimension**
 - Create new 'green' jobs in order to Increase local economy
 - Creation of Joint Purchasing Groups

STRATEGIES



- **Educational Dimension**
 - Creation of a web site that provides informations on urban gardens, 0 km market, Joint Purchasing Groups, ...
 - Use of urban gardens also with an educational and therapeutic way
- **Social Dimension**
 - Create structures where people can make a range of activities in order to increase socialization
- **Ecological Dimension**
 - Use of technological innovations studied by Local Excellence Research Centers
- **Economical Dimension**
 - Creation of new green jobs (urban gardens, markets, eateries)
 - Application of an Economic Sustainable Model

ACTIONS

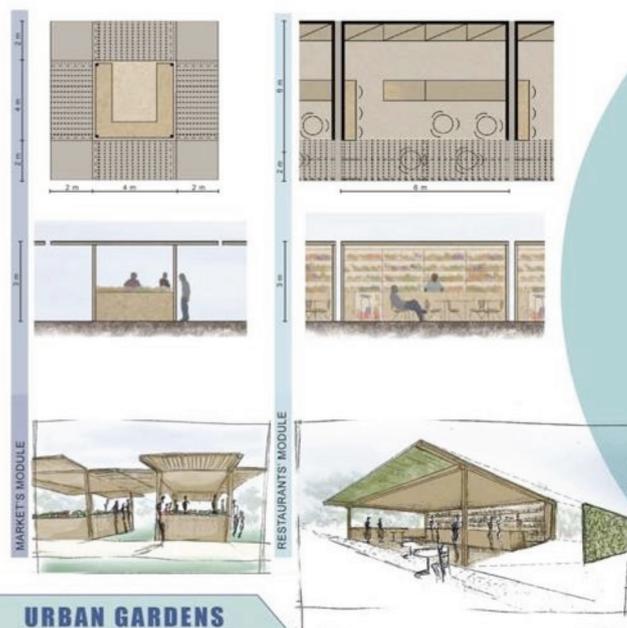
GARDENS



- There will be a range of urban gardens that are going to be gestured by different groups of people (students, elderly, ecc.)
- A number of green houses will guarantee the productions independence of the weather conditions
- Design, achievement and gesture of a research program in order to promote the relationship between sustainable lifestyle and agrivismo
- Urban gardens will be managed by a Consumer Cooperative: the employees will be people in need like unemployed, graduates, ecc..
- Development of criteria and tools for promoting the improvement of the eco-friendly urban gardens
- Use of the gardens also with an educational and therapeutic way

- **Km 0 market:** to create a Km 0 market, in order to promote a sustainable local food production cycle, to reduce transportation costs and CO₂ production and to stimulate social integration. The met of a flexible model that may respond in dimension, quantity and activities according to citizenship demands and/or requirements, allow to integrate G.A.S system as a support for market publicity and business plan.

MARKET _ EATERIES



- MARKET: 324 mq
9 modules 6x6 m
- EATERIES: 108 mq
3 modules 6x6 m
- TOILETS: 36 mq
1 module 6x6 m



URBAN GARDENS

Conclusions and Recommendations

Conclusions

Over half of the world's population lives in urban areas, and this number will increase to 70 per cent by 2050. Meaning that around 3.9 billion people live in cities, and that number will continue to increase. Such increase puts a major pressure on natural resources such as water and energy and materials which will eventually deplete if cities continue their current use as Business as Usual (BaU). As cities around the world exhaust large amounts of natural resources and consume a huge quantity of materials, energy and water and also generate waste and air pollution; developing and/or transforming cities to be green and sustainable is becoming a must.

The lack of comprehensive climate action plans in cities supported by significant data and robust tools has led to high GHG emissions amounting to 70 – 75 per cent. Hence, climate change has severely impacted many cities worldwide as a result of the increasing rate of GHG emissions, mainly CO₂.

Climate Change has globally gained tremendous attention over the last decade. The signed Paris Agreement at the end of COP 21, signed by 196 countries and followed by COP 22 in Marrakesh is a clear manifestation of such commitment that changed the world's view regarding the imminent impacts of Climate change and the global joined actions to keep and increase adaptation measures to offset climate change risks.

Climate change risks have to be taken into consideration in making the national strategies and policies. With that tremendous growth of population and the imminent environmental risks, there's a dire need for the development of green and sustainable cities. Governments should take measures in decreasing the use of fossil fuel, and start investing in Renewable energy. In addition, cities at risk of climate change should quickly start developing adaptation measures to fight the impact of severe events caused by climate change risks.

There is an urgent need for developing Green and Sustainable Cities, and upgrading conventional cities to adopt and incorporate features of a green city such as renewable energy and energy efficiency, and managing material consumption as well as waste management and recycling. Sustainable development of cities is becoming vital when it comes to developing cities.

Creating cities in line with sustainable development measures, linking urban development and related policies with sustainable development goals (SDGs), particularly SDG 7 (Affordable and Clean Energy); SDG 11 (Sustainable Cities and Communities); SDG 12 (Responsible Consumption and Production); and SDG 13 (Climate Action), is becoming of a prime priority for governments, especially in developing countries. Thus, there is an urgent need to broaden the understanding at the local authorities' level of the definitions of a green city along with actions required to reduce carbon emissions in cities are presented and discussed.

Developing of green cities requires the full understanding of the green city's features (Clean and smart transport, Green and smart buildings, Renewable energy, Water and waste management

and recycling; and Sustainable land management). It is also very important in transforming existing cities to meet green measures to apply new technologies and innovation, yet use robust tools to achieve green, sustainable and resilient cities. The criteria for ranking Green Cities must be included in the city planning and assessment of a city to meet green standards. The most renowned criteria for ranking a green city, include: a) Green City Index (GCI); b) EU Green Capital Programme (EU-GCP); and c) Sustainable City Index (SCI), are highlighted and discussed. Also, the recent “33 Green Indicators” are highlighted and discussed along with the examples of cities that scored high on the GCI and EU- GCP which should be portrayed as good models to be adopted.

Recommendations

Some of the **recommendations** are:

1. Raise regional awareness on climate change risks and adaptation measures.
2. Assist developing countries and countries at risk of climate change in developing green cities.
3. Develop policies and strategies to promote green, smart and sustainable cities.
4. Support and set climate actions, including current cities’ resilience to combat CC risks.
5. Start the transformation of conventional cities to be smart and adopt green measures.
6. Encourage government and communities to limit or decrease their GHG emissions.
7. Increase Renewable Energy and energy efficiency in areas such as transportation, buildings and generating electricity.
8. Invest in making green and sustainable cities as well as energy efficient and green buildings.
9. Reduce energy consumption in buildings; during construction, operation and maintenance.
10. Constitute legal measures on new construction projects to be green and sustainable.
11. Recycle waste and limit production with non-biodegradable materials.
12. Make water use rational through awareness campaigns and utilising new technologies.
13. Reuse and recycle waste-water and waste-to-energy.
14. Encourage clean, sustainable and smart transport, mainly public transportation, Bike lanes and Bikes’ sharing parking areas in cities.
15. Increase green open spaces and encourage walking paths for better health benefits to make cities liveable.
16. Adopt new technologies and innovation in cities.
17. Foster collaboration between stakeholders to promote green cities in the Islamic world.
18. Establish best practice Award for Green City in the Islamic world.
19. Enhance capacity building in the local authorities to assist in developing green cities.
20. Establish an effective mechanism of green crediting in the financial institutions to promote developing green cities.