

## Low Carbon Growth, Climate Change and Sustainable Development Nexus: The Tale of Hong Kong

*Anutosh Das\**

*Assistant Professor, Department of Urban & Regional Planning,  
Rajshahi University of Engineering & Technology (RUET), Rajshahi, Bangladesh.*

*\*Corresponding Author*

*E-mail Id:-anutosh@urp.ruet.ac.bd*

### **ABSTRACT**

*Balancing the three dimensions of sustainable development: economic, social and environmental is a complex task. Creating the conditions for sustainability is precisely an attempt to bridge these three dimensions of sustainable development. However, reducing carbon emission and sustainable development are closely allied. Maintaining a low carbon growth path consequently makes a city more efficient, livable and eventually sustainable. The challenges are rather more complex for ever-growing metropolises to make and maintain a healthy balance among carbon emission reduction and sustainable development. Hong Kong, one of the most densely populated cities with a very high population-land ratio and world's most significant financial center [13], faces considerable challenges to promote sustainability in real terms. The government of HKSAR has already put much effort to encourage sustainable development in Hong Kong ranging from formulating "Council for Sustainable Development", "Sustainable Development Fund (SDF)" to stimulating public awareness as well as integrating community participation toward the promotion of sustainable development [5]. Alongside, to maintain a healthy balance between the mounting economic growth and urban sustainability of Hong Kong, a clear understanding of the complex nature of sustainable development and the intertwined nexus among its drivers is vital. Therefore, this research paper is primarily an attempt to offer a comprehensive understanding of the relationship between low-carbon growth and urban sustainability integrating global climate change impact. Moreover, it will look closely into the carbon footprint of Hong Kong and thereby suggesting options to reduce carbon emission to proceed toward a low carbon city as well as promoting sustainable development through systematic review of literatures.*

**Keywords:-** *Climate Change, Low Carbon City, Sustainable Development, Carbon Footprint.*

### **INTRODUCTION**

The world is increasingly becoming urban with a lion's share of its population is already living in the urban areas and the number is projected to grow nearly seventy percent by 2050. Being home to a large number of population, to meet their ever-increasing energy demand, cities are conceived as the main contributor of world's energy-related greenhouse gases (GHG) emission [1]. In such a situation, cities must serve its population; primarily the vulnerable ones, in an efficient, well-

managed manner toward a sustainable future. But to do that, one of the foremost challenges for cities is to take immediate action to reduce its carbon emission and leading to inclusive and sustainable urban growth. The situation exacerbates by additional problems such as the continuing influx of urban population and growing needs for energy demands. Uninterrupted economic growth has eventually resulted in a high standard of lives with a major transformation of the built environment [8].

**THE NEXUS BETWEEN LOW-CARBON CITY AND URBAN SUSTAINABILITY**

Sustained economic growth and inclusive urban development must be concentrated in cities side by side to accommodate the massive urban population. But with continuing economic growth, the persuasion of a high standard of life and oblivious lifestyle, cities are creating new resource constraints and thereby results in

as a potential Green House Gas (GHG) emitter and eventual contributor to global climate change [7]. Meanwhile, cities can take an effective role in mitigating the impact of climate change by reducing GHG emission. Becoming a low carbon city henceforth offers a variety of co-benefits ranging from sustainable, livable and environment friendly urban development to generally a high quality life with cost savings [1].

Smart urban form and spatial development	Energy-efficient industry and buildings	Low-carbon vehicles and a public transport-oriented system	Low-carbon waste management and other services
<ul style="list-style-type: none"> <li>• Preserved agricultural land</li> <li>• Reduced contingent financial liabilities</li> <li>• Improved rural land compensation and equity concerns</li> <li>• Limited encroachment into sensitive sites</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced air pollution</li> <li>• Improved energy security</li> <li>• Enhanced energy efficiency and industrial competitiveness</li> <li>• Increased resource efficiency in buildings and heating</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced congestion</li> <li>• Reduced air pollution</li> <li>• Improved traffic safety</li> <li>• Increased urban livability</li> </ul>	<ul style="list-style-type: none"> <li>• Improved solid waste management</li> <li>• Reduced air pollution</li> <li>• Increased efficiency of water resource utilization and protection</li> </ul>

*Fig.1:-Juxtaposition of Sustainable Urban Development Objectives and Low-Carbon Growth. [1]*

Low carbon development is an important indicator in measuring a city’s overall performance toward sustainable development [1]. Therefore, sustainable urban development strategies and low carbon growth are closely associated and result in a healthy balance among the threefold dimension of sustainable development as exemplified in Figure 1.

A clear understanding of the city’s carbon footprint is of paramount importance toward offering a low carbon transition[1]. Low carbon city development objective particularly focuses on how to curtail its overall carbon footprint by minimizing or abolishing the fossil fuels energy dependency without compromising its economic development potential. But it is rather complex to identify what constitutes

a low carbon city as calculation of city’s overall carbon footprint is dependent on several multidimensional factors as the energy intensity, total GDP as well as energy mix of the city. Whereas, city’s energy intensity itself is a complex determinant constitutes of population density, life standard, economic structure, infrastructure services, climate and so on. The fundamental theme of the nexus between low carbon city and sustainable development particularly lies in the aspiration to move toward a low carbon community as well as promoting economic prosperity and healthy built environment side by side incorporating the necessary climate adaptation and mitigation measures adopted and integrated in the future city development initiatives [1,2,4,9].

**CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT OF CITIES**

Cities are particularly vulnerable to climate change impacts as they are significant sources of greenhouse-gas and contribute more to global climate change emissions. Responding to climate change has become one of the foremost challenges for cities toward congruent future development in a sustainable way. Actions on climate change and fostering sustainable development are two sides of the same coin. Without tackling climate change impact, sustainable development of cities are not at all possible. The new urban agenda and Sustainable

Development Goals (SDG's) has a dominant focus on taking urgent and immediate action to combat global climate change impacts (SDG Goal 13) for creating a more resilient and healthy environment for now and future [15]. Climate change has both short and long term impacts; particularly on economic activities, human health, social system and so on. But the impacts can somehow be managed if the city is well prepared in response to climate change. Based on IPCC projections, Table 1 summarizes some possible impacts of climate change on cities for the mid- to late 21<sup>st</sup> century.

**Table 1:-Possible Impacts of Climate Change on cities. [17]**

Projected Change in Climate Phenomena (Likelihood)	Consequences for Cities	Geographic Locations Most Affected
Warmer with fewer cold days and nights, more hot days and nights (virtually certain) Hot spells/heat waves — increased frequency (very likely)	Exacerbation of the urban heat island effect, leading to increased risk of heat-related mortality and illness, especially for the elderly, chronically sick, very young, and socially isolated Increased demand for cooling, and reduced energy demand for heating Declining air quality in cities Greater stress on water resources, including those that rely on snowmelt, from increased water demand, declining water quality Wider geographical incidence of vector-borne diseases (for example, malaria spreading to higher-altitude cities) Less disruption to transport from snow or ice	All, especially inland cities and cities reliant on snowpack for water supply
Heavy precipitation events— increased frequency (very likely) Intensity of tropical cyclone activity increases (likely)	Flooding, strong winds, and landslides Disruption of public water supply and sewer systems, and adverse effects on quality of surface and groundwater Damage and losses to physical assets and infrastructure: houses, public facilities, utilities Increased risk of deaths, injuries, and illnesses (especially water-borne diseases) Disruption of transport, commerce, and economic activity Withdrawal of risk coverage in vulnerable areas by private insurers Water stress may be relieved (short-term benefit)	Coastal cities, those on riverbanks or marginal land in floodplains, mountainous regions
Areas affected by drought increase (likely)	Greater stress on water resources, from increased water demand, declining water quality Reduced energy supply from hydropower generation Land degradation, with lower agricultural yields and increased risk of food shortages, and dust storms Potential for population migration from rural to urban areas	All, especially cities in regions unused to arid conditions
Rising sea level (virtually certain)	Permanent erosion and submersion of land; and costs of coastal protection or costs of relocation Decreased groundwater availability because of saline intrusion into aquifers Exacerbated effects of tropical cyclones and storm surges, particularly coastal flooding	Coastal cities

The cities in the developing countries are far more vulnerable to climate change impact despite their low or minimum contribution toward it. Different urban infrastructure system (Sanitation, Drainage Energy, Transport, Water), amenity services (ecosystem services, health care, emergency services, the built environment)

will largely be impacted by climate change in the coming decades. These eventually interact with other socio-economic and environmental factors and thereby compounding the household as well as individual risk [12]. It will be difficult for cities and countries to move ahead toward achieving SDG's without addressing and

standing against climate change impacts. Hence, cities as well their residents should stand immediately to be well prepared for the growing climate change impacts through wide ranging adaptation and mitigation efforts. Several research and practical instances have identified two

necessary types of responses to face challenges of climate change: (1) Preparedness for climate change (adaptation of lifestyles and urban development patterns) (2) Slowing down the process of climate change (managing the avoidable impacts through mitigation) [17,18]

**CLIMATE CHANGE MITIGATION AND ADAPTATION PERSPECTIVES:  
CRITICAL ROLES OF CITIES**

**Table 2:-Policy Tools for Local-Level Action on Climate Change in Different Cities. [1]**

<i>Policy goals</i>	<i>Policy tools</i>	<i>Policy sector</i>	<i>Purpose</i>	<i>Mode of governance</i>	<i>Complementary with policy tools that:</i>
Reduce trip lengths	Restructure land value tax to increase value of land closer to urban core, jobs, or services	Land-use zoning	Mitigation	Regulatory	<ul style="list-style-type: none"> <li>• Increase mass transit use</li> </ul>
	Mixed-use zoning to shorten trip distances	Land-use zoning	Mitigation	Regulatory	<ul style="list-style-type: none"> <li>• Discourage vehicle use</li> <li>• Support non-motorized means of travel</li> </ul>
Increase building energy efficiency	Energy efficiency requirements in building codes	Building	Mitigation	Regulatory	<ul style="list-style-type: none"> <li>• Coordination of public-private retrofitting programs</li> <li>• Stringent enforcement policies</li> <li>• National building codes</li> </ul>
Increase local share of renewable and captured energy generation	District heating and cooling projects	Building	Mitigation	Regulatory / service provision	<ul style="list-style-type: none"> <li>• Remove regulatory barriers to requiring connection to district heating/cooling system</li> </ul>
	Waste-to-energy programs	Waste	Mitigation	Regulatory	<ul style="list-style-type: none"> <li>• Strictly regulate incinerator emissions</li> <li>• Remove recyclables from waste stream</li> </ul>
Reduce vulnerability to flooding and increased storm events	Zoning regulation to create more open space	Land-use zoning	Adaptation	Regulatory	<ul style="list-style-type: none"> <li>• Zoning regulation to promote multifamily and connected residential housing</li> </ul>
	Designation of open space as buffer zones for flooding	Natural resources	Adaptation	Regulatory	<ul style="list-style-type: none"> <li>• Zoning regulation to create more open space</li> <li>• Zoning regulation to promote multifamily and connected residential housing</li> </ul>
Reduce urban heat island effects and vulnerability to extreme heat	Building codes requiring design materials that reduce heat island effects	Building	Adaptation	Regulatory	<ul style="list-style-type: none"> <li>• Energy efficiency requirements in building codes</li> </ul>

An efficient and simultaneous synergy of adaptation and mitigation is necessary to effectively handle climate change impacts at the city level. The strategies for adaptation and mitigation in short terms are less and more expensive consecutively. However, progressively the situation becomes completely contrasting having the long term mitigation strategies more sustainable through a fundamental change in complex urban systems. Practical experiences revealed that the cities which offer a wide range of efficient city services, integrate emergency preparedness into their city planning and proves strong social cohesion are more prepared in face of climate change and hence called resilient one [1]. Table 2 exhibits an array of policy tools that are currently being implemented by different cities as best management practices (e.g. Singapore, Stockholm, Barcelona, São Paulo, Zurich etc.).

#### **POSSIBLE LOW CARBON DEVELOPMENT STRATEGIES IN HONG KONG'S CONTEXT**

To achieve a low carbon society, long term goals and strategies following sustainability trail should be adopted at both individual and community levels ranging from a simple personal decision on

lifestyle to complex urban infrastructure and environmental management [19]. Cities like Hong Kong, aspiring to lead toward a low carbon growth as well as sustainability path should focus on a comprehensive multi-sector approach to reduce its GHG emission to a minimum level. The city management authority should have clear priorities based on their specific conditions. As carbon emission and urban spatial forms are closely interconnected, careful attention should be given to land use and spatial development of cities to achieve a low carbon city. If cities once have grown and had already defined their built form, it is quite impossible and expensive to reverse them toward a healthy and environment friendly fashion. Cities need renewable energy options, energy efficient buildings and industries. Efficient management of solid waste, water, wastewater and promotion of green technology based public transportation system are of paramount importance for sustainable development. Moreover, responses to climate change, mitigation as well as adaptation measure, emergency preparedness actions should be integrated into the city planning process [1]. Figure 2 represents a roadmap toward how to achieve the status of low carbon and sustainable development.



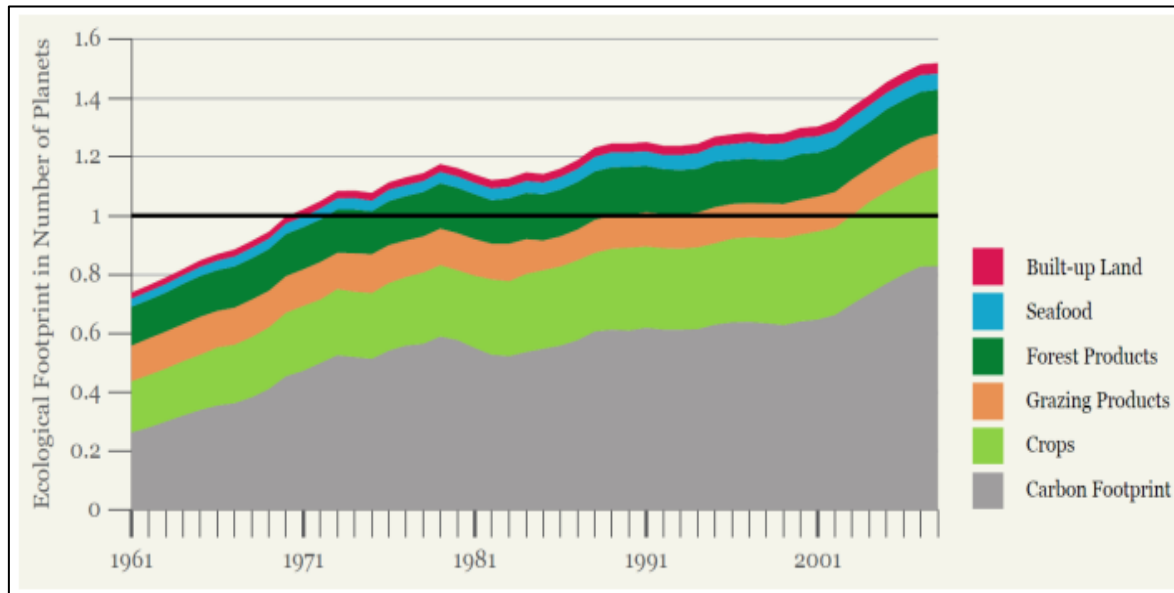
*Fig.2:-Four Components Roadmap to Help Cities Becoming Low Carbon Development [1]*

The urban form of the cities should be compact and smart through efficacy in public transport network as high density cities emit comparatively less amount of GHG. Public awareness creation and community engagement are necessary to encourage citizen to lead a low carbon as well as resource efficient lifestyle. As a city's future economic prosperity will largely be dependent upon its services and lower carbon industries, it must need to address its economic structures and to develop strategies to minimize their carbon footprints comparative to the current carbon intensity standard. Finally, Hong Kong can follow the four step roadmap provided by London through its action a best management practice to progress as a low carbon city. The roadmap constitutes the subsequent steps as (1) Knowing the city's own carbon footprint (2) Developing a vision and setting a low-carbon target (3) Implementing a low-carbon city action

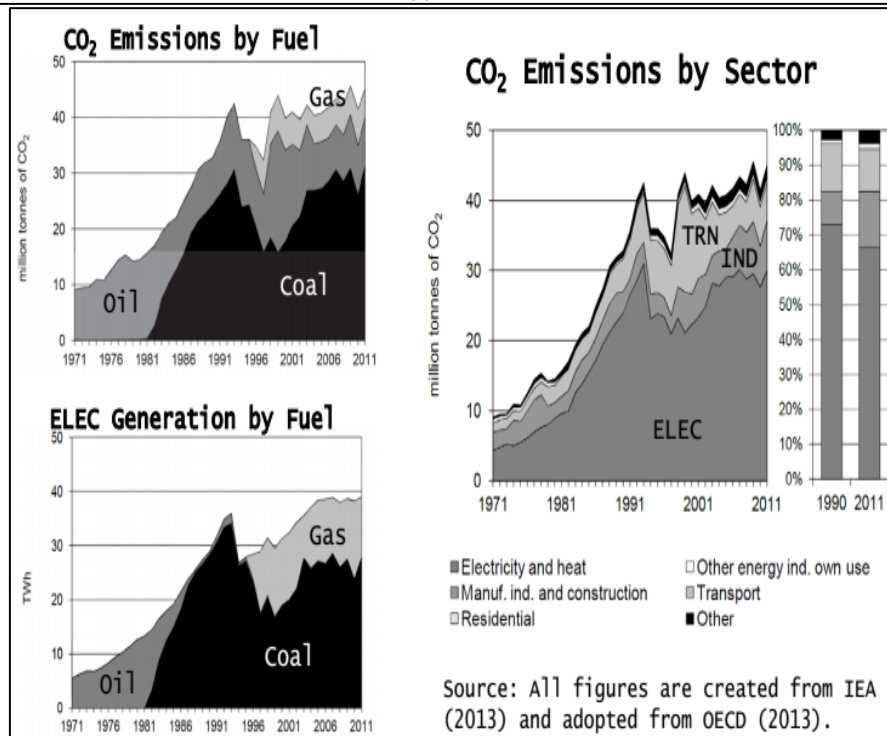
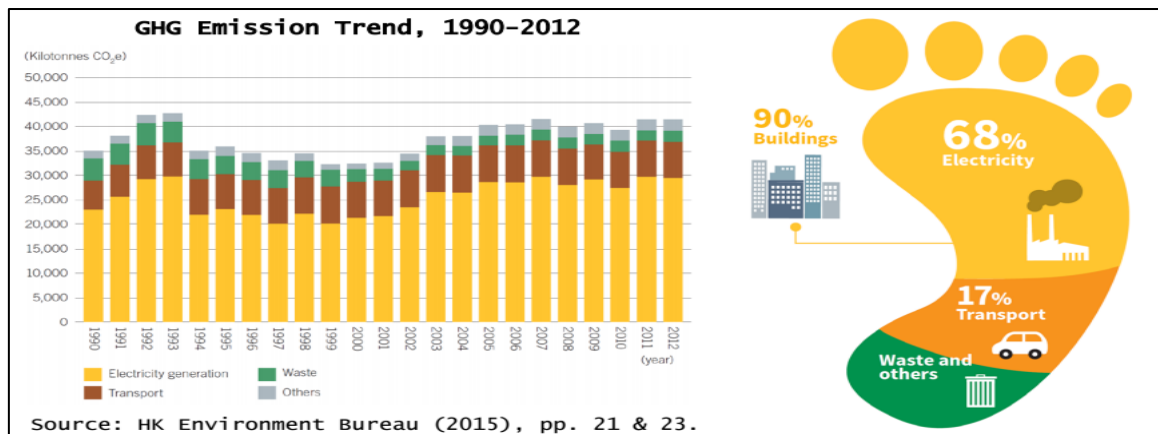
plan (4) Carefully monitoring progress [1].

### **CARBON FOOTPRINT OF HONG KONG**

Carbon emission assessment is primarily based on locational attributes of urban economic activities rather than overall consumption of produced goods and services. The first step toward a low-carbon transition is to gain a clear idea regarding the trend and current carbon footprint of the city [1]. Carbon footprint is the largest component of the Ecological Footprint (55%). According to Global Footprint Network's most recent National Footprint Accounts (2011), for mostly one quarter of the countries throughout the world, the carbon footprint represents more than half of the Ecological footprint at the national level [6]. Figure 3 provides a clear idea regarding the global trend of humanity's ecological footprint.



**Fig.3:-Global Humanity's Ecological Footprint by Component, 1961-2008. [6]**



**Fig.4:-Carbon Footprint of Hong Kong. [10, 11]**

The carbon footprint database of Hong Kong (Figure 4), clearly exhibits that power generation is the major contributors to the carbon footprint and largest source of GHG in this territory which consumes the lion's share of fossil fuels (primarily coal). Transportation is the second largest GHG emitter, constituting 17 percentage of the total emission mainly from fuel usage of the vehicle. The proportion of GHG emission sources may change over the period due to changes in activities. The trend of GHG emission indicates that GHG emission from waste have gradually decreased over time and a sharp drop in

overall GHG emission is observed in 1994 when Hong Kong started to import nuclear electricity from the Mainland China [10].

### **RECOMMENDATIONS TO REDUCE CARBON EMISSIONS IN HONG KONG**

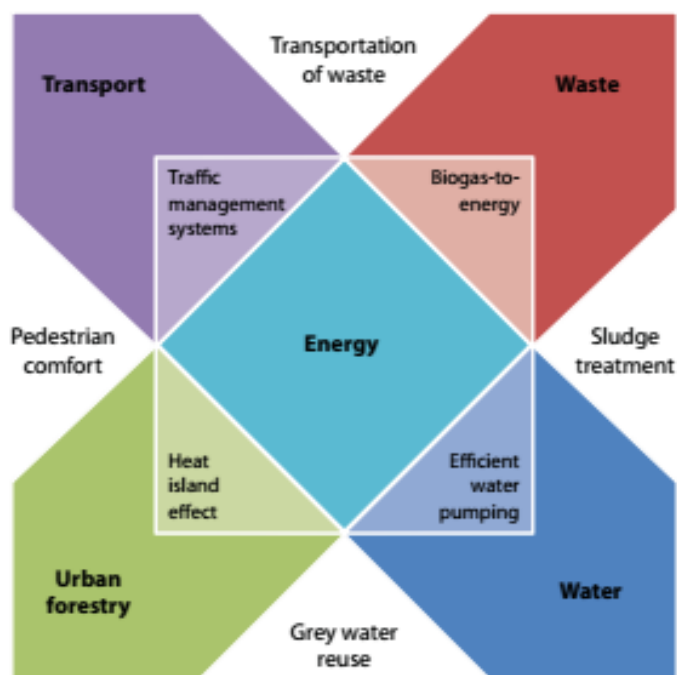
To achieve low carbon development, Hong Kong should adopt the most advanced technologies for GHG reduction and follow the best urban practices and a comprehensive multisector approach. The carbon footprint of Hong Kong is already known which will act as a baseline to measure the progress and to search for

alternative sources or advanced technologies to reduce GHG emission. It should develop an overall vision, set a low carbon target and action plan toward sustainability. Most importantly, to ensure it remains on track to the low carbon growth path, careful measures should be taken to monitor progress continually.

As per the carbon footprint of Hong Kong, energy consumption for electricity generation and transport sector constitute the largest share of GHG emissions. Thereby, the introduction of renewable energy sources (e.g. Nuclear Power), promotion of cutting edge technology, incentive green transportation and major use of public transport (e.g. electric buses) can be proved efficient for major emission reductions in Hong Kong. The government of HKSAR is fully committed to take immediate action to combat climate change and has already adopted a series of key efforts on climate change adaptation and mitigation as promised in “Paris Agreement” and “Climate Action Plan 2030”. The territory has a long term vision to integrate sustainable development needs

(economic, social and environmental) of the cities in the urban development strategies as acknowledged in “Hong Kong Declaration on Sustainable Development for Cities”. Moreover, to achieve 2030 carbon target, the government has put necessary concentration to down phase carbon emission from the two largest GHG emitter sector in Hong Kong (e.g. Introduction of cleaner energy sources for electricity production by 2030, promotion of renewable energy, expansion of railway network, promoting use of electric vehicle and so on). [16]

In addition, spatial planning approaches as integrated waste management or urban densification, promoting and preserving more urban forestry as a carbon sink can pave the pathway of Hong Kong to a sustainable and low carbon city. Figure 5 generally illustrates some measures and the interlinkage between the general four sectors of GHG emission that can be integrated at the overall city planning of Hong Kong to move toward sustainable urbanism.



*Fig.5:-Generalized Opportunities for GHG mitigation in Cities. [14]*



## CONCLUSION

Low carbon growth, Sustainable development and Climate Change: These three aspects are intractably interrelated. Modern and ever growing metropolises like Hong Kong acts as a complex urban system. To ensure pertinent future growth, all three aspects should be carefully considered and integrated into long term city planning measure. Despite HKSAR government has an ambitious vision and striking effort toward GHG emission reduction, careful attention should be given to the sustainable urban governance, promoting bottom-up planning approach and public engagement and participation for building consensus. Finally, the promotion of a low carbon living and tapping the potential of a low carbon economy can bring Hong Kong a sustainable future.

## REFERENCES

1. Baeumler, A., Ijjasz-Vasquez, E., Mehndiratta, S. (eds.) (2012), *Sustainable Low-Carbon City Development in China*, 1818 H Street NW, Washington, DC 20433, USA: The World Bank.
2. Chen F, Zhu, DJ. (2009), "Research on the content, models and strategies of low carbon cities", *Urban Plan Forum*.2009.182(4):7–13p.
3. Council For Sustainable Development (2018), "Public Engagement on Hong Kong's Long-term Climate Mitigation Strategy", <https://www.enb.gov.hk/sites/default/files/susdev/html/en/council/Paper02-18e.pdf>, (last accessed on 17 October 2019).
4. De Jong M, Joss S, Schraven, D. (2015), "Sustainable– smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization", *J Clean Prod*.2015.109:25–38p.
5. Environment Bureau, The Government of HKSAR (2003), *Sustainable Development*, <https://www.gov.hk/en/residents/environment/sustainable/dev.htm>, (last accessed on 14 October 2019).
6. GFN & WWF-Hong Kong (2013), "Hong Kong Ecological Footprint Report 2013", [https://www.footprintnetwork.org/content/images/article\\_uploads/hong\\_kong\\_ecological\\_footprint\\_report\\_2013.pdf](https://www.footprintnetwork.org/content/images/article_uploads/hong_kong_ecological_footprint_report_2013.pdf), (last accessed on 19 October 2019).
7. Gouldson, A., Sudmant, A., Khreis, H., Papargyropoulou, E. (2018), *The Economic and Social Benefits of LowCarbon Cities: A Systematic Review of the Evidence*, Coalition for Urban Transitions. London and Washington, DC: <http://newclimateeconomy.net/content/cities-working-papers>, (last accessed on 15 October 2019).
8. Hills, P., Barron, W., (1997), "Hong Kong: the challenge of sustainability", *Land Use Policy*.1997.14(1):41–53p.
9. Heiskanen E, Johnson M, Robinson, S. (2010), "Lowcarbon communities as a context for individual behavioural change", *Energy Policy*.2010.38(12):7586–7595p.
10. Hong Kong Environmental Bureau (2015), "Hong Kong Climate Change Report", <https://www.enb.gov.hk/sites/default/files/pdf/ClimateChangeEng.pdf>, (last accessed on 18 October 2019).
11. Nam, K. M. (2019) "Planning for Resilient Cities and Regions", [https://moodle.hku.hk/pluginfile.php/2278743/mod\\_resource/content/4/NAM\\_URBP6007\\_Lec6\\_9OCT2019.pdf](https://moodle.hku.hk/pluginfile.php/2278743/mod_resource/content/4/NAM_URBP6007_Lec6_9OCT2019.pdf), (last accessed on 16 October 2019).
12. Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, and W. Solecki, (2014), "Urban areas. In: *Climate Change 2014: Impacts, Adaptation, and*

- Vulnerability. Part A: Global and Sectoral Aspects*”, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, United Kingdom and New York, NY, USA: Cambridge University Press, Cambridge.2014.535-612p.
13. The Government of HKSAR (2004), “*Hong Kong Declaration on Sustainable Development for Cities*”, Adopted at the at the Asia and Pacific Leadership Forum on Sustainable Development for www.un.org Cities, Hong Kong SAR, China, 26 February 2004, [https://esa/sustdev/csd/csd12/HK\\_declaration.pdf](https://esa/sustdev/csd/csd12/HK_declaration.pdf), (last accessed on 13 October 2019).
  14. The World Bank (2010), *A City-wide Approach to Carbon Finance*. Washington, DC: World Bank, [http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/A\\_citywide\\_approach\\_to\\_carbon\\_finance.pdf](http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/A_citywide_approach_to_carbon_finance.pdf), (last accessed on 15 October 2019).
  15. The United Nations (2015), *Sustainable Development Goals*, <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>, (last accessed on 14 October 2019).
  16. The Government of HKSAR (2019), *Hong Kong – the Facts*, <https://www.gov.hk/en/about/abouthk/facts.htm>, (last accessed on 15 October 2019).
  17. The World Bank (2011), “*Guide to Climate Change Adaptation in Cities*”, <http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/3363871318995974398/GuideClimChangeAdaptCities.pdf>, (last accessed on 18 October 2019).
  18. Thomas J. C., T. J., and Godschalk, D., R. (2012), *Resilience*, Oxford University Press.
  19. Zhou G, Singh J, Wu, J. (2015), “*Evaluating low-carbon city initiatives from the DPSIR framework perspective*”, *Habitat Int.*2015.50:289–299p.